Norwegian Association for Development Research Annual Conference 1997

People, Food and the Environment 200 years after Malthus

Conference report[1]

by
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Chair of the conference organising committee

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[1] This conference report includes all papers and comments presented at the NFU annual conference 1997. Please note that several of the presented papers will be carefully reviewed and according to academic assessments published in Forum for Development Studies.
[2] In addition to Ruth Haug, the organising committee consisted of Ian Bryceson, Lars Olav Eik, Stein T. Holden, Fred H. Johnsen, Ingrid Nyborg, Anne Ringlund, Edel Urstad, Trond Vedeld og Gunnar Øygard.

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1. Introduction

It is almost 200 years since Malthus presented his iron law:

> *The power of population is indefinitely greater than the power of the earth to produce subsistence for man. Population, when unchecked, increases in geometrical ratio. Subsistence only increases in arithmetic ratio.*
> (Malthus, 1798: An essay on the principles of population)

Malthus' idea of an upper limit to the size of human populations in relation to fixed natural resource endowments, *absolute scarcity*, still dominates the development discourse and farmers, politicians, donors, environmentalists and development researchers still struggle over its meaning. Malthus continues to receive strong support, particularly evident in recent Worldwatch publications including: *Full House, Who will feed China* and *Tough choices - facing the challenge of food scarcity.*

In contrast to Malthus' iron law, Boserup predicts a theory of *induced technological change* which builds on a theory of *relative scarcity* developed by Ricardo: *Population pressure gives rise to own solution because pressure of land scarcity leads to technological change and more intensive systems of land use*. Boserup's theory has been developed further in relation to induced *institutional* change. Institutional structures and technologies evolve because they are subject to incentives and other pressures to change them. Population is one pressure among several leading to change. Technologies also evolve in response to entrepreneurial interactions in the market and the development of new enterprises. These enterprises give rise to new social organizations that continuously re-shape the cultural, political, and economic preconditions for market institutions.

What does this imply in terms of current development discourse? Malthusian inspired development thought assumes a direct link between population increase, poverty, and environmental degradation, where population growth forces farmers onto marginal, unproductive lands leading to environmental degradation and a downward spiral of poverty and hunger. This view has been challenged by several empirical studies (Machacos, Yatenga, Kissidougou, Latin American hillside) which appear to confirm Boserup's thesis by indicating that more people can lead to the initiation of actions towards sounder management of natural resources - provided certain conditions are fulfilled related to infrastructure, institutions and policies. Do these analyses, however, give us adequate insight into the relationship between population, poverty and environment? Is there a relationship at all, or are there other relationships and processes hiding behind Our Common Future's obsession with growth as a poverty alleviator and environmental panecea? Are there new perspectives emerging in development research which offer a better analytical springboard from which to dive into the development challenges of the coming century?

People, food and environment – 200 years after Malthus

Thursday 12 June

0830	Registration
0930	Opening by Thor Larsen, Director, Noragric, Agricultural Univ. of Norway
1000	Food security for the poor – what does it take? Policies aimed at eradicating poverty and inequality ensuring access by all at all times to sufficient and safe food. V. Balaji, M.S. Swaminathan Research Foundation, India
1100	Coffee
1130	Comments by Wenche Barth Eide, the Nutrition Institute, Univ. of Oslo and Desmond McNeill, Centre for Development and Environment (SUM), Univ. of Oslo
1150	Discussion
1215	Lunch
1315	Sustainable agriculture, people and the resource base: Impacts on food production and challenges for food security. Jules N. Pretty, International Institute for Environment and Development (IIED), London
1415	Comments by Ruth Haug, Noragric, Agricultural Univ. of Norway
1430	Coffee
1445	People and environment: What is the relationship between exploitation of natural resources and increased population pressure in the South? Sara J. Scherr, Int. Food Policy Research Institute (IFPRI), Washington, DC
1545	Comments Thor Arve Benjaminsen, Centre for Development and Environment (SUM), Univ. of Oslo
1600	Discussion
1630	End of day one
1700-1900	Norwegian Association for Development Research (NFU) annual meeting Theme: UD/NORAD's new research strategy Presentation by Elisabeth Jacobsen, Ministry of Foreign Affairs
2000	Dinner at Samfunnet

Norwegian Association for Development Research
Annual Conference

People, food and environment – 200 years after Malthus

Friday 13 June

0830	Parallel workshops: Development studies. Coffee Presentation of papers
1200	Lunch
1300	The poverty – environment thesis: Was Brundtland wrong? Arild Angelsen, Christian Michelsens Institute (CMI), Bergen
1330	Peasant agriculture and environmental degradation in Ethiopia: Analysis of policies and incentives for soil conservation. Shiferaw Bekele, Dept. of Economy & Social Sciences (IØS), Agricultural Univ. of Norway
1400	Village politics: Heterogeniety, leadership and collective action. The case of Mali. Trond Vedeld, Noragric, Agricultural Univ. of Norway
1430	Discussion
1500	Closing by Jessica Kathle, Deputy Vice Chancellor, Agricultural Univ. of Norway

2. Opening

by

Thor Larsen,
Director General, Noragric,
Agricultural University of Norway

We are repeatedly reminded about gloomy future which Thomas Malthus described 200 years ago. We also remember the famous - and controversial - "guestimates about the future" which were presented to us by Paul Ehrlich, the Club of Rome and others. We witness the annual debate and disagreements between Worldwatch and other institutions. Who is wrong and who is right?

First, let us look at some facts. The Plan of Action from the World Food Summit in Rome in November 1996 stated that "...The 5.8 billion people in the world today have, on average, 15 per cent more food per person than the global population of 4 billion people had 20 years ago." According to literature available to me, the world already produces enough cereals and oilseeds to feed 10 billion people a vegetarian diet adequate in protein and calories. If, however, the idea is to feed people on the kind of meatladen meals that we in the West eat, the production of grains and oilseed may have to triple - primarily to feed livestock.

From 1961 to 1994 global production of food doubled. Global output of grain rose from about 630 million tons in 1950 to about 1.8 billion tons in 1992, largely as a result of greater yields. Between 1974 and 1994, developing countries increased wheat yields per acre by almost 100 per cent, corn yields by 72 per cent, and rice yields by 52 per cent. The Worldwatch Institute has reported that "by 1984, the world had outstripped population growth enough to raise per capita grain output by an unprecedented 40 per cent." From a two-year period ending in 1981 to a two-year period ending in 1990 the real prices of basic foods fell 38 per cent on world markets, according to a United Nations report. Prices for food have continually decreased since the end of the eighteenth century, when Thomas Malthus argued that rapid population growth must lead to mass starvation by exceeding the carrying capacity of the Earth."

Is this possible? Maybe. If so, what are the opportunities and constraints which we face as we are about to enter the 21st century? It has been stated that farmers could double the acreage in production, but this should not be necessary. Better seeds, more and better irrigation, multi-cropping, and additional and better use of fertilisers should greatly increase agricultural yields in the developing world. Super strains of cassava, a staple food eaten by millions of Africans, promise to increase yields tenfold. American farmers can also do better. 1994 was a good year in Iowa, but the state's farmers nevertheless more than doubled that years bumper yield in National Corn Growers Association competitions.

It is important, however, that we also address some important constraints to increased food production and eradication of hunger. Scientists claim that it is biologically possible to raise yields of rice to about four times the current average in developing countries today. Vietnam can serve as an example of a successful rice producer. Vietnam has a population of almost 77 million of which more than 80 per cent live in rural areas. The agricultural sector employs 72 per cent of the total labour force. Over the last 20 years, Vietnam went from being a rice importer to become the world's third largest rice exporter. But due to limitation in the expansion of agricultural production and a high population growth during the last 20 years, the agricultural land per capita has decreased by almost 20 per cent. Soil erosion and soil degradation, deforestation and massive use of pesticides are rampant today. Foreign investors are queuing up in Vietnam. But they are not interested in food production. Investments in agriculture, social services, health and education - all interlinked - receive very little attention whilst investments in industry and the business sector grow by 8 - 10 per cent every year.

Scarcity of fresh water and mismanagement of available water resources represents perhaps the greatest challenge to agriculture, and not only in drier parts of the world. Agro-economic policies which do not recognise ecological constraints can do much harm - as when public funds are used to supply large and costly irrigation systems with free water and by providing subsidies to fertilisers. In many developing countries, water supply and irrigation systems are subsidised in ways which makes farmers perceive water as a free commodity - and hence waste and misuse this precious resource. Estimates from Pakistan suggest that of the land where agriculture require irrigation, more than 70 per cent has been destroyed by salination and/or waterlogging. Studies in India suggest that similar practices have led to salination, waterlogging and soil erosion on 1.75 million square kilometres of arable land. Agriculture based upon irrigation made India succeed in its efforts to feed its people. However, the hidden costs of the degradation of the resource base is becoming more and more evident.

Lack of investments, poor distribution of services, and mismanagement by political systems and their bureaucracies represent major problems. Although food production is increasing in Africa, it is not able to cope with needs of a steadily growing population

"Agricultural production (in Sub-Saharan Africa) grew at an average rate of 1.7 per cent from 1980 to 1993, which was not sufficient to keep up with population growth (3.3 per cent)" (World Bank Publication (1996), "Toward Environmentally Sustainable Development in Sub-Saharan Africa").

"In Africa, per capita food production has plummeted 20 per cent from its peak in 1967. Extrapolation of present trends by World Bank analysts yields a "nightmare scenario" for the entire continent" (UNEP, 1993).

"It is estimated that the industrial giants in the 25-nation Organization for Economic Cooperation and Development (OECD) spend more than US$150 billion annually in direct and indirect agricultural subsidies to keep potentially low-cost farmers in the developing nations from entering the market" (UNEP, 1993).

"Food security must be the first priority of sustainable development" (Dr. Mostafa Tolba, Executive Director of UNEP).

Finally, I would like to mention another factor which adds to Africa's food shortage problems. Even in countries where the majority of the people live off the land, where agriculture contributes 50 per cent or more to the national economy, and even when the countries in question literally are like the Garden of Eden - still there is serious lack of incentives. There can be many reasons. But one of them is the lack of proper and well-functioning institutions and lack of educated and trained personnel. (I was recently told that when compared with Asia, Africa has only one fifth of the agricultural experts per capita)

The "Rome Declaration on World Food Security" from the World Food Summit in November 1996 stated that it is «... intolerable that more than 800 million people throughout the world, and particularly in developing countries, do not have enough food to meet their basic nutritional needs. This situation is unacceptable.» The Declaration follows up this observation by stating: «The problems of hunger and food insecurity have global dimensions and are likely to persist, and even increase dramatically in some regions, unless urgent, determined and concerted actions is taken, given the anticipated increase in the world's population and the stress on natural resources."
And the World Food Summit presented some very ambitious statements as it pledged its political will and commitment to "... eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level no later than 2015."

This is an ambitious goal indeed. Nevertheless, the Norwegian Minister for Development Co-operation, Ms. Kari Nordheim-Larsen, was equally determined in her statement to the Summit:

"Widespread undernutrition is not acceptable .... If I should highlight one important result of the Summit, it is the clear recognition of the right to food as a human right.... The international community has an obligation to support national efforts.... Poverty is a major cause of food insecurity, and offend human dignity. Our inability to attain the objective of poverty eradication, is a discredit to our common political record and undermines our credibility.... Hence, increased investments in agriculture is needed.... Concerted action is needed.... Food security is a global challenge and responsibility.... Those who suffer, need our solidarity now."

I am not much in favour of «problems». I prefer the word «challenges». Much can undoubtedly be done to meet the hunger and food shortage challenges. Lester Brown of the Worldwatch Institute, points out that there are vast opportunities for increasing water efficiency, particularly in arid regions, ranging from installing better water-delivery systems to planting drought-resistant crops. He ads that "scientists can help push back the physical frontiers of cropping by developing varieties that are more drought-resistant, salt tolerant, and early maturing. The payoff of the first two could be particularly high."

Programs to develop water-efficient and salt-tolerant crops, including genetically engineered varieties, are already well under way. Mexico have announced the development of drought-resistant corn that can boost yields by a third. Biotechnologists are converting annual crops into perennial ones, eliminating the need for yearly planting. They also hope to enable cereal crops to fix their own nitrogen, as legumes do, minimising the need for fertiliser. Genetically engineered nitrogen-fixing bacteria have already been test-marketed to farmers. Commercial varieties of crops which have been genetically engineered to be resistant to pests and diseases have been approved for field testing in the U.S., and several are now being sold and planted. A new breed of rice, 25 per cent more productive than any currently in use, suggest that the Gene Revolution can take over where the Green Revolution left off.

Let me, however, share with you some concerns over genetic engineering and a future Gene Revolution. Noragric's Acting Research Director, Dr. Ruth Haug, has just returned from CGIAR's semi-annual meeting, which was held in Kairo in May. She tells me that biotechnology was a very hot issue during the meeting. Delegates expressed concerns over the release of genetically modified varieties into nature. Genetic engineering raises all kind of questions related to biosafety, ownership and property rights, ethics, equity etc. I share these concerns. Genetically engineering can very easily become a modern, but ugly, Pandora's box.

Neither biotechnology, nor improved farming methods can, however, resolve the major causes of famine, such as poverty, trade barriers, lack of political incentives and corruption, mismanagement, ethnic antagonism, anarchy, war and male-dominated societies that deprive women of much needed incentives. And, those who think in Malthusian terms assume that when absolute levels of food supplies are adequate, famine will not occur, need to think again. This conviction diverts attention from the actual causes of famine, which has occurred even in places where food output kept pace with population growth, but where people were too destitute to buy it. Or, when they are too poor to use sound farming practices, they are compelled to over-exploit the resources on which they depend. Population growth, poverty and degradation of local resources often fuel one another, and poor people are trapped in a vicious circle. The amount of food is constrained less by the resource base than by the maldistribution of power and wealth.

Let me now summarise my address: History has shown us, that no country has been able to promote economic and social development unless its people have access to food and are healthy. Support to the agricultural sector, which include forestry and fisheries, create important synergism. Good agricultural policy contributes more than anything else to economic growth and social benefits to poor and often marginalised groups of people. But sustainable food production depends upon a healthy environment and upon well-managed natural resources, such as water and soils. Labour-intensive agriculture can be very effective in the fight against un-employment, and particularly in rural areas. Furthermore, food security and freedom from hunger is a prerequisite for poor people to exercise their democratic rights. All this has been convincingly documented through extensive and internationally acknowledged research.

I am very happy that the Norwegian Government has recognised and addressed these very important issues in its Report no 19 to the Storting (195-95, p. 23):
" I de fattigste land er landbruket dominerende i produksjonslivet, og av stor betydning for samlet sysselsetting, inntekt og eksportinntjening... næringspolitikken (vil) i slike land særlig måtte konsentreres om å legge forholdene til rette for vekst i landbruksproduksjonen.... Større produktivitet i landbrukssektoren vil gi økte inntekter og grunnlag for økt sysselsetting og verdiskapning.... En slik politikk vil videre bedre matvaresikkerheten og eksportgrunnlaget og dempe dyrkningspresset på marginale områder.... Utvikling av bærekraftige produksjonssystemer... vil omfatte innsats for å sikre en bærekraftig produksjon innen jordbruk og skogbruk samt en forsvarlig utnyttelse av det biologiske mangfold...er en grunnleggende forutsetning for landbruksutvikling" (Stortingsmelding nr. 19, p. 32).

"Regjeringen vil konsentrere den miljørettede bistanden til de fattigste land og regioner til... økt matvaresikkerhet og ... utvikling av bærekraftige produksjonssystemer innen jordbruk, skogbruk og fiske" (Stortingsmelding nr. 19, p.33).

And furthermore, that the Parliament has highlighted and emphasised these very important issues by introducing a new main goal for Norwegian development co-operation:

"Å bekjempe fattigdommen og bidra til varige bedringer i levekår og livskvalitet..."(Innst.S. nr. 229 (1995-96), p.16). *"Flertallet viser til at jordbruk er helt grunnleggende for de fattigste landene. Det er et stort potensiale i utvikling av jordbruket og til en bedre forvaltning av jord og vann.... En utvikling av jordbruket som kan bidra til a bedre regionenes (Afrikas) matvaresikkerhet er derfor viktig"* (Innst.S. nr. 229 (1995-96), p. 20).

"... bærekraftige produksjonssystemer... bærekraftig bruk av biodiversitet.... Bedring av økonomiske rammebetingelser, styrking av produksjon innen primærnæringene, fremme av lokalt næringsliv... vil være hovedelementer i arbeidet for å bidra til økonomisk vekst. ... Innsatsen (til landbruk og fiske) vil totalt sett holdes på om lag samme nivå i 1997, men det vil bli lagt økt vekt på primærnæringene" (St.prp. nr. 1).

These political signals are important indeed. But what is the real world like? Although the Government has declared that the support to the agricultural sector should be maintained at the 1995 level (7.8 per cent, or NOK 423 millions), NORADs statistics show a steady decline for the years ahead. NORAD's own data indicate a shortfall of NOK 847 millions by 1999..

Even 7.8 per cent to the agricultural sector is not very impressive. Norway was once a lead country in its support to rural communities and food production in poor countries. But today there are others who have taken the lead. The average for other countries is 14 per cent. Denmark aims to increase its support to agriculture to 20 per cent, and - when rural development is included - to 40 per cent. Thirteen per cent of the loans from the World Bank are for support to the agricultural sector, and the Bank wants to increase such support.

So, what can Norway do? NLH's Vice Chancellor, Professor Roger K. Abrahamsen has recently written to Ms. Nordheim-Larsen and urged her to increase the support to the agricultural sector in order to attain the Government's goals and objectives. We at Noragric had a very encouraging meeting with NORAD's Director General Ms. Tove Strand Gerhardsen, and we have summed up our recommendations in a recent letter to her.

An increase in development assistance to the agricultural sector will require much professional assistance, from Norwegian institutions and from our partner institutions in the South. NLH should play a key role in such efforts, and Noragric can play a catalyst role. We believe in partnership and we are prepared to work with anybody who share our concerns and dedication.

Thank you.

3. Food Security for the Poor - What Does it Take ?

Policies Aimed at Eradicating Poverty and Inequality Ensuring Access by All at All Times to Sufficient and Safe Food

by

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UNESCO-Cousteau Chair in Ecotechnology

and

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I. Introduction

Thomas Malthus in his essay *the principle of population as it affects the future improvement of Society* published in 1798, warned that "the period when the number of men surpass their means of subsistence has long since arrived". Two centuries ago when Malthus wrote his essay, the global population was less than a billion. Now the population exceeds 6 billion.

Inspite of a 6-fold increase in human population since 1798, there is enough food on the market today for all who have the requisite purchasing power. The average life span of human beings has gone up considerably all over the world. While the death rates are dropping rapidly, birth rates have not shown a commensurate decline in most developing countries. Consequently, the human population will increase by a billion during the next 11-12 years. In addition to population increase, the following factors raise the question, "will Malthusian predictions come true in the early part of the coming millennium? ".

- Diminishing per capita arable land and irrigation water availability
- Expanding demand for food, particularly animal products, as a result of higher purchasing power
- Stagnation in marine fish production since 1990

- Increasing environmental damage and distinct possibilities of adverse changes in climate and sea level
- Fatigue of green revolution due to technology stagnation, leading to a decline in the per person world grain production from 415 kg in 1985 to 360 kg in 1996

The above situation has led experts like Dr. Lester Brown to predict that China and India may have to import over 240 and 60 million tonnes respectively of food grains by the year 2030. The entire world trade in food grains now is about 200 million tonnes. Under conditions where trade is free and not fair, the price of wheat and other food grains will go up steeply in the international market, if China and India go for large food imports. Also, there is no way that the industrialised countries can produce the amount of grain that Lester Brown fears that China and India may have to import by 2030, since further intensification of agriculture in such countries will be environmentally disastrous. (See *box* for an optimistic view of who will feed China).

II. Population

Ashish Bose (1996) has recently summarised the present demographic scenario in India. The desired demographic transition to low birth and low death rates is yet to take place in most parts of the country, excepting in the states of Kerala, Tamil Nadu, Goa and Mizoram. Based on consideration of population, illiteracy, percentage of malnourished children and per capita income, Mahbub ul Haq (1997) has developed a measure of human deprivation. He concludes "the overall extent of human deprivation is simply colossal in the SAARC region. The deprivation of human capabilities far exceeds the deprivation of income alone and affects over 500 million people in South Asia". Of this 500 million children, women and men, nearly 50% are in India.

Who will feed China ?
- an analysis by the Science Academies of China (1997) *

- Food grains per capita (1996) : 400 kg
- Total food grains production (1996) : 480 million tonnes
- Estimated food grain requirement in 2036 : 640 million tonnes

Achieving such an increase and sustainable food security is possible through the following steps :

- Stabilising population at about 1.4 billion
- Harnessing water resources through inter-basin transfer of water and by improving irrigation water use efficiency to reach the level of efficiency achieved by Israel
- Two thirds of the present cropped area amounting to 90 million ha. provide opportunities for increasing yield by more than 30% even with the technologies now available.
- 20 million ha. of waste lands can be made productive
- There is scope for increasing fish yield in two million ha. of inland waters and 3 million sq.km. of shallow sea waters, without causing ecological harm.
- Emerging technologies, particularly in rice, can help to increase average yields to 6 to 7 tonnes

* by Song Jian, Chairman, State S & T Commission, China (Personal communication, Mar. 1997)

Table 1
Human Deprivation Characteristics of the SAARC Region
(India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan and Maldives)

- Most illiterate region : 48% adult illiteracy
- Most malnourished region : 50% children are underweight
- Least gender-sensitive region: Gender Equality Measure of 0.235
- Highest Human deprivation : Human deprivation affects over 500 million people

from : Haq (1997)

Inter-state variation in India in human and social development indicators [Tables 2(a) & 2(b)] sheds light on the pathways we should adopt for achieving a balance between human population and the supporting capacity of the ecosystem. A Government of India

Committee for drafting a national population policy statement for the consideration of Parliament recommended a paradigm shift in our population stabilisation strategy, with a view to achieving a Total Fertility Rate (TFR) of 2.1 by the year 2010 (Table 3).

Table 2 (a)

Poverty and literacy profile of major Indian states (rural areas)

State	Per capita income (Rs.per annum)	Persons below absolute poverty line (%)	Literacy rate, age 7+ (%)
Punjab	6,380	32	60
Haryana	6,368	27	55
Kerala	5,778	30	90
Maharashtra	5,525	34	58
Gujarat	5,288	39	59
Andhra Pradesh	5,046	21	50
Rajasthan	4,229	40	41
Uttar Pradesh	4,185	40	47
Himachal Pradesh	4,168	45	68
Bihar	3,691	42	44
West Bengal	3,157	51	59
Orissa	3,028	55	55
Average for rural India	4,485	39	54

Source : NCAER, 1996 (personal communication)

Table 2 (b)

Disaggregated HDI for India

Indian States	HDI Value
Madhya Pradesh	0.341
Uttar Pradesh	0.343
Tamil Nadu	0.432
Kerala	0.597
West Bengal	0.452
Haryana	0.476
Maharashtra	0.513
Punjab	0.516
India (Average)	0.436

Source : Haq, 1997

Table 3

Paradigm shift recommended by the Swaminathan Committee (1995)

Existing	Swaminathan Committee
Strategy	
Target and Technology Driven	Human and Social Development Centred
Approach	
Think and plan centrally and act locally	Think, plan and act locally and support nationally
Awareness Generation	
National slogans, symbols and educational strategies	Sensitisation and self-awareness of rural and urban communities concerning the population supporting capacity of their ecosystem
Planning Tool	
Five year Plan of the Department of Family Welfare, Government of India	Socio-demographic charter for the village/town prepared by the people
Delivery services	
Contraceptive Services	Integrated health security including reproductive health and user-preferred family planning devices

Unfortunately, a well-defined population policy is yet to be adopted by Parliament on the basis of an all-party consensus. I can only repeat what we said in our report "if population policies go wrong, nothing else will have a chance to succeed".

III. Environment and development

Since the advent of the industrial and technological revolutions, economic indicators have been used as the principal criteria for measuring sustainability. Population expansion, rapid industrialisation, commercialisation of agriculture and quantum jumps in economic activity have been some of the results of the development paradigm adopted after World War II. Technological progress in several areas such as space, information technologies, biotechnology, energy and new materials has been impressive. At the same time there is a growing understanding of the ecological and social costs of such progress. The UN Conference on the Human Environment held at Stockholm in 1972 and the UN Conference on Environment and Development held at Rio de Janerio in 1992 helped to articulate the serious environmental repercussions of contemporary development pathways. The Population Summit of sixty science academies of the world (Delhi, 1993) identified population growth as well as resource use as primary influences on the threats to the ecosystem. The population growth in the tropical countries leads to shifting of cultivators into forests, and thus is a cause of loss of biodiversity (Myers, 1994). In the developed countries, inefficient technologies and wasteful consumption couple to create the equivalent of overpopulation which leads to excessive carbon dioxide emissions (Myers, 1994; Ehrlich and Ehrlich, 1995).

In addition to the natural carrying capacity of the earth, its social carrying capacity is also now in focus (Daily and Ehrlich, 1996). The UN Conference on Social Development held at Copenhagen in 1995 warned that development which is not socially equitable will lead to social disintegration and conflicts. Jobless economic growth and feminisation of poverty are the other consequence of the current pattern of development. Thus, the concept of sustainable development has now to be viewed in terms of ecology, social and gender equity, employment and economics. How to achieve such a synthesis in developmental thinking, planning and implementation, thereby enabling humankind to take to the pathway of green productivity, is the task facing us today.

In its report titled *Changing Course* the International Business Council pointed out that where there is a will there is a way (Schmidheiny, 1992). If technology has so far been a major cause of ecological damage, it can be a leader in finding methods to ensure that development is sustainable. In a recent study, Repetto *et al.* (1996) have shown that environmental protection not only need not reduce productivity growth but can in fact stimulate growth without accompanying ecological damage.
The U.S. National Academy of Sciences, the Royal Society of London, the Indian National Science Academy and 55 other scientific bodies in a statement made in 1993 pointed out "stress on the environment is the product of four interacting factors: population growth, consumption habits, technology and social organization." Concurrent attention is needed on all these four factors to promote sustainable development and sustainable societies. The report *Sustainable America* indicates what an affluent society should do. In poor nations, the social sustainability of the development process is as important as ecological and economic sustainability. Also, if the current pace of damage to the ecological foundations essential for sustainable advances in biological productivity, namely land, water, flora, fauna, forests, oceans and the atmosphere, continues, sustainable food and nutrition security cannot be achieved. Therefore, as we approach the new millennium, we need a broader concept of sustainability which encompasses environmental, economic and social parameters. Among social factors, gross economic and gender inequity needs priority attention. If such a paradigm shift in developmental thinking and pathways does not occur, the successes achieved in the twentieth century in abolishing skin colour based apartheid, in conquering space and in splicing genes will be overshadowed by the spread of technological and economic apartheid. If these forms of apartheid are allowed to grow and spread, they will lead to social disintegration and ecological genocide.

IV Ecotechnology : the emerging solution

Technologies rooted in the principles of ecology, economics and equity are now referred to as ecotechnologies. UNESCO and the Cousteau Society established by Commandant Jacques Cousteau are promoting ecotechnology networks in different parts of the world. The M.S. Swaminathan Research Foundation at Madras is the co-ordinating centre for the Asian Ecotechnology Network. A major purpose of this Network is the creation of *ecojobs*, which are economically viable, environmentally benign and socially equitable. A multimedia database on opportunities for ecojobs is being developed, since the dissemination of information on ecojobs is essential for creating opportunities for sustainable livelihoods in rural and urban areas.

The most serious manifestation of poverty is hunger. It is now recognised that endemic hunger is largely the result of inadequate livelihood opportunities which in turn leads to inadequate purchasing power. Hidden hunger results from both micro-nutrient deficiencies and poor environmental hygiene which impair the biological absorption and retention of food.

A Science Academies Summit on uncommon opportunities for a food secure world held at MSSRF in July 1996 stressed that national policies for sustainable food and nutrition security should ensure :

- that every individual has the *physical, economic, social and environmental access* to a balanced diet that includes the necessary macro- and micro-nutrients, safe drinking water, sanitation, environmental hygiene, primary health care and education so as to lead a healthy and productive life.

- that food originates from efficient and *environmentally benign production technologies* that conserve and enhance the natural resource base of crops, animal husbandry, forestry, inland and marine fisheries.

During the next three decades, population is expected to increase by another 2.5 billion people. Food requirements will grow both due to increases in population and due to per capita purchasing power. World grain production has grown from 631 million tonnes in 1950 to nearly 1900 million tonnes in 1995. Such a phenomenal growth has had its environmental cost in terms of soil degradation, aquifer depletion, genetic erosion and pesticide pollution. This is why we have to produce more in the coming decades but produce it differently. To achieve such a shift, the following basic ground rules must be followed in technology development and dissemination as well as in public policy[#] .

- First, production advances must be based on linking the ecological security of an area with the livelihood security of the people in a symbiotic manner.

[#] *Extracted from the concept paper on Food and Nutrition Security, prepared by MSSRF (Jan. 1997) and accepted by the UNDP - Govt. of India country programme for the years 1998-2001 as the strategy document.*

- Second, steps must be taken to create widespread awareness of the human and animal population supporting capacity of different ecosystems. Sustainable systems of management of soil, water, biodiversity and forests should be internalised in rural societies.

- Third, since the poor remain poor, because they have no productive assets and there is no value to their time, *asset creation and value addition to time should receive high priority in poverty alleviation programmes.* Women belonging to the economically underprivileged sections of the society, in particular, are often over-worked and under-paid. What they need is a reduction in the number of hours of work and an increase in the economic value of each hour of work. This will call for massive efforts in information and skill empowerment of the poor, particularly women. The emerging technologies are largely knowledge intensive and *hence the transfer of knowledge and market-driven skills can become the most powerful instrument for fighting poverty and deprivation.* Modern information technology affords opportunities for reaching the unreached and thereby achieving a learning revolution within a short span of time.

- Fourth, equal attention is needed to the problems of the rural and urban poor. Lack of livelihood opportunities in rural areas leads to the proliferation of urban slums. Damage to common property resources in villages results in the growth of environmental refugees. Since in many developing countries agriculture, including crop and animal husbandry, forestry, fisheries and agro-processing, provides most of the jobs and income in rural areas, the triple challenge of producing more food, income and jobs from diminishing per capita land, water and non-renewable energy sources can be met only through agricultural intensification, diversification and value addition. Integrated, intensive farming systems, which are ecologically sustainable, are needed for this purpose.

- Fifth, micro-credit and micro-enterprises should be linked in a symbiotic manner, as is being so successfully done in Bangladesh through the Grameen Bank and other innovative initiatives.

- Finally, an ever-green revolution can be imparted a self-propelling and self-replicating momentum only if it is based on the self-mobilisation of the people. *In all externally funded and introduced development projects, there should be a built-in withdrawal strategy, so that the programme does not collapse when the external inputs are withdrawn.*

V. Towards an ever-green revolution in agriculture

The term *green revolution* coined by Dr. William Gaud of the United States of America in 1968 has come to be associated with not only higher production through enhanced productivity, but also with several negative ecological and social consequences. There is also frequent reference to the *fatigue of the green revolution*, due to stagnation in yield levels and due to a larger requirement of nutrients to produce the same yield as in early seventies.

Is it likely that as we enter a new millennium, we will not have the benefit of new technologies which can help our farmers to produce more food and other agricultural commodities from less land and water?

I believe we are now in a position to launch an ever-green revolution which can help increase yield, income and livelihoods per units of land and water, if we bring about a paradigm shift in our agricultural research and development strategies. The green revolution was triggered by the genetic manipulation of yield in crops like rice, wheat and maize. *The ever-green revolution will be triggered by farming systems which can help produce more from the available land, water and labour resources without either ecological or social harm.* Thus, progress can be achieved if we shift our mind set from a commodity-centred approach to an entire cropping or farming systems approach. This does not mean that we should decelerate our efforts in the area of crop improvement research. But such research should be tailored to enhancing the performance and productivity of an entire production system. The transition from the fatigue of the green revolution to an ever-green revolution involves a shift from a crop-centred approach to a systems-based approach to technology development and dissemination.

Let us take for example the prospects for "super-rice", capable of yielding over 10 tonnes of rice per ha. Such a rice plant will need a minimum of 200 kg N per ha, together with other major and micro-nutrients. Addition of such nutrients solely through mineral fertilizers will lead to serious environmental problems, and hence, the introduction of legumes in the rotation becomes important.

Scientists now have unique opportunities for designing farming systems for achieving the triple goals of "*more food, more income and more livelihoods*" per ha. of land by harnessing the tools of ecotechnologies resulting from a blend of traditional knowledge with frontier technologies such as biotechnology, informatics including GIS mapping, space technology, renewable energy technologies (solar, wind, biomass and biogas) and management and marketing technologies.

We can prove experts like Lester Brown wrong if we abandon the old concept of a crop-centred green revolution and substitute it with "a farming systems and frontier technologies" centred ever-green revolution. Ecotechnologies should occupy a pride of place among frontier technologies.

Industrial countries are responsible for much of the global environmental problems such as potential charges in temperature, precipitation, sea level and incidence of ultraviolet-B radiation. *While further agricultural intensification in industrialised countries will be ecologically disastrous, the failure to achieve agricultural intensification and diversification in developing countries where farming provides most of the jobs will be socially disastrous.* This is because, agriculture including crop and animal husbandry, forestry and agro-forestry, fisheries and agro-industries provides livelihood to over 70 percent of our population. The smaller the farm, the greater is the need for higher marketable surplus for increasing income. *Eleven million new livelihoods will have to be created every year in India and these have to come largely from the farm and rural industries sectors.* Importing food and other agricultural commodities will hence have the same impact as importing unemployment. Thus, what we need now is an environmentally sustainable and socially equitable green revolution or what may be termed on ever-green revolution.

VI. Meeting the mutli-dimensional challenges : the response of the M.S.Swaminathan Research Foundation

The responses being developed and field tested by MSSRF to identify implementable approaches at the micro and policy levels to meet the challenges outlined earlier are briefly described below :

a. Linking the ecological security of an area with the livelihood security of the local community : creating an economic stake in conservation

The community biodiversity programme of MSSRF illustrates how such mutually beneficial linkages can be fostered in biodiversity rich areas. It is a sad fact that the tribal and rural families who have conserved and enhanced biodiversity remain poor, while those who are utilising the products of their efforts become rich. When the conservers have no social or economic stake in conservation, denudation of natural ecosystems becomes more rapid. MSSRF has adopted a three-pronged strategy for creating an economic stake in biodiversity conservation.

First, a transparent and implementable methodology has been developed for incorporating in *sui generis* systems of plant variety protection procedures for recognising and rewarding informal innovations in genetic resources conservation and enhancement.

Second, a symbiotic social contract between commercial companies and tribal and rural families is being fostered for the purpose of promoting the cultivation by local communities of genetic material of interest to the companies on the basis of buy-back arrangements. Such a linkage will prevent the primary material being unsustainably exploited.

Third, local women and men are trained in the compilation of biodiversity inventories and in bio-monitoring, so that they themselves become custodians of their intellectual property. Such trained women and men constitute an Agrobiodiversity Conservation Corps and will be able to help their respective communities to deal with issues such as "prior informed consent" in the use of genetic resources.

For assisting the community biodiversity movement, MSSRF has established a Technical Resource Centre for the implementation of the equity provisions of the Convention on Biological Diversity. Since this is the first Technical Resource Centre of its kind in the world, the six major components of the Centre are described below.

i. *Chronicling the contributions of tribal and rural families to the conservation and enhancement of agrobiodiversity* through primary data collection in the states of Tamil Nadu, Kerala, Andhra Pradesh and Orissa as well as in the Lakshadweep and Great Nicobar group of islands.

ii. *Organisation of an Agrobiodiversity Conservation Corps* of young tribal and rural women and men, who have a social stake in living in their respective villages and who, with appropriate training, can undertake tasks such as compilation of local biodiversity inventories, revitalisation of the *in situ* genetic conservation traditions of their respective communities, monitoring of ecosystem health with the help of appropriate bio-indicators and restoration of degraded sacred groves. The members of the corps will be able to assist their respective communities in dealing with "the prior informed consent" provision of the Convention on Biological Diversity in the use of genetic resources.

iii. *Development of multimedia databases* documenting the contributions of tribal and rural families in the conservation and improvement of agrobiodiversity, for the purpose of enabling them to secure their entitlements from National and Global Community Gene Funds.

iv. *Maintenance of a Community Gene Bank and Herbarium.* A Community Gene Bank with facilities for medium term storage has been established to conserve farmer preserved and developed seeds from the tribal areas of South India. The material will be catalogued and linked to the Technical Resource Centre database. The Herbarium serves as a reference centre for the identification of landraces, traditional cultivars and medicinal plants conserved by tribal and rural families.

v. *Revitalisation of genetic conservation traditions of tribal and rural families* through social recognition of their contributions and the creation of an economic stake in conservation. For this purpose, replicable models of private sector engagement in contract cultivation by tribal and rural families of plants of commercial value are being developed.

vi. *Legal Advice Cell* This cell will make available to tribal and rural families appropriate legal advice in matters relating to intellectual property rights and plant variety protection.

b. *The population supporting capacity of ecosystems: local level socio-demographic charter*

In order to help internalise an understanding of the vital need to restrict population growth within the supporting capacity of land, water, forests and the other components of the ecosystem, training modules have been developed to enable the women and men members of village level democratic institutions to prepare socio-demographic charters for their respective villages. These are local level planning tools designed to assist in priority setting in the matter of meeting unmet minimum needs. A gender code is an important component of the charter. Such socio-demographic charters will help local communities to view population issues in the context of social development and to ensure that children are born for happiness and not just for existence.

c. *Information and skill empowerment*

For this purpose, the concept of *Information Villages* has been developed. Trained rural women and men will operate *Information Shops* where generic information on the meteorological, management and marketing factors relevant to rural livelihoods will be converted into location-specific information. Trained farm women and men themselves become trainers. The computerised extension system adopted in the information shops also helps sensitise local families on their entitlements from government and other programmes. Information technologies provide considerable opportunities for value-added jobs in rural areas. While new technologies are important, folk media are often even more effective in reaching the unreached. Hence, folk plays and folk arts and theatre are fully mobilized for achieving information empowerment. For ensuring the success of information empowerment programmes, the information disseminated should be demand-driven and should be locale-specific.

d. *Agricultural intensification, diversification and value addition*

This is achieved through participatory research with farm families. Ecotechnologies like integrated pest management and integrated nutrient supply are used. Ecotechnology development involves the blending of the best in frontier technologies with traditional wisdom and practices. Modern science and the ecological prudence of the past can thus be combined.

Ecotechnologies are also practiced in aquaculture. Integrated agriculture and aquaculture techniques enhance both farm income and the nutrition security of the household. Whole villages are being enabled to adopt such integrated, intensive farming systems (IIFS). This approach is essential for meeting the triple goals of more food, income and jobs from the available land and water resources. The seven basic principles guiding the IIFS movement are described below (See also Figure 1) :

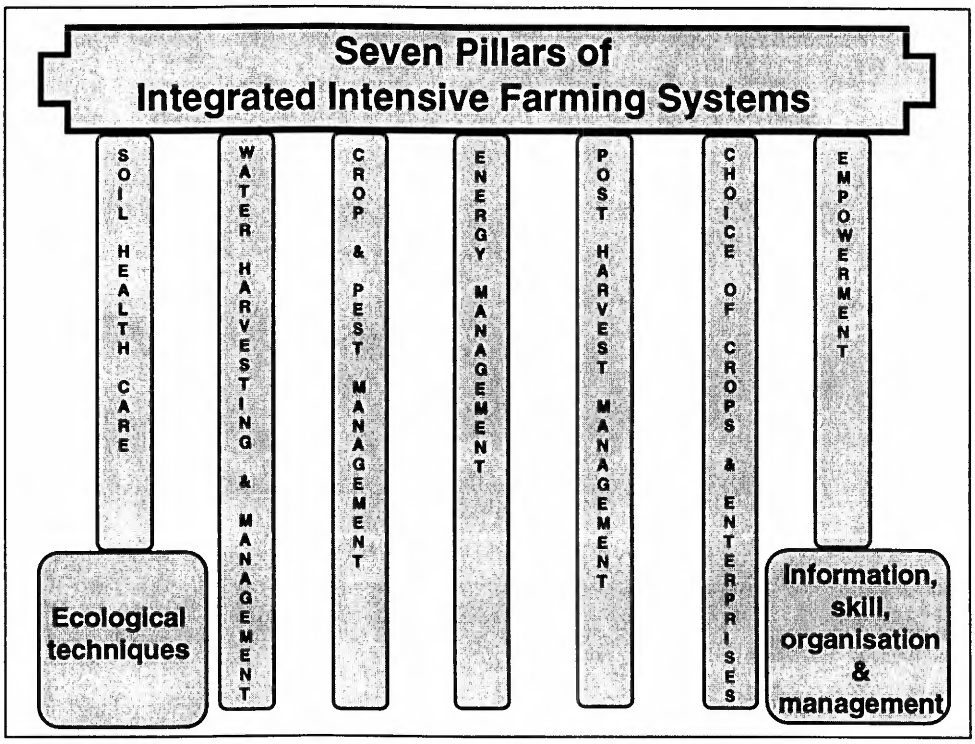

Figure 1

i. *Soil health care*

This is fundamental to sustainable intensification. IIFS fosters the inclusion of stem nodulating legumes like *Sesbania rostrata,* incorporation of *Azolla*, blue green algae and other sources of symbiotic and non-symbiotic nitrogen fixation and promotion of cereal-legume rotation in the farming system. In addition, vermiculture composting and organic recycling constitutes essential components of IIFS. IIFS farmers are trained to maintain a Soil Health Card to monitor the impact of farming systems on the physical, chemical and microbiological components of soil fertility.

ii. *Water harvesting and management*

IIFS farm families include in their agronomic practices measures to harvest and conserve rain water, so that it can be used in a conjuctive manner with other sources of water. Where water is the major constraint, technologies which can help to optimise income and jobs from every litre of water are chosen and adopted. Maximum emphasis is placed on on-farm water use efficiency and on the use of techniques such as drip irrigation, which help to optimise the benefits from the available water.

iii. Crop and pest management

Integrated Nutrient Supply (INS) and Integrated Pest Management (IPM) systems form important components of IIFS. The precise composition of the INS and IPM systems will depend on the components of a farming system as well as on the agro-ecological and soil conditions of the area. Computer-aided extension systems will provide farm families with timely and precise information on all aspects of land, water, pest and post-harvest management.

iv. Energy management

Energy is an important and essential input. Besides the energy efficient systems of land, water and pest management described earlier, every effort will be made to harness biogas, biomass, solar and wind energies to the maximum extent possible. Solar and wind energy will be used in hybrid combinations with biogas for farm activities like pumping water and drying grains and other agricultural produce.

v. Post- harvest management

IIFS farmers will not only adopt the best available threshing, storage and processing measures, but will also try to produce value-added products from every part of the plant or animal. Post-harvest technology assumes particular importance in the case of perishable commodities like fruits, vegetable, milk, meat, egg, fish and other animal products and processed food. A mismatch between production and post-harvest technologies affects adversely both producers and consumers. Growing urbanisation leads to a diversification of food habits. Therefore there will be increasing demand for animal products like milk, cheese, eggs and processed food. Agro-processing industries can be promoted on the basis of an assessment of consumer demand. Such food processing industries should be promoted in villages in order to increase employment opportunities for rural youth. In addition, they can help to mitigate micronutrient deficiencies in the diet.

Investment in sanitary and phytosanitary measures is important for providing quality food both for domestic consumers and for export. To assist the spread of IIFS, Governments should make a major investment in storage, roads, transportation and on sanitary and phytosanitary measures.

vi. Choice of the crop and animal components of farming systems

In IIFS, it is important to give very careful consideration to the composition of the farming system. Soil conditions, water availability, agro-climatic features, home needs and above all, marketing opportunities will have to determine the choice of crops, farm animals and aquaculture systems. Small and large ruminants will have a particular advantage among farm animals since they can live largely on crop biomass. Backyard poultry farming can help to provide supplementary income and nutrition.

vii. Information, skill, organisation, management and marketing empowerment

IIFS is based on the principle of precision farming. Hence, for its success, IIFS system needs a meaningful and effective information and skill empowerment system. Decentralised production systems will have to be supported by a few key centralised services, such as the supply of credit, seeds, biopesticides, and animal disease diagnostics. Ideally, an *Information Shop* will have to be set up by trained local youth in order to give farm families timely information on their entitlements as well as on meteorological, management and marketing factors. Organisation and management are key elements and depending on the area and farming system, steps will have to be taken to provide to small producers the advantages of scale in processing and marketing.

IIFS is best developed through participatory research between scientists and farm families. This will help to ensure economic viability, environmental sustainability and social and gender equity in IIFS villages. The starting point is to learn from families who have already developed successful IIFS procedures.

It should be emphasised that IIFS will succeed only if it is a *human-centered rather than a mere technology-driven* programme. The essence of IIFS is the symbiotic partnership between farming families and their natural resource endowments of land, water, forests, flora, fauna and sunlight. Without appropriate public policy support in areas like land reform, security of tenure, credit supply, rural infrastructure, input and output pricing and marketing, small farm families will find it difficult to adopt IIFS.

e. Increasing farm and non-farm employment

The *biovillage programme* addresses three key areas - preventing resource degradation, improvement of crop and animal productivity and alleviation of poverty. The biovillage programme in progress in villages in the Pondicherry area of India places equal emphasis on off-farm livelihood opportunities and on-farm jobs. This programme avoids a patronage approach to poverty alleviation.

It regards the poor as producers and innovators and helps to build their assets through value addition to time and labour. The basic approach is on asset building and sustainable human development leading to the growth of entrepreneurship.

The programmes are designed on a pro-nature, pro-poor and pro-women foundation. By placing emphasis on the strengthening of the livelihood security of the poor, the biovillage model of sustainable development revolves around the welfare of the economically and socially underprivileged.

It is thus a human-centered pattern of development. The enterprises chosen are based on marketing opportunities. The technological and skill empowerment of the poor is the major approach. Because of the market-driven nature of the enterprises, the economic viability of the biovillage approach is assured. Production and post-harvest technologies and farm and non-farm occupations are brought together in a manner that both producers and consumers benefit.

Biovillages around biosphere reserves would help in providing alternative sources of meeting the day-to-day needs for food, fuel, fodder and other commodities of the families living near such biodiversity rich areas. Also, biovillages near urban areas help to link the rural producer and the urban consumer in a mutually beneficial partnership. By producing the processed and semi-processed food products needed in urban areas in the villages around towns and cities, the need for the rural poor to migrate to urban centres for livelihood opportunities is minimised. Also, food processing can be used as a method of providing the needed micronutrients by including millets and grain legumes in the food.

VII. Issues in research

i. Transition from Mendelian to molecular plant and animal breeding

The stagnation in maximum yield levels during the nineties in crops like rice and wheat has been a cause of concern. Also, increase in productivity have to be accomplished without associated ecological harm. Productivity-increasing technology and food loss reduction strategies (improved storage, processing and marketing) should be ecologically sustainable, economically viable and socially equitable. Cost and risk must be low and return must be attractive, if the poor are to derive benefit from new technologies. Recent research on ecotechnologies involving low external input sustainable agriculture in several countries in Africa and Asia suggest that farm yields can be doubled.

What will be the impact of the transition from Mendelian to molecular genetics on the productivity, profitability, sustainability and stability of major farming systems? Can a blend of Mendelian and molecular breeding help to raise ceiling to yield and help in developing strains processing resistance/ tolerance to a wide variety of exotic and abiotic stresses? Can the benefits associated with genetic engineering and recombinant DNA experiments outweigh risks? Can an internationally accepted biosafty protocol be appended soon to the convention in Biological Diversity? Will a blend of traditional and frontier technologies including bio-information and space technologies help us to produce more agricultural commodities from less land and water without damage to the ecological foundations essential for sustainable advances in biological productivity? These questions need understanding and answer, if the Malthusian fears are not to come true in the coming millennium.

ii. Research for international and national public good

Recent trends in the privatisation of agricultural research, globalisation of economics, introduction of Trade-related Intellectual Property Rights(TRIPS) leading to a strengthening and widening of patents, plant variety protection procedures and other forms of intellectual property rights (IPR) regimes lead to the question, "will the economically and socially underprivileged section of farm families tend to get by-passed by frontier science?" Should not research for public good get strengthened particularly in areas having a bearing on food and health security. What should be the future role of organisations like the CGIAR and NARS devoted to international and national public good be? How can a symbiotic social contract be fostered between private sector companies and resource poor families? With a view to including the excluded in terms of technological and skill empowerment? Who will carry out anticipatory research to help meet potential changes in temperature, precipitation, ultraviolet-B radiation and sea levels? Who will standardise technologies for managing the impact of climate on agriculture?

There is obviously need for strengthening research for public good at the global and national levels. There is also need for new patterns of research organisation which can help (a) to promote ecologically and socially sustainable agriculture in partnership with farm men and women, and by promoting meaningful partnerships among "public good" research institution, private sector research organisation and farm families.

iii. Achieving a transition from capital and chemical-intensive agriculture to knowledge -intensive ecological agriculture

Such a transition is possible through the information empowerment of small families, utilising modern information technologies. This transition involves a shift from generic extension recommendations to location - specific recommendations. Only such a shift can help farm families to adopt precision - farming techniques which can reduce the cost of production and increase net income. The methodology developed at MSSRF for this purpose involves the organisation of *Information Shops* managed by women belonging to resouce-poor families. (At the very basic level, a bulletin board collection at a village site is linked through short-range radio handsets to the value-adding centre (which has a collection of databases) which is linked to national networks / online services and to internet. The village bulletin boards are supported by stand-alone Pcs which maintain / update information. The combination of bulletin boards with the instruments (PCs & radio handsets) constitutes the information shops that retail value-added information).

Conclusion

We are facing a battle against time in safeguarding our natural resources. In his book, *The Diversity of Life*, E.O. Wilson has warned that *Homo sapiens* is in imminent danger of precipitating a biological disaster of a greater magnitude than anything we have witnessed so far in our evolutionary history. There is hence no time to relax, if we are to ensure that the Malthusian prophecy of famine and pestilence do not come true in the coming millennium. Legal, educational and participatory measures of programme implementation and equity in benefit sharing will all be needed for promoting a peoples' movement for conservation.

Clearly, sustainable development should be broad based so as to incorporate considerations of ecology, equity, employment and energy , in addition to those of economics. This will call for a systems approach in project design and implementation. *Both unsustainable lifestyles and unacceptable poverty have to be eliminated.* Factors, which influence climate and sea level, have to be addressed with the seriousness they deserve and need. Sustainable development will become a reality if we keep in mind that the greatest responsibility of our generation, to quote Dr. Jonas Salk, is "to be good ancestors".

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Comments

by

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Ecofarming and Biovillages for Sustainable Food and Dietary Systems

I feel honoured to be given the opportunity to briefly comment on this most interesting paper. It is a paper that on the first quick perusal left me with optimism and a good feeling that "where there is a will there is a way", as cited in the paper. I felt that for once, one discusses responses to Malthusian prophecies beyond averages and per capita - namely in the reality of real people, still within the perspective of what some of those data tell us.

On the second, more thorough reading I was left with admiration for the comprehensiveness in modelling and testing of several unorthodox and interlinked roads to food security and poverty alleviation at local level that the paper describes. Here the idea of a participatory *village-or-town socio-demographic charter* in combination with the more familiar community resource assessment techniques probably could do more to population stabilisation than any earlier family planning strategy. I also particularly like the idea of *legal advice cells* for matters relating to intellectual property rights and plant variety protection. This mechanism could be useful also with a view to education and mobilisation around people's right to adequate food as a human right, as embedded in numerous international instruments ratified by the Indian Government and strongly recommended for follow-up by the World Food Summit held in November 1996.

On the third, detailed reading while preparing this commentary, I was encouraged to recognise that there could still be a dimension or two added to the Swaminathan Foundation model of ecofarming in biovillages or towns, that would enrich the models and help underscore that the ultimate task of agriculture is to feed human beings - which is very different from feeding animals!

I will quickly introduce what I have in mind by first sharing an observation that has become more and more clear to me, namely the parallelism between what one may call the paradigmatic shifts in the agricultural and nutrition sciences and practice respectively. Swaminathan and Balaji describes the paradigm shift regarding agricultural production to be "...from a crop-centred approach to a system-based approach to technology and dissemination". I see the evolving new nutrition paradigm on a global basis as a shift

"...from a nutrient-centred to a system-based approach to dietary/nutrition security within ecologically viable food systems". This parallelism implies opening a window for better communication between the communities of scientists and practitioners within agriculture and nutrition, following conscious efforts over the last two decades to find appropriate entry points for such communication and cooperation.

Another window is being opened through the increasing emphasis *on systems approaches.* Already the emergence of the farming systems and farming systems research starting in the late seventies/early eighties can be said to have had a parallel in the move from a nutrient-based nutrition research alone to a community nutrition approach, although we did not call it a systems approach at the time.

Today farming systems are in some circles being expanded into "system agriculture", and nutritionists are on the move from "community" nutrition to "public nutrition". Thus more windows of communication can be envisaged. Still, we seem to lack a common denominator that could logically help integrate the world of the farm and the farmer with that of the human being as the ultimate consumer of the farmers' goods. Such integration is needed for research as well as policies and action.

For long we have been operating with the concept of a *food chain* from production to consumption. While for certain purposes this can still be useful, for an integrated systems approach it is not. That is why "food systems" now ought to replace the food chain as a virtual designation of the complexities of linkages and feed-back loops within the realities where we want policies and projects to be ecologically viable, human centred, and witness for the future that we were "good ancestors".

Implicitly Swaminathan and Balaji talk about several of the linkages and actors from producer to consumer, including processors, markets etc.- but they do so in terms of the IIFS - the *Integrated Intensive Farming System.* I firmly believe it has virtues to talk in terms of food systems even if I know that farming systems will of course produce also other things than food. But as long as we talk about food security in the context of poverty alleviation, also farm production for cash is ultimately meant to contribute to food security.

What we gain from thinking in terms of *food systems*, is that we thereby more easily approach another set of factors, or subsystem, that ought to contribute to the ecological viability we want to strive for in the next millennium. This subsystem of the food system can be called the "dietary system", which connotes the ultimate transformation of natural resources into attractive meals on the plate or in the bowl, made possible by human skills and human values within the opportunities for resource acquisition and management by the household.

The notion of *dietary system* or subsystem will help us remember that we don't *eat* improved cropping systems, nor do we change our demand for certain foods *only* because the markets are being improved, or because opportunities for growing a new cash vegetable are made possible through a women's credit scheme. What we eat is determined *also* but factors belonging to the cognitive world of values and ideologies around food, to food as cultural identity markers, to the symbolic and ritual meaning of foods, to perception of foods for status etc.

Thus through a dietary system approach we are forced into a *double analysis,* on the one hand of the material resource base for food *acquisition*, and on the other the cognitive and behavioural basis for food *choices.*

There are obvious linkages back and forth between the two. I am persuaded that this can help agricultural and nutrition scientists and practitioners together to add value to the *information and skills empowerment schemes* described in the paper, and enrich the efforts of *Agricultural Biodiversity Corps,* the *multimedia databases* for village documentation, the *Information Shop,* and other proposed technologies that are described in the paper. Experiences from parallel efforts under other names in the field of nutrition could be merged with those described into an enriched system where all elements point in the same direction towards ecological and human sustainability.

We simply need to think in terms of agriculture and nutrition as partners in the food system, where "food" doesn't stop at the farmgate, nor does "nutrition" begin on the plate!

A further refinement of the food system concept in the direction of higher ecological viability and dietary security, is that recently proposed by Jack Kloppenberg at the University of Madison, namely the notion of "foodshed", the concept to be compared with "watershed" but with less firm contours. First and foremost the foodshed concept offers a new way of thinking of how to reduce the distance between producers and consumers as a more ecology-friendly approach. From the idea of a regional or local "foodsheds" we can proceed to that of "regionalisation of diets", a direction in which there is an increasing interest in the United States, again parallel to the many innovative experiments and programmes for sustainable agriculture even in some of the richest farmland areas in that part of the world.

I see the efforts of the Swaminathan Research Foundation and the Asian Ecotechnology Network as working towards *maintaining* the best of existing foodsheds and regional and local diets, and then of course improving these as needed. It would however be helpful to us all if the seven pillars of the Integrated Intensive Farming Systems could be expanded into, say, nine pillars of an *Integrated Community Food System* - to capture important elements that are today taken for granted, but which may hold special keys to some of the current mal-adjustments between the farmgate and what appears at people's plates..

I would like to end by saying that the most recent step of maturation of these ideas in my own mind, came while I participated as part of the faculty for a Nordic course in ecological farming for Ph.D. students, two weeks ago in Stange in the Hedmark county in Norway, organised from scholars at this agricultural university for the third time in a row. This year the course had changed title and was now called "From farming systems to food systems". The meeting of agricultural and nutritional minds over how to approach the understanding of the *food system* in that particular community, within that particular county, made it clear to the participants that without such a broader understanding, the knowledge of ecofarming systems technologies alone would be of limited value in promoting any *expansion* of ecological farming in that region. Because by limiting it to a matter of technologies in the stricter sense, we miss the point regarding *actors,* and actors are human beings who are placed and perform in some relation to each other.

When subsequently reading Swaminathan and Balaji's paper, things came together. We are clearly in for a new *global* movement, perhaps an "ever-green revolution" as the authors talk about it, a world where agricultural and human values are coming increasingly together. But also one where all those of us working in academia, as most of us here do, must be prepared for new educational challenges - the old way of splitting up the reality because it better suits the social construction of universities and disciplines, will not be sufficiently responsive to these trends. And there I am perhaps not too optimistic for the immediate future - *even* if we try to maintain that "where there is will, it can be done"!

Here, however, I believe that the emergence of what has been called a "soft-systems methodology" can help those of us who, for some reason, like to move around in the gray and nebulous interface between constructed academic disciplines or administrative sectors. Concrete examples are however very much needed for inspiration - such as the models and methodologies developed by the Swaminathan Research Foundation, as well as those that have emerged during the three years of Nordic courses in ecological farming as I mentioned. At the end of the day, we see that the two kinds of efforts are talking about the same things, although in very different settings. By combining efforts that are today often taking place in closed circles or subsystems, we may contribute better to helping the globe become a good place to live for our successors.

Comments

by

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We are never going to run out of food. Any policy that is based on the belief that we <u>are</u> going to run out of food is therefore likely to be mistaken.

These may seem to be dangerously blind or arrogant claims, so let me try and explain why I am so sure, and at the same time state what problems I do believe the world will face when it comes to feeding itself in the next century. In doing so, I want especially to focus on the <u>process</u>; on dynamics rather than comparative statics. This is the way we should formulate policy; by analysing what is likely to happen when food begins to run short; rather than imagining what the situation may be at some hypothetical future date when the shortfall between the total food required and the total available is forecast to be 50 million tons, or 500 million tons, or whatever.

As an economist, I am very critical of those who display a blind belief in the market, and the panacea of «getting the prices right». But economics does have valuable insights into how systems work - whether we like it or not. And in the context of this discussion, perhaps the most basic of all economic laws, the law of supply and demand, is very relevant. It tells us what will happen if food begins to be in short supply: the price will go up; and this will lead both to a reduction in demand and an increase in supply.

But how, one might ask, can the demand for food possibly be reduced? Surely food is a basic need - a necessity for survival?

There are different types of food, and we can change the pattern of our food consumption; for example by eating more foodgrains and less meat which is fed on foodgrains. Whether we will in fact do so or not depends - for those who can afford to choose - on our own priorities. For the affluent, and even the middle income groups, there is no danger of running out of food. At most there may be some changes in consumption patterns, with no deleterious dietary effects. A problem may, however, arise for the very poor, who already spend a high proportion of their income on food, and have little scope for substitution.

How can the supply of food be increased sufficiently? Are there not limits to what technology can achieve?

Experience suggests that technology can achieve a great deal - given sufficient incentives. If the price of food rises steeply, a very great effort will be put into methods of increasing productivity with, no doubt, dramatic results. But these results may come at a cost; and more specifically there may be environmental risks involved in, for example, biotechnology. (Other very important aspects of environmental risk are the danger of reducing soil productivity through, for example, waterlogging, salination and soil erosion. But these are reversible - at a cost). Much, however, can also be achieved by changes which do not require new technology, and such changes will also be brought about if the price of food is high enough. To take an extreme example, we could see urban land converted from ornamental gardens and golfcourses to farmland.

If the price of food increases very greatly, this will of course have a considerable effect on our lives; but this effect will vary significantly both across countries and within countries. Consider the effect of the oil price hike, and how it redistributed income - especially between countries, but also within them.

Thus my contention, in brief, is that the problem we have to face is not a shortage of food; it is a shortage of cheap, safe food. What we should concern ourselves with is not: «what happens when the world runs out of food?», but «what happens when food becomes expensive and/or environmentally more risky?»

Against this background, how do I respond to Swaminathan and Balaji's paper? I find it interesting, and I agree with much that is recommended in it. I could have wished, only, that they had made more attempt to analyse the process; to examine more concretely how, in the coming decades, the world will respond to the ever-increasing demand for food. But this is more a question of emphasis, for I find support in their paper for most of the claims that are central to my argument.

Thus, they are very aware of the workings of the market: «... there is enough food on the market today for all who have the requisite purchasing power.» (page 1). «Under conditions where trade is free and not fair, the price of wheat and other food grains will go up steeply in the international market» (2).

They are also well aware of potential environmental dangers: «Any intensification of agriculture in such countries (China and India) will be environmentally disastrous» (2) and
«World grain production has grown from 631 million tonnes in 1950 to nearly 1900 million tonnes in 1995. Such a phenomenal growth has had its environmental cost in terms of soil degradation, aquifer depletion, genetic erosion, and pesticide pollution.» (8)

And they also appear to believe in the power of technology: «Recent research ... sustainable agriculture in several countries in Afria and Asia suggest(s) that farm yields can be doubled» (20)

They also indicate, I suggest, how the problem of food can be turned into a solution - at least for many - if the right policies are adopted: «what they (women) need is ... an increase in the economic value of each hour of work» (9) Such an increase will occur if the price of food rises and women in poor countries are able to grow more food.

But they note that this will not be easy: «The triple challenge (in developing countries is) of producing more food, income and jobs from diminishing per capita land, water and non-renewable energy sources ....» (9) And they pose the problem in stark terms:

«While further agricultural intensification in industrial countries will be ecologically disastrous, the failure to achieve agricultural intensification and diversification in developing countries where farming provides most of the jobs will be socially disastrous» (11)

The answer, then, appears to be to increase the production of food in developing countries, through both intensification and diversification. This may not be easy. One should remember, for example, that a very high proportion of the world's exports of foodgrains at present come not from developing but from developed countries. And developed countries have erected barriers to imports from developng countries. But there is undoubtedly a great potential, which some countries have begun to demonstrate.

If this is not achieved, then we will be faced not by world hunger, but by a shortage of cheap, safe food. Different countries and different income groups are likely to make different trade-offs in such a situation. The rich will be able to pay more for safer food, and will probably be willing to do so. The majority will probably accept (knowingly or unknowingly) an increased environmental risk in order to keep food prices low. How great such a risk will be, I am not technically qualified to judge. There may be some - the very poor - who will face real food shortages because they simply cannot afford the increased prices; but it is my contention that these will still be fewer in number than those who starve as a result of war or sudden natural disasters. We should continue to be concerned for these: the silent and powerless victims. But we will be badly misled if we believe that Malthus was right after all.

4. Sustainable Agriculture, People and the Resource Base: Impacts on Food Production[1]

by

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Summary

As this century draws to a close, agricultural development faces some unprecedented challenges. But the views on how to proceed vary hugely, and there are five distinct schools of thought. Sustainable agriculture seeks the integrated use of a wide range of pest, nutrient, soil and water management technologies. Contrary to popular opinion, such regenerative and low-input (but not necessarily zero-input) agriculture can be highly productive, provided farmers participate fully in all stages of technology development and extension. But there remains a huge challenge to find ways to spread or `scale up' the processes which have brought about these transitions. For sustainable intensification of agriculture to spread widely, there is a need for fundamental reform of both policies and policy formulation processes.

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Current Challenges for Agricultural Development

As this century draws to a close, agricultural development faces some unprecedented challenges. By the year 2020, the world will have to support some 8.4 billion people. Even though enough food is produced in aggregate to feed everyone, some 800 million people still do not have access to sufficient food. This includes 180 million underweight children suffering from malnutrition. The gap between the wealthy and poor has widened. Despite a doubling in global income in the past three decades, the number of people living in poverty has continued to rise, from 944 million to 1300 million.

Recent models constructed to investigate agricultural production and food security changes over the next quarter to half century all conclude that food production will have to increase substantially (IFPRI, 1995; Crosson and Anderson, 1995; Leach, 1995; CGIAR, 1994; FAO, 1993, 1995).

But the views on how to proceed vary hugely. Some are optimistic, even complacent; others are darkly pessimistic. Some indicate that not much needs to change; others argue for fundamental reforms to agricultural and food systems. Some indicate that a significant growth in food production will only occur if new lands are taken under the plough; others suggest that there are feasible social and technical solutions for increasing yields on existing farmland.

There are five distinct schools of thought for future options in agricultural development (for summaries, see McCalla, 1994; Hazell, 1995; Hewitt and Smith, 1995; Pretty, 1995a; Hinchcliffe et al., 1996).

Contrasting Schools of Thought

Business-as-usual optimists

The business-as-usual optimists, with a strong belief in the power of the market, say supply will always meet increasing demand, and so growth in world food production will continue alongside expected reductions in population growth (Rosegrant and Agcaolli, 1994; Mitchell and Ingco, 1993; FAO, 1993).

As food prices are falling (down 50 per cent in the past decade for most commodities), this indicates that there is no current crunch over demand. Food production will continue as the fruits of biotechnology research ripen, so boosting plant and animal productivity; and as the area under cultivation expands, probably by some 20-40 per cent by 2020 (this means an extra 79 million ha of uncultivated land converted to agriculture in sub-Saharan Africa alone). It is also expected that population growth will slow, and that developing countries will substantially increase food imports from industrialised countries (perhaps by as much as fivefold by 2050).

Environmental pessimists

The environmental pessimists contend that ecological limits to growth are being approached, or have already been reached (Harris, 1995; Brown and Kane, 1994; Ehrlich, 1968).

Following a neo-Malthusian line, these pessimists claim that populations continue to grow too rapidly, while yield growth of the major cereals will slow or even fall, particularly because of growing production constraints in the form of resource degradation (soil erosion, land degradation, forest loss, pesticide overuse, fisheries over-exploitation). Dietary shifts, especially increasing consumption of livestock products, are an emerging threat, as this results in the consumption of an even greater share of cereal products. They do not believe that new technological breakthroughs are likely. Solving these problems means putting population control as the first priority.

Industrialised world to the rescue

The *'industrialised world to the rescue'* lobby believes that Third World countries will never be able to feed themselves, for a wide range of ecological, institutional and infrastructural reasons, and so the looming food gap will have to be filled by modernised agriculture in the industrialised countries (Avery, 1995; Wirth, 1995; Carruthers, 1993; Knutson et al., 1990).

By increasing production in large, mechanised operations, this will force smaller and more 'marginal' farmers to go out of business, so taking the pressure off natural resources. These can then be conserved in protected areas and wildernesses. The larger producers will then be able to trade their food with those who need it, or have it distributed by famine relief or food aid. It is also vigorously argued that any adverse health and environmental consequences of chemically-based agricultural systems are minor in comparison with those wrought by the expansion of agriculture into new lands. External inputs (especially pesticides and fertilizers), and free trade are said to represent a crucial part of any strategy for feeding the world (see Avery, 1995, in particular).

New modernists

One group, what we might call the *'new modernists'*, argues biological yield increases are possible on existing lands, but that this food growth can only come from 'modern' high-external input farming (Borlaug, 1992, 1994; Sasakawa Global 2000, 1993-1995; Paarlberg, 1994; Winrock International, 1994).

This group argues that farmers simply use too few fertilizers and pesticides, which are said to be the only way to improve yields and so keep the pressure off natural habitats. This repeat of green revolution model is widely termed 'science-based' agriculture, the objective being to increase farmers' use of fertilizers and pesticides. It is also argued that high-input agriculture is more environmentally sustainable than low-input agriculture, as the latter represents the intensive use of local resources which may be degraded in the process.

Sustainable intensification

Others, though, are making the case for the benefits of *`sustainable intensification'*, on the grounds that substantial growth is possible in currently unimproved or degraded areas whilst at the same time protecting or even regenerating natural resources (Pretty, 1995a, b; Hazell, 1995; McCalla, 1994, 1995; Scoones and Thompson, 1994; NAF, 1994; Scherr, 1997).

It is argued that empirical evidence now indicates that regenerative and low-input (but not necessarily zero-input) agriculture can be highly productive, provided farmers participate fully in all stages of technology development and extension. This evidence also suggests that agricultural and pastoral lands productivity is as much a function of human capacity and ingenuity as it is of biological and physical processes.

Such sustainable agriculture seeks the integrated use of a wide range of pest, nutrient, soil and water management technologies. It aims for an increased diversity of enterprises within farms combined with increased linkages and flows between them. By-products or wastes from one component or enterprise become inputs to another. As natural processes increasingly substitute for external inputs, so the impact on the environment is reduced.

What is and What is not Sustainable Agriculture

Defining sustainability

Sustainability is a word that has entered common use in recent years. Since the Brundtland Commission put `sustainable development' on the map in the mid to late 1980s, close to 100 definitions of `sustainability' have been published. Each emphasises different values, priorities and practices. Clearly no reasonable person is opposed to the idea. But what does it mean?

To some it implies the capacity of something to continue unchanged for a long time. To others, it implies not damaging natural resources. To others still, it is just accounting for the environment whilst continuing on a business-as-usual track.

Does any of this help in the context of farming? We all know sustainability represents something good, but what exactly? And, more importantly, has the notion of `sustainable agriculture' contributed to better farm practices, or is the term too easily hijacked?

In any discussion of sustainability, it is important to clarify what is being sustained, for how long, for whose benefit and at whose cost, over what area and measured by what criteria. Answering these questions is difficult, as it means assessing and trading off values and beliefs (Pretty, 1995a; Viederman, 1994).

It is critical, therefore, that sustainable agriculture does not prescribe a concretely defined set of technologies, practices or policies. This would only serve to restrict the future options of farmers. As conditions change and as knowledge changes, so must farmers and communities be encouraged and allowed to change and adapt too. Sustainable agriculture is, therefore, not a simple model or package to be imposed. It is more a process for learning (Pretty, 1995b; Röling, 1994).

Goals for sustainable agriculture

During the past fifty years, agricultural and rural development policies have successfully emphasised external inputs as the means to increase food production. This has produced remarkable growth in global consumption of pesticides, inorganic fertilizer, animal feedstuffs, and tractors and other machinery.

These external inputs have, however, substituted for natural control processes and resources, rendering them more vulnerable. Pesticides have replaced biological, cultural and mechanical methods for controlling pests, weeds and diseases; inorganic fertilizers have substituted for livestock manures, composts, nitrogen-fixing crops and fertile soils; information for management decisions comes from input suppliers, researchers and extensionists rather than from local sources; and fossil fuels have substituted for locally-generated energy sources. What were once valued local resources have often now become waste products.

The basic challenge for sustainable agriculture is to make better use of available physical and human resources. This can be done by minimizing the use of external inputs, by regenerating internal resources more effectively, or by combinations of both. This ensures the efficient and effective use of what is available, and ensures that any dependencies on external systems are kept to a reasonable minimum.

A more sustainable agriculture is any food production system that systematically pursues the goals in Tab. 1.

Current Extent and Impact of Sustainable Agriculture

Documented evidence

There is increasingly good evidence to show that regenerative and resource-conserving technologies and practices can bring both environmental and economic benefits for farmers, communities and nations. The best evidence comes from countries of Africa, Asia and Latin America, where the concern is to increase food production in the areas where farming has been largely untouched by the modern packages of externally-supplied technologies. In these lands, farming communities adopting regenerative technologies have substantially improved agricultural yields, often only using few or no external inputs (Bunch, 1990; GTZ, 1992; UNDP, 1992; Krishna, 1994; Shah, 1994; SWCB, 1994; Balbarino and Alcober, 1994; de Freitas, 1994; Pretty, 1995a; Swaminathan and Balaji, 1997).

But these are not the only sites for successful sustainable agriculture. In the high-input and generally irrigated lands, farmers adopting regenerative technologies have maintained or improved yields whilst substantially reducing their use of inputs (Bagadion and Korten, 1991; Kenmore, 1991; Kamp et al., 1993; FAO, 1994; Pretty, 1995a). And in the industrialised countries, farmers have been able to maintain profitability, even though input use has been cut dramatically, such as in the USA (Liebhart et al., 1989; NRC, 1989; NAF, 1994; Hewitt and Smith, 1995); and in Europe (El Titi and Landes, 1990; Vereijken, 1990; Jordan et al., 1993; Pretty and Howes, 1993; Somers, 1997).

Current extent

The International Institute for Environment and Development has examined the extent and impact of sustainable agriculture in a selected number of countries (Pretty et al., 1996). The government and non-government programmes and projects included in this analysis share important common characteristics. They have:

- made use of resource-conserving technologies in conjunction with group or collective approaches to agricultural improvement and natural resource management;

- put participatory approaches and farmer-centred activities at the centre of their agenda, and so these activities are occurring on local people's terms, and are more likely to persist after the projects and programmes have ended;

- not used subsidies or food-for-work to buy the participation of local people, or to encourage them to adopt particular technologies, and thus improvements are unlikely to fade away or simply disappear at the end of the projects or programmes;

- supported the active involvement of women as key producers and facilitators;

- emphasised adding value to agricultural products through agro-processing, marketing, and other off-farm activities, thus creating employment, income-generating opportunities and surplus retention in the rural economy.

Two types of transition to sustainable agriculture were assessed: from modern or conventional high-external input agriculture (such as farming in Green Revolution lands or in the industrialised countries); and from traditional, rainfed agriculture where cereal yields have largely remained constant over centuries. As these transitions are recent (within the past 5-10 years), they provide compelling evidence that similar improvements could occur elsewhere and that they could be repeated on a larger scale.

In the 20 countries of the South (and the total of 63 projects) examined and analysed, there are some 1.93 million households farming 4.1 million hectares with sustainable agriculture technologies and practices (Tab. 2).

The data in Table 2 do not represent a comprehensive survey of sustainable agriculture in each of the countries. They do illustrate, however, what has been achieved by specific projects and what could be replicated elsewhere. Most of these improvements have occurred in the past ten years (many in the past two to five years). The assumption is that these are representative of what is possible on a wider scale. It could be argued, however, that they are only successful because they have occurred where there is a combination of the least resistance and most opportunity, although the sheer diversity of approaches and contexts represented undermine such an assertion. Moreover, many of the improvements are occurring in difficult, remote and resource-poor areas that have commonly been assumed in the past to be incapable of producing food surpluses.

Contested views

This empirical evidence is still contested. Many commentators and farmers still believe that any low-input approach to agriculture is inevitably low-output. Norman Borlaug (1992) summarised these views when he said that 'leaders in developing countries must not be duped into believing that future food requirements can be met from continuing reliance on ... the new and complicated low-input, low-output technologies'. In the USA, more than 80 per cent of conventional farmers believe that low input agriculture will always be low output, even though the top quarter of sustainable agriculture farmers get better yields and gross margins than conventional farmers (Hewitt and Smith, 1995; NAF, 1994). Influential politicians continue to reinforce these beliefs. In 1991, the former Secretary of State, Earl Butz, said

> we can go back to organic agriculture in this country if we must - we once farmers that way 75 years ago. However, before we move in that direction, someone must decide which 50 million of our people will starve. We simply cannot feed, even at subsistence levels, our 250 million Americans without a large production input of chemicals, antibiotics and growth hormones.

Yet a selection of recent evidence shows that some 40,000 farmers in 32 states are using sustainable agriculture technologies and have cut their use of external inputs substantially. This includes 2,800 sustainable agriculture farmers in the North Western States, who grow twice as many crops compared with conventional farmers, use 60-70 per cent less fertilizer, pesticide and energy, and their yields are roughly comparable; they also spend more money on local goods and services (NAF, 1994).

The Spread and Scaling Up of Sustainable Agriculture

Why we should be concerned with spread

Despite the increasing number of successful sustainable agriculture initiatives in different parts of the world, it is clear that most of these are still only `islands of success'. There remains a huge challenge to find ways to spread or `scale up' the processes which have brought about these transitions.

Sustainability ought to mean, therefore, more than just agricultural activities that are environmentally neutral or positive; it implies the capacity for activities to spread beyond the project in both space and time. A `successful' project that leads to improvements that neither persist nor spread beyond the project boundary should not be considered sustainable.

When the recent record of development assistance is considered, it is clear that sustainability has been poor. There is a widespread perception amongst both multilaterals and bilaterals that agricultural development is difficult, that agricultural projects perform badly, and that resources may best be spent in other sectors. Reviews by the World Bank, the European Commission, Danida and the British Department for International Development (formerly ODA) have all shown that agricultural and natural resource projects both performed worse in the 1990s than in the 1970s-1980s and worse than projects from other sectors (World Bank, 1993; Pohl and Mihaljek, 1992; EC, 1994; Danida, 1994; Dyer and Bartholomew, 1995). They are also less likely to continue achievements beyond the provision of aid inputs.

A recent analysis of 95 agricultural project evaluations recorded on the OECD Development Assistance Committee database shows a disturbing rate of failure, with at least 27 per cent of projects having non-sustainable structures, practices or institutions, and ten per cent causing significant negative environmental impact (Pretty and Thompson, 1996). The cited reasons for failure included an emphasis on only external technologies; no participation by local people; ineffective training of professionals; and institutions working with no orientation towards the diversity of local conditions and needs of local people.

This evidence from completed agricultural development projects suggests four important principles for sustainability and spread:

1. *Imposed technologies do not persist*: if coercion or financial incentives are used to encourage people to adopt sustainable agriculture technologies (such as soil conservation, alley cropping, IPM), then these are not likely to persist.

2. *Imposed institutions do not persist*: if new institutional structures are imposed, such as cooperatives or other groups at local level, or Project Management Units and other institutions at project level, then these rarely persist beyond the project.

3. *Expensive technologies do not persist*: if expensive external inputs, including subsidised inputs, machinery or high technology hardware are introduced with no thought to how they will be paid for, they too will not persist beyond the project.

4. *Sustainability does not equal fossilisation or continuation of a thing or practice forever*: rather it implies an enhanced capacity to adapt in the face of unexpected changes and emerging uncertainties.

The problems with comprehensive technology packages

Modernist agricultural development has begun with the notion that there are technologies that work, and it is just a matter of inducing or persuading farmers to adopt them. Yet few farmers are able to adopt whole packages of conservation technologies without considerable adjustments in their own practices and livelihood systems.

The problem is that the imposed models look good at first, and then fade away. Alley cropping, an agroforestry system comprising rows of nitrogen-fixing trees or bushes separated by rows of cereals, has long been the focus of research (Kang et al., 1984; Attah-Krah and Francis, 1987; Lal, 1989). Many productive and sustainable systems, needing few or no external inputs, have been developed. They stop erosion, produce food and wood, and can be cropped over long periods. But the problem is that very few, if any, farmers have adopted these alley cropping systems as designed. Despite millions of dollars of research expenditure over many years, systems have been produced suitable only for research stations (Carter, 1995).

There has been some success, however, where farmers have been able to take one or two components of alley cropping, and then adapt them to their own farms. In Kenya, for example, farmers planted rows of leguminous trees next to field boundaries, or single rows through their fields; and in Rwanda, alleys planted by extension workers soon became dispersed through fields (Kerkof, 1990).

But the prevailing view tends to be that farmers should adapt to the technology. Of the Agroforestry Outreach Project in Haiti, the evaluators said that

> Farmer management of hedgerows does not conform to the extension program... Some farmers prune the hedgerows too early, others too late. Some hedges are not yet pruned by two years of age, when they have already reached heights of 4-5 metres. Other hedges are pruned too early, mainly because animals are let in or the tops are cut and carried to animals... Finally, it is very common for farmers to allow some of the trees in the hedgerow to grow to pole size (Bannister and Nair, 1990).

This could be read as a great success - farmers were clearly adapting the technology to their own special needs. But it was not. The language of the evaluators is quite clear - this was considered a failure.

What does this mean for sustainable agriculture? How should we proceed so as to ensure farmers are fully involved in developing and adapting these sustainable and productive technologies?

Farmers' adaptations of technologies

There are few published studies that give evidence of impacts years after outside interventions have ended. In 1994, however, staff of the Honduran organisation COSECHA (Associaciòn de Consejeros una Agricultura Sostenible, Ecològica y Humana) returned to three sustainable agriculture programme areas in Guatemala and Honduras, and used participatory methods with local communities to evaluate subsequent changes (Bunch and Lòpez, 1996).

They first divided all 121 villages into three categories, according to where they felt there had been good, moderate and poor impact. Twelve villages were sampled from these - four from each programme comprising one of the best, two of the moderate and one poor. These villages had some 1,000 families (with a range of 30 to 180 per village). The first major finding was that crop yields and adoption of conserving technologies had continued to grow since project termination (Tab. 3).

Surprisingly, though, many of the technologies known to be `successful' during the project had been superseded by new practices. Altogether, some 80-90 successful innovations were documented in these twelve villages. In one Honduran village, Pacayas, there had been 16 innovations, including four new crops, two new green manures, two new species of grass for contour barriers in vegetables, chicken pens made of king grass, marigolds for nematode control, use of lablab and velvet bean as cattle and chicken feed, nutrient recycling into fishponds, human wastes in composting latrines, napier grass to stabilise cliffs, and home-made sprinklers for irrigation.

Had the original technologies been poorly selected? It would appear not, as many that had been dropped by farmers are still very successful elsewhere. The explanation would appear to be that changing external and internal circumstances had reduced or eliminated their usefulness, such as changing markets, droughts, diseases, insect pests, land tenure, labour availability, and political disruptions. Technologies had been developed, adopted, adapted and dropped. The study concluded that the half-life of a successful technology in these project areas is six years. Quite clearly the technologies themselves are not sustainable. As Bunch and Lòpez have put it 'what needs to be made sustainable is the social process of innovation itself'.

A similar picture has emerged in Gujarat, where many farmers have developed new technical innovations after support from the Aga Khan Rural Support Programme for undertaking simple conservation measures. Farmers have introduced planting of grafted mango trees and bamboo near the embankments, so making full use of residual moisture near gully traps. They have also introduced cultivation of vegetables, such as brinjal and lady's finger, other leguminous crops, and tobacco in the newly created silt traps. This has increased production substantially, particularly in poor rainfall years. Most of these innovations and adaptations have been introduced and sustained with support from the local network of village extensionists (Shah, 1994).

In south Queensland, Australia, extensionists from the Department of Primary Industry using very simple learning tools that enabled farmers to investigate the impact of rainfall on their soil have encouraged more than 80 per cent of farmers to adopt conservation technologies. Many of these have gone on to develop and adopt new and different technologies for their own farms, and they now fully support the values and principles that once they would have opposed (Hamilton, 1995).

Another example comes from Thailand, where the four different phases of the Thai-German Highland Development Project clearly illustrate the importance of genuine participation with local people (TG-HDP, 1995; Steve Carson, pers. comm. 1996). The project has been working with upland communities in Northern Thailand to support the transition towards sustainable agriculture. The resource-conserving technologies developed and adapted for local use include hedgerows on contours, buffer strips, new crop rotations, IPM, crop diversification, and livestock integration.

The approach, however, has changed significantly since the mid 1980s (Table 3). In the first phase, cash incentives and free inputs were used to encourage adoption of these technologies; as a result adoption rates were high, though there was little or no adaptation of the technologies by the farmers. In 1990, all the incentives were stopped when the project adopted a participatory approach; immediately adoption rates fell and withdrawal increased by threefold. By 1993-94, the participatory village planning had fully involved communities, and the ratio of adopters to withdrawers was equal. Most recently, the numbers of farmers using sustainable technologies has grown rapidly and crucially, they are now actively adapting them and innovating new technologies to satisfy their particular needs (Steve Carson, pers. comm. 1996).

Participatory Approaches

The many interpretations of participation

There is a long history of participation in agricultural development, and a wide range of development agencies, both national and international, have attempted to involve people in some aspect of planning and implementation. In recent years, there have been an increasing number of comparative studies of development projects showing that participation is one of the critical components of success. It has been associated with increased mobilisation of stakeholder ownership of policies and projects; greater efficiency, understanding and social cohesion; more cost-effective services; greater transparency and accountability; increased empowering of the poor and disadvantaged; and strengthened capacity of people to learn and act.

As a result, the terms 'people's participation' and 'popular participation' are now part of the normal language of many development agencies, including NGOs, government departments and banks (Adnan et al., 1992; World Bank, 1994). It is such a fashion that almost everyone says that participation is part of their work. This has created many paradoxes. The term 'participation' has been used to justify the extension of control of the state as well as to build local capacity and self-reliance; it has been used to justify external decisions as well as to devolve power and decision-making away from external agencies; it has been used for data collection as well as for interactive analysis.

In conventional rural development, participation has commonly centred on encouraging local people to sell their labour in return for food, cash or materials. Yet these material incentives distort perceptions, create dependencies, and give the misleading impression that local people are supportive of externally-driven initiatives. This paternalism undermines sustainability goals and produces impacts which rarely persist once the project ceases (Bunch, 1983; Pretty and Shah, 1994; Ghimire and Pimbert, 1997). Despite this, development programmes continue to justify subsidies and incentives, on the grounds that they are faster, that they can win over more people, or they provide a mechanism for disbursing food to poor people. As little effort is made to build local skills, interests and capacity, local people have no stake in maintaining structures or practices once the flow of incentives stops.

The many ways that development organisations interpret and use the term participation can be resolved into seven clear types. These range from manipulative and passive participation, where people are told what is to happen and act out predetermined roles, to self-mobilisation, where people take initiatives largely independent of external institutions (Tab. 4). This typology suggests that the term 'participation' should not be accepted without appropriate clarification.

The World Bank's internal `Learning Group on Participatory Development', in seeking to clarify the benefits and costs of participation, distinguished between different types of participation: 'many Bank activities which are termed "participatory" do not conform to [our] definition, because they provide stakeholders with little or no influence, such as when [they] are involved simply as passive recipients, informants or labourers in a development effort' (World Bank, 1994). The problem with participation as used in types one to four is that any achievements are likely to have no positive lasting effect on people's lives (Rahnema, 1992). The term participation can be used, knowing it will not lead to action. Indeed, some suggest that the manipulation that is often central to types one to four means they should be seen as types of non-participation (Hart, 1992).

One study of 121 rural water supply projects in 49 countries of Africa, Asia and Latin America found that participation was the most significant factor contributing to project effectiveness and maintenance of water systems (Narayan, 1993). Most of the projects referred to community participation or made it a specific project component, but only 21 per cent scored high on interactive participation. Clearly, intentions did not translate into practice. It was when people were involved in decision-making during all stages of the project, from design to maintenance, that the best results occurred. If they were just involved in information sharing and consultations, then results were much poorer. According to the analysis, it was quite clear that moving down the typology moved a project from a medium to highly effective category.

Great care must, therefore, be taken over both using and interpreting the term participation. It should always be qualified by reference to the type of participation, as most types will threaten rather than support the goals of sustainable agriculture. What will be important is for institutions and individuals to define better ways of shifting from the more common passive, consultative and incentive-driven participation towards the interactive end of the spectrum.

Terms and principles for participatory methodologies

Recent years have seen a rapid expansion in new participatory methods and approaches to learning in the context of rural development. There are now close to 50 different terms for these systems of learning and action, some more widely used than others[2]. This diversity and complexity is a strength. It is a sign of both innovation and ownership.

There are six principles that are common to these methodologies for interactive participation:

1. *Methodology for collective learning*
   There are defined and organised methodologies for cumulative learning by all actors; the processes are structured, but rarely as a blueprint; methodologies are context-specific and so there are many variants; the methods encourage interaction - more than just consultation.

2. *User-friendly and quick*
   The inquiry and learning processes are user-friendly, as the visual and dialogue methods are simple and widely applicable; processes are group-based and interactive, with people from different disciplines, sectors and mixes of professionals and non-professionals; the processes create enthusiasm and participants have fun.

[2] A selection of terms for systems of participatory learning and action include:

Action Planning, Agroecosystems Analysis (AEA), Beneficiary Assessment, Citizens' Juries, Community Audits, Community Profiles, Community Visions, Development Education Leadership Teams (DELTA), Diagnostico Rurale Participativo (DRP), Evaluacion Rural Participativa (ERP), Farmer Participatory Research, Farming Systems Research, Future Search, Groupe de Recherche et d'Appui pour l'Auto-Promotion Paysanne (GRAAP), Méthode Active de Recherche et de Planification Participative (MARP), Open Space Technology, Parish Appraisals, Participatory Appraisal (PA), Participatory Analysis and Learning Methods (PALM), Participatory Action Research (PAR), Participatory Forest Resource Assessment (PFRA), Participatory Monitoring and Evaluation (PME), Participatory Poverty Assessment (PPA), Participatory Research Methodology (PRM), Participatory Rural Appraisal (PRA), Participatory Rural Appraisal and Planning (PRAP), Participatory Technology Development (PTD), Participatory Urban Appraisal (PUA), Planning for Real, Process Documentation Research, Rapid Appraisal (RA), Rapid Assessment of Agricultural Knowledge Systems (RAAKS), Rapid Assessment Procedures (RAP), Rapid Assessment Techniques (RAT), Rapid Catchment Analysis (RCA), Rapid Ethnographic Assessment (REA), Rapid Food Security Assessment (RFSA), Rapid Multi-perspective Appraisal (RMA), Rapid Organisational Assessment (ROA), Rapid Rural Appraisal (RRA), Real Time Strategic Change (RTSC), Regenerated Freiréan Literacy through Empowering Community Techniques (REFLECT), Samuhik Brahman (Joint trek), Soft Systems Methodology (SSM), Theatre for Development, Training for Transformation, Village Action Plans, Village Appraisals, and Visualisation in Participatory Programmes (VIPP).

3. Diversity represented

Diversity and inclusion so as to give multiple-perspectives are emphasised throughout, with complexity not characterised simply in the form of averages; different individuals and groups evaluate situations differently, and this leads to different actions.

4. External actors play a key role

External actors facilitate learning and are concerned with transformations that people in the situation regard as improvements; new attitudes and values amongst professionals are crucial, with listening and facilitating more important than teaching and telling; professionals also contribute technical support.

5. Self-assessments leading to visions for the future

External actors help people in their situation carry out their own study and so achieve something; the skills and knowledge of different stakeholders are put at the centre of the process.

6. Enhanced capacity for action

The learning process should be the basis for lasting change and the development of individual and organisational capacity; the analysis and debate about change leads to an increased readiness to contemplate action; the motivation to act increases as people find they can do what they never realised they could; action plans identify responsibilities for action and potential sources of funding.

Towards a new professionalism for sustainable agriculture

A central principle of sustainable agriculture is that it must enshrine some of these new ways of learning about the world. But learning should not be confused with teaching. Teaching implies the transfer of knowledge from someone who knows to someone who does not know. Teaching is the normal mode of educational curricula, and is also central to many organisational structures (Argyris et al., 1985; Bawden, 1992; Pretty and Chambers, 1993). Universities and other professional institutions reinforce the teaching paradigm by giving the impression that they are custodians of knowledge which can be dispensed or given (usually by lecture) to a recipient (a student). Where these institutions do not include a focus on self-development and enhancing the ability to learn, then 'teaching threatens sustainable agriculture' (Ison, 1990).

A move from a teaching to a learning style has profound implications for agricultural development institutions. The focus is less on *what* we learn, and more on *how* we learn and *with whom*. This implies new roles for development professionals, leading to a whole new professionalism with new concepts, values, methods and behaviour (Tab. 5). Typically, normal professionals are single-disciplinary, work largely in ways remote from people, are insensitive to diversity of context, and are concerned with themselves generating and transferring technologies. Their beliefs about people's conditions and priorities often differ from people's own views. The new professionals, by contrast, make explicit their underlying values, select methodologies to suit needs, are more multidisciplinary and work closely with other disciplines, and are not intimidated by the complexities and uncertainties of dialogue and action with a wide range of non-scientific people (Pretty and Chambers, 1993).

But it would be wrong to characterise this as a simple polarisation between old and new professionalism, implying in some way the bad and the good. True sensibility lies in the way opposites are synthesised. It is clearly time to add to the paradigm of positivism for science, and embrace the new alternatives. This will not be easy. Professionals will need to be able to select appropriate methodologies for particular tasks (Funtowicz and Ravetz, 1993).

Where the problem situation is well defined, system uncertainties are low, and decision stakes are low, then positivist and reductionist science will work well. But where the problems are poorly defined and there are great uncertainties potentially involving many actors and interests, then the methodology will have to comprise these alternative methods of learning. Many existing agricultural professionals will resist such paradigmatic changes, as they will see this as a deprofessionalisation of research. But Hart (1992) has put it differently: 'I see it as a "re-professionalisation", with new roles for the researcher as a democratic participant.'

A systematic challenge for agricultural institutions, whether government or non-government, is to institutionalise these approaches and structures that encourage learning. Most organisations have mechanisms for identifying departures from normal operating procedures. This is what Argyris calls single-loop learning. But most institutions are very resistant to double-loop learning, as this involves the questioning of, and possible changes in, the wider values and procedures under which they operate. For organisations to become learning organisations, they must ensure that people become aware of the way they learn, both from mistakes and from successes.

Institutions can, therefore, improve learning by encouraging systems that develop a better awareness of information. The best way to do this is to be in close touch with external environments, and to have a genuine commitment to participative decision-making, combined with participatory analysis of performance. Learning organisations will, therefore, have to be more decentralised, with an open multidisciplinarity, and heterogeneous outputs responding to the demands and needs of farmers. These multiple realities and complexities will have to be understood through multiple linkages and alliances, with regular participation between professional and public actors. It is only when some of these new professional norms and practices are in place that widespread changes in the livelihoods of farmers and their natural environments are likely to be achieved.

Policies for Sustainability and Learning

Policy reform has been underway in many countries, with some new initiatives supporting elements of a more sustainable agriculture. Most of these have focused on input reduction strategies, because of concerns over foreign exchange expenditure or environmental damage. Only a few as yet represent coherent plans and processes that clearly demonstrate the value of integrating policy goals. Nonetheless, it is clear that many policy reforms are leading to changes in the sustainability of agriculture.

The current need is for governments to declare a national policy for sustainable agriculture. This would help to raise the profile of these processes and needs, as well as giving explicit value to alternative societal goals. New policies must be enabling, creating the conditions for development based more on locally-available resources and local skills and knowledge. Policy makers will have to find ways of establishing dialogues and alliances with other actors, this interaction giving rapid feedback, so allowing policies to be adapted iteratively. Agricultural policies could then focus on enabling people and professionals to learn together so as to make the most of available social and biological resources.

Sustainable agriculture should not, therefore, be seen as a set of practices to be fixed in time and space. It implies the capacity to adapt and change as external and internal conditions change. Yet there is a danger that policy, as it has tended to do in the past, will prescribe the practices that farmers should use rather than create the enabling conditions for locally-generated and adapted technologies.

Throughout the world, environmental policy has tended to take the view that rural people are mismanagers of natural resources. The history of soil and water conservation, rangeland management, protected area management, irrigation development, and modern crop dissemination shows a common pattern: technical prescriptions are derived from controlled and uniform conditions, supported by limited cases of success, and then applied widely with little or no regard for diverse local needs and conditions (Ostrom, 1990; Benhke and Scoones, 1992; Pretty and Shah, 1994; Pimbert and Pretty, 1994). Differences in receiving environments and livelihoods then often make the technologies unworkable and unacceptable. When they are rejected locally, policies shift to seeking success through the manipulation of social, economic and ecological environments, and eventually through outright enforcement.

For sustainable agriculture to spread widely, policy formulation must not repeat these mistakes. Policies will have to arise in a new way. They must be enabling, creating the conditions for sustainable development based on locally available resources and local skills and knowledge. Achieving this will be difficult. In practice, policy is the net result of the actions of different interest groups pulling in complementary and opposing directions. It is not just the normative expression of governments. Effective policy will have to recognise this, and seek to bring together a range of stakeholders and institutions for creative interaction and joint learning.

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Table 1. Goals for sustainable agriculture

A more sustainable agriculture systematically pursues the following goals:
• A thorough integration of natural processes such as nutrient cycling, nitrogen fixation, and pest-predator relationships into agricultural production processes, so ensuring profitable and efficient food production;
• A minimisation of the use of those external and non-renewable inputs with the potential to damage the environment or harm the health of farmers and consumers, and a targeted and balanced use of the remaining inputs used with a view to minimising costs;
• The full participation of farmers and other rural people in all processes of problem analysis, and technology development, adaptation and extension, leading to an increase in self-reliance amongst farmers and rural communities;
• A greater productive use of local knowledge and practices, including innovative approaches not yet fully understood by scientists or widely adopted by farmers;
• The enhancement of wildlife and other public goods of the countryside.

Source: Pretty, 1997

Table 2. Examples of the extent and impact of sustainable in different agricultural systems

Countries	Number of farming households reported	Number of hectares reported	Dominant crop	Cereal yield improvement factor (%)
RAINFED SYSTEMS				
Brazil	223,000	1,330,000	Maize, Wheat	198 to 246%
Burkina Faso	22,500	37,360	Sorghum/millet	250%
Ethiopia	24,175	21,850	Maize	154%
Guatemala	17,000	17,000	Maize	250%
Honduras	27,000	42,000	Maize	250%
India	307,910	993,410	Sorghum/Millet	288%
Kenya	222,550	250,000	Maize	200%
Mexico	7400	23,500	Coffee	140%
Nepal	3000	1300	Maize, Wheat	164 to 307%
Philippines	850	920	Upland rice	214%
Senegal	200,000	400,000	Sorghum/Millet	300%
Uganda	9426	21,379	Maize	150%
Zambia	6300	6300	Sorghum/Millet	200%
Total	***1,146,111***	***3,257,519***		
IRRIGATED SYSTEMS				
Bangladesh	11,025	4772	Rice	110%
China	47,000	12,000	Rice	111%
India	50,000	71,300	Rice	108%
Indonesia	400,000	267,000	Rice	107%
Malaysia	2500	3925	Rice	108%
Philippines	175,000	385,000	Rice	112%
Sri Lanka	100,000	95,350	Rice	117%
Thailand	500	2040	Rice	109%
Vietnam -	6600	3540	Rice	108%
Total	***792,625***	***844,927***		

Note: Improvements are measured against non-sustainable farming equivalents, which are taken to be 100%. Thus an improvement of 200% implies a doubling of yields; one of 90% implies a fall in yields of 10%. The time frame for these improvements is during the life of programme activities, usually less than 5 years. Some improvements are expected to occur in the season following the adoption of sustainable agriculture, and these tend to increase over time.

Source: Pretty, Thompson and Hinchcliffe, 1996.

Table 3. The changing phases in the Thai-German Highland Development Project: the case of 113 villages in Nam Lang, Northern Thailand

1. 1987-1990	cash incentives and free inputs high adoption, but little or no adaptation of technologies *Adoption: withdrawal = 5:1*
2. 1991-92	all incentives stopped; beginning of participatory work adoption rates fell to 25% of phase I withdrawal increased immediately by 3 fold *Adoption: withdrawal = 1:2.2*
3. 1993-94	participatory village planning; communities fully involved adopters and withdrawers now equal *Adoption: withdrawal = 1:1*
4. 1995-96	adopters increasing; farmers adapting technologies and diversifying - eg pineapple strips, lemon grass, cash crops, soil and water conservation. *Adoption: withdrawal = 3:1*

Source: Steve Carson, pers. comm. 1996

Table 4. A typology of participation

Typology	Characteristics of Each Type
1. Manipulative Participation	Participation is simply a pretence.
2. Passive Participation	People participate by being told what has been decided or has already happened. Information being shared belongs only to external professionals.
3. Participation by Consultation	People participate by being consulted or by answering questions. Process does not concede any share in decision-making, and professionals are under no obligation to take on board people's views.
4. Participation for Material Incentives	People participate in return for food, cash or other material incentives. Local people have no stake in prolonging technologies or practices when the incentives end.
5. Functional Participation	Participation seen by external agencies as a means to achieve project goals, especially reduced costs. People may participate by forming groups to meet predetermined objectives related to the project.
6. Interactive Participation	People participate in joint analysis, development of action plans and formation or strengthening of local groups or institutions. Learning methodologies used to seek multiple perspectives, and groups determine how available resources are used.
7. Self-Mobilization	People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used.

Source: Pretty, 1995b

Table 5. Towards a new professionalism for sustainable agriculture

Elements	**Components of the new professionalism**
Assumptions about reality	The assumption is that realities are socially constructed, and so participatory methodologies are required to relate these many and varied perspectives one to another.
Underlying values	Underlying values are not presupposed, but are made explicit; old dichotomies of facts and values, and knowledge and ignorance, are transcended.
Scientific method(s)	The many scientific methods are accepted as complementary; with reductionist science for well-defined problems and when system uncertainties are low; and holistic and constructivist science when problem situations are complex and uncertain.
Who sets priorities and whose criteria count?	A wide range of stakeholders and professionals set priorities together; local people's criteria and perceptions are emphasised.
Context of researching process	Investigators accept that they do not know where research will lead; it has to be an open-ended learning process; historical and spatial context of inquiry is fundamentally important.
Relationship between actors and groups in the process	Professionals shift from controlling to enabling mode; they attempt to build trust through joint analyses and negotiation; understanding arises through this interaction, resulting in deeper relationships between investigator(s), the objects of research, and the wider communities of interest.
Mode of professional working	More multidisciplinary than single disciplinary when problems difficult to define; so attention is needed on the interactions between members of groups working together.
Institutional involvement	No longer just scientific or higher-level institutions involved; process inevitably comprises a broad range of societal and cultural institutions and movements at all levels.
Quality assurance and evaluation	There are no simple, objective criteria for quality assurance: criteria for trustworthiness replace internal validity, external validity, objectivity, and reliability when methods is non-reductionist; evaluation is no longer by professionals or scientists alone, but by a wide range of affected and interested parties (the extended peer community).

Source: adapted from Pretty and Chambers (1993)

Comments

by

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Introduction

To start with the conclusion, I find Prettys presentation and paper indeed excellent and a very useful contribution to the ongoing discussion in Norway on development paths in the South and the role of people-centred sustainable agriculture. However, it is a bit difficult to comment since I happen to share so many of Pretty`s views and values and hence find it difficult to be really critical, but rather would like to express my support.

The gap between the wealthy and the poor: Sustainable agriculture and the North - South dimension

Pretty starts his paper by stressing, under the heading of current challenges for agricultural development that the gap between the wealthy and the poor in the world has widened. Despite a doubling in global income in the past three decades, the number of people living in poverty has continued to rise from 944 million to 1300 million. In addition, it might be timely to add that a generation ago the top 20% of the world was 30 times as rich as the bottom 20%. Today the top 20% are 78 times as rich as the bottom 20% (UNDP, 1997). In this regard, I would have expected the North - South dimension to be more thoroughly addressed. What does a sustainable agricultural development path implies both in the South and in the North, as well as North-South interaction and processes of change and redistribution of power and access to resources. To give a simple example of a possible way of changing our perceptions of production in a more sustainable direction, yield might not only be recorded as kg or ton pr ha, but as production pr unit of energy or production pr unit of water use (Serageldin, 1997).

What is causing poverty and environmental degradation

Pretty states that all actors involved appear to agree that there is an urgent need to increase food production substantialy over the next quarter to half century. The question is *how to do it.* If he in this how to do it include where, by who and in what way I agree. The question is indeed not only *how to increase the production*, but how to increase production in a way that facilitate hungry people access to the food being produced and in a way that is not harmful to the environment. The question is how to increase production in low income food deficit countries and at household level. It is difficult to build on an agreement that food production has to be increased, if a careful analysis of the situation is not undertaken. The policy and solutions must be based upon analysis of why we have 840 mill undernourished people in a world of plenty, the causes of poverty and malnutrition as well as the causes of environmental degradation. Although there appears to be agreement on the need to produce more food at least in low-income food deficit countries, if there is no agreement on the underlying causes of the present problems relating to poverty and environmental degradation, it will be difficult to develop appropriate policies and actions. On the other hand, if the aim is to improve the hungry people access to food other actions than increased production might be equally efficient e.g. poverty reducing measures, redistribution and improved access to production resources and income generating activities; reducing the workload of women and hence, contribute to an increase in availability of time for family care; reducing the 30-40% production loss during postharvest, storage and food processing etc.

Sustainable intensification - the missing role of technology?

Pretty outlines the five contrasting schools of thoughts on how to increase food production as follows:

- Business-as-usual-optimists
- Environmental pessimists
- Industrialised world to rescue
- New modernists
- Sustainable intensification

Pretty falls into the sustainable intensification school which has been added to McCalla`s four categories. Regarding the sustainable intensification view, I have a question to the role of technology e.g. biotechnology or information technology (GIS). Do this kind of advanced technologies have a role to play in the sustainable intensification school? Will such advanced technology be possible in a self-mobilisation participatory mode? What about ethics, equity, intellectual property rights and biosafety in relation to biotechnology?

Dr Balaji stated in his paper to the NFU-conference that if technology so far has been a major cause of ecological damage, it can be a leader in finding methods to ensure that development is sustainable. He introduced the concept of ecotechnology rooted in the principles of ecology, economics and equity. I would like Pretty to elaborate on the role of technology in particular biotechnology in the sustainable intensification school.

How to define sustainable agriculture

Pretty tries to define sustainable agriculture, which is a difficult task. Sustainable agriculture means different things for different people, evidently it is so broad that nobody is against sustainable agriculture, whereas many people might be against organic or ecological agriculture. Some people might not like the term sustainable agriculture because they find it rather meaningless. But so far, nobody has come up with a better concept. Pretty stresses the importance of clarifying *what is being sustained, for how long, for whose benefit and at whose costs, over what area and measured by what criteria.* In particular he stresses the that sustainable agriculture should be regarded as a *process for learning.* We definitely have a long way to go in learning what sustainable agriculture is all about, and how to put that knowledge into action both in the North and the South. Sustainable agriculture might be regarded as a situation specific moving target. We have to learn as we go ahead and to discuss definitions might just be a waste of time?

Low-input, low or high output agriculture

Pretty provides interesting evidence showing that regenerative and resource-conserving technologies and practises can bring both environmental and economic benefits for farmers, communities and nations. The notion of low input means low output appears to be rejected. Both transition from modern high external input agriculture and from traditional rainfed agriculture to sustainable agriculture might give considerable yield increase. This sounds very promising from an environmental point of view. However, within agricultural settings, we are hearing all the time that chemical fertilisers are *the* only solution e.g. for depleted African soils, and in Africa the fertiliser consumption is close to zero anyway so an increase will not do any harm on the environment. Another problem might be that chemical fertiliser is not an economically viable solution for most African farmers. What is the role of chemical fertiliser in the sustainable intensification school?

New professionalism

I would like to support Pretty`s analysis and conclusions on participatory approaches, learning processes and the call for a new professionalism. Apparently, there is a need for a change of attitudes and behaviour among researchers as well as contributions towards empowerment of local people. Pretty describes "normal" professionals as *single disciplinary, who work largely in ways remote from people, are insensitive to diversity of context, and are concerned by themselves generating and transforming technologies.* What does it take to change an academic environment, where participatory methods are not recognised and if at all used, appears to be manipulative and passive, and the attitudes among researchers more towards the kind of information extracting, driven by the publishing trauma? And second, are people able to deal with the complexity that may surface with regards to interest groups at the community level and the whole new mode of partnership which opens up?

Conclusion

Pretty`s message appears to be a call for a world-wide change to

- sustainable agriculture - whatever that might be,
  facilitated though
- the right policy - whatever that is
- and through a mutual learning process and a self-mobilizational participation leading to empowerment of local people - where people are the solution and not the problem.

The question which remains is whether this is feasible. The scientific evidence should have been provided by Pretty although a methodological critique was not possible based on Pretty`s paper.

5. People and Environment: What is the Relationship Between Exploitation of Natural Resources and Population Growth in the South?

by

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Summary

While the potential for global agricultural production is far greater now than in Malthus' time, their environmental impacts raise concerns about the long-term sustainability of farming systems. The challenges vary greatly in intensive irrigated systems, intensifying rainfed systems in high potential and environmentally fragile areas, and the agricultural frontier. Theories of induced suggest that the microeconomic changes associated with population growth may themselves encourage technological and institutional innovations in natural resource management. Empirical evidence from tropical hillsides confirms these potentials. However, the pace of innovation is too slow relative to population growth. Public policies to promote land-improving technologies, foster social institutions needed for good resource management, and enhance resource values through public investments and price policies are essential to accelerate the process and prevent ecosystem degradation and impoverishment as populations increase.

Biographical Statement

Sara J. Scherr, a U.S. citizen, was born in 1954. She earned a B.A degree in Economics from Wellesley College in 1975, an M.Sc. and Ph.D. degrees in International Economics and Development from Cornell University in 1978 and 1983. A Research Fellow at the International Food Policy Research Institute in Washington, D.C. since 1992, she previously worked with the International Center for Research in Agroforestry (ICRAF), the International Tree Crops Institute (ITCI), and the Food Research Institute of Stanford University. She has published numerous articles and books on policies for sustainable natural resource management and on agroforestry development.

INTRODUCTION

Two hundred years ago, Thomas Malthus raised the specter that human population growth would eventually outstrip food supply (Malthus, 1798). During the past century, however, technological and institutional innovations have dramatically raised the global capacity to produce food, although the challenge of equitable food distribution remains. But as Malthusian pessimism over *food production potential* recedes, a neo-Malthusian pessimism is taking its place--to paraphrase, that as population grows geometrically, our *capacity to maintain environmental integrity* may grow...not even arithmetically.
By the year 2020, global population is expected to increase by 40%, reaching 8 bln. Food production must rise by even more, to meet new demands expected from income growth. Not until the end of the 21st century, is global population expected to stabilize around 11-12 bln people (Bongaatz, 1995). As the world attempts to develop life support systems to accommodate a population of this magnitude, one of the major potential threats to ecosystem function is the expansion and intensification of agricultural and forestry production. Moreover, there is even doubt whether recent yield increases will be sustainable over the long run: in many areas the land base for agricultural production is degrading, through soil erosion, nutrient depletion, compaction, devegetation or salinization.

The nexus between population, agriculture and natural resource management (NRM) is the subject of this paper. It first briefly explores the nature and scale of the problem, and then presents a framework for examining the dynamics of land quality change. As an example, the next section presents the available evidence on land management under population pressure in the tropical hillsides--ecosystems of particular concern in terms of both the sustainability of agricultural production and maintenance of environmental services. This evidence suggests, perhaps surprisingly, that the effect of population on degradation is indeterminate; the outcomes depend much more on other economic and institutional factors. The final section draws lessons from this analysis for policy action to promote sustainable land management as populations grow.

AGRICULTURAL LAND USE AND DEGRADATION

The magnitude of recent changes in agricultural land use and degradation are illustrated by aggregate and regional data, although these to some extent mask important variation in the underlying dynamics of change.

Aggregate Changes

Between the early 1960s and the mid-1990s, land area under annual crops increased by 18 mln hectares in Asia, 28 mln in South America and 31 mln in Africa. Area under permanent crops rose notably in Africa and Asia. Areas under permanent pastures expanded even more in aggregate terms, while total forest and woodland area declined in Asia and South America (Table 1; FAO). Although considerable land which is potentially productive remains outside these uses (and deforestation is likely to continue), area under crop production is only expected to expand a further 12% by 2010 (mainly in Latin America and Africa), due to environmental limits, lack of infrastructure, opportunity costs for forest and pasture uses, and potential recovery of currently degraded lands (Crosson, p. 148).

Average crop yields grew rapidly since the 1970s and are projected to continue rising in the next 15 years, although at lower rates (Table 2). Total growth rates for agricultural production in the developing countries (even in Africa) rivalled or surpassed historical growth rates in the industrialized countries. Unfortunately, per capita yields rose much more slowly due to the effect of rapid population growth.

Indeed, during this period, average rural populations rose markedly, even as urbanization in these countries took place on an unprecedented scale (Table 3). Although the rural growth rate declined from 2.2 % in 1960-65 to 1 % in 1990-95, the absolute number of rural dwellers is projected to continue increasing until around 2015 (later for the least developed countries). By 2015, 94% of the world's rural population (3 bln people) will be in the developing countries (United Nations, 1995).

Production increases and rural population growth appear to be associated with significant land degradation, although the effects on production have been masked by aggregate yield increases due to non-land inputs. Using an expert survey method, the Global Land Assessment of Degradation (GLASOD)[1] estimated that of 8.7 billion hectares of agricultural land, pasture, forest and woodland, nearly 2 billion hectares (22.5 percent) have been degraded since the mid-1900s. Some 3.5 percent of the total was judged to be so severely degraded that it is reversible only through costly engineering measures, if at all; just over 10 percent was moderately degraded, reversible only through significant on-farm investments. Nine percent is lightly degraded and easily reversible through good land husbandry practices (Oldemann, et al., 1990; Figure 1). Figure 2 shows that forest and agricultural lands are most affected in Asia, and pastures in Africa. Notable causes of degradation are agricultural practices and overexploitation of vegetation, overgrazing and deforestation (Table 4).

No global (or even national) data are available to indicate the scale or value of land-improving improvements, such as terracing, nutrient and organic matter enrichment, contour hedges, tree-planting, etc., or improved management practices, during this period.

Dynamics of Change

But the aggregate figures do not tell the whole story. As indicated in Figure 2, production increases since the 1960s resulted from both yield increases and expansion in cultivated area. Indeed, four distinct patterns of land use change can be identified in areas with different population, market, and agro-environmental conditions, and these are associated with different NRM problems.

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[1] The GLASOD study was designed to provide qualitative, continental-scale estimates of the degradation problem. For degradation data from regional, national and sub-national sources, including both biophysical and economic estimates, see Scherr and Yadav, 1996.

The first pattern results from the spread and intensification of irrigated agriculture. Irrigated area grew by 100 mln hectares (over 60%) between 1961 and 1990, mainly in developing countries; accounting now for 17% of cropland, but a third of world food production. These areas--closely integrated with urban markets, with well-developed institutions--have reaped the benefits of the Green Revolution, with multiple cropping and high yields, and the development of intensive livestock operations. These are the great bread baskets and rice bowls of Asia and the irrigated wheat fields of Latin America and North Africa. The most serious on-site degradation problem is salinization, but important environmental concerns include threats to groundwater supply, water-borne diseases, water pollution and health hazards from excessive agrochemical applications and animal wastes, and growing conflicts with urban and industrial land and water uses.

The second pattern is intensification in the rainfed plains and hillsides with relatively fertile soils and reliable rainfall, which have shifted from short-fallow systems to permanent cropping (and sometimes perennial export crops), through the increased use of fertilizers and improved seed and planting material. This pattern characterizes disparate areas in India, Zimbabwe, the uplands of Java and the Kenyan highlands. The main on-site degradation concerns are mechanization damage to fragile soils, acidification and soil degradation on smallholdings, while broader environmental concerns are pesticide pollution and health hazards and deforestation of previously communal lands converted to cropping.

A third pattern is found in long-settled areas with less favorable environments for crop cultivation (drylands, rain forests, acid soils, shallow soils, high altitudes, steep slopes, etc.). Population and market growth have forced a transition from traditional long-fallow systems to short-fallow or permanent cropping systems, with intensification of ecological niches not historically used intensively. Yet for many areas (especially those with poor infrastructure and greater reliance on subistence production), fertilizer use is uneconomic, insufficient, or inadequate without complementary organic inputs. Land improving investments are uneconomic, and technologies and genetic material adapted to these conditions are unavailable. Recurrent crop failures lead to depletion of other resources (e.g., forest products) to meet consumption needs. These conditions characterize large areas of Africa, and many hillsides, drylands and highlands in Asia and Latin America. These farming systems are threatened by soil erosion, serious fertility depletion, and de-vegetation, which in turn create environmental problems by depleting biodiversity and degrading watershed function.

The fourth pattern is found in formerly remote or sparsely settled areas and forest or rangeland reserves. Migration of the landless (planned and unplanned) has led to new settlement and land-clearing in more marginal environments for crop cultivation and extensive grazing, especially in rain forests, drylands and steep slopes. Infrastructure is typically poor and product and factor markets undeveloped, with limited services or regulatory capacity by either government or local institutions. External inputs are unavailable, overall land use intensity--and yields--are low. Examples are rainforest clearing in the Amazon and the Atlantic zone of Central America, drylands in West Africa and Indochinese hill country. Deforestation, loss of biodiversity, and watershed

degradation are prominent concerns.
Because of variation in the relative importance of each of these trends in different regions of the world, the "hot spots" of degradation vary markedly.[2] Environmental concerns tend to be politically more important in the richer, more urbanized countries, salinization in countries dependent on irrigated agriculture; devegetation, nutrient depletion and erosion in countries and regions more dependent on food production from marginal lands. Population growth and market conditions in these different circumstances pose different challenges for sustainable NRM and strategies of agricultural growth. The following section presents a conceptual framework which allows us to assess the dynamics of land use change under these diverse conditions, and to define the policy space for addressing problems of degradation.

DETERMINANTS OF LAND QUALITY

Figure 3 illustrates alternative pathways of change in natural resource conditions that may result from increasing pressure on the resource over time (Scherr and Hazell 1994). Such pressure could come from increasing population, market demand, or other factors. Pathway II represents situations in which overexploitation lead sto resource degradation--a neo-Malthusian outcome. Resource users may suffer a decline in welfare, or replace the resource with substitutes (e.g., purchased feed for degraded grazing land, kerosene for scarce woodfuel).

Pathway I represents a situation in which resource users eventually (at T_2) respond to natural resource degradation by improving management or investment in the resource base, leading to higher total output from the resource. With intensification alone, human welfare will not necessarily increase, as labor productivity may decline. With technical or institutional innovation, however, welfare improvements may be expected. Pathway III is an example where resource-conserving intensification is delayed until much later in the resource degradation process, such that the potential for full recovery is compromised. In Pathway IV, policy or other interventions accelerate the endogenous innovation process. These different pathways of change in NRM can be explained by theories of induced technical and institutional innovation, as the local response to changing microeconomic incentives for resource managers (Boserup 1965 and 1990; extended by Binswanger and Ruttan, 1978; Ruthenberg, 1987, Lele and Stone, 1989; Pingali, Bigot and Binswanger, 1987). The model can be enriched by incorporating variables suggested by recent work on determinants of community-level change in NRM, such as local processes of innovation, collective action, local market and institutional development, and landscape ecology (Scherr, et al. 1996). Land management innovations may be the result of local invention based on agroecological observation and experience, diffusion of ideas or plant materials from other areas, or exposure to extension.

Figure 4 illustrates this conceptual framework. The outcomes of interest for sustainable

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[2] "Hot spots" for land degradation were identified an international group of experts at a workshop held in April 1995; results are reported in Scherr and Yadav, pp. 11-22.

development are the "critical triangle": growth in economic output and productivity, improvement in human welfare, and protection of the natural resource base. Pressures from population growth, new technology or markets induce change in local community markets, prices and institutions. The local effects of these shifts are conditioned by community characteristics, such as their human and natural resource endowments, infrastructure, distribution of land and other assets, market linkages, and culture. Community changes may induce responses in NRM at both household and collective levels, in land use, investment, input use, conservation practices, migration patterns and collective action. The resulting changes in NRM affect natural resources, economic conditions and welfare, and these have feedback effects on decisions. Public policies potentially influence most of the variables in this framework. This framework is valuable in helping to make sense of the empirical evidence on land use changes with population growth, as illustrated in the next section discussing tropical hillsides.

LAND QUALITY AND POPULATION GROWTH IN TROPICAL HILLSIDES

Population and agricultural production have increased in most of the hilly and mountain areas of the tropics. While outmigration to cities and lowland centers of commercial agriculture is an important phenomenon in some historically densely populated mountain areas (the Andes, the Himalayas, Mexican highlands), in most places this has been more than balanced by natural population increase in the long-settled highlands, and immigration from densely settled lowland farming areas up the hillside into former forest or grazing reserves (Central America, Philippines, central Asia). Around 500 mln people are now estimated to live in tropical hillsides and mountains. Concern about population growth arise not only because of the potential for further impoverishment of already marginal populations, but also because the uplands constitute critically important watersheds for urban populations and for lowlands irrigation, and include important reserves for forest resources and biodiversity.

Evidence of Land Degradation and Improvement

Templeton and Scherr (1997) reviewed over 150 English-language studies from economics, sociology and geography pertaining, primarily, to land management in hilly-mountainous areas of the Himalayas, Andes, Southeast Asia, East Africa and Central America, representing all three types of rainfed land intensification. The studies looked at three key features of land management: tree cover, soil erosion and fertility, and pasture land quality.[3]

Most of the empirical evidence from both case studies and cross-country comparative studies suggests that population growth is indeed associated with deforestation of natural

[3]Data on changes in hydrology and water quality with population change are rare, however land cover variables are considered to be fairly good indicators of watershed condition (from agricultural use). Data on biodiversity changes were not reviewed.

forests, although the proximate cause of deforestation may be logging or infrastructure development, rather than agricultural activity. Annual tropical deforestation rates between 1981 and 1990 were higher in the tropical uplands (1.1%/yr, with 204.3 mln hectares remaining in 1990) than in the lowlands (0.8%/yr, with 1,543.9 mln hectares remaining). However, increases in population density are commonly associated with increases in planted tree density, with the highest documented levels of tree cover found in densely populated areas like the Kenyan highlands and Java. Trees are planted to meet a wide range of subsistence needs and market opportunities for fruits, wood products, resins, fuel, as sources of organic matter for farming or animal feed, or to control the movement of soil, water or wind across the farm landscape. Depending upon their numbers, species mix, configuration, associated ground cover, and water management practices, planted trees can provide many of the watershed functions of natural forests (water infiltration and storage, biodiversity, protection against soil erosion).

Population density is negatively correlated with length of fallow, and positively correlated with cropping frequency. Both of these features, without countervailing management practices, expose the soil to degradation. Longitudinal case studies for quite a few African and Asian sites document greater soil erosion, declining soil fertility, or slope failures as population density increased. Expansion of cultivation onto hilllsides is estimated to have seriously eroded about 160 mln hectares of upland watersheds (World Food Council 1988).

However, in numerous case studies from historical and more recent periods documented in Asia, Africa and Latin America, in longer-settled areas, land users do substitute other means of replenishing soil fertility for fallowing and make land improvements that conserve soil, water and fertilizer. These investments and use of additional non-land inputs improve land quality, or maintain land capability for further use. Particularly striking was the evidence relating increased land degradation to hillside *de*-population in the Middle East, east Africa, west Africa and Mesoamerica. Fertilizer and pesticide pollution are problems mainly in pockets of high-input commercial agriculture, on more fertile soils and geographically close to markets.

In general, livestock populations tend to grow as human populations grow from low to medium-high densities[4], and then decline as human densities rise further. As livestock numbers rise, people tend to substitute crop residues for pasture, gather forest fodder, cultivate fodder grasses on separate plots or on erosion-control bunds, and eventually restrict livestock to stalls and switch to smaller animals. Thus, similar livestock population densities are possible at a wide range of human population densities in all agro-ecological zones, but the feeding methods are land-intensive at low levels and labor-intensive at high levels. The association of livestock production with land degradation is mainly a result of

[4] Generally, I consider "low" rural population density to be below 25/km2; "medium" density to be 25-100/km2; and "high" density to be above 100/km2. Rain forest densities may be under 5/km2 and a few areas (parts of southern Nigeria, western Kenya and Java), have population densities ranging from 500-1000/km2.

grazing practices which cause de-vegetation, which tend to be found at lower to moderate human population densities. A few case studies from Kenya and Nepal document historical improvements in grazing land conditions as human populations grew.
The empirical evidence provides a basis for several generalizations about the relationship between population growth, production systems, and land qualities in hilly and mountain lands. First, the changes in farming systems associated with population growth can lead either to land degradation or land enhancement, or aspects of both. Population growth from low population density levels often leads to conversion of 'natural' grazing land into agricultural land or of 'natural' forests into grazing lands or farms, or the fragmentation of such areas. Some of these conversions can indeed cause irreversible damage to certain aspects of the ecosystem, such as loss of unique habitats and biodiversity. Population decline from medium or high levels of population density may lead to extensification of production systems and land degradation, although depopulation which leads to large-scale land abandonment or reversion to natural vegetation may have positive environmental effects.

As population grows, people use land more frequently to increase production. However, people also tend to produce more labor-intensive crops and substitute labor-intensive and capital-intensive inputs and production techniques for land-intensive ones. Some of these enhance vegetative cover or soil nutrient levels. Population growth commonly induces people to make landscape investments, such as trees, terraces, vegetative barriers, and fodder banks, which improve the land's capacity for intensive and sustainable use. Because people can change crops, inputs and management techniques, production systems that enhance landscapes, minimize degradation or mimic the ecological functions of 'original' vegetation in watersheds exist at all levels of population density.

However, the type of land investment and management changes as population density increases. People may protect naturally-growing trees or maintain dry season grazing reserves in low density systems, while in systems with high population density they construct contour-hedgerow terraces or intensively managed fodder banks. More labor- or capital-intensive land improvements often represent a transition to less degrading land use systems, following earlier adaptations in technologies, use of variable inputs or management practices.

The Determinants of Land Quality in Tropical Hillsides

Most of the environmental impacts of production increases in the hills and mountains thus depend on whether sufficient microeconomic incentives exist for people to choose production systems--products, inputs, land use intensities, technologies, and landscape investments--that enhance land characteristics or, at least, retard their degradation. While household-specific factors clearly influence these decisions, community-wide changes in NRM induced by exogenous pressures occur mainly through mechanisms which modify community baseline conditions and thus the nature of local markets and institutions (Figure 4).

Factor markets. Population growth affects general factor markets as well as individual household resource endowments. Both processes induce technical change, as a direct response to shifting relative prices, and by creating incentives for local invention and active borrowing of technologies better suited to the new economic environment. Fifteen hillside studies found that increasing land scarcity or declining farm size led to intensification of crop, livestock or tree production, and/or greater use of terracing and soil conservation. For example, Tiffen, Mortimore and Gichuki found that erosion rates and erosion risk in the Machakos district of Kenya declined as population tripled between the 1930s and 1980s. Scherr (1995) traced the evolution of more intensive agroforestry practices between the late 1700s and 1980s in the mixed crop-livestock systems of western Kenya.

Labor market conditions influence cost and access of labor for land-improving investments and labor-intensive management practices. Hillside data from sites in 16 countries showed mixed effects of rising non-farm incomes on land management. In 13 cases, higher non-farm incomes were associated with abandonment or neglect of terraces and reduced adoption of soil conservation measures, while in four cases, they resulted in more tree-planting and -growing, and more investment in soil conservation structures.

Product markets. The growth of agricultural and forest product markets and relative price increases offer new opportunities for cash income to purchase cash inputs and capitalize land improvements. Eighteen hillside studies demonstrated a strong positive relationship between increased market opportunities or product prices and farmer investment in tree-planting, cropland intensification, or terracing.

Local institutions. Population growth may also induce the evolution of property rights. Greater land scarcity increases the benefits of creating and rigorously enforcing rules that better define the rights and obligations among people for the use of this valuable resource, and reduce conflict. Empirical evidence on the effect of property rights in tropical hillsides is mixed; security of land claims and rights to harvest appear more important than formal title.

As the value of land increases, so may the benefits of organizing and participating in collective action to to invest in land improvements or to manage the externalities associated with more intensive land uses (Baland and Plateau, 1994). Five sub-regional hillside case studies in Haiti, Kenya, Mexico and Bolivia found membership in local labor-sharing or collective work groups associated with construction and maintenance of conservation structures and practices.

Because hill and mountain areas generally have greater agroecological diversity, cropping patterns and production techniques exhibit greater variety than in flat areas. Some hillside studies illustrated systematic variation in farmer investment in land improvements, depending upon climatic and plot-level ecological conditions. In some cases, investments were concentrated on more vulnerable plots (those which were drier, steeper or less fertile); more often investments were concentrated on the higher potential plots within a diverse landscape. Successful cases of innovation in NRM were documented in both higher and lower potential hillsides, though more often in wetter and more fertile environments.

In summary, many hill and mountain areas could potentially sustain production at higher population levels, without ecessive resource degradation. The policy challenge is to influence local economic conditions and institutions to provide the necessary incentives, resources and institutional support for farmers to invest in appropriate land management systems.

CONCLUSIONS AND POLICY IMPLICATIONS

The example of tropical hillsides illustrates that 'carrying capacity" is not a useful absolute concept for analysis of the environmental impact of human population and production over time or space. In any instance, carrying capacity for humans depends on the extent of landscape transformations and the nature of production systems. Since changes in socioeconomic conditions induce changes in land management, carrying capacity is endogenous. Moreover, certain landscape transformations are irreversible; hence carrying capacity is also path dependent (Turner, Hyden and Kates, 1993).

Higher rural population is not directly associated with degradation. However, a slower rate of demographic growth or decline allows people the more time to innovate or adopt products, technologies, property rules, and collective management. Evidence suggests that endogenous processes of induced innovation are widespread, but they are too slow, relative to high current rates of population growth, to achieve sustainable outcomes (and avoid irreversible degradation) in the short to medium term. Policy action is needed to slow the rate of demographic change and speed up the innovation process. There is a clear danger that people's need for subsistence security and income will overwhelm the technical, legal and institutional mechanisms that ordinarily keep farming sustainable. Governments and non-governmental organizations (NGOs) cannot afford large-scale direct investment and regulation for land improvements; rather they need to catalyse and build on local processes of innovation. Do we understand how to promote such innovation? Can we identify the different potentials and priorities for different types of intensification processes?

Technological Innovation

Areas with habitat of great value for biodiversity should be carefully delineated and protected. But it should be recognized that government capacity to protect large areas from settlement, under conditions of rapid population growth, is demonstrably limited. Elsewhere, the priority objectives should be sustainable farming and protection of key environmental services, although opportunities exist and can be developed to protect biodiversity even in agricultural landscapes.

Areas undergoing the four different patterns of intensification described above have different technological requirements, and thus different research and extension priorities. For example, in more fragile environments more perennial vegetation is essential, and options such as polycultures, land-shaping, and minimum tillage may be needed, as well as genetically improved materials adapted to these environments. By contrast, irrigated areas need more sophisticated technologies for water and pest management. Intensively managed conservation practices may be appropriate in densely-populated areas, while more extensive practices (for example, leaving strips of land uncultivated) may be more suitable in areas of low population density.

Research and extension programs, both national and international, need to enhance their capacity to integrate agricultural and ecological analysis, at different scales. With intensification, most rural regions are not likely to have the luxury of spatially separating areas for production from areas for environmental services. Technical innovations need not only to increase production or protect resources, but also to increase returns to labor, so as to avoid impoverishment.

Land improvement strategies should be designed together with farmers to meet their priority needs, using technology appropriate to local economic and social conditions. Financial credit, co-financing arrangements, and subsidies may sometimes be appropriate incentives for land improvement. But where the innovations are intrinsically profitable for farmers, demonstration, extension and farmer organization will be sufficient and are likely to reach far more producers. Re-structured extension services need to draw on new media and communication tools to catalyze and accelerate local technical innovation. Education and culture may play important roles in establishing the values of good land husbandry.

Institutional Innovation

But appropriate technology is neither sufficient, nor the most difficult challenge. Far more demanding are the needs for institutional innovation, to encourage and facilitate household efforts to improve land quality, and to enable the adoption of effective resource management strategies at higher-than-farm scale.

Secure property rights and rights of access to natural resources are essential for long-term investments. But the priority issues are quite different for irrigated production; permanent rainfed production in well-integrated markets; marginal lands with imperfect markets; and frontier agriculture. Depending upon the situation, reforms in land titling, women's land rights, rental arrangements, or regulations on public lands may be essential. National policies must be flexible enough to accommodate and support a range of local adaptations. Regulations should be used sparingly and ideally focus on environmental outcomes (for example, defining acceptable levels of sedimentation from a critical watershed), rather than on specific land uses or farming practices.

Local organizations and collective action will play an increasingly important role in promoting good land management under intensification. We need to understand how to organize and support communal institutions and NGOs to play various roles on a large scale. More flexible and participatory planning systems are needed to resolve conflicts and effect compromises among competing land uses and users. Different types of organizations are feasible, and needed, at different levels of population density and market integration.

Supportive Policies

Land must become relatively more valuable to farmers, before they are likely to invest in land conservation and improvement. Population growth raises relative land values, but too often by lowering the absolute value of labor. The development of product and factor markets, improvements in transport infrastructure to reduce input and marketing costs, and removal of market distortions which artificially lower the value of land can promote more widespread adoption of land-improving practices. Where markets function relatively well, public pricing policies for natural resources, farm inputs and products can be effective policy instruments. Pricing of irrigation water and forest logging concessions or taxes on land or pesticides can be reformed to better reflect the real costs and benefits of land management practices.

More generally, rural income growth and diversification can help promote good land husbandry by creating markets for higher-value products more suitable to areas at environmental risk for annual crop cultivation (e.g., tree crops), providing incentives for land investments, and offering employment opportunities that reduce pressures on marginal lands or offer a source of capital for land-improving investment. Public agricultural services and investments can be relatively more important to farmers in marginal or difficult areas, which are less well-served by commercial interests.

Conclusion

Land degradation could indeed be a potentially serious threat to food production, rural livelihoods and ecosystem integrity in the next century. Further expansion of cultivation into areas of fragile soils, important watersheds or critical habitats can lead to significant environmental deterioration unless carefully managed. In areas with rapidly increasing domestic and industrial demands for water, and those where growing populations reside in water-scarce environments, poor agricultural management could threaten water availability, quality and human health.

Many types of land degradation can potentially be reversed, but the process requires long-term commitment. Population growth in the rural tropics is a double-edged sword. Land-improving investments and better land management can be more feasible at higher population densities and higher land values. But without better technologies at farm level, better organization and planning at landscape or watershed level, and a supportive policy environment for land-improving investment, a neo-Malthusian scenario will indeed threaten the South. Greater national and international attention to these challenges is long overdue.

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Comments

by

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This is an excellent and very interesting paper, which I appreciated to read. The nexus between population, agriculture and natural resource management is the subject of Sara Scherr's paper. Or, put in another way, Scherr discusses environmental impacts of population growth and agricultural intensification. So, this paper deals with the Malthus-Boserup controversy on the environment rather than on food production.

First, the paper describes the nature and scale of environmental problems related to population growth and agricultural intensification, then it presents a framework for examining these relationships. Entering this field, Scherr draws on induced innovation theory. This theory, which was first suggested by Ester Boserup in her classic book from 1965, has later been developed and qualified by authors like Ruthenberg, Binswanger, Pingali, and Lele and Stone. As most of you would know, the theory says in brief that increased population pressure may itself induce technological and institutional improvements, also in the area of environmental management. The main conclusion in Scherr's paper is that yes, there is induced innovation caused by increasing population pressure, but the pace of innovation is too slow relative to population growth. She is therefore seriously concerned about the long-term sustainability of farming systems under increasing population pressure.

Her approach as well as her conclusion made me think of Lele and Stone's World Bank document from 1989 which was sub-titled «Variations on the Boserup hypothesis» (Lele & Stone, 1989). They compiled data and literature from six African countries and concluded that «the environmental damage caused by deforestation and decline in soil fertility... would outweigh the effects of autonomous intensification.» This is just as much a variation on the Malthus hypothesis as on the Boserup hypothesis. Malthus also thought that inventions and discoveries would take place, but these would be the result of accidents and would only temporarily increase the means of subsistence. In the long run, however, population growth would outstrip food production or in this case environmental capacities. Therefore, Lele and Stone's paper as well as Sara Scherr's paper might be said to include a combination of the ideas of Malthus and Boserup.

Following their conclusion, Lele and Stone as well as Sara Scherr state that public policies are essential to achieve increased agricultural production per capita and to avoid environmental degradation. Public policies promoting the interests of the smallholders would be needed, because autonomous or induced intensification does not manage to cope with the situation alone.

I would very much agree with the part of the conclusion saying that public policies would determine whether population growth and intensification lead to degradation or to land improvements. This conclusion is also supported by the famous Machakos case study from Kenya, which I suppose most of you would know or have heard of by now (Tiffen et al., 1994). The authors of the book studied the interactions between people and the environment in the Machakos District over a sixty years period (from 1930 to 1990). In the 1930's, with 240 000 people, the district was considered an environmental disaster area, while the environment in 1990 was in a much better condition, with 1.4 million people more than five times as many as in 1930. This had been made possible through increased tree planting, terracing and improved soil and water conservation in general. A necessary condition for this development to take place was increased population densities, but it was not sufficient in itself. The agricultural policy of Kenya after independence has also been essential in enabling this type of development. Important factors have been increased access to markets and the development of infrastructure.

However, Sara Scherr seems to see the Machakos case as an exception to the norm, or as a unique success story, because in her diagnosis of environmental impacts of increasing population pressure, the image given is one of serious environmental degradation. She says that while rural population growth leading to agricultural intensification has caused production to increase per capita, severe land degradation has been the result. As the main support for this claim she refers to the Global Assessment of Soil Degradation (GLASOD) study from 1990. This study claims that 22.5% of the World's agricultural land, pasture, forest and wood land has been degraded since about 1950: 3.5% is seen as severely degraded, 10% as moderately degraded, and 9% as lightly degraded. Unfortunately, these figures and the whole GLASOD methodology are somewhat problematic. The study was not based on primary research and data collection for example in the regions most severely affected, but it was rather based on estimates and sometimes guesses. In fact, the GLASOD study is a compilation of the views of over 250 different experts, and a serious methodological problem arises when comparing the opinions from these 250 individuals, each one with potentially different perceptions of the problem, its definitions and maybe also with different political agendas. Such a methodology therefore implies severe reliability problems. One example of this is that Southern Sweden, probably one of the most high yielding agricultural regions of the World, has been placed in the worst category for physical and chemical soil degradation.

Another problem with the GLASOD study, and also with Scherr's paper, is that land degradation in Africa is said to be most severe on pastures. This claim can be traced back to the old Malthusian view of the 1970's and 80's, that pastures in Africa, especially in the Sahel and other drylands are being seriously depleted due to overgrazing. This overgrazing was again associated with the Tragedy of the Commons model. Man-made desertification was believed to be the result of these processes. This Malthusian trend coincided with the droughts in the 1970's and 80's.

However, the view that pastures in Africa are being heavily degraded, is flawed because it is based on impressions and beliefs without the support of long-term studies. One has therefore mixed up temporary change caused by lack of rain with long-term degradation. In fact, few of the studies of environmental change undertaken in African drylands during the last 10 years have been able to detect any long-term degradation. On the contrary, most studies stress the resilience of dryland resources, especially pastures, and their capacity to recuperate after periods of low rainfall. One therefore today talks about a paradigm shift regarding issues of desertification and overgrazing in African drylands (Behnke et al., 1993, Benjaminsen, 1997).

By being based on expert opinions, the GLASOD study conserves traditional views on land degradation, instead of throwing new light on a very controversial issue (for further reading about the problems with the GLASOD study, see Olsson, 1993). I am sorry for spending so much time on this, but this is maybe my favourite issue; that we need good long-term data before we can claim there is degradation. Often when such long-term data are provided, the findings are surprising.

Another question, related to this discussion, which I would like to raise in this conference is «what is degradation?». Surprisingly, this question is not very often discussed in the literature. One often gets the impression that degradation is something measurable. But it isn't. Degradation cannot be measured. Deforestation can maybe be measured, and soil erosion on a particular site can be measured. But whether this environmental change represents degradation or not, differs with the perception of the individual actors involved. A Western conservationist would tend to perceive any loss of forest cover in Africa as degradation, while the local farmer, who is actually clearing the land, would see this as land improvement, because he is extending his cultivated area and thereby maybe increasing the food security of the household. As Blaikie & Brookfield have put it: «Degradation is a perceptual term». Our norms and values are guiding our perception of environmental questions in the South. We should probably be more conscious and explicit about this. This was more a general comment to the conference rather than a specific comment to this particular paper.

I mentioned in my introduction that Sara Scherr's paper has two parts. The first is a discussion of environmental problems caused by increasing population pressure, while she in the second part presents a framework for examining these relationships. I apologise for having spent most of my time here commenting on the first part. In the second part, she first conceptualises a model where four different patterns of land use change are associated with different environmental problems. Then she depicts alternative pathways of change taken under increasing population pressure. This second part is an excellent and very useful attempt at trying to think in general patterns and models. I think we need more systematic comparative research in this area. The linkage between population growth and environmental change needs to be investigated empirically in more studies of both high- and low-density situations. In so doing, we might be able to build on the model proposed by Scherr, and, if we are lucky, we might also manage to refine it.

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Parallel Workshops in Development Studies

SESSION A:

Model Approaches to Food Issues

Expensive Food: The Environmental Benefits to a Political Strategy for Individual Food Security

by

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Abstract

This paper discusses the "physical" and "political" barriers to individual food security in the developing world. It defines and evaluates two strategies that can be pursued in order to overcome these barriers. These evaluations are made in light of the developing world's human carrying capacity. To evaluate these strategies, I modify an FAO model that is used for measuring the prevalence of undernutrition. This modified model provides concrete estimations of the environmental costs of pursuing a strategy which emphasizes increasing production at the expense of redistribution. I conclude by emphasizing the importance of redistribution in the battle for individual food security in the developing world.

Paper presented to the 1997 Annual Meeting of the Norwegian Association for Development Research: "People, food and environment--200 years after Malthus". Ås, Norway, 13 June.

Introduction

Each day more than 30,000 people die from hunger-related causes; today nearly 800 million people are chronically undernourished (Meadows et al., 1992, pp. 69-70; Alexandratos, 1995, p. 50; Foster, 1992, p. 3). Undernourishment and starvation are among the developing world's most pressing problems, and world organizations are rising to meet the challenges of feeding the most unfortunate among us. The urgency of solving this problem is obvious, and was expressed by the Director General of the United Nation's Food and Agricultural Organization (FAO), Jaques Diof: "World food production will have to increase by more than 75 percent over the next thirty years to keep pace with population growth. We must prepare now to feed nine billion people who will inhabit the world in 2030" (Winkel, 1996, p.1).

How do we prepare to feed the nine billion people who will inhabit the world in 2030? There are several contending strategies. Some suggest that the current (and future) problem is not one of too little food, but too many people: the carrying capacity of the earth cannot allow for such a formidable (projected) increase in food production. These pessimists fear that the hunger problem will persist, or even explode, because there are too many people and not enough natural resources available to meet the world's growing food needs. Adherents to this "Malthusian School" assume that the earth's capacity to produce food is limited, and they argue that we are about to reach an ecological limit. Over-intensive agricultural methods have deteriorated the earth's resource-base, and the remaining reserves are insufficient for supporting an increase in food production large enough to provide for the world's rapidly increasing population. From this perspective, solving the world's hunger problem means controlling population growth (e.g., Brown, 1995; Brown and Kane, 1994; Ehrlich, 1969; Meadows, 1992, 1972).

From other perspectives things do not look quite so gloomy. A contending school, we can call them "technological optimists", argues that there is no need to panic: calls for population control are unnecessary as the future holds an almost limitless potential for increasing food production. These optimists believe that the current tension between population growth and food production rates is a temporary one; it will soon be relieved by technological developments. With reference to the unused potential of the Green Revolution, and to recent developments in the field of biotechnology, technological optimists see no limits to the earth's capacity to increase its potential food production levels (Hoell, 1993; Borlaug and Dowswell, 1993; Boserup, 1979, 1981; Bumb, 1995; Daw, 1994; Simon, 1981; Hodges, 1995).

As these two predominate perspectives suggest, most of the current debate over alleviating hunger focuses on the earth's capacity to provide a growing population with enough food--i.e., on the earth's human carrying capacity. In this way, strategies for resolving the hunger problem are based on physical constraints and developments, determined by the forces of population and food production rates. This, I argue is a mistake, as discussions of this sort are focused on an aggregate level of analysis. Decreasing population rates and/or increasing food production rates might solve the global food security problem, but they cannot alone solve the problem of food insecurity at the individual level. To eradicate hunger, *all people*, at all times, must get enough to eat (Bie, 1995). To analyze food security at the global, regional or even national level, and to make conclusions from these analyses about the effects on individuals, implies an ecological fallacy.[1] By focusing on increasing future food production rates, and contrasting it against future population growth rates, the problem of *access* to the food is simply avoided. But the current and future problem, as we shall see below, is not one of having too little food; rather, the problem is in the distribution of that (limited) food supply.

In this paper I argue that the key to alleviating hunger in the developing world will not necessarily be found in the field of science. The key to alleviating hunger lies in the political realm. I do not mean to suggest that the technological and ecological aspects of the problem are irrelevant; far from it. These physical forces set the larger parameters within which the world's hunger problem needs to be solved. Obviously, mapping the earth's capacity to produce sufficient food (per capita) is one very important step in eradicating world hunger: but it is not, in itself, sufficient. As I will show below, the real problem of the developing world's hunger lies in the unequal distribution of the earth's current productive output.

One of my main objectives is to bring politics back into the debate about how to solve the world's pressing hunger problem. The current debate is dominated by biologists, demographers, geographers and the odd economist. These fields are adept at understanding the natural trends which set the framework for the current study. With a few exceptions, however, they seem uninterested in addressing the distributional problems which accompany them. These are political problems.

I propose that we contrast the dominant (physical) strategies for alleviating hunger in the developing world with an idealized political strategy that emphasizes the redistribution of existing food supplies. While I am aware that there are potential problems with employing a political strategy, it is important to introduce explicit alternatives to the physical strategies which currently dominate the research agenda. It is only with explicit alternatives that we can fully evaluate the costs and benefits associated with each strategy.

Indeed, this paper concludes by arguing that a redistributive strategy is less costly in one significant area: the ecological costs of pursuing a redistributive, as opposed to a physical, strategy are very small. If ecological constraints become greater with the passing of time, a redistributive strategy will only become more attractive; a physical strategy less so. It is important to emphasize at the outset that, in pursuing the political aspects of the hunger problem, we are not resolved from the problems facing the other disciplines. Solutions to alleviating world hunger are constrained by the boundaries of technology, ecology *and* politics. It is at the nexus of these three fields that the solution lies.

The analysis which follows will study the consequences of choosing one strategy over the other. The first section introduces a stylized model of the physical and the political strategy. I then apply this model to estimate the amount of food that is needed to achieve individual food security in the developing world, given each of the two,

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[1]For two of the better known works on ecological fallacies, see Robinson (1950) and Iversen (1973).

stylized, strategies. After doing this, I compute the ecological costs (measured in terms of reserves of land with potential for rain-fed crop production) associated with increasing production to the requisite level by each strategy. The last section concludes.

The Method

In order to estimate the effects of a political strategy on the environment, we need to introduce a stylized model of the political strategy and a parallel model which corresponds to the physical strategy. These stylized models can then generate estimates suitable for comparison. This section is dedicated to introducing these stylized models.

The model I am about to introduce is a modified version of a model used by the FAO to estimate the number of undernourished people in a region (FAO, 1992). This model is shown as the bell curve in Figure 1a. This bell curve represents the log-normal distribution of food within a region (the FAO model assumes a log-normal distribution). The area to the left of the minimum requirement line (MIN) represents the percent of undernourished people. We can see that the prevalence of undernutrition in this model is dependent on the following three factors: 1) the threshold under which a person is considered undernourished; 2) the average per capita food supply in a region; and 3) the distribution of this food supply among individuals in the region. Since the minimum nutritional requirements are constant, the prevalence of undernutrition is dependent upon the amount of food that is available in a region, and how it is distributed. This suggests that undernutrition can be alleviated by manipulating these two variables (i.e., increasing the amount of food, or redistributing it). These we can call the physical and political strategy respectively.

I will use this model to estimate how much food would be necessary to alleviate hunger if either the physical or the political strategy is pursued. To do this, I need to reverse the logic of the model. The driving question is no longer, "how many people are undernourished?" The new model must now ask, "how much greater must the food supply be in order to ensure that all people in the region will get enough to eat?"

Figure 1 (a) represents the starting point of the two stylized models. In order to estimate the effects of choosing the physical strategy, we need to increase a region's production, while controlling for its distribution. In order to estimate the effects of choosing the political strategy we need to equally redistribute the current production in a region. These two strategies are depicted graphically in Figures1b and 1c.[2]

Figure 1 about here

We might briefly describe the two strategies as follows:

The physical strategy. In this strategy the average food supply increases enough so that the whole distribution ("all" of the people) will be situated to the right of

[2]A more technical description of both the FAO model and my modified model, as well as the assumptions underlying my estimates in the following section, can be found in my thesis (Brigham 1996):" The Distributional Silence of the Malthusian Debate. An Evaluation in Light of Ecological Concerns".

(above) the minimum requirement (MIN).[3] The shift to the right is of the magnitude . In Figure 1, this shift is represented by the move from diagram (a) to diagram (b). The "new" average per capita food supply that result from the physical strategy is depicted in the figure as $AVERAGE_2$. Thus, in the new distribution (that arises by following the physical strategy), 99 percent of the population finds itself above the minimum nutritional requirements of the region (MIN). Individual food security is achieved by producing more food without changing the distribution of that food within a region.

The political strategy. In this strategy the region's total food supply is equally distributed among the population. This is done by taking the minimum nutritional requirement for the region (MIN in the top diagram), and using it as the standard for the average per capita food supply.[4] In this strategy, the distribution curve is collapsed, as all people will have access to the same amount of food. This "new" average food supply per person is represented in Figure 1c by the bar located at MIN on the X-axis. There is no "bell curve" in this diagram as the food is equally distributed at the minimum level. If there is more than enough food to satisfy the minimum requirement for all the population, we can measure the surplus of food that is generated by this strategy. If there is not enough food, that amount can be measured as well.

Obviously, real political choices may involve elements of both ideal strategies. By presenting the choice in such stark, ideal, terms, I do not mean to suggest that a fruitful strategy would not include elements of both the physical and the political strategies. But for purposes of analytical clarity, it is important to distinguish between the effects of each strategy separately, in stylized form.

At the most general level we may be indifferent about which of the two (above) strategies is used, as long as everyone gets enough food. But, in light of the earth's carrying capacity, the strategy chosen may make a big difference. If undernutrition is to be alleviated by simply producing more food (i.e., the physical strategy), without affecting its distribution, we will need a lot more food. How much food, exactly, will be calculated in the following section. Choosing the political strategy may reduce these ecological demands significantly.

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[3]As the theoretical bell-shaped distribution curve never meets the X-axis, it is impossible to move the distribution such that every single person is situated above a certain value. Consequently, a cut-off point of one percent is applied in the analysis that follows. Although this means that (no more than) one percent of the population is to be found below the minimum requirement, I will refer to this situation as one of "no undernutrition". This is a practical solution to the problem. Obviously, from a normative perspective it is questionable to operate with a cut-off level that accepts that as much as one percent of the population is undernourished.

[4]For real individual food security to be achieved, the food must be distributed according to each person's need. The average minimum requirement reflects these individual differences, albeit imperfectly. Problems arise because the distributions are calculated from data derived from a sample of individuals that is placed in different sub-groups, according to age and sex. The average requirement in each group are applied to everyone with the same age and sex in the population. For the sake of simplicity, I call "equal" that distribution of food that would give all individuals enough to eat.

Empirical Estimates

The previous section provided the theoretical and practical foundations upon which this paper builds. Here we will engage in a series of comparisons based on contemporary counterfactuals, and future scenarios. By contrasting the food supply requirements (and potential) for each strategy over time, we obtain a firm comparative context for measuring the feasibility of both strategies. In addition, we obtain an equally firm measure of the potential environmental costs of each strategy. Because we make these comparisons over four time periods (three historical and one future), we get an idea of the changes that are affecting each region over time.

The driving question of each comparative point is: how much more food needs to be produced by each strategy in order to obtain simple food security objectives given contemporary food supplies and demographic levels?[5] Answers to these questions will provide us with a simple number: how much additional (or less) food is necessary to reach food security using the physical and political strategies. This (computed) amount of additional food is then used to estimate the amount of land necessary to produce that food under each strategy. This, then, gives us a concrete measure of the impact on the developing world's reserves of arable land associated with each strategy.

Besides simplicity and comparability, there is an additional advantage to this method. As we can assume that the total quantity of arable land remains (more or less) fixed over time, these comparative measures will allow us to see if the developing world will reach its carrying capacity with respect to arable land (given contemporary demographic and productivity levels) under each of the two alternative strategies.[6]

This section is divided into three parts. The *first* part examines developments over four decades: 1970, 1980, 1990 and 2010. In each period I will start with a brief description of each region's actual undernutrition level, and its measure of per capita food supply. The data for these descriptions comes largely from the FAO's (1995) *SOFA95* data set. From these base points, I will contrast counterfactual outcomes developed on the basis of each strategy.

In other words, for the political strategy I will consider the following counterfactual comparisons. Each comparative point (i.e., each region at each period of time) will consider whether enough food was produced to satisfy basic food security objectives if the food supply was distributed equally. This amount corresponds to the "MIN" bar in Figure 1c. If, after redistribution, enough food was produced in a region, we will have a number, representing Kcals, per person, per day (ppd), with which to compare against other regions, times and strategies. If there was not enough food produced to satisfy these basic food security requirements under the redistribution

[5]The food security requirements are defined as the minimum number of Kcals a person needs per day to maintain his/hers bodyweight and support light activity.

[6]As we only consider the amount of additional land with rain-fed potential we will avoid the problem of (potential) eventual water shortages.

strategy, I will compute the amount of additional food that would be required to reach these goals.

I can then translate this additional amount of food into the requisite amount of arable land needed to produce that food, given contemporary productivity levels in the region. Thus, for each region in each period, we will have a measurement (in terms of new hectares under production) of the environmental costs associated with attaining food security under the redistribution strategy.

The same, two pronged, method is applied for evaluating the costs of the physical strategy. Each comparative point will consider the costs of meeting basic food security requirements in terms of increasing the level of food production and land. Thus, I begin by developing a counterfactual scenario for the physical strategy based on the actual data for each region and time. If we assume that the region's distribution of food remains the same, I ask (for each region and time): how much more food would the region need to produce in order to be certain that everyone in the region would satisfy their basic food security objectives? As explained in the previous section, this counterfactual scenario consists of simply shoving the log-normal distribution curve upwards (by in Figure 1a), so that everyone in the region achieves food security. This new distribution's average ($AVERAGE_2$ in Figure 1b) corresponds to a higher level of food production. Like the computations for the political strategy, this computation will provide us with the amount of additional food required. Then, as in the political strategy, we can compute the amount of arable land needed to produce that food, given contemporary productivity levels in the region under consideration.

These two strategies are compared for each region over all four periods. This gives us a full diachronic comparison, and allows us to *generalize* about regional trends over time. This is the theme of the *second* part of this section. Here I describe patterns across regions over time. The *third* part looks at the explicit environmental costs of each strategy. Because we know the amount of arable land in the developing countries' reserves, and because we can generate estimates of the potential costs (measured in additional land required), this third section provides a measure of the enormous (and growing) ecological costs associated with the physical strategy.

Comparing Strategies

We will now begin the heavy empirical analysis. I will be comparing the food-costs and environmental-costs for each strategy in each region, at each period of time.[7] This entails sixteen comparative points, and much intellectual juggling. I have tried to simplify the presentation by listing the findings for each period in its own table. Thus, the 1970s findings are in a different table than the 1980 findings, and so on. While this format helps us to understand the relative costs of each strategy in that decade, it makes it more difficult to evaluate developments over time. Because of this I have added a second section, following, which collects the data and analyzes it diachronically.

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[7]The background statistics FAO all these calculations can be found in Brigham (1996).

1970

There were 941 million undernourished people in the developing world in 1970. Of these, more than 750 million lived in Asia and the Pacific, close to one million lived in Sub-Saharan Africa, and there were about half a million people in both the North Africa and the Near East and the Latin America and Caribbean regions. Given the agricultural technology at the time (1970), would it have been possible to supply these people with enough food--without encroaching on the regions' reserves of arable land? We can answer this question by employing both the political and physical strategies. I begin with the political strategy. All of the figures in the section are collected in Table 1.

In Asia and the Pacific, where most of the developing world's undernourished population resided, the average food supply was 2114 Kcals-ppd. When we compare this to the region's average requirement for basic food security (1761 Kcals-ppd), we find that there was more than enough food available in the region to adequately feed each and every person. This means that if the region's food had been distributed equally, full individual food security could have been achieved without expanding production or the amount of arable land under production.

North Africa and the Near East started from a somewhat better position, with a lower percentage of undernourished people (24 percent) than the Asian and Pacific region. The North Africa and Near East region had an actual per capita food supply of 2354 Kcals in 1970. Since the minimum nutritional requirement in this region is 1825, we find that the political strategy would have satisfied the region's basic food security requirements, as in the previous region, without increasing production.

The 1970 prevalence of undernutrition in the Latin America and Caribbean region was nineteen percent: considerably lower than was the case in the other developing regions. In 1970, the region's actual food supply was 2509, and its minimum nutritional requirement was 1836 Kcals-ppd. Thus, this region, like the others, could have overcome undernutrition by redistributing its present food supply.

Let us now see if the 1970 food supply in Sub-Saharan Africa, if distributed equally, could have provided everyone with enough calories. Sub-Saharan Africa's actual daily per capita supply was 2174 Kcals in 1970, and the minimum nutritional requirement for the area is 1788 Kcals. Thus, as was the case in all of the developing regions, there was enough food in Sub-Saharan Africa to provide each and every inhabitant with more than the minimum requirement. This could be done without increasing food supplies or expanding production output. By "simply" redistributing the food in a more egalitarian manner, it would have been possible to alleviate undernutrition in all the regions of the developing world.

Table 1 about here

In order to test the effects of the *physical* strategy we need to pursue a different series of counterfactual experiments. In the next section we assume that the distributional pattern of consumption does not change in each region. We then ask, how much additional food would be required to provide even the poorest people in each region with enough food? The percentage increases (or decreases) are listed in Table 1.

If basic food security requirements in Asia and the Pacific had been met by simply increasing the food supply, while leaving the distributional pattern unchanged, the average food supply per person in 1970 would have had to have been 3522 Kcals/day. As the region's actual average food supply (per person) in 1970 was only 2114 Kcals, the Asian and Pacific food supply would have had to have been increased by 1408 Kcals-ppd, or 67 percent.

By repeating the same process, we arrive at the following food supply increases for each region in 1970. In North Africa and the Near East we would require an average food supply of 3670 Kcals-ppd, or 1316 Kcals-ppd (56%) higher than was the actual supply. In Latin America and the Caribbean the food supply needed to increase by 1163 to reach an average of 3672 Kcals-ppd. This is the smallest increase among the developing regions in 1970; a result of the fact that the Latin American and Caribbean region had the lowest rate of undernutrition.

In the final region, Sub-Saharan Africa, the numbers are even less encouraging. For this region the average food supply would have needed to increase to 3862 Kcals-ppd. The number is so much higher in this region because Sub-Saharan Africa suffered from the developing world's most unequal distribution of food. Since the region also had a low actual food supply level (2174 Kcals-ppd), it needed to increase its food supply by 1688 Kcals-ppd. This is a phenomenal increase of 78 percent.

If the physical strategy had been employed throughout the developing world in 1970, the total level of food production in the area would have had to have increased by 68 percent in order to alleviate food insecurity. The environmental consequences of employing this strategy, as we shall see in the section below, would have been enormous. This is especially true when we contrast this strategy against the political one. Pursuing the political strategy would have allowed for an *excess* of food supply in the realm of about 20 percent.

1980

As with the previous (1970) section, this section begins by surveying the consequences of the political strategy. All of the figures in this section can be found in Table 2. We then do the same for the physical strategy. As we are following the same procedure in this section as in the previous (and in the two sections to come!), I will provide the information in as straight-forward a way as possible.

By 1980, Sub-Saharan Africa had become the most food insecure region in the developing world. The number of undernourished people in the region had increased from 35 percent in 1970 to 36 percent in 1980. In spite of considerable growth in the region's total food supply, Sub-Saharan Africa experienced a decline in its per capita food supply, because of its rapid population growth. The region's actual supply had decreased from 2174 to 2082 Kcals-ppd. Still, the average ppd food supply remained above the region's average minimum nutritional requirements (i.e., 1788 Kcals-ppd). As in 1970, this meant that all of the region's people could have gotten enough to eat if the region's food had been distributed equally.

Asia and the Pacific improved their opportunities for food security considerably during the seventies. By 1980, the percent of undernourished people was down from 40 to 19. Still, 644 million people did not have access to food in adequate quantities (or quality). Could these people have been well nourished if the food supply at the time had been equally distributed? Yes, the actual food supply in the region was 2253 Kcals-ppd; more than 20 percent higher than the 1761 Kcals that would have been necessary to alleviate undernutrition, had the food been equally distributed.

In the two remaining regions the story is a similar one. In Latin America and the Caribbean the average food supply per person was 2730 Kcals per day. In North Africa and the Near East, the number was 2806. In both regions this was above the minimum regional nutritional requirements. As was the case in 1970, all of the developing regions could have alleviated their food insecurity problems by redistributing the existing food supplies. Did the 1980 conditions improve for advocates of the physical strategy?

Table 2 about here

The short answer to the question is "hardly". Although the average per capita food supply had increased in three of the developing regions during the seventies, it fell in Sub-Saharan Africa. This meant that the estimated increases in food supply (as derived from the physical strategy) declined in three of the four regions. In the fourth, sub-Saharan Africa, the estimated increase rose from 79 percent to 86 percent (see Table 2).

To meet the requirements of individual food security, given the physical strategy, Sub-Saharan Africa would have needed to increase its per capita daily supply to 3862 Kcals. To obtain these 3862 Kcals-ppd, the actual food supply needed to increase by 86 percent. (This is eight percent higher than the increase that was required in 1970, because the actual food supply per person had declined from 2174 to 2082 Kcals-ppd.)

The actual ppd food supply in Asia and the Pacific increased by 6.5 percent from 2114 in 1970 to 2253 in 1980. Meanwhile, the population had increased by 23 percent. This means that the total food supply had increased by almost 30 percent over the decade. Although progress was being made in the region, employing the physical strategy to alleviate food insecurity would require that the food supply needed to increase to 3522 Kcals-ppd, or by another 56 percent.

The above regions started from considerably worse positions than did Latin America and the Caribbean and/or North Africa and the Near East. In these areas the prevalence of undernutrition was "only" 10 and 13 percent, respectively. In Latin America, the physical strategy would have required an average food supply of 3672 Kcals-ppd, this figures to be an increase of 35 percent over the actual (1980) supply. In North Africa and the Near East the food supply needed to increase by 864 Kcals-ppd, or 31 percent.

1990

The number of undernourished people in the developing world declined from 36 to 20 percent in the decade between 1980 and 1990. The picture, however, is more nuanced when we look at the trends within the individual regions. In Sub-Saharan Africa, for example, the prevalence of undernutrition actually increased from 36 to 37 percent (of the population), and 46 million more people lacked food security in 1990 (than was the case in 1980). The number of undernourished people also rose in Latin America (but remained unchanged when measured in percent of population). The prevalence of food insecurity in North Africa and the Near East fell from 10 to 8 percent, while--in absolute numbers--this corresponded to an *increase* of 1 million people. The only region in which the overall situation had improved (both with respect to the number of people and as a percent of the population) was Asia and the Pacific: 19 percent of the population lacked food security in 1990 (compared to 28 percent in 1980), an improvement for 121 million people. Still, more than 520 million people living in Asia and the Pacific were undernourished in 1990.

In Sub-Saharan Africa, the ppd food supply had decreased from 2082 (in 1980) to 2046 Kcals (in 1990). This was still above the average minimum requirement; had the food been equally distributed, there would have been enough for everyone. The actual ppd supply had also declined (slightly) in Latin America and the Caribbean: down to 2715, from 2730 (in 1980). Still, these figures continued to be well above the region's minimum nutritional requirement; distributed equally, the region's food supply could have provided all of the inhabitants with more than enough calories. The ppd food supply continued to increase in both the Asia and Pacific and in the North Africa and Near East regions. With a ppd supply of 2528 and 2912 Kcals, respectively, there was more than enough food to provide all the people in these regions with their minimum nutritional requirements (i.e., 1761 and 1825 Kcals-ppd, respectively).

Table 3 about here

The consequences of pursuing the physical strategy are as follows. The level of ppd food supply required to achieve full food security with this strategy would, as in the previous years, have been 3522 Kcals in Asia and the Pacific, 3670 Kcals in North Africa and the Near East, 3862 Kcals in Sub-Saharan Africa and 3672 Kcals in the Latin America and Caribbean region. This means an actual increase in Kcals-ppd of 944 in Asia and the Pacific; 758 in North Africa and the Near East; 1816 in Sub-Saharan Africa; and 957 in the Latin America and Caribbean region.

As with all the earlier periods, there was enough food in the developing world in 1990 to adequately feed the population--if only it had been equally distributed. By pursuing the physical strategy, food supplies would have needed to increase throughout the developing world. Most remarkably is the Sub-Saharan Africa case, where the increase required is of the magnitude of 89 percent!

2010

Predictions for food and population levels in the year 2010 has been provided by the FAO (1995) and the UN Population Division (United Nations, 1995), respectively. With these estimations it is possible to continue our evaluation of the two strategies into the future. Using the "most likely" projections, we can--by and large--expect that the trend towards increasing per capita food supplies in most developing countries will continue. Should business continue as usual (i.e., without employing one or the other main strategies in this paper), we can expect fewer undernourished people in the future. The problem, however, is that the food insecurity dilemma will not be solved.

Approximately eleven percent of the developing world will still suffer from undernourishment in the year 2010. But, as before, this burden will be distributed unequally among the world's poorest regions. Sub-Saharan Africa can expect as many as 32 percent of its population to be undernourished. The other regions can expect between 6 to 7 percent. As the size of the regional populations vary substantially, we can expect to find as many undernourished people in the Asia and Pacific region as in Sub-Saharan Africa. On the other hand, we can expect a lot fewer undernourished people in both North Africa and the Near East and in the Latin American and Caribbean region.

According to the FAO's projections, the ppd food supply in Asia and the Pacific will most likely increase to an average of 2776 Kcals. This average is well above the minimum nutritional requirement (of 1761 Kcals), and would therefore be enough to adequately feed the whole population. Since the food will probably be distributed in as unequal fashion as it is today, there will be as many as 272 million people that will be undernourished in the region.

The best future scenario is found in North Africa and the Far East, where the average food supply is projected to increase from 2912 Kcals-ppd in 1990 to 3120 in the year 2010--a level well above the region's minimum nutritional requirement of 1825. In the Latin America and Caribbean region, the average ppd supply is expected to be 2950 Kcals; 1114 Kcals (or 38 percent) above what is required. Despite this, we can expect that six percent of the population will remain undernourished. This is about the same level of undernourishment as we can expect in both the North African and Near East, and the Asian and Pacific regions.

Sub-Saharan Africa, as usual, will find itself in the worst position: it can expect that as many as 32 percent of its population will be undernourished in 2010. Even though the relative proportion of the undernourished population is projected to decline by five percent, the region's high rate of population growth will lead to an overall increase in the absolute number of undernourished people. We're talking about a lot of people: 121 million more! The per capita food supply is expected to be only 2170 Kcals per day (which is about the same level that the region had in 1970) but it will still be above the average minimum requirement in the region. Although Sub-Saharan Africa can expect the worst undernutrition statistics in the year 2010, even this region could feed all of its people should it divide the food equally among its inhabitants.

If current trends continue, the overall food situation in the developing world in

2010 will be an unfortunate one: 637 million people can expect to be undernourished. Still, there is hope in these figures, given political will. The future average food supply for the whole developing world is expected to be above the minimum nutritional requirements in all of the developing world's regions. Thus, food security could be reached with an equitable distribution of the regions' future foods supply.

Table 4 about here

What if the distribution of Kcals in the future doesn't change at all: what sort of increases in the developing world's food supply would be required to alleviate food insecurity?

In Asia and the Pacific, a strategy to provide the whole population with enough food --without changing the distributional pattern--would require an increase in the average per capita food supply to 3522 Kcals per day (in 2010). This would be 27 percent higher than the level projected as most likely for the region. In North Africa and the Near East, the food supply will need to increase to 3670 Kcals-ppd if security is to be achieved by the physical strategy. The increase in this region is larger than that in the Asian and Pacific region, even though it was the region with the highest per capita food supply in 1992. The reason for this is that the average per capita food supply necessary to alleviate undernutrition is higher in North Africa and the Near East than it is in the Asian and Pacific region. Again, this a result of the region's (North Africa and the Near East) slightly higher minimum nutritional requirement, and its more unequal distribution of the food supply. Compared to the projected food supply, this strategy would lead to an additional increase of 18 percent.

Sub-Saharan Africa is the region where the food supply will have to increase the most in order to achieve food security for all. Compared to the region's 1990 level, the total supply has increased by an enormous amount: 244 percent! This is mainly because of the region's rapid population growth and its pathetic starting point (only 2046 Kcals-ppd) in 1990. In order to provide all people with (at least) the minimum nutritional requirement for the region (1788 Kcals-ppd), the region's food supply will have to increase to 3862 Kcals-ppd. This is 79 percent more Kcals than what the region is expected to have in 2010 (i.e., 2170 Kcals-ppd). The Latin American and Caribbean region will have to increase its average food supply per person to 3672 Kcals, which is 25 percent more than the 2950 Kcals they are expected to achieve in 2010.

In conclusion, the future does not have to look as gloomy as the physical strategy would have it. By equally dividing the developing world's projected food supply in 2010, hunger can be alleviated without requiring that more food is produced, or that more land is put under cultivation. In all likelihood, however, the physical strategy will continue to dominate into the future. It is therefore important that we spend some time and examine the ecological costs of pursuing the physical (as opposed to the political) strategy. This analysis follows below. But first, it will be helpful to summarize some of the major trends that our analysis has uncovered.

Trends and Developments

In this section I intend a simple overview of the trends associated with each strategy over time. Because the previous section had cut the data up into ten year cross-sections, it is difficult to get a good glimpse of the developments over time. This glimpse might be provided in two new tables, Table 5 and Table 6.

In Table 5 we get a good picture of how the average per capita food supplies in the various regions developed over time. In two of the four regions the actual average food supply increased over time: in Asia and the Pacific and in North Africa and the Far East. In both of these regions we see that the regional food supplies have grown since 1970, and they are expected to continue growing into the near future. The other two regions, however, fared less well.

Table 5 about here

In Latin America and the Caribbean the overall trend is positive. In the year 2010 the region can expect much more food (per capita) than it had in 1970. The development over time, however, has been rather uneven. Indeed, between 1980 and 1990 the region's actual food supply, measured in Kcals-ppd, actually declined from 2730 to 2715. The situation is all the worse in Sub-Saharan Africa. In this region the food supply has simply been falling: from 2174 to 2082 to 2046. The future projections are a bit more positive. In 2010, Sub-Saharan Africa can expect about the same average per capita food supply level as it did in 1970.

Table 6 shows us how the effectiveness of the different strategies change over time. The easiest way to read this table is by taking a region and following its development over time. Thus, the North African and Far East region has experienced very favorable developments over the period under consideration. In 1970 this region would have required 56 percent more food to satisfy the food security objective--given the physical strategy, but by 2010 it is expected that this region will only need to increase its food supply by 18 percent. The big loser was Sub-Saharan Africa.

Table 6 about here

The most important trend to notice in Table 6 is that, there was enough food to satisfy basic food security requirements--in all of the 16 comparative points--given the political strategy. The benefits from this strategy varied widely, from an excess of food supply of 13 percent (in Sub-Saharan Africa in 1990) to an excess of 43 percent (in North Africa an the Far East in 2010). The costs of employing the physical strategy stand in strong contrast to these two cases. Food supplies would need to increase from between 18 and 89 percent. As the reader might imagine, these increases represent formidable ecological costs.

Environmental Costs

The environmental constraint is probably one of the most significant ones on attempts to feed current and future populations. Still, it is difficult to find good comparative statistics for evaluating the environmental costs associated with different strategies for better feeding the world's undernourished. This closing section provides some measure of the potential environmental costs associated with the two idealized strategies pursued throughout this paper.

In the previous section we found that a simple redistributive strategy is actually sufficient for satisfying the minimum nutritional requirements of the world's poorest populations. While this, in itself, is an important finding, the environmental consequences of this are seldom considered. Over-intensive farming techniques are depleting the earth's resources. If it is actually possible to decrease the amount of food being produced, enormous environmental gains could be won.

This is wishful thinking. Still, it may be likely that today's (or tomorrow's) policy-makers, when considering future strategies, will want to weigh the environmental--as well as the political and social--costs of pursuing different strategies for overcoming food insecurity. In order to do this, policy-makers need some comparative indicator of the potential environmental costs associated with the two main strategies. The closer we come to approaching the limits to ecological expansion, the greater these environmental costs.

In Table 7, I have listed the estimated effect--or impact (on the developing world's arable land reserves) of employing both strategies.[8] Because the political strategy in all four periods (1970, 1980, 1990, 2010) does not require additional food sources, the environmental costs of this strategy are *zero*. All of the developing world's arable land reserves could remain in tact, given this strategy. Of course, the same is not the case for the physical strategy, and it is worthwhile to spend a minute examining the data more closely.

Table 7 about here

In 1970 there were approximately 598,000 million hectares of land being cultivated in the developing world. Had policy-makers pursued the physical strategy to alleviate hunger, it would have required another 388,000 million hectares to produce the additional food necessary for food security. At the time, the developing world's reserves of land with rain-fed production potential was estimated to be 425,000 million hectares. This means that it would have been possible to pursue this strategy (given contemporary population and yield levels) within the developing world's agricultural carrying capacity (with respect to land).

In 1980 the picture had changed radically. Pursuing the physical strategy (at that time) would have meant bringing nearly 386,000 million new hectares under cultivation. This is an increase in land-use of 57 percent! More importantly, when we compare these 386,000 million hectares to the actual reserves that the developing world then had (i.e.,

[8]See Brigham (1996) for a clarification of the assumptions employed in this analysis.

only 345,000 million hectares) we find that the environmental limits to this strategy had already been met in 1980! There simply was not enough remaining arable land in the developing world to meet the additional cultivation demands of the physical strategy. As a result, the problem of undernutrition in 1980 *could not* have been alleviated without some redistributional measures.

In 1990 things became only worse. In order to meet the demands of the physical strategy, 45 percent more Kcals (ppd) needed to have been produced in the developing world. Such an increase in production would require 340,000 million additional hectares of land. Yet the developing world's arable land reserves had been reduced to 266,000 million hectares. The developing world is simply running out of arable land reserves.

It is important to note that the physical strategy for alleviating undernutrition, while leaving distributions intact, has required less and less land over the years; the actual levels of food supply have been growing. But, because of these high levels of per capita food supply, and because there has been a substantial increase in the population, more and more land with the potential for rain-fed production has been put under the plough. In addition, a growing population has claimed more land for housing, infrastructure, etc. As a result, the arable land reserves are shrinking from one decade to the next. Nineteen seventy was the only year when the developing world's reserves were sufficient to support the amount of land that would have been required by the physical strategy.

In the future, things could possibly get even worse. In 2010, both the actual arable land reserves and the amount of land required by the physical strategy are expected to decline. Unfortunately, the decline in reserves is expected to be greater than the decline in the demand for new land. All in all, the physical strategy will require 32 percent more food than the amount that is projected for the developing world in 2010. To produce this amount of food, 271,000 million more hectares will need to be cultivated, corresponding to a deficit in arable land of 115,226 million hectares. It will then have been forty years since the developing world had had enough arable land reserves to pursue the physical strategy.

Conclusion

This paper has covered a great deal of empirical and conceptual territory. It has introduced two potential strategies for alleviating world hunger and tested those (idealized) strategies at 16 different comparative points, consisting of four regions and four time periods. The conclusions from this comparative exercise promise to be overwhelming. Instead of listing all of the findings that were generated in the paper, I will conclude with a brief synopsis of the different strategies and the social and ecological costs associated with each.

For reasons of analytical parsimony, I began with a series of assumptions. First, I began by suggesting that there are two main strategies for achieving food security. This is obviously an over-simplified assumption, as there are a number of other potential strategies that might be pursued--in combination with the two strategies outlined above. In addition, I have postponed an important discussion about the other, more general, costs associated with pursuing the two strategies under consideration. Obviously, there are costs and benefits associated with both the physical and political strategies that can explain the current prevalence of the former, at the expense of the latter. For reasons of space, these costs are not discussed in this paper.

The physical strategy was shown to include enormous ecological costs. This is especially true when contrasted against the redistributional (i.e., the political) strategy. If fighting world hunger is a priority, the physical strategy is exorbitantly priced in term of both the amount of additional food required, and the amount of newly cultivated land required to grow that food. As the last section of this chapter showed, there is simply not enough reserves of arable land in the developing world to meet the requirements of this strategy.

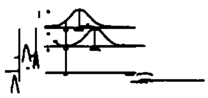
Of course, the assumptions I have employed in this strategy may be too confining. In addition to simply expanding the amount of land under cultivation, we might expect increases in agricultural productivity (increasing yields per hectare). This could be done by exploiting the potential of both conventional technology (from the Green Revolution), as well as the hope of the new Biotechnological Revolution. In many ways, this strategy--combined with efforts to decrease the rate of population growth--is the dominate strategy today.

But the future holds shrinking environmental reserves. The more that these reserves decline, the higher the costs associated with pursuing the physical strategy. In this light, the political strategy becomes much more attractive. This strategy holds that it is possible to distribute the food that is already produced (or producible) in such a way that all people are guaranteed (at least) as much food as they need to "maintain body weight and support light activity".

This strategy is not only attainable today, but it would bring with it an environmental windfall. The developing world today produces enough food to feed all of its inhabitants. The excess production (from this strategy) could either be used to supply people with more food (than just their minimum requirement), or it could allow us to take some of the "excess" land out of production.

While this strategy appears to be the most costly today (at least nobody has been willing to pay for it!), this paper has endeavored to show that there are enormous social and ecological gains to be made by relying more heavily on this strategy. Future policy-makers must take distributional solutions more seriously as the environmental costs associated with other strategies will only grow.

Figure 1
Food Supply Estimation Models



Number of people

Table 1
Strategic Outcomes, 1970

Region	Actual Supply[1]	Political: Kcals[2a]	Political: % change[b]	Physical: Kcals[3c]	Physical: % change[d]
		Outcomes (by Strategy)			
Asia & the Pacific	2114	1761	-17	3522	67
N.Africa & the Far East	2354	1825	-23	3670	56
L.America & the Caribbean	2509	1836	-27	3672	46
Sub-Saharan Africa	2174	1788	-18	3862	78

Sources:
[1]FAO (1995); [2] FAO (1992, p.13); [3]Author's calculations.

Notes:

[a]Kcals, per capita, per day. The figures in this column represent the reference standard for undernourishment in each region. This reference standard is then used as the minimum requirement, distributed equally to the whole population in the region.

[b]Percent decrease (-) in food production and arable land that would have been possible, while still providing the whole population (100%) with the minimum nutritional requirement, if the food had been equally distributed.

[c]Kcals, per capita, per day. The figures in this column represent the average food supply necessary to alleviate undernutrition if the physical strategy were pursued.

[d]Percent increase (+) in food supply and arable land that would have been necessary to provide the whole population (99%) with the minimum nutritional requirement (or more) given the real (existing), unequal, distribution.

Table 2
Strategic Outcomes, 1980

		Outcomes (by Strategy)			
		Political		Physical	
Region	Actual Supply	Kcals	% change	Kcals	% change
Asia & the Pacific	2253	1761	-22	3522	56
N.Africa & the Far East	2806	1825	-35	3670	31
L.America & the Caribbean	2730	1836	-33	3672	35
Sub-Saharan Africa	2082	1788	-14	3862	86

Sources and Notes: See Table 1.

Table 3
Strategic Outcomes, 1990

		Outcomes (by Strategy)			
		Political		Physical	
Region	Actual Supply	Kcals	% change	Kcals	% change
Asia & the Pacific	2528	1761	-30	3522	39
N.Africa & the Far East	2912	1825	-37	3670	26
L.America & the Caribbean	2715	1836	-32	3672	35
Sub-Saharan Africa	2046	1788	-13	3862	89

Sources and Notes: See Table 1.

Table 4
Strategic Outcomes, 2010

Region	Projected Supply	Outcomes (by Strategy)			
		Political		Physical	
		Kcals	% change	Kcals	% change
Asia & the Pacific	2776	1761	-37	3522	27
N.Africa & the Far East	3120	1825	-43	3670	18
L.America & the Caribbean	2950	1836	-38	3672	25
Sub-Saharan Africa	2170	1788	-18	3862	79

Sources: As in Table 1, except for the "Projected Supply" figures. These come from Alexandratos (1995, p. 83)

Notes: As in Table 1, except that the "% change" figures for both strategies are measured in terms of the percent of projected food supply for that year.

Table 5
Actual and Projected Food Supply (by Strategy)
Kcals/person/day

Region	Outcomes (by Strategy)		Actual Supply			Projections
	Political[a1]	Physical[b2]	1970[3]	1980[3]	1990[3]	2010[4]
Asia & the Pacific	1761	3522	2114	2253	2528	2776
N.Africa & the Far East	1825	3670	2354	2806	2912	3120
L.America & the Caribbean	1836	3672	2509	2730	2715	2950
Sub-Saharan Africa	1788	3862	2174	2082	2046	2170

Sources: [1] FAO (1992, p.13); [2] Author's calculations; [3] FAO (1995); [4]Alexandratos (1995, p. 83).

Notes:

[a]The figures in this column represent the reference standard for undernourishment in each region. This reference standard is then used as the minimum requirement, distributed equally to the whole population in the region.

[b]The figures in this column represent the average food supply necessary to alleviate undernutrition if the physical strategy were pursued.

Table 6
Calculated Increases/Decreases (-) in Food Supply and Arable Land (in percent)

Region		1970	1980	1990	2010
Asia and the Pacific	Political	-17	-22	-30	-37
	Physical	67	56	39	27
North Africa and the Far East	Political	-23	-35	-37	-43
	Physical	56	31	26	18
Latin America and the Caribbean	Political	-27	-33	-32	-38
	Physical	46	35	35	25
Sub-Saharan Africa	Political	-18	-14	-13	-18
	Physical	78	86	89	79

Source: Author's calculations.

Notes:

Political: % increase in food production and arable land that would have been (will be) necessary to provide the whole population (100%) with the minimum nutritional requirement, if the food had been (will be) equally distributed. For the year 2010 the increase is measured in terms of the percent of projected food supply for that year.

Physical: % increase in food supply and arable land that would have been (will be) necessary to provide the whole population (99%) with the minimum nutritional requirement (or more) given the real (existing), unequal, distribution.

Table 7
Projected Impacts on Reserves of Arable Landin the Developing World, Millions of Hectares

	Actual		by Political Strategy		by Physical Strategy	
	In-use	Reserves	Extra Land Required	Difference[a]	Extra Land Required	Difference[a]
1970	597 698	425 000	0	425 000	388 497	+36 503
1980	677 127	345 000	0	345 000	385 962	-40 962
1990	756 566	266 000	0	266 000	340 454	-74 545
2010	847 583	156 000	0	156 000	271 226	-115 226

Sources: Alexandratos (1995, pp. 151-168) and Author's calculations.

Note:

[a] "Difference" refers to the amount of land that will be remaining of the reserves, after land is brought under cultivation (in the amount projected by each strategy). For the political strategy, because no additional land will be required to meet individual food security requirements, the difference is equal to the remaining reserves. For the physical strategy, however, the difference can be significant. When more land is required than exists in the actual reserves, the difference is negative.

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Impact of Structural Adjustment Programme on Maize Production in Northern Province of Zambia: An Econometric Study

by

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Abstract[1]

Structural Adjustment Programme (SAP) was adopted by the Government of Zambia as a measure to strengthen the economy and service debt. Maize is the main staple food of Zambia's urban population. Maize subsidies comprised of fertiliser, credit and consumer price subsidies. Withdrawal of the fertiliser subsidy was a major component of the adjustment programme.

To asses the impact of SAP on maize production, a study was conducted in two districts of Northern Province (Kasama and Impika districts). Impact of SAP on peasants welfare and the environment focusing on maize production was emphasised. Linear and non-linear regression models and profit functions (based on quadratic and Cobb-Douglas production forms) have been used to study the objectives.

During the pre-adjustment period, maize production was encouraged by fertiliser subsidies. However, profitability from production has declined during the post-adjustment period by the effect of removal of fertiliser subsidies. Continuous use of fertiliser, without sustainable soil management practices, has on the other hand caused soil acidity.

Comparing the pre- and post- adjustment periods, fertiliser use by the farmers has decreased in the post- adjustment period. This is due to lack of access to credit and decline in farm income. Female headed households were found to be using less fertiliser than male headed households in the post- adjustment period. Goals and preferences may also be gender specific.

[1] This paper evolved from my MSc thesis in economics and resource management at the Agricultural University of Norway, 1995. The remaining errors are my sole responsibility

There is no clear evidence for impact of the adjustment programme on the technical efficiency dimension of maize production. The removal of subsidies on fertiliser has resulted in more efficient resource allocation of fertiliser.

As a result of the SAP, farmers have shifted towards other crops, which are more profitable than maize, and increased animal husbandry. A common belief has also been in the region that fall in maize production has expanded chitemene shifting cultivation which can cause deforestation.

My findings support the diversification of crop production and development of livestock sector which have been emphasised by the new agricultural policy in Zambia.

***Key Words:** Adjustment programme, Maize Production, Production subsidies, Economic efficiency, Peasants, Environment, Regression analysis.*

1. Introduction

The aim of this study is to measure the impact of structural adjustment programme on maize production in Northern Province of Zambia. The focus is to look at the policies that have actually been put into practice at the macro level of the economy and the results thereafter at the meso and micro levels. The implications of adjustment programme on peasants welfare and the environment focusing on maize production are also emphasised in this study. It is important to note that the Zambian economy has over the past two decades undergone a series of economical policy changes. There have been little continuity of economic policies in Zambia and the same moved from adjustments in accordance with the International Monitory Fund / World Bank prescriptions to pre-adjustment policies (Sankhayan et al 1993). This study will, however, mainly concentrate on impacts of economic reforms after the 1989 structural adjustment programme.

In the chapter 2, I state the problems related to the maize production before and after the Structural Adjustment Programme. Then the objectives be to studied are addressed. Chapter 3 follows with the theory and the methods used in this study . In the chapter 4, I presents the results of the regression analysis. Finally I summarise and conclude with some policy recommendations in the chapter 5.

2.1 Problem statement

In an attempt to provide cheap food to urban consumers in the 1980s, the government of Zambia created monopoly institutions to enable it to intervene and control the markets through use of subsidies for some of main crops, including maize. The excessive promotion of maize was at the expense of other crops by providing fertiliser subsidies for maize, credit for maize production and subsidised maize marketing and consumption, disproportionate allocations of resources to maize research, extension, storage and processing (MAFF 1992).

The government also enforced pan territorial prices (equity pricing) for maize throughout the country. As a result, production of maize spread to areas with no comparative advantage. This led to adverse effects on food security of areas with low rainfall and contributed to soil acidification through use of fertilisers without liming (Øygard 1987).

As production moved away from the main consuming centres, transport costs and subsidies increased. Initially the revenues from copper (mining) provided the resources to meet the subsidy bill. However, with the fall in copper revenues and the oil price shocks in the 1970s, forced the government to borrow from domestic and external institutions. This introduced further distortions, such as, debt crises, high inflation in the economy, etc..

It has also been postulated that there might have been further effects on the intra-household division of labour and the control of family income by the maize policy since the maize was regarded as men's crop in most areas (Geisler & Narrowe 1990).

In 1989, as the government recognised the past policies, the Structural Adjustment Programme (SAP) were accepted as the basis for the future direction of the economy. In the agricultural sector, the SAP has focused on the removal of price controls, trade barriers and subsidies. However, at initial stage wrong signals were sent to farmers in that fertiliser subsidies for maize were removed before output prices were decontrolled. As a result, input costs increased while farm gate prices of maize remained unchanged or increased less. The increased input costs reduced the producer margins and therefore discouraged farmers from producing maize. Coupled with the credit squeeze in Zambia, farmers failed to buy the necessary quantities of inputs, thus there was a contraction in maize production.

The contraction in maize production implies that the past technologies, i.e., fertilisers, may no longer be appropriate because the production increasingly will be based on comparative advantage. The marginal areas will need new technologies or should go back to the old (traditional) technologies.

The contraction in maize production also led into insufficient supply of food for the urban population. Zambia therefore now imports large quantities of maize. The urban poor are those suffering most and will suffer if consumer subsidies are fully removed. There has been switch from maize towards other stables (Geisler & Narrowe 1990).

The impact of removal of fertiliser subsidies has also resulted into increase in traditional farming systems, particularly, a switch towards chitemene production which may accelerate deforestation.

In the case of gender, household model predictions by Holden (1991b) stated that the impact of removal of fertiliser subsidies would be largest on male headed households since they were the major users of fertilisers for maize production. On the other hand, Geisler (1992) stated that females and female headed households were likely to suffer most from the SAP because males controlled the cash income and gave higher priority to their personal expenditure than to the needs of their wives and families.

It has also been stated by Geisler (1992) that labour market effects were such that rural wages and employment opportunities deteriorated with the fall in maize production, and this affected female headed households adversely. Because it was often women who took such type of seasonal piecework and they were often paid with basic commodities.

Another effect may be a reduction in the market for beer since men are the main customers of beer, while many women and female headed household have sale of beer as an important source of income. Profitability of beer-brewing declined by 1990 as compared to that in the 1980s from cash crops. However, some of these findings by Geisler (1992) have not been well documented through quantitative surveys. The fall in maize income may thus have caused several local general equilibrium effects through the labour markets, or through the market for beer and other commodities since these markets are largely controlled by women while much of the demand for beer is from men (Holden et al 1994).

2.2 Objectives

Two districts in the Northern Province have been considered for this study. These districts are Mpika and Kasama. They differed somewhat in conditions, such as, agro-ecological, market access and population density, etc. (Central Statistical Office 1994). Matama village, 136 km south of Mpika in Mpika District was one of the major maize producing areas in Northern Province during the 1980s due to improved infrastructure provided by the Integrated Rural Development Programme (IRDP). This district is a low population density area where chitemene system has been on the increase recently (Hvoslef & Phiri 1993).

The densely populated Kasama District is considered to belong to the typical chitemene shifting cultivation region in terms of climate, soils and traditional farming system. Three villages from this district have been considered for this study. These villages are New Chambeshi, Old Chambeshi and Yunge (Holden 1991b; Holden et al 1994).

The socio-economic data available from the above mentioned districts were collected by the Department of Economics and Social Sciences and the Noragric (Centre for International Environment and Development Studies), Agricultural University of Norway.
Two types of data were available from the above mentioned villages to the present study. First type was the 'time series cross sectional data'. These data were collected by the IRDP project at Matama village in Mpika District for the cropping seasons 1980/81 to 1989/90. The first objective of this research is based on the information related to maize production these data provide.

The second type is 'cross sectional' data collected at two different cropping seasons, 1986/87 and 1992/93 respectively. These data provide information related to maize production, farming systems and socio-economic states of the farmers for the three villages, i.e., New Chambeshi, Old Chambeshi and Yunge in Kasama District. Thus the data for the above three (same) villages for both the cropping seasons are used to study the second, third, fourth and fifth objectives of this research. It thus became possible to do 'before - after' comparisons. There are some limitations of using these secondary data. Particularly, they did not provide the exact or direct information for certain variables. In such occasions some estimations were made for those variables on the basis of other available information. These estimated variables are quoted wherever they are used.

Thus the objective of this study falls under following directions;

i). To study the nature of maize production in Mpika District during the pre- adjustment period, i.e., from 1980/81 to 1988/89 cropping seasons, and analyse the various reasons for the observed behaviour.

ii) To estimate the change in profitability (gross margin) of maize production due to the removal of fertiliser subsidies in Kasama District.

iii). To identify the factors influencing the use of fertilisers by the farmers for the pre and post adjustment periods, i.e., 1986/87 and 1992/93 cropping seasons respectively, in Kasama District.

iv). To measure the impact of structural adjustment programme on technical efficiency dimension of maize production in Kasama District.

v). To compare the allocative efficiencies of the peasants with respect to the fertiliser use for the pre- and post- adjustment periods, i.e., 1986/87 and 1992/93 cropping seasons respectively, in Kasama District.

3. The profit maximising model and economic efficiency

The household decision making on maize production is influenced by many internal as well as external factors. Thus the household's ability on the decision making can be explained by their optimising behaviour with the assumption that peasant farmers are "rational". In this regard this study is an attempt to look at the profit maximising behaviour of the peasants, and as such, the theory of profit maximising peasants is used.

In general this theory assumes that the peasant household maximises one or more household objectives. This theory is also based on a set of assumptions about the larger economy within which peasant production takes place. In addition, this theory has certain limitations like the household or family treated as a single decision making unit. This means that the objectives of the household head are assumed to represent the goals of all household members. The division of labour between women and men in the household, and the differences in their command over resources and income are negligible (Ellis 1993).

Schultz advanced a hypothesis that farm families in developing countries are " efficient but poor ", and thus that " there are comparatively few significant inefficiencies in the allocation of the factors of production in traditional agriculture " (Ibid.). This hypothesis has had influence on the perception about peasant decision making. The preposition that peasants are efficient ascribes to the peasant household the motivation of profit and/or utility (welfare) maximisation. However, a risk averse household may maximise utility without maximising profit. But for the simplicity it is assumed that the households maximise profit.

Neo-classical theory of farm production is the basis for this model. The basic theory of farm production involves some important simplifications with respect to the possible goals and constraints. The consumption side of the farm household is ignored. Only a single goal, that of short term profit maximisation, is explored. The short term means that some factors must be used in predetermined (fixed) amounts. Other assumptions include competition in the markets for farm output(s) and input(s), and unlimited working capital for the purchase of variable input(s) (Ellis 1993; Varian 1993).

However, the simplifications and the assumptions involved in this theory are very implausible in the case of the peasantry and the working of markets in Northern Province of Zambia. The assumption of competitive markets for farm outputs and inputs may not be a necessary condition for a farmer to be a profit maximiser as long as the relevant prices are informed through non-market forces as in the case of northern Zambia. There may also be conflicts between the goals and the constraints the farmers confront. Particularly, the assumption of unlimited working capital for the purchase of variable input(s) is very unrealistic. Farmers have limited working capital. Or, some farmers do not have capital. Thus the profit maximisation may be constrained, i.e. "constrained profit maximisation", because the capital available for the purchase of the variable input(s) quantities for the use in the production process may be limited (Sankhayan 1988). But the simplifications and the assumptions involved in this theory are still kept for the sake of convenience and policy implications.

Under the given simplifications and assumptions, the decision making in farm households can be examined by a profit function. A profit (or cost) function relates maximised profits (or minimised costs) to the prices of product(s) and input(s), as also to other exogenous variables such as fixed inputs, or agro-climatic and social variables (Ibid.). Input(s) and output(s) in the function are measured as rates over a specified time period, usually the crop season.

In a profit maximising condition the economic optimum level of an input occurs when the marginal value product of the input (MVP) is equal to the price of input (Marginal Factor Cost), i.e., when the marginal physical product (MPP) is equal to the inverse (input-output) price ratio. This brings us to the impact of price changes on the optimum levels of input and output in the model. What is important is not the absolute levels of input or output prices but the ratio between them. It follows that changing the price ratio between input and output alters the position of the economic optimum (Varian 1993).

A farm may have achieved economic efficiency as the te.m "economic efficiency" is reserved for a situation of both allocative efficiency and technical efficiency. The concept of allocative efficiency, by contrast, refers only to the adjustment of inputs and output to reflect the relative prices within the technology of production already having been chosen. But what defines technical efficiency is the maximum attainable level of output for a given level of production inputs given the range of alternative technologies available to the farmer.

In the profit maximising model we assume for the consideration of peasant efficiency that farmers operate on, rather than within, the production possibility frontier available to them, i.e., the technically most superior production function available to them. The problem with this assumption is that it overlooks those kinds of inefficiencies that result from operation on an inferior production function. For this reason, an average farm household is considered for the profit maximising model. This can be found when estimating the production function by regression analysis. In effect the profit maximisation model tends to focus on only one aspect of efficiency, the allocative efficiency, which is the adjustment of output and inputs to their relative prices. And the same is true of the efficient peasant hypothesis advanced by Schultz.

There are then three ways to look at the optimal point; At the economic optimum extra return equals extra cost, i.e., MVP = MFC. By rearranging this expression, the optimum condition can also be stated as MVP/ MFC = 1. This way of expressing the economic optimum is concerned with research into the economic efficiency of peasant farmers where the question asked is whether or not this ratio is statistically different from one for each variable input, and if so, in what direction. Thus if the MVP/MFC > 1 the farmer is applying too little of an input; or if MVP/MFC < 1 the farmer is applying too much of an input.

4. Results

This chapter is a synthesis of the results obtained from the analysis of the data and is aimed at giving information on aspects of pre- and post- adjustment period effects of agricultural and adjustment policies on maize production and on peasants and the environment in relation to the maize production.

4.1 Nature of maize production in the pre adjustment period

It is useful to reconcile the nature of maize production during the pre adjustment period in the Northern Province. For this purpose a linear production function was estimated based on the available data to study the variables influencing maize production per household in Matama village (Mpika District). The type of data used for regression analysis was 'time series cross sectional' for the cropping seasons 1980/81 to 1988/89.

Table 1 : Linear production function explaining the variables influencing maize production per household in Matama village

Predictor	Coef	Stdev	t-ratio	p
Constant	-1629	1442	-1.13	0.260
Family size	209.2	177.1	1.18	0.239
Own oxen	12	1680	0.01	0.994
Fertiliser (kg)	4.435	1.127	3.94	0.000***
Maize area cultivated (ha)	2107.6	548.1	3.85	0.000***
Hired labour (0,1, yes is 1)	2712	1081	2.51	0.013**
Hired oxen (0,1, yes is 1)	730	1206	0.60	0.546
Hired tractor (0,1, yes is 1)	4140	7645	0.54	0.589
Insecticide (0,1, yes is 1)	-7	1191	-0.01	0.996
Manure (0,1, yes is 1)	-417.69	84.83	-4.92	0.000***

Dependent variable : Maize production (kg). $R^2 = 0.222$. F value for model = 7.94 ***. df = 259

***Significant at 1-per cent level. **Significant at 5-per cent level.

The data contained some quantitative variables, such as, family size, own oxen, quantity of fertiliser used and maize area cultivated as well as qualitative (dummy) variables, such as, hired labour, hired oxen, hired tractor, insecticide use and manure use.

The estimated linear multiple regression model, i.e., linear production function, is given in Table 1. Risk / uncertainty related to soil, climatic conditions and other factors during the periods considered for the analysis was assumed to be represented by the error term of the model. The explanatory variables were included in the model because of either direct and/or indirect influence on the dependent variable. To a certain degree some of these (included) variables can also act as proxies for the important omitted variables, for example, the included variable family size can be a proxy for the missing important variable family labour. The variable own oxen can indirectly influence the maize production by directly influencing the maize area cultivated by the household. Market for maize and input markets (including for labour) are assumed to exist.

- Family size may explain the maize production of the household because of the following reasons. Family labour available for maize production and/or need for cash by the household by sale of maize. The influence of consumption side of the household on the production side is ignored.

- Own oxen (with dummy variable hired oxen) may explain the impact of the ox-programme launched by the IRDP in the Matama village in order to increase the maize field (maize area cultivated by the household) by using draught animals to rationalise the work (Hvoslef and Phiri 1993).

-Quantity of fertiliser used may explain how the yield of hybrid maize (maize production) depends on inorganic fertilisers.

- Maize area cultivated may explain how the maize production depends on land input.

-The dummy variable, hired labour, may explain how the hiring of labour influence the maize production of the household, at least in the peak season of maize cultivation.
- The dummy variables hired oxen, hired tractor, insecticide use and manure use may explain the influence of these alternative technologies in maize production, i.e., whether to hire oxen or tractor is better depends on their costs and access. Whether to use cattle manure or inorganic fertiliser depends on their costs, effectiveness in the yield, or combination of them depending on their availability, would be better to apply. The same applies for the use of either insecticide or (integrated) biological pest management method, depends on the cost and the efficiency in controlling the pests, etc..

The prediction of model shows that the null hypothesis, "none of the explanatory variables included in the model influenced maize production per household", can be rejected for those variables which are significant at 5 per cent level (see table 1). Nevertheless, there is no serious multi-colinearity among the explanatory variables as tested by Klein's multi-colinearity test (see appendix 1).

Maize production per household in the village was influenced by some variables either positively or negatively. The amount of (inorganic) fertiliser used, maize area cultivated and hiring of labour are the variables significantly influencing an increase in maize production of the household. On the other hand, manure use is a variable significantly influencing a decrease in (hybrid) maize production.

Thus, the results imply that (inorganic) fertiliser, land and labour (in this case hired labour) were some of the important inputs in boosting the maize production during the pre adjustment period in the Matama village. The implications of using oxen (owned or hired), tractor (hired) and insecticide were relatively not important in relation to the maize produced by the household. The variable family size was not significant in explaining the maize produced by the household.

However, the value of R^2 (coefficient of multiple determination) of the estimated model is poor. The model could explain only 22 % of the variation in the dependent variable. This is probably because of the omitted important explanatory variables, such as, family labour, seed, credit (capital), etc. in the model.

Though not significant, the constant term of the model (-1629) predicts that there would be no maize production without some level of inputs. However, this constant term may also be biased as well as inconsistent since some important explanatory variables are omitted from the model even though these variables are correlated or uncorrelated with the other included explanatory variables (Gujarati 1988).

In addition, when a legitimate variable is omitted from the model, the consequences may be very serious. The OLS estimators of the coefficients of the variables retained in the model may not only be biased but be inconsistent as well, no matter how large the sample is. Also the variances and standard errors of these coefficients may be incorrectly estimated, thereby vitiating the usual hypothesis testing procedures. But the consequences of including irrelevant variables in the model, for example variable like own oxen which may not be so relevant in the model, may be (fortunately) much less serious. The estimators of the coefficients of the relevant as well as irrelevant variables may remain unbiased as well as consistent. Thus the error variance, i.e., σ^2 may remain correctly estimated. The only problem may be that the estimated variances tend to be larger than necessary, thereby leading to less precise estimation of the parameters (Ibid.). Therefore, including more relevant explanatory variables in the model would be useful to avoid possible specification bias and have higher explanatory power, i.e., high R^2 value, of the model.

Matama village was one of the major maize producing areas in Northern Province during the 1980s, due to improved infrastructure provided by the IRDP programme. However, the ox- programme launched by the IRDP dose not explain significantly the maize production of the household. Among the inputs and the technologies incorporated in the model, quantity of fertiliser used appeared to be one of the important factors in influencing the maize production positively. This could be due to fertiliser subsidies, credit facilities, favourable fertiliser-maize price ratios, and better delivery systems for inputs which prevailed during the pre- adjustment period.

However, it has been reported (Hvoslef and Phiri 1993) that maize production has been discouraged during the last years due to drought, high fertiliser and seed prices, small fertiliser quantities and late deliveries, poor seed availability, non existence of pesticides, etc. It has also been reported that the sale of maize reduced substantially and the cash crop substitutes has been an increase in rearing of goats and pigs. The chitemene and cassava systems were to be on the increase in the village as a response to the break down in maize production (Ibid).

4.2 Impact of adjustment programme on profitability of maize production

Removal of fertiliser subsidies combined with price ceiling of maize reduced the producer margin (profitability) in maize production. An estimation for the reduction in profitability in maize production in terms of fertiliser has been thus estimated based on a quadratic production function (see table 2). An equation of this kind is fairly common for describing the responses of a crop output to fertiliser use (Ellis 1993). The costs for inputs other than the fertiliser were treated (assumed) as constant for both the cropping seasons, i.e., 1986/87 and 1992/93, since data on input(s) used, for example the amount of seed used, along with the prices, and the wages for labour were not available.

The results show that there is a reduction in profitability in terms of fertiliser use by 41 Kwacha per hectare for the 92/93 cropping season compared to that for the 86/87 cropping season. This reduction is only due to unfavourable fertiliser-maize price ratio resulting from the adjustment programme. However, this kind of estimation may be implausible because of the substitution possibilities between the fertiliser and the other inputs. Thus a precise sequence estimation on profitability in maize production, for example from the 1986/87 cropping season to the 1992/93 cropping season, would be more appropriate to see the impact of the adjustment policies. An approximate estimation of this kind may also be inappropriate since the response to fertiliser up to the rates used can be proved to be linear at 1 per cent level of significance.

Table 2: An (approximate) estimation for the reduction in profitability in maize production in terms of fertiliser use (per hectare basis) in Kasama District

	Cropping season 1986/87	Cropping season 1992/93
Estimated production function (quadratic)[†]	$Y = -6 + 5.95X - 0.00197X^2$ (Y = Maize in kg/ha ; X = Fertiliser in kg/ha)	
Marginal physical product	$\partial Y/\partial X = 5.95 - 0.00394X$	
Fertiliser-Maize price ratio	1.5738	2.3516
Factor cost on fertiliser at profit maximisation	1066.224 kwacha	1894.334 kwacha
Gross return on maize at profit maximisation	2548.728 kwacha	3336.216 kwacha
Gross margin in terms of fertiliser use	1482.504 kwacha	1441.88 kwacha
Reduction in profitability		40.62 kwacha

[†] Parameters X and X^2 are significantly different from zero at the probability levels of 1-percent and 10-percent respectively. R^2 for model 0.518. df = 38. Prices were adjusted to constant term (1975 = 100).

The equation shows also that if there is no fertiliser application there will be no yield as its intercept term gets a negative value. This may imply a condition of infertility of the soil and the development of soil acidity, i.e., negative externality/environmental effect, which may be developed by the continuous application of fertiliser in maize production without sustainable soil management practices, such as, liming, mulching, crop rotation with legumes, etc. (Øygard 1987).

4.3 Factors influencing the use of fertilisers by the farmers

Since the amount of fertiliser applied with respect to its prices has an influence on the yield and profitability (gross margin) of maize production, linear multiple regression models were used to study the other variables or factors influencing fertilising behaviour of a peasant for the respective cropping seasons. For this purpose, (explanatory) variables, such as, work force (family labour), chitemene shifting cultivation (hectare) by the household, farm income (via maize production) of the household in the previous season, access to credit (dummy variable) and sex of household head (dummy variable) were included in the models because of the following reasons;

- Work force, i.e., family labour, can be a substitute for the fertiliser use in maize production to some extent.

- Chitemene shifting cultivation can be regarded as an alternative and/or low risk technology for the fertiliser use, i.e., the chitemene shifting cultivation can be a substitute for the cultivation of fertilised hybrid maize to some extent. Thus there may be a negative correlation between the fertiliser use and the chitemene shifting cultivation.

- Farm income of the household in the previous season can explain the ability of the household to purchase fertiliser for the current season. It can also explain the motivation of the household to continue on the maize production because of the profit and favourable fertiliser - maize price ratio experienced in the previous season.

- Access to credit can explain the ability of the (cash poor) household to purchase the fertiliser and/or get subsidised fertiliser.

- Sex of household head can explain whether the goals and preferences of the household are gender- specific with respect to the fertiliser use in maize production, and/or the ability of the male and female headed households in producing fertilised maize.

The estimated models for the respective cropping seasons are given in Tables 3 & 4.

Table 3: Multiple regression model : Variables influencing fertiliser use by the farmers for the cropping season 1986/ 87 in Kasama District

Predictor	Coef	Stdev	t-ratio	p
Constant	14.01	61.27	0.23	0.820
Work force	-6.336	7.627	-0.83	0.410
Chitemene	-0.003356	0.006527	-0.51	0.609
Farm income 1985/86	178.72	25.59	6.98	0.000***
Credit (0,1, yes is 1)	173.96	28.19	6.17	0.000***
Sex (0,1, 1 is female)	-15.86	29.08	-0.55	0.588

Dependent variable: Fertiliser use (kg). $R^2 = 0.707$. df = 57. F- value for model = 25.12 ***

***Significant at 1 per cent level.

Table 4: Multiple regression model : Variables influencing fertiliser use by the farmers for the cropping season 1992/ 93 in Kasama District

Predictor	Coef	Stdev	t-ratio	p
Constant	349.0	121.6	2.87	0.007***
Work force	1.07	17.68	0.06	0.952
<u>Chitemene</u>	-0.00280	0.02022	-0.14	0.891
Farm income (1991/92)	96.50	32.93	2.93	0.006***
Credit (0,1, yes is 1)	316.73	57.94	5.47	0.000***
Sex (0,1, 1 is female)	-191.75	61.12	-3.14	0.003***

Dependent variable: Fertiliser use (kg). $R^2 = 0.675$. df = 45. F- value for model = 16.63 ***

***Significant at 1 per cent level.

For the 86/87 season the null hypothesis that " none of the explanatory variables influencing fertiliser use" is rejected for those variables which are significant at 1 per cent level. And for the 92/93 season the same null hypothesis is rejected for those variables which are significant at the same probability level.

It is found that access to credit significantly influenced the quantities of fertiliser used for both of the cropping seasons. The influence was higher for the 92/93 cropping season compared to that for the 86/87 cropping season as indicated by the respective regression coefficients. Of the other variables, previous years farm income significantly influenced quantities of fertiliser used for both of the cropping seasons, but the influence was higher for the 86/87 cropping season compared to that for the 92/93 cropping season as can be seen by the respective regression coefficients. However, sex of household head had influence only for the 92/93 cropping season. The female headed households have reduced the fertiliser use by 191.75 kg than the male headed households.

The results thus indicated that access to credit is an important factor irrespective of pre- and post- adjustment period but its relative importance is higher for the post- adjustment period than that for the pre- adjustment period. As the previous year farm income (via maize) influenced quantities fertiliser used in 86/87 season more than that for the 92/93 season, it may be stated that maize has been a more profitable crop during the pre-adjustment period than the post- adjustment period. Since the female headed household has used less amount of fertiliser than the male headed household, it may be stated that the effect of high fertiliser cost due to removal of subsidies seems to be more on the female headed household than the (labour rich) male headed household and/or the goals and preferences of the households with respect to the fertiliser use may be gender- specific and this may have important policy implications (Ellis 1993; Holden 1991b).

However, the above least squares estimates may be biased and inconsistent as the dependent variable for both the cropping seasons had some zero values. This bias and inconsistency may also be larger for the estimates of the 86/87 season than that for the 92/93 season. It is because the dependent variable for the 86/87 season had more zero values than that for the 92/93 season. Therefore, some advanced techniques to deal with this type of data, for example estimation of TOBIT models, would give more precise estimates. Alternatively, by formulating appropriate Linear Probability Models (with large samples) or LOGIT /PROBIT models to study the respective objective would be another way to deal with the data (Gujarati 1988).

4.4 Impact of adjustment programme on technical efficiency

In order to measure the impact of adjustment programme on the technical efficiency dimension of maize production in Kasama District, a number of production forms were tried. The dependent variable was maize production in kg and the independent variables, i.e., inputs, were fertiliser in kg, work force in man labour and land in hectare. In addition, a dummy variable taking value of "1" for maize production in the pre adjustment period (cropping season 1986/87) and "0" for maize production in the post adjustment period (cropping season 1992/93) was incorporated into the model in order to capture the impact of adjustment programme on the technical efficiency dimension of maize production.

Table 5: Cobb-Douglas production function (log - linear form) explaining the impact of adjustment programme on the technical efficiency dimension of maize production in Kasama District

Predictor	Coef	Stdev	t-ratio	p
Constant	2.8321	0.4733	5.98	0.000***
ln L (Work force in man labour)	-0.1693	0.1318	-1.28	0.205
ln A (Land area in ha)	0.1340	0.1354	0.99	0.327
ln F (Fertiliser in kg)	0.77481	0.07982	9.71	0.000***
Dummy (1986=1, 1992=0)	-0.3126	0.1856	-1.68	0.098*

Dependent variable: ln Y (Maize production in kg). $R^2 = 0.733$. F-value = 37.10***. df = 58

***Significant at 1-percent level. *Significant at 10-percent level.

ᶲWork force = {Family labour x (Maize area cultivated / Total area cultivated) }. Off-farm employment and other business activities of the households have been neglected.

°Fertiliser amount represents an average of basal and top dressings which are applied in equal proportions.

The different production forms were estimated by the conventional OLS method.

For the goodness of fit to the available data, final choice rested with the single Cobb-Douglas function (see table 5). The alternative production forms, such as, linear, square-root and quadratic functions are given in Appendix 2.

The production function describe the technical or physical relationship between output (maize) and the three variable inputs (fertiliser, land and labour). Inputs and output were measured as rates over the specified time period, for the respective cropping seasons.
In this example those resources (inputs) not included in the production function were assumed to be held constant for both of the cropping seasons. It was also assumed that the physical input-output relationship of the production function was constant for both of the cropping seasons.

The model predicts that there is an upward shift in the production function for the 1992/93 cropping season as compared to that for the 1986/87 cropping season by the coefficient term of the dummy variable. However, as this coefficient is a small value and significant only at 10 per cent of the probability level, it may be said that there is no clear evidence to accept the alternative hypothesis that the adjustment programme had improved the technical efficiency dimension of the maize production in the Kasama District.

This lends support to the opinion that maize production in the Northern Province may not be increased simply by eliminating price distortions but assurance of provision of other factors and agrarian services like inputs, access to credit, markets, infrastructures, extension, research, etc. are also important in boosting the production in the region.

However, the dummy variable could also be influenced by several other factors which can vary from year to year, such as, climate (rainfall) , soil fertility, management practices, quality of other inputs (for example seeds), timing of input delivery (application of fertilisers), attacks on crop by insects (pests) and microbes (pathogens), etc.. Thus a precise estimation which can also take into account the yield variations that might have been caused by these variables (factors) would be more appropriate to test the validity of the lends. Another problem may be that the time span between the 1989 adjustment programme and the 1992/93 cropping season may be too short to measure the impacts.

5.5 Impact adjustment programme on allocative efficiencies of the inputs

As the dummy variable is significant only at 10 per cent probability level in the Cobb-Douglas production function presented in Table 5, it was decided to estimate appropriate production functions for the respective cropping seasons also, as to test the impact of adjustment programme on allocative efficiencies of inputs.

Table 6: Estimates of Cobb-Douglas production functions for maize in order to find the allocative efficiencies of inputs for the periods of both the pre- and post- 1989 adjustment programme in Kasama District

Production function (maize)	Estimate of constant (ln β_0)	Coefficient of land area (β_1)	Coefficient of Fertiliser (β_2)	Coefficient of Work force (β_3)	R^2	df	F	SE_v
Cropping season 1986/87	1.5644** (0.6431)	0.2797 (0.2966)	0.9887*** (0.1154)	0.0027 (0.2721)	0.776	25	25.35***	0.6728
Cropping season 1992/93	3.7061*** (0.7015)	0.2226 (0.1641)	0.6222*** (0.1237)	-0.1845 (0.1512)	0.757	32	30.06***	0.5784

***Significant at 1-per cent level. **Significant at 5-per cent level. Standard errors of the estimated parameters are given in the parentheses.

Again, Cobb-Douglas production functions were preferred in this case partly because of the advantages in estimation and interpretation but mainly because of the goodness of fit to data. The estimated production functions for the cropping seasons 1986/87 and 1992/93 presented in Table 6 were used to study the allocative efficiencies of the inputs for the pre- and post- adjustment periods respectively. Estimates of geometric means and the marginal value products of variables are given in Table 7.

Table 7: Geometric means of variables and marginal products

Inputs	Cropping season 1986/87			Cropping season 1992/93		
	Geometric mean	MPP	MVP	Geometric mean	MPP	MVP
Work force (man labour)	0.8508	1.0445	0.6372	1.8084	-79.429	-70.037
Fertiliser (kg)	127.7148	2.5483	1.5545***	214.9918	2.2531	1.988***
Land area (ha)	0.3359	274.0975	167.199	0.45168	383.6733	338.333
Out put (kg)229.	1718 _	_	778.	5241 _	_	

® Marginal Physical Products were estimated by $\beta \cdot Y/X$ where Y is the geometric mean of expected production, X is the geometric mean of input and β is the estimate of regression coefficient of the respective input. Prices were adjusted to constant term (1975 = 100)

***Significantly different from zero at a probability level ≥ 99 per cent. The standard error of marginal value products were calculated by the following formula;

$$SE_X = (Y/X) \cdot S \cdot P_Y$$

Where: Y is the geometric mean of expected production, X is the geometric mean of input, S is the standard error of the regression coefficient of input, and P_Y is the price of output (Heady and Dillon, Agricultural Production Functions, Iowa State University Press, 1961, pp. 231).

The ratio of marginal value product to marginal factor cost for fertiliser tested statistically for its departure from one (see table 8). The statistical tests showed that farmers were allocatively inefficient in using fertiliser during the pre- adjustment period but they made efficient allocation of fertiliser in the post- adjustment period. This investigation supports the hypothesis that the removal of price distortions, particularly removal of fertiliser subsidies, of the adjustment programme led to efficient way of resource (fertiliser) allocation.

However, a problem with this analysis is that the actual prices farmers got for the maize were used. But in practice the farmers may not decide on investment of inputs, i.e., fertiliser, labour, land, etc. without knowing the price they will get for the maize. It may therefore be more relevant to use an expected price which could be based on a form of an "expectations model". Introducing an expectations model would probably lead to different conclusions.

Table 8: Ratios of marginal value product to the marginal factor cost of fertiliser[a]

Input	Cropping season 1986/87	Cropping season 1992/93
Fertiliser	1.92912***	0.95811+

[a]Student's t distribution was used to test for statistical significance of the difference between the coefficients required to make MVP/ MFC = 1.0 and the coefficients obtained in the regression analysis (table 6).

*** Significantly different from one at a probability level ≥ 99 per cent.

+ Not significantly different from one even at a probability level ≥ 80 per cent.

© Fertiliser price is an average of prices of both basal and top dressings which are applied in equal proportions. Input prices for work force and land area are not available to estimate their MVP/MFC ratios.

The question of how efficiently farmers use farm resources, particularly fertiliser, after the adjustment programme was of considerable interest. But the time span may be too short to find any significant difference. Because in the long-run it may expect a "screening" where farmers with the best soils and best management continue with maize production while others may find it unprofitable.

On the other hand, the economic theory stated that farmers will increase an input (e.g., fertiliser) until the value of the product (e.g., maize) produced by the last additional unit of input (called the marginal value product of the input, i.e., MVP) just equals its marginal factor cost (MFC). Thus, at that "optimal" quantity of input, the ratio MVP/MFC will then equal one (under the given assumptions and simplifications). Previous empirical studies of Third World farmers, however, suggest that farmers increase fertiliser use until the ratio of MVP/MFC is not one but greater than or equal to two (Gladwin 1991).

The ratio is usually two or more because farmers can not base their decisions to use or increase fertiliser on the criterion of profit maximisation alone. They also face constraints such as lack of cash, lack of credit, lack of knowledge in how to apply the fertiliser, and the presence of risk/uncertainty about the weather, markets, prices, etc. They usually do not know just how much fertiliser they are applying, because they manually apply it with bottle caps or handfuls. In Africa, an additional problem is that farmers usually do not know the exact size of their field due to poor ability to estimate areas. In Zambia (and Malawi) a plot is called an acre (hectare) but may not be an acre (hectare). Because of these other factors, farmers usually end up applying a "sub-optimal" quantity of fertiliser and the ratio MVP/MFC is greater than one (Ibid.).

The neo-classical theory of farm production, which was the basis for the study of optimum level of inputs use, is applied with some simplifications and the assumptions. The capacity for the way in which farm production is organised only attains analytical relevance when placed in the context of goals of the farm family and resource constraints of the individual farm. In practice farm families may have many different goals: long term income stability, family food security (risk averse), achievement of certain preferences in consumption, leisure (drudgery averse) and fulfilment of community obligations (culture and norms). Other problems may be related to possible intra-household conflicts over the access to farm resources and the farm income, and the prevalence of kinds of interlocking markets (share cropping peasants) and/or missing markets between the land, labour, inputs, credit, outputs, off-farm employment, etc. (Ellis 1993).

The neo-classical view treats the individual (household) as a perfect rational person when decisions are to be made. But this view has been challenged by other views, mainly due to the unrealism underlying the former approach. Individuals are not always as rational as pointed out by the neo-classical theory. The ability and/or certainty of an individual for getting perfect information may be limited due to complexities existing in the surrounding environment. Thus alternative theories, for example bounded rationality, suggests that individuals are not able to make decisions on perfect rational consideration (Elster, 1984)), and since there are many needs (goals) to be fulfilled simultaneously and with limited capacity (constraints) household might not maximise needs (goals).

Thus the applicability of the result obtained on the basis of the neo-classical theory of farm production, i.e., the theory of profit maximising peasants, that the farmers made efficient allocation of fertiliser (from private perspective) by the effect of removal of fertiliser subsidies (removal of price distortions which altered the fertiliser - maize price ratio), may be unjustifiable in the case of peasantry in Northern Province of Zambia due to some of the reasons / arguments given above. However, there is no method that enables scientific theories to be proven true or enables scientific theories to be conclusively disproved either (Chalmers 1987).

5. Summary and conclusions

The result of Zambia's marketing and price policy prior to the (1989) adjustment programme had an emphasis upon maize production in the areas like the Northern Province which traditionally were not known for maize production. The benefits to the Northern Province farmers have been a result of the Government of the Republic of Zambia's (GRZ) policy of equity pricing and cheap food for the urban consumers. The Northern Province peasant households might not have grown hybrid maize if they had not been encouraged by fertiliser, credit and transport subsidies. This means that the increase in the amount of marketed maize has been paid for by the GRZ, rather than by the consumers.

The maize policy had also negative environmental effects in those areas where soils are not suited for growing maize or the areas where the production had been without sustainable soil management practices. Thus, maize may not a well suited crop for acid soils and for the densely populated areas in the province.
The government has removed the fertiliser subsidies, and reduced the credit subsidies, but failed to increase the producer price for maize. Even if the government increase producer price for maize, it is unclear whether increasing the price of maize can by itself a compensation for keeping the price of fertiliser low, if (some) smallholders are maize-deficit households. But, there are other staple crops which can be substitute for the maize to these smallholders. However, increasing the price of maize may be detrimental to the urban poor.

The drastic fall in maize production is also due to low producer price for maize compared to other crops with decontrolled producer prices. The rise in the price of fertiliser has made maize less profitable than bean, groundnut and other crops which do not need this input. Since the profitability in maize production has declined, the expansion of chitemene production (an increased deforestation) may be realised in some areas. Because the chitemene system may be reviewed as a low risk production technology used to generate both food and cash. The farmers have also moved to more animal production and other cash crops than maize.

The removal of subsidies on fertiliser has, however, resulted in more efficient resource allocation of fertiliser. But the reduction in the maize production and the consequent effects on food security, household income, beer business and the employment opportunities, particularly, for women and in general peasant households may not be taken for granted for the achievement of efficiency in fertilisation. Thus what might appear as increased efficiency may instead be actually a shifting of costs from the payable economy to the unpayable economy.

In a liberalised economy, government does not directly compete with the private sector in the areas of input supply, marketing, transportation, storage or retailing. However, the government will both support and regulate the private sector in these activities. Support for the private sector is needed to provide services, such as, infrastructures, agricultural research, etc. which the private sector cannot provide its own. Inappropriate regulation and/or inadequate support can seriously impede the production. But there was no significant improvement have been seen by the post adjustment period policies compared to that for the pre adjustment period polices. Perhaps it may too early to see the improvements. The structural adjustment is still in transition.

It may also be agreed that farmers, to increase production for the urban market even in response to higher food prices, must have access to agricultural supportive services, such as, access to credit and/or adequate credit subsidies. However, it was found that women often have more limited access to such resources than men. The main factor limiting fertiliser use by the farmers was lack of access to credit and/or inadequate credit.

Thus the possible hope of increasing the income of farmers may be to encourage their use of fertiliser on maize and cash crops (millet) combined with sustainable soil management practices. So that more of their land can be taken out of subsistence and planted to cash crops. It implies that the maize price may be increased and/or credit subsidies must be maintained. An argument for reintroducing a targeted fertiliser subsidy (combined with sustainable / biological soil conservation technological package) said to be difficult for some (environmental) reasons in this area since such subsidies are far from sufficient to stop the decapitalization of stocks of woodland (Holden & Shanmugaratnam 1994).

The new agricultural policy in Zambia does not emphasise maize production in northern Zambia as past policy did. The adjustment programme generally states that subsidies should be removed. The policy regarding the continuation of credit subsidies is still unclear. This also makes it more difficult to defend the continuation of credit subsidies to small scale maize producers in the region.

However, the diversification from maize monocropping to the other cash crops and animal husbandry can be seen as some positive developments in the farming systems and the household economy in northern Zambia. New agricultural policies in Zambia emphasise the diversification of crop production and improvement of high yielding varieties, and development of the livestock sector (MAFF 1992). Agricultural research in Zambia has recently developed new higher yielding varieties of finger millet, cassava and sweet potato and these are being introduced to farmers. Thus the result may be an enhancement of livelihood of peasants and reduced pressure on the marginal land and natural forest resources at least in the long run.

On the other hand, it is also an important task to mobilise and channel money into the essential human needs (e.g., health, education) and the infrastructures (e.g., roads, communication systems and the marketing channels), and various social services (e.g., crop insurance scheme, extension services, rural development and/or eco-development projects) which are suffering in the region. If the provision of these factors are continued to deteriorate, it is likely that the impediments on natural resource conservation may also be severe.

The question is how much the larger society, in particular the IMF, the WB and the donors, is willing and able to invest, and the Zambian government and the citizens are committed, to face the challenges.

Some recommendations

i. Diversification of crop production - It has the advantage of facilitating crop rotation, especially maize with legumes (e.g. beans, soybeans, or groundnut) to reduce the requirement for purchased nitrogen, improve disease control, and maintain soil quality.

ii. Drought resistant crops - Areas not in the high rainfall zone of the province are not well-suited to maize production and clearly require more drought resistant crops (e.g. sorghum, millet, or sunflower).

iii. Food (traditional) crops - Giving more incentives to the farmers to produce food crops (e.g. cassava) with lower cash requirements than maize, to the areas where market potential is minimal and promoting these crops to the urban markets.

iv. Export oriented crops - The market (e.g. export market) for maize is obviously limited. Small-scale farmers can produce other crops successfully for both domestic and export markets if they are provided with better transport and marketing channels. Export to be produced by small-scale farmers may include food crops (e.g., soybean), and non-food crops (e.g. cotton, tobacco with the environmental concern).

v. Promotion of crops suitable for agro-industries - Providing opportunities for post harvesting technologies, such as, canning, oil extraction, etc. with suitable crops (e.g., fruits, oil crops like groundnut and castor) in addition to beer-brewing in the region. The products can be promoted to the urban markets.

vi. Development of the livestock sector - Increased productivity of livestock (e.g. poultry, pigs) could play a role in improving the welfare of the rural people both through expanded food supplies and increased cash incomes. Cattle and goats could also help to make effective use of land (or areas where soils are acidic) which is not suitable for continuous cropping of maize, or even for any other types of crop except (suitable) pasture.

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APPENDICES

Appendix 1:

Variables :

Y = Maize production (kg)
X1 = Family size
X2 = Own oxen
X3 = Land (ha)
X4 = Hire labour (0,1, yes is 1)
X5 = Fertiliser (kg)
X6 = Hire oxen (0,1, yes is 1)
X7 = Hire tractor(0,1, yes is 1)
X8 = Manure use (0,1, yes is 1)
X9 = Insecticide use (0,1, yes is 1)

Correlation matrix

	Y	X1	X2	X3	X4	X5	X6	X7	X8
X1	0.115								
X2	0.061	0.029							
X3	0.225	0.324	0.250						
X4	0.215	0.013	0.118	0.112					
X5	0.281	0.017	0.072	0.115	0.134				
X6	0.112	-0.010	-0.099	0.086	0.130	0.177			
X7	-0.041	-0.030	-0.012	-0.010	-0.038	-0.093	-0.031		
X8	-0.210	0.138	0.111	0.306	-0.030	-0.007	0.006	0.136	
X9	0.015	0.140	-0.031	0.035	0.071	0.003	0.044	-0.031	0.051

Appendix 2:

i. Quadratic production function

Predictor	Coef	Stdev	t-ratio	p
Constant	-321.7	244.2	-1.32	0.192
F	1.923	1.130	1.70	0.093
L	249.9	212.0	1.18	0.242
A	-13.5	725.3	-0.02	0.985
A*A	-129.5	253.1	-0.51	0.610
F*F	0.002771	0.002224	1.25	0.216
L*L	-23.10	39.14	-0.59	0.557
A*F	1.097	1.541	0.71	0.479
A*L	-51.9	239.6	-0.22	0.829
F*L	-0.0369	0.6505	-0.06	0.955

D	365.5	209.6	1.74	0.085

s = 754.0 R-sq = 68.0% R-sq(adj) = 64.1%

ii. Linear production function

Predictor	Coef	Stdev	t-ratio	p
Constant	-334.1	215.0	-1.55	0.124
F	4.4962	0.4593	9.79	0.000
A	-47.2	221.3	-0.21	0.832
L	77.31	76.73	1.01	0.317
D	303.6	197.6	1.54	0.128

s = 762.4 R-sq = 64.9% R-sq(adj) = 63.3%

iii. Square-root production function

Predictor	Coef	Stdev	t-ratio	p
Constant	-359.0	273.2	-1.31	0.193
sqA	403	1395	0.29	0.773
sqL	33.3	794.3	0.04	0.967
sqF	-20.16	38.44	-0.52	0.601
A	-301	1241	-0.24	0.809
L	107.7	369.2	0.29	0.771
F	3.747	2.209	1.70	0.094
A*L	-183.8	238.6	-0.77	0.443
A*F	1.130	1.515	0.75	0.458
F*L	0.3741	0.6335	0.59	0.556
D	398.2	213.6	1.86	0.066

s = 766.3 R-sq = 67.0% R-sq(adj) = 62.9

Parallel Workshops in Development Studies

SESSION B:

North/South Relations:
Conflicts and Learning Processes

"Reversing the Spiral...", by Cleaver and Schreiber: A Brief Africa-Centred Critique.*

by

Andy C. Y. Kwawukume

Reversing the Spiral: The Population, Agriculture and Environment Nexus in Sub-Saharan Africa does not only chronicle the serious problems of fast population growth and slow agricultural growth and/or stagnation currently afflicting sub-Saharan Africa (SSA); above all, it recommends wide-ranging measures to break the vicious circles of constraints leading to increasing impoverishment of many, increasing environmental degradation and decreasing ability of SSA to feed her burgeoning population. The proposed recommendations are thus to avert what others have chosen to label the «coming anarchy», with a ring of inevitability to it.

The authors fall within the dominant but contentious school which locates the problem of agricultural stagnation in the population and poverty syndrome, as opposed to those emphasising market factors such as prices, access costs and property rights. This divide is significant as different solutions are prescribed, but the authors identification of causes and recommendations for solutions avoid orthodoxy.

Chapters 1 to 5 elaborated the nexus located within the past three decades, beginning from the second half of the 1960s. «*Rapid population growth,*» is recognised as «*the principal factor that has triggered and continues to stimulate the downward spiral of environmental resource degradation, contributing to agricultural stagnation and, in turn, impeding the onset of the demographic transition,*» p.2. In the face of population growth outpacing agricultural growth, the increasing food deficit, fuelwood needs, and decreasing pasture land are thus causing shorter fallow periods, deforestation, cultivation and grazing on woodlands and marginal lands, and thus the ensuing environmental degradation. This in turn weakens the basis for agricultural growth, with population growth faster than the former, so the argument goes.

Chapter 5 deserves special attention for dealing with the much misrepresented roles and problems of women in the "rural-urban" production systems of SSA: their inferior access and rights to productive resources, high fertility, poorer nutritional status, and their "invisibility". Highlighted are the «new» problems arising from the increased pressures on women's time (in the absence and/or severe shortage of male labour, or inability to afford hired labour: which makes one wonder why then the concern about over population?). These have far-reaching implications beyond the argument that men's "leisure" time spent together, perhaps drinking the local brew and settling «palavers», is essential in maintaining the communal tranquillity and bonds in the midst of severe stresses in the rural community. Increased pressures on women's time due to male migration to urban areas and/or cultivation of cash crops, walking longer distances to get water and fuelwoods, and dwindling non-wood forest products have far-reaching implications to both child and maternal well-being. Reduction of time for hot meals, and consequences for child and infant welfare and mortality, and controversially, persistent high fertility rates to supply the needed farm labour, p.7, are serious implications. Family preferences and choices are also affected, as girls (and children in general) may not be sent to school in order to help on the farm.

Other causal factors are identified besides this nexus such as civil wars; inadequate land tenure and cultivation systems; lack of private investment in agriculture; inadequate processing and marketing facilities; inefficient agricultural services, and inappropriate macroeconomics policies, (poor price and exchange rate fixing), that make investment in commercial agriculture unprofitable and risky. Certainly, a smorgasbord of causes designed to capture all! And certainly a list of causes few will argue with.

In chapters 6-10, a policy framework and oft-repeated recommendations for redress are presented, (a fine summary made in the conclusion). These hinge around population policy measures such as family planning and education, and improved primary health care, mainly to reduce fertility rates by 50 percent by 2020; and, secondly, agricultural intensification and diversification into a sustainable and profitable, market-oriented agriculture. Thus agriculture is projected to grow at the rate of 4 % per annum from 1990 - 2020, in order to maintain an economic growth of same rate. These growth rates are to be realised through changing farming systems in order to increase land and labour productivity by use of appropriate, low-cost, efficient and innovative technology and techniques; adapted through research and development to local agroecological and socio-economic conditions in agriculture and animal husbandry and other spheres of life. Accordingly, also important are suitable rural transportation, and fuelwood and time saving cooking stoves, for example. But better research, education and higher school enrolment, especially for females, are recognised as equally important as diversification and genetic improvements in crops and livestock. Ecologically sound forest and wilderness resource management and conservation; appropriate macroeconomics policies; managed migrations and balanced urbanisation to promote rural towns and secondary cities to stimulate non-farm activities and income are other major recommendations.

The authors validly observed the hangover error of most post-independent African governments and external agencies in seeing customary land tenure systems as "*not conducive to the introduction of modern agricultural technology and market-oriented agriculture,*" p.9. This marks their recommendation, in line with advocates linked to NGO and grassroots movements, to include local people and their institutions in the planning and implementation of the needed measures. This re-discovery of faith in Africa's "traditional" institutions, with some reservations, should be an eye-opener to the "institutional assimilitionists" who still think in terms of adoption of "modern = Western" models in order to ensure institution-building and development in the developing countries! Tellingly, actions such as nationalisation of land and other "modern" forms of land administration have led to weakening or loss of local property rights and open-access farming: developments which are contributing more to deforestation and environmental degradation, as now realised. Land policies in Ethiopia after 1975 offer a good example of how land nationalisation can have devastating effects on land use and conservation (Admassie 1995).

The book's insights and far-reaching recommendations are backed by a large array of data, projections into the next century, a rich bibliography, and boxes providing empirical cases from different countries which highlight the wide diversities in SSA. These provide the basis for locally suitable measures based on the policy recommendations contained in the World Bank's (1989) report on SSA, *Sub-Saharan Africa: From Crisis to Sustainable Growth.* This betrays the authors' abundant faith in market-driven forces to resolve the problems in question. The hitch is the record of the World Bank/IMF bloc supported neo-liberal economic reforms in solving SSA's problems, one need not be an expert to know, is rather pitiful. There is therefore a general lack of faith not only among a great many Africans but also in both internal and external NGOs circles.

However, it is refreshing to note that, in spite of fostering private investment by individuals and community organisations, supported by NGOs, [it is important to be aware of recent demystifying of NGOs' efficacy (Tvedt 1995, among others), and the unresolved theoretical and practical problems of expanding micro gains to the macro plane], the primary role of governments in ensuring success through proper macroeconomics policies and provision of social infrastructure is considered crucial. This, in an era when market forces, decentralisation and community participation have become the endemic means for governments to balance budgets by avoiding provision of social amenities and services to the already overburdened, and, in many cases, overtaxed but neglected rural peoples of SSA.

A fact often ignored, but stressed here, is that if increased outputs or benefits do not accrue to the farmers and others affected by reforms, they often refuse to co-operate further. Even bumper harvests from good rains often turn out to be a misfortune, as the farmers become worse off because of over-production and falling prices. It is not always the case of cheap food rotting away in the rural area due to lack of transport, as we often read in the press. The reality is closer to this report from a rural area through the research effort of the rural people themselves. The quotation below comes from the 1987 Annual Report of the Chairperson of the Odotobri Rural Bank in Ghana.

> "*With the rural dweller, his misfortune is that when the weather is good, which helps with good production of food-crops, he becomes worse off because of over-production and falling prices. This was the trend in the 1985/86 financial year. But with the occurrence of drought in the second half of the 1986/87 financial year there is an acute shortage of food in the catchment area and cost of living index at the Jacobu market is about 30 % more expensive than at the Bekwai market and 50 % more than the Kumasi market.*[1] *The result of this is incessant withdrawal by customers of their deposits just to make up for the bare existence of life*" (Kwawukumė, 1995).

[1]Bekwai and Kumasi are the district and regional capitals respectively.

How can someone then expert risky capital and labour-demanding investment ventures that hold uncertain promises of benefits under these circumstances? And when subsidies and other price supports have been removed under World Bank/IMF conditionalities?

The authors have debunked a lot of myths about agricultural production and production relations in SSA, it must be granted. However, some suggested conservation measures such as keeping forests intact, with "traditional" people hunting in them with traditional weapons, and eco-tourism (for Western tourists) smacks of "green primitivism" - a process involving turning formerly subjected and grossly exploited and abused people into living fossils; an unhappy fate not dissimilar to that met by the so-called Bushmen of south-western Africa (Gordon, 1992). What is «traditional» and what is «modern» in SSA when practically every community's life has been touched for the worse or better by the intrusion of either Arabs and later Europeans for centuries now; not to mention the far-reaching cross-domestic interrelations and diffusions, to put it mildly, which were by no means benign?

Then, insights provided recognise the invalidity of the simple dichotomy: cash crops = men's crops, food crops = women's crops, but the authors are still caught within that outdated dichotomy between «subsistence» (often equated with food production by women) and «cash» crop farming (for export and local markets by men); instead of seeing the former as historically complementary to the latter, even if on separate plots (Frimpong-Ansah,1991; Hill, 1956). Without this complementarity (as is happening now with evident competition for resources), either cash crop farming may be seriously threatened, as the farmers have to ensure their food needs for survival first, if income from produce cannot ensure that, or the reverse may occur. Whether either cash (export) crop farming becomes threatened or food crop production suffered, now depend largely on the skew of incentives and prices, that is, which crops farmers consider more or less rational to produce, since there are effective markets for both types of crops. Thus, as land and farm labour pressures increase and prices paid for either cocoa or coffee deteriorated, there is now competition with food crops production, where farmers have much greater control over prices in spite of government price fixing.

Hart (1970) observed long ago that, "*... when maize is several times the current world price in Ghana and cocoa less than the world price, as has happened frequently since 1960, many entrepreneurs have switched their farming interests out of cocoa....*" Ghanaian farmers risking serious charges of economic sabotage and the attendant capital punishment and burning their cocoa farms in the mid-1980s, that is, even after the introduction of the ERP and substantial hikes in producer prices to farmers2, and

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2 Not only the State is arraigned against the cocoa farmers. It was noted for Ghana that "*some 75% of all cocoa farms now operate a system whereby sharecroppers are allowed small secondary plots for food.*" When cocoa prices dropped and food prices rose in the 1970s, "*tenants attempted to switch to food crops, but were resisted by their landlords, who either evicted them or imposed abusa* (sharecropping) *conditions to cover food crops (IFAD 1988b).*" Source: Jazairy, et.al., 1992. This reality is a far cry from the picture neo-liberal economics paint of producers making free choices to maximise their self-interests. Paramount here is the interest of absentee landlords.

Rwandans uprooting their coffee trees in the early 1990s (Chossudovsky, 1995)3, in order to grow food crops, which allow them greater control over prices and full stomachs too, are just parts of the ironies that characterise the SSA dilemma of vicious constraints.

With this importance of so-called subsistence crops over the resource lavished export crops which has led to the almost total neglect of the food sector, the dichotomy between subsistence and cash crop farming is practically meaningless now. Men, just as women, are caught within the vicious trap and constraints, internal and international, that shape their choices which may at times appear to the outsider as non-rational.

Perhaps, *ceteris paribus,* without the prolonged poor terms of trade and low price fixing for both food and especially exports crops since the 1960s, enough resources might have been garnered to meet the necessary private investment and consumption needs to ensure agricultural transformation, better nutrition, and the other necessary measures, thus leading to the demographic transition, and thereby averting the current pressures on forests and the environment. The authors can hardly, therefore, be absolved from accusations of putting the cart before the horse in their nexus identifying the causes of the specified problems, since their main objective was "*to gain a better understanding of the underlying causes*" of agricultural stagnation in SSA, p.1.

Now, how come SSA, with its vast other natural resources, not only in cultivable land and water, to be regarded as so resource-poor that it cannot even triple its present population without unleashing Malthusian demons? The Sudan alone, with a population of about 25 million and vast unexploited resources, is bigger in size than Western Europe!4 Thus, can a bigger and denser population not support an intra-African market for value-added, processed goods from African industries, instead of continuing as a source for undervalued and cheap primary products for North industries? For a book which makes deep and extensive recommendations touching practically the life of every African, it is strange the question of industrialisation of SSA - for example, the processing of SSA's vast primary exports before export - scarcely receive attention. SSA is still cast in the role of a primary producer, with all the attendant disadvantages that it entail.

The problem of the acknowledged unreliable data on SSA makes many of the conclusions drawn from the correlations in the nexus contentious. One gets a feeling that SSA (and other South countries) are getting more blame for the present eco-climatic crisis. For instance, if Africa accounts for 31 (or is it 42?) percent of annual biomass burning, South and Central America 46 percent, how come Africa contributes "more to

3 It was noted that "*despite soaring domestic prices, the government had frozen the farmgate price of coffee at its 1989 level (125 RwF a kg.), under the terms of its agreement with the Bretton Woods institutions.*"

4 After all, as pointed out already, two scientific studies have concluded that the Earth can feed around 40 billion people. See Smil Vaclav (1994). Reinert's (1992:105) concern that, after unsuccessfully running development assistance as a welfare programme, the West's '*next grand plan seems to contain only two elements: neo-classical economics (which is void of any theory of economic development) combined with family planning and abortion*' cannot be brushed aside.

gas and smoke emissions from biomass burning than any other region of the world"? p.28. This reinforces the impression that for SSA, depending on your source of data, anything can be proven. Thus, despite the vast array of supportive data provided (in some cases different from what other UN bodies provide and use), there will be many who will remain sceptical. Among them may be the Nigerian academics and clergy who not long ago came out with a strong reaction against Western-financed family planning projects in their country. These projects are seen, among other things, as Western plots to keep Africa's population from growing in order to prevent Africans from taking advantage of the vast natural resources of their continent. These fears, even if unfounded, must be overcome, in order to gain the confidence of important sections of the African civil society behind population policy measures. Of course, the population cannot be allowed to grow unchecked, faster than economic development can absorb it.

Furthermore, it appears lingering problems created by past external interventions and internal, exploitative extractive structures in SSA before and during the colonial era, and the environmentally damaging throughput economic growth policies of the modernisation school of the 50s and post-independence era have been given scarce attention as mainly contributing to the present malaise. Thus, for example, for much of southern and central Africa and other parts of SSA, the effects of European colonisation and settler intrusions: seizure of the best arable lands from whole populations, and/or their devotion to (export) cash crops at the expense of food security, and the continuation of this policy after independence with the abysmal neglect of food crops; proletarianisation and increasing pauperisation of peasants (the Arrighi thesis[1970]); the constraints resulting from the imposition of the unequal relationship and non-reciprocal incorporation of SSA into the global capitalist system barely appear as «endnotes» (Palmer and Parsons, eds.1977; Bayart 1993). This situation has, of course, not changed much despite the World Trade Organisation agreement, from which SSA emerged among the main losers.

Also, that SSA's population is simply recovering from millennia of regular decimation caused by the high losses from slave-catching and export or domestic use, the resulting medical problems and mortality associated with the slave trade and economy (which lasted well into this century), and, later, indifferent colonial exploitation is hardly mentioned in contemporary researches on population growth in SSA (Manning 1982; Blier, 1995). The fact is that it was only after the WW11, particularly after achievement of independence in the 1960s, that serious efforts at the improvement and expansion of health care to reach the masses have made it possible for the current fast growth in SSA's population, due to a vastly reduced mortality. A steady recovery and growth had already begun by the turn of the century (Manning, 1982). But attitudes and values giving preference to large families remain largely in place, while production in the whole region becomes more engulfed in the capitalist world system. This lack of historicity and, as the authors themselves admitted, the poorly understood cultural underpinnings of birth and reproduction in SSA, as many economists are wont to be afflicted with, in explaining the causes of the present population growth problems of SSA, (and, I dare say, other socio-economic and political problems), are major gaps in this otherwise well-researched book too.

All said and done, this book is a must read for not only beginners but also seasoned contributors to the development debate in SSA.

Notes.

***_Reversing the Spiral: The Population, Agriculture and Environment Nexus in Sub-Saharan-Africa,_**

Kevin M. Cleaver and Götz A. Schreiber, The World Bank, Washington, 1994. ISBN 0-821-2769-0.Pp. iii-xv, 293. Price: US$ 17.95. Critique by Andy C. Y. Kwawukume, Cand. polit., UiB; and formerly research assistant, Chr. Michelsen Institute, Bergen.

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The Pastoral Boran of Southern Ethiopia
Aid From Above
The Role of Norwegian Church Aid[1]

by

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Introduction

Pastoralists[2] constitute a great share of the total population of arid and semi-arid regions in East and West Africa. The arid rangelands are highly variable in rainfall and biomass productivity and pastoral societies have had to cope with harsh, fragile and unreliable environments. Hence, the environment conditions their existence and reproduction. Throughout centuries, pastoral societies have developed certain insurance mechanisms in order to protect themselves against various types of risks[3] related to drought, diseases, politics, property rights and markets[4] (Swallow, 1993). As a result, pastoral economies are characterised by a high degree of mobility, herd diversification, high stocking rates, trade relations, co-operative inter-household arrangements and flexibility (NOPA, 1992; Cousins, 1992). Pastoralism is found to be the most prominent and sustainable land use practise in arid areas, as the rangelands have been successfully tended under the pastoral management of common property regimes[5] for thousands of years (Shanmugaratnam,

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[1] This paper is an edited and extended version of the summary and conclusion of my M.Sc. thesis in Development Economics at the Agricultural University of Norway, February 1997. Therefore only some few references are referred back to in this paper. But the references used for the thesis is attached at the back.

[2] *Pastoralists* can be defined as those who primarily derive their living from the management of livestock herds, usually composed of different species such as cattle, sheep, goats, horses and camels, on rangelands (Prior, 1994; Barfield, 1993). *Rangelands* are areas where limitations such as climate (rainfall and temperature), and/or topography, restrict the use of land to extensive grazing of natural pastures, rather than cultivated pastures or fodder crops (Ibid.). Pastoralists may be sedentary, more or less permanently settled with their animals in an area; solely nomadic, moving with their herds and transportable homes seeking pastures and water for their animals; or they may practise semi-nomadism taking their livestock to different grazing areas, settling for part of the year in a permanent home area (Ibid.).

[3] *Risk* can be defined as a problem were a certain (numerical) probability can be related to a possible negative outcome (Holden, 1991; Hazell and Norton, 1986). *Uncertainty*, on the other hand, is related to incidents where the probabilities are not known (Ibid.).

[4] *Market* is defined as a physical place/ actions between people (i.e. inter-household contracts), where commodities (i.e. cattle, livestock products, grain etc.), labour, land, credit or services (i.e. information, insurance, help/assistance etc.) are traded for money, and/or exchanged by other goods or services (barter trade). As contracts are found to be important to inter-household relationships within the Boran society, I will term this market as 'contracts'. Other types of markets will be termed as 'commodity markets', 'conventional markets', or just 'markets'.

[5] *Common property regimes* (CPRs) can be defined as a private property regime for a group (varying in nature, size and internal structure), where the management group (owners) have the right to exclude non-members. The members have rights and duties with respect to use rates and maintenance of the resources owned (Bromley, 1992).

1996; Cousins, 1992). However, the problems pastoralists face these days have raised a new round of debate about whether the pastoral systems are efficient and appropriate or not. Non-pastoralists tend in addition to be subject to myths, generalisations and misconceptions about pastoral societies and their lifestyle, production system and culture (NOPA, 1992). Outsiders ignorance to pastoral societies has for instance been expressed through i.e. agricultural bias, and lack of public investments (Ibid.).

Drought has been considered as an unexpected catastrophic event in dry rangeland areas, something which made the framework for emergency interventions (Behnke and Kerven, 1996). As a consequence, drought interventions have often risen through relief, being haphazard, uncoordinated, arriving too late and carried out in a poorly thought-through manner without analysis of the longer-term consequences (NOPA, 1992). Also, pastoralists have typically been given 'help' through technical livestock interventions such as vaccination schemes, water point development and the promotion of agricultural activities (NOPA, 1992). Food aid, both free distributions and in terms of cash/or food-for-work (FFW), has been distributed in times of 'emergency'.

During the drought in 1973, NCA became the first NGO to provide large-scale famine relief in Borana among the semi-nomadic pastoral Boran located in the marginal, dry rangelands in the Southern part of Ethiopia and the Northern part of Kenya (Helland, 1996, unpublished). NCA has since then funded projects operated by the Ethiopian Evangelical Church Mekane Yesu (EECMY) and the South Ethiopian Synod (SES). The Borana Community Development Project (BCDP)[6] is the local NGO serving for EECMY/SES, that implements the assistance in Dirre Warreda[7] in Borana. At present, nobody seem to know the impact of relief and the current state of most pastoral societies, Helland (Ibid.) concludes. Equally, it is worrying that there exists rather limited knowledge concerning the more long-term effects of such interventions. In the meantime, interventions continue to be carried out without consciousness about the former interventions, and in particular the so-called short-term, relief assistance.

The overall aim of this thesis is thus to explore the response the Boran has given to earlier aid interventions, based on the experiences from food-for-work, and to study the role of the NCA supported interventions through the SES/BCDP on the long-term development interventions currently carried out in Borana.

My objectives have been to: (1) analyse how household strategies, inter-household relationships and collective actions manage to buffer risk; (2) provide a sound explanation of the rationale behind the Boran attitude in terms of cattle marketing; (3) analyse FFW in a pastoral context, related to the households response to FFW projects and the assets provided; (4)set FFW in a longer-term perspective and discuss possible effects of FFW interventions on existing power structures and the collective action pattern of the Boran society; (5) analyse the definitions on 'community participation' and 'development' among policy planners and NGO officials, and relate it to the long-term development project currently carried out in Borana supported by NCA.

[6] BCDP is a combination of the acronym for the Borana Community Development Programme BCDP, under the South Ethiopian Synod.
[7] Dirre Warreda is one of the regional State Administration Districts in the South of Ethiopia.

Risks and risks managing strategies

The pastoral Boran are living in an environment were the risks are many, diverse, and severe. The pastoral Boran society has evolved over centuries buffering environmental, property, and market risks through profound institutions such as *'aada*[8]' and the 'peace of the Boran'. These long enduring institutions prescribe actions of individual households as well as collective responsibilities of the society. The Boran household tend to buffer risk by being mobile, flexible and keeping a collective opportunistic management practise. Inter-household relationships, such as contracts[9] in various forms, are found to serve as local insurance mechanisms for both wealthy and poor households. Contracts seem to ensure an effective utilisation of both range resources and animals as they interlink transactions of animals, food, labour, and credit. Poorer households take loans in terms of money from wealthier households. This has not been recorded earlier among the Boran. Contracts are also found to (i) reduce transaction costs, as enforcement and information costs are lowered through the transparency the contracts provide; (ii) distribute wealth among the members of the society; and (iii) stabilise the political and economical environment of the Boran society. Collective responsibility is thus important in the promotion of the common property regime[10] and grazing patterns, and in the management of the scarce water resources in Borana.

Contracts seem also to be closely related to power structures and collective action[11] patterns in the Boran society. I have discussed three ways in which FFW may distort these structures: (i) through targeting the poor; (ii) through payment of traditionally collective tasks; and (iii) by preventing the poor from being excluded from pastoralism, something which is considered to 'overheat' (overpopulate) the pastoral system.

Cattle Marketing

The Boran keep a diverse herd and sell cattle only when they are forced to due to external stresses (except some few luxuary sales for gifts and jewellery). Other income generating activities, such as wage labour and self employment, have also become common among the pastoral and agro-pastoral Boran in times of stress. However, marketing of cattle is found to be one of the most important coping strategies for Boran

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[8] *'aada'* is the Boran law which dictates everything from hairstyles, dress and customs, to rituals, and political negotiations and warfare.

[9] *Contract* is defined as.an agreement or arrangement between two or more parties where both parties are gaining from the 'partnership'. A patron-client (or a principal-agent) relationship is a type of contract commonly referred to in development economics. A patron-client contract is characterised by an unequal balance of power between the parties, where the 'patrons' carries certain legal rights on their side (Holden, 1996, pers.com.). However, it is important to note that not all contracts are of a patron-client character. Contracts based on *mutual* benefits and a kind of symbiosis do also exist (Sikana and Kerven, 1991).

[10] *Common property regimes* (CPRs) can be defined as a private property regime for a group (varying in nature, size and internal structure), where the management group (owners) have the right to exclude non-members. The members have rights and duties with respect to use rates and maintenance of the resources owned (Bromley, 1992).

[11] *Collective action* is defined as activities that require the coordination of efforts by two or more individuals (Sandler, 1992). Nabli and Nugent (1989) explain that the key issue of collective action is to explain the likelihood of failure of a given set of self-interested individuals in undertaking actions that might benefit them collectively.

household these days. However, they tend to sell animals only when they are *forced* to (except for some luxury sales), mainly in the middle and end of the long dry season. At this time the animals are weak, in bad shape, and the price is low. I found that most households expected having to sell cattle next dry season. Despite that they know prices are lower during the dry season, they are not willing to sell in advance just in order to get better prices. This strategy seems irrational to policy planners, NGO officials and other non-pastoralists. Repeated attempts from NGOs and the government to persuade the Boran to sell *in advance* of the dry season, when prices are higher, do not affect the Boran's attitude. I have therefore discussed various factors found to determine the Boran's marketing of cattle in order to try to provide an understanding seen from the Boran point of view.

Cattle are important reference points in the daily life of a Boran. Cattle is also the main asset on which the pastoralists directly depend on. The sentimental value related to cattle are found to be high. Together with prestige related to their cattle, profit, number of animals (wealth), risks, time preference, and future expectations, the Boran households are found to be reluctant of selling before they actually *have* to. These factors influence their expected utility function, which indicate that they do not sell cattle as long as there are a slight possibility that they can manage to pass the dry season without having to sell. A sound explanation was that cattle should multiply, and not be exchanged into money. A young Boran explained that "*Money looks better walking around as cattle!*" Money are in addition a non-storable asset among the Boran due to obligations of sharing access resources with other members of the society. The common perception of the Boran as irrational and perverse do not hold when relating these additional factors.

By accepting that the Boran do not sell in advance of the dry season, the role of policy planners and NGOs should be reconsidered from promoting further sale of cattle at this period. The policy planners and the NGOs should rather assist the Boran *the time they have to sell.* I suggest one such possibility. This imply to provide information about the possibilities the Boran might have in creating their own cattle monopoly (or cooperative). The Boran society inhabits viable institutions that should be able to enforce the required monitoring of a *joint marketing* rather than individually vulnerable sales in times of stress, setting a least price for their animals. This way, they could become the 'masters' of the cattle markets, instead of the victims.

Household responses to FFW

FFW turned out to be a key factor in understanding parts of the relationship between NCA and their partner organisations, and the Boran. Most households have been involved in FFW activities, and have been provided free food distributions. The respondents are, however, more concerned about the *food* coming from FFW schemes than the assets typically being water point supply and maintenance, roads etc.) provided. This attitude might explain why many of the FFW assets deteriorate and are being mismanaged. It also suggests that the assets are not what is most needed in Borana, and that the traditional institutions are not able to, or not willing to include additional administrative tasks into their daily responsibilities. The fact that the community has not been deciding on their own project might be one of the major errors to the maintenance of the assets. It is concluded that the obvious ignorance to, and lack of recognition of local authority and skills through the interventions of the FFW schemes might have had an deteriorating effect on the self-governance of the Boran society. It is also concluded that the FFW interventions probably have distorted the traditional power structures, and insurance mechanisms based on mutual obligations and dependency between wealthy and poor people.

Furthermore, when discussing possible long-term impact from FFW, it seems reasonable to believe that FFW interventions have had a disturbing effect on the self-governance of the Boran, on existing power structures, and hence on the collective action pattern central for the monitoring of the common property regime. On the other hand, there is a possibility that FFW-projects have not been implemented frequently enough in order to distort the profound Boran institutions.

Prospects for long-term development attempts in Borana

Furthermore, when discussing possible long-term impact from FFW, it seems reasonable to believe that FFW interventions have had a disturbing effect on the self-governance of the Boran, on existing power structures, and hence on the collective action pattern central for the monitoring of the CPR. However, it might also be that FFW has not been implemented frequently enough in order to distort much.

Twenty-two years of aggregated experiences from FFW and other top-down approaches, have seemingly not benefited the current development project carried out in Borana. Large-scale innovations have so far turned out to be failures. There are no long-enduring sustainability in providing assets without the aspirations and participation from the community. The current 'participatory' development project supported by NCA has the potential to end as yet another failure. The *goals* of the project somewhat differ from earlier approaches and stresses community participation and institution building. However, community participation seem to be mainly limited to people's contribution in terms of labour force. Institution building are mostly concentrated around building houses as schools, clinic and service corporations. However, the implementations done show that there has been a considerable change in strategy from the earlier top-down and emergency-planned FFW schemes. However, this does not mean that the *underlying attitudes and perceptions* about the Boran, by the external field agents, has changed accordingly. I believe that one of the major causes for the problems at current stage is the surviving assumptions about the Boran as backward, simple-minded people who cannot manage on their own.

Who are to be blamed for over-utilising the rangelands

The rural pastoral Boran are typically being blamed for the mistreat and overgrazing of the rangelands. This might be the case, as there are obvious stresses to the traditional institutions managing the use of the rangeland resources. Yet, it is important to note that the traditional system with its specified institutional arrangements control the use of the rangelands in terms of common obligations. However, it has been discussed that external commercialised livestock keepers, not being a part of the Boran institutional setting, serve as one of the main additional factors causing the deterioration of the range. This issue has not been discussed earlier in the Boran context, but are a common phenomena in other pastoral areas. It seems alarming to be that there are so little attention paid to the effect of commercialised livestock rearing on the cost of traditional grazing structures and strategies. This might be factors causing the Boran loss of property and buffer areas in times of stress, hence worsening their livelihood situation. Before blaming the rural communities, therefore, the use of the range should be seen in a wider perspective. It is suggested that this issue should be given more attention in future research and policy planning.

Conlusions

It is concluded that the base for any required development must be to acknowledge the Boran to be both the true expert of the rangelands, and the only ones who might have the key to solve their own problems. However, there are ways in which the NCA and BCDP can make use of their resources. There are four major factors I want to highlight as the main findings of this study:

(1) From my discussions, it seems like the Boran society are not able to, or not willing to include additional administrative burdens to their traditional institutions. This implies that the focus on provision of assets and new institutions should cease. Instead,
I suggest that NCA and their partner organisations should try to implement as small but significant projects as possible in order to make the community able to include it in their daily tasks. This implies to a large extent to provide information about i.e. the cattle marketing environment.
(2) However, an increased marketing of cattle should not automatically be considered as a viable solution to the Boran problem. The Boran has clearly shown that they are not finding this strategy sufficient to serve their needs. Thus, in stead of trying to persuade the Boran to commercialise, they should rather try to find viable alternatives to assist the Boran when they finally are selling in the dry season. The Boran society has the enforcement mechanisms required to handle a monopoly of cattle. NCA and BCDP's role could be to inform the Boran properly about the possibilities in creating a monopoly of cattle on which the Boran can 'control' the transactions themselves. This is also a type of institution building, but it might be more of a evolution of already existing institutions than providing completely new ones.
(3) The permeated attitudes of the Boran found among the urban dwellers of Borana, do not seem to serve the Boran fair. There will be no success in a participatory, local development unless these perceptions changes. Thus, *the role of the field agents* should be given a higher emphasis in the development work. I have found that the extension agents themselves feel that theree is a 'desperate' need for better training and information about how to deal with development planning and extension services.
(4) The local community should be facilitated in analysing their own development .By giving proper training to field officials the field agents cold facilitate the local population in their own development. Equally, NCA's role could for instance be to give proper training of field agents in order to serve the Boran in their own development. If the NCA wants to contribute to a true bottom-up and 'participatory' development they should emphasise and direct most of their efforts help facilitating the Boran to analyse their own situation.

In my opinion the NCA are supporting projects that are too technically sound, too little based on local participation (despite their attempt), and which are not targeting essential factors of livelihood improvement. As I have discussed, assets introduced require administrative tasks, hence often some major changes in the traditional structure of monitoring. Water point supply, and agricultural innovations are types of technical innovations which require severe changes within the society, with the implementation of new institutions, input resources, change in behaviour, and a considerable change of lifestyle. These projects are, in my opinion, not likely to succeed. They might change the society in one or another way, but it is no guarantee that it will be changed in the calculated direction of the project. It is a well-known phenomenon that technological introduction of innovations may trigger off unexpected, and often adverse effects, which were not intended (Sclove, 1995). Thus, the Boran tradition of evaluating innovations and discussing what seems reasonable to their desires should be considered as a valuable strength, rather than a rigidity and backward feature of their society.

It is concluded that the historical record of twenty-two years of the 'top-down' FFW interventions indicates that this approach serve as a limitation to the development effort currently carried out in Borana. It is probable that the current long-term development project will turn out to be another failure because it does not seem to be addressing the main point of departure for any development effort; mainly the felt and expressed desires from the local population.. One of the main obstacles to reach a participatory development success in Borana seems to be the absence of acknowledgements from policy planners and field agents towards the rural Boran population. This limit the scope of participation. Thus, one of the main tasks for NCA, if they are to be involved in pastoral development interventions in the future, should be to emphasise training of field staff in order to facilitate and assist the Boran community in analysing their *own* situation.

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Possible Integration of PLA[1] in Norwegian Institutions - May it Also Help the South?

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A core statement

Participatory Learning and Action (PLA)[1] "parallels and resonates with paradigm shifts in the social and natural sciences, business management, and development thinking, supporting decentralisation, local diversity, and personal responsibility" (Chambers 1994). This contribution wish to promote a dialogue on what implications for our work in Norway this statement may indicate.

Introduction

Though most people today in principle agree about asking the recipients of Norwegian aid what they in fact want, it is more confusion about how this should be implemented (Refsdal 1997). However, our contact with the South present us for other, but connected challenges as well. Can we for example take it for granted that Norwegian health workers and systems are more efficient than those of the poor countries of the world? Or may it be in part be the other way (Bøhler 1996)? If so, we have to search for what we can learn from the South and simultaneously look for what Northern "knowledge" is preventing us from obtaining such a profit and thus what to unlearn. On the whole most of us would want to prioritise *the most effective transfer of important knowledge in both directions.*

We will here not try to promote a dispute but rather a dialogue (Dahl 1996). Your answers to the following questions may help decisions on possible useful bi-directional transfer of knowledge and understanding (Dalin 1992).

A. How strongly does ethics indicate the use of a *participatory* learning and action methodology in Norway even if it is developed in the South?

B. May there be an extended family of PLA-compatible methodologies?
Is it necessary and possible to get an *umbrella* under which they can be harmonised ?

C. Which Norwegian institutions may be the first to *internalise* the umbrella? Will it be those which already recommend participatory work in the South?

D. Should the participation umbrella be *institutionalised more generally* in Norwegian NGOs, official administrations and research institutions?

E. What is your *conclusions ?*

A brief background for our comments you may find in IDS (1996) and the notes:
(1) What is PLA? (2) Theory - why do PLA work? (3) Norwegian experiences and acknowledgements.

A. How strongly does ethics[2] indicate the use of a participatory learning and action methodology in Norway even if it is developed in the South?

An ethical attitude is one of the main pillars for facilitators of PLA. The core attitude required is to respect every person as a human being irrespective of his apparent actions and attitudes. All the human rights can be deducted from this general principle and today almost nobody challenges these rights. Educational theory[2] tells us that our thinking is guided by the methods we use. Thus, our own ethics is successively improved by participating in PLA processes. Personal experiences have supported this.

Medical ethics has shown that an inefficient health service is á priorí unethical (e.g. Bøhler 1996). An inefficient development methodology must correspondingly á priorí be unethical. It is thus unethical not to compare methodologies for finding the most efficient one.

Both efficiency and respect are closely related to our humbleness concerning own knowledge and viewpoints. Due to our cultural and traditional formal learning we Northerns are usually not humble in all respects. We most often are not aware of the relative importance of "the four squares of knowledge" (Tolley & Bentley 1996). In addition we tend to define the contents of textbooks as knowledge whereas unrecorded local experience at best is just an "understanding" of the thus defined "real knowledge" (Dalin 1992). Experience with PLA[3] shows that important parts of self-esteem and humbleness go very well together! Stressing competition between individuals as the main natural force for progress would indicate the opposite. This is but one example of how PLA leads to uncovering of some of our embedded illusions.

The tentative conclusions may be that:
- all who work on our common ethical basis have to connect the aspect of *total importance* for the stakeholders to the efficiency objectives of a project
- we must *dare to compare* a wide range of methodologies and dare immediately to do business as unusual if the results so indicate
- according to the existing evidence on the flexibility and efficiency, an *PLA-compatible approach should be included* in any relevant comparison of methodologies from now on. One may argue that it is only those who knows both the PLA and at least one other practical approach who are competent to judge what method to recommend.

B. May there be an extended family of PLA-compatible methodologies? Is it necessary and possible to get an <u>umbrella</u> under which they can be harmonised ?

Some causes for making *specific methods* may be to hit the target more precisely and to protect the revir of ones own profession or niche of activity (cf. Chambers 1995). Respecting the revirs of others may help keeping up the number of specific methods. However, the more *flexible* the user is, the more general method she can apply. The *general methods* can be applied by a wider range of users and for more kinds of tasks. Practice with an general method may easier be seen as connected with theory. We need a mix of specific and general methods but the latter is naturally more holistic. Some evidence comes from the history of statistical methods. However, the target for these reflections are how appropriate it will be to integrate and co-ordinate the extended family of PLA-compatible approaches.

Ancestral methodologies of PLA which were effective in extracting knowledge from local people include rapid assessment procedures (RAP) and rapid rural appraisal (RRA). Other relations have been listed as PALM, AEA, PAR, RSA, MARP and so on.

PLA-like elements are important in a number of approaches known in Scandinavia. Due to different terminology it has taken some time to discover this fact. Some of the approaches are social pedagogy, action research, district active schools, network learning, quality assurance, problem based learning, experience based learning (including use of silent knowledge), search conference, future workshop (framtidsverksted), partnership planning (dugnadsmetoden), generative planning, formative evaluation, partnership idea search (idédugnad), re-evaluation counselling (strukturerte parsamtaler), and even "molecular anthropology". Above all the change agents (Burkey 1993) and focus groups approaches belong to this list. Not at least the practical experience from under other headings like neighbourhood work, or under no heading at all are relevant. Here we find a large number of projects with ad hoc or undefined methods but stressing the participation of clients, patients, consumers, or grassroot. If harmonised they may increase the number of elements under a possible wide PLA umbrella a little but above all they will connect much earlier experience to the common pool of techniques and thus display the practical use of several elements in different contexts for a much wider audience.

The great weight on visual communication is included in few of the methods on the list and thus more specific for PLA. Still, branches of pre-school teaching and special pedagogy may also have such elements.

Harris (1990) found that the human nature when placed in different but corresponding environments often produce very similar cultural solutions. In line with this, the extended family of PLA-like methodologies could not have emerged under different circumstances unless they were deeply founded in human nature. (This is not to say that human nature has denied us other options as well.) Probably it is these natural liabilities which create the astonishing great power of true participatory practices. This power may often bring us fine successes with many participatory methods when we are replacing them for non-participatory methods. The paradox then surfaces that the elation of our successes prevent

us from seeing that yet greater benefits with another participatory methodology may be within close reach.
Because PLA is a general and holistic approach the *list of possible uses* of PLA is endless (IIED 1995+ & IDS 1996). Probably, most of the problems on which the methods listed above have been applied could alternatively have been solved with PLA. In fact, many of them are PLA processes even if the users not are aware of this or may not like to term them as such. Anyway we see now that PLA may well serve as an umbrella for co-operative processes and teamwork whether in "routine" departments or multidiciplinary research. Havnevik (1997) suggested that development researchers should negotiate more with donors to bring aims and methods of the projects more in line with the professional and personal interests of the researchers. We think PLA should be tried in some such processes.

The main benefit from harmonisation, syntheses and co-ordination under a common participation or stakeholder umbrella is the much increased availability of an efficient and very practical approach for those researchers, planners, implementors, and others truly interested in empowering people, reaching the weakest too. The holistic aims and processes are most feasible in local space.

The World Bank has for some time followed the development of practical participation methods and is increasingly using them for assessments and evaluations, less for direct empowerment. Their new tool kit for participatory approaches (Rietbergen-McCracken & Narayan 1997) comprises six modules or methodologies stemming from various traditions: Social assessment, Stakeholder analysis, Participatory Rural Appraisal, SARAR (self-esteem, associative strength, resourcefulness, action planning, responsibility), Beneficiary assessment, and Participatory monitoring and evaluation. The kit represents a step in the direction advocated above. When the facilitators within each of these traditions thus easily can have a look on the others, they eventually will see that most of the differences are questions of terminology, and much of the rest differences are due to weighting the elements according to kind of tasks they primarily were constructed for. Then time will be ripe for more direct harmonisation as suggested above.

C. Which Norwegian institutions may be the first to internalise the umbrella? Will it be those which already recommend participatory work in the South?

Norwegian aid workers returning from development tasks in the South have long been frustrated because their experience not have been systematically utilised to inform new recruits and the administrations. For those who tried applying their experiences from the South in their Norwegian context and frankly declared this it was not easier. Openness for import of ideas from countries "on a completely different and lower level of development" is not too often met. The use of people with long service in the South in some administrative positions at home is but a weak substitute for what a PLA process with group reflections on the experiences of all returnees could have yielded.

Acknowledgements to the South for their contributions to knowledge utilised elsewhere (Bøhler 1996) would of course demonstrate the respect for the Southerns themselves and for the conditions under which they struggle. There has been a shortage of such systematic feedback which certainly generates "good circles" in our learning together. However, we have some examples of acknowledged help from the South to the North. The Ugandan Redd Barna has arranged seminars in Africa for Norwegians who want to use PLA in Norwegian contexts. The change agent association in Uganda is also establishing good circles with at least a couple of NGOs in Norway. Some other dramatic net transfers are well known, many others are known only for a few. The pricing of knowledge is difficult.

Since long we have known that quality work in a knowledge institution is greatly facilitated if one organise most of its processes within one level (a flat structure). With PLA the knowledge exchange will be within one informal level whereas the decision power may be distributed according to a more formal and hierarchical structure. Studies on the quality of research from many research departments have revealed only one common characteristic of the outstanding ones. That was the presence of a good co-operative culture within those departments. Using formal PLA as a prioritising and sorting method of information more departments may be trained to better co-operative cultures at large. However, other kinds of institutions have different main obstacles and if "transforming a bureaucracy" always is possible it may be demanding (Korten & Siy 1989).

We will now hint how an hypothetical institution interested in an optimal exchange of knowledge and experience among its multidiciplinary staff stepwise may handle the challenge. The point of departure is the indications that one can build PLA competence into a Norwegian institution. The director then has to take the leadership and honestly be willing to give the option a real try. He should immediately assess the results of each step in order to start the next one without delay if the assessment indicate so. This may in fact remove any risks with the experiment as well as it accords with the PLA principles. The cautious steps might be:

1. evaluation by an external PLA facilitator of one finished not too large aid project
2. educate two PLA facilitators from within own staff
3. plan and implement formative PLA-evaluations for some own aid projects
4. make a team of about five people comprising at least one internal and one external PLA facilitator as well as the director. Its task would be to prepare information for and facilitate a dialogue during an one day meeting for the whole staff.
5. the staff meeting should design how to introduce the PLA approach in the whole institution and recommend or decide if this should be implemented.

The first three steps can follow many examples. However, their evaluations will be broader because reflections upon their significance or learning for the two last steps will enter.

D. Should the participation umbrella be __institutionalised more generally__ in Norwegian NGOs, official administrations and research institutions ?

What is the present working culture in all organisations in our country? Some authorities may not agree with Andvig (1997) in his vivid but depressing description of one group of organised activity: the management of research proposals. But again to speak with Chambers (1996): "whose reality counts"? Anyway, most of us will agree that in spite of - or partly because of - the numerous organisation development activities with the help of a lot consultants, there is still much left to adjust.

Some business management schools are now applying several of our umbrella principles with good success. The trade and industry do not risk loosing profit by ignoring important effectivity factors. The late organisation psychologist Arne Ebeltoft was a pioneer in Norway who 25 years ago helped me to see some aspects of participation. He started with schools and official administration but these sectors were then far from ripe for the message. Later he worked with industrial psychology (Ebeltoft 1993), stressed local studies and challenged many by announcing that the results of much expensive research went directly into the garbage bin because of the traditional approaches behind.

These aspects together with what else we have presented in this communication indicate that the PLA umbrella could and should be tried in many sectors in our society. It is especially important that official administrations and research departments and NGOs aiming at the common good honestly will try implementing PLA working approaches. Then they may satisfy their staff, the people they serve and for once convey both efficiency and culture to the trade and industry instead of being only recipients as usual. We hope for two vanguard fronts with aims and commitments for holistic, total and practical implementations. One front is at least two local municipalities. The other one is two aid organisations or more as mentioned under C. However, the research community may choose to be free to meet three important challenges: to use PLA as a research methodology, to study PLA as such, and to study the harmonisation with possibly compatible approaches. From the umbrella one can choose a profile of techniques which is powerful for the tasks in almost any sector. Thus "it is a revolutionary potential in the patient-oriented medicine" (Førde & Solbakk 1991).

Each of these aspects is interesting, but daily one sees new examples of actions and projects that ignore the full interests of the target population group in Norway. The responsible don't know how to be informed about these interests or how to act upon them.

E. What is your __conclusions__ ?

You may follow Chambers (1996) and "use your own best judgement at all times" when answering the following:

May some benefits from widespread use of PLA in the North - pioneered both from the local grassroot and some institutions - be:

1. increased efficiency at a multitude of tasks in the North ?
2. that before new field workers start practising in the South they can have practical training in Norway in effective and flexible co-operation with local populations ?
3. that practise in the South will be seen as an advantage by Norwegian employers?
4. that aid organisations show their counterparts in the South that participation principles already have been taken seriously by the aid organisation itself ?
5. that the Norwegian population at large will be so acquainted with an feasible approach for true participation and consequently will support an aid which uses the same approach in the South ?

Does this list show that aid organisations aiming at participation may not be afraid of supporting some Norwegian projects planned for immediate domestic results? May the spin-off sometimes be serving the ultimate aim of the organisation better than some projects planned for solely obtaining immediate results for the South ?

Referring to the core statement, are we sure that the new paradigm will win at all or soon enough for today's individuals, groups and projects to profit? If any doubt, may it then be imperative to join forces in transforming the processes for evaluations, projects and ourselves as well as organisations ?

Notes

Note 1) ***What is PLA ?***

PLA is "a growing family of approaches, methods and behaviours that enable people to express and analyse the realities of their lives and conditions, to plan themselves what action to take, and to monitor and evaluate the results" (IDS 1996). Such a wide goal may seems impracticable. However, an analogy with the diversity of tasks and disciplines in which the personal computer is used may open our minds to a possible corresponding array of applications for PLA. This is demonstrated in the PLA Notes (IIED 1995+). The methodology has no discipline specificity though it has much in common with anthropology which certainly has inspired its development.

We prefer participatory learning and action (PLA) to participatory rural appraisal (PRA) because it is more descriptive at introductions in new fields (IIED 1995+). Till now the terms have been used interchangeably though PLA sometimes has be used for a wider umbrella than PRA (IDS&IIED 1997). A simplified term is just participatory appraisal (PA). Practice with the methodology often reveals different meanings of words. With these headings it is the other way round, please don't let this prevent your uptake of the concepts.

We are lucky that some real experts on the approach are present at this meeting. Their comments will be appreciated by all of us. Some who have worked in the South have used the principles there. Especially those who also have used PLA in the North should tell us about it? In contrast with many other research meetings I guess all the participants of this congress are familiar with the basics of this issue.

The power of the PLA approach as applied in other countries is recently described in a leaflet which can be recommended as a first, short introduction for most people who not are familiar with the methodology but curious about it (IDS 1996). This note is an even shorter account. Anyway, to be acquainted with the methodology you have to see it in practise, any reading comes second!

The three principal pillars of the methodology are attitudes, sharing, and methods (see e.g. Mascarenhas 1991). *Attitudes* indicates the ethics of fully respecting every individual as a person. *Sharing* indicates our honest will and ability to communicate to anybody what we believe is the most important aspects even if we think it we risk not to be correctly understood. (I am just now trying to share!) Another side is to desist from copyrights (see e.g. Pretty & al. 1996). *Methods* is characterised by visualisation and flexibility which allows everybody to contribute (Pretty & al. 1996).

There are various models of the levels of participation illustrated by staircase steps. However, PLA aims at, and with good facilitators often manages, to go directly to the highest level. Alternatively one goes to a lower level which the local people and the facilitator carefully agree upon in the start. If not, frustration raised by rising expectations for empowerment embedded in the approach naturally may be dangerous. This is but one of the many threats against a quality assured practising of PLA not elaborated here (IDS 1997).

Note 2) ***Theory - why do PLA work?***

One may speculate a lot on *why* PLA works so well. One point of departure to such journeys is the failure of earlier models. Another is "why do we choose the theory we choose" (Havnevik 1997). Both protecting and respecting the revirs of each other's professions keeps up the numbers of specific methods or works against multidiciplinary work.

The methodology is holistic and therefore eventually will be related to many theories in different disciplines. PLA respects empirical evidence and silent knowledge very much. It implies the shortest possible way from practice to practice in the research spiral. Again, nobody can understand the approach without taking part in practical work. The applied and holistic nature of PLA regulates the weight put on each item under the pillars of a PLA process. This demands a good facilitator. Partly intentionally much earlier work and studies according to mainstream blueprint methodology had what we now will term bad weightings from the onset and also poor adjustment procedures.

Both nature and nuture we have different aptitudes for extrapolations. Some of us are very careful not to use the methods in apparently different contexts. As other of us see it, transferability of this and any other method depends upon which level of generalisation the analogies are based, what kind of details are truly relevant for the possible new application.

Not at least the participatory action research (PAR) tries to combine theory and practice. However, successful practical PAR projects looks very like PLA-exercises. Paulo Freire who contributed so much to the theory of empowerment just died on May 2 at an age of 75 (Shafer 1997). One of the very few who dared to attend our first PLA-seminar was an admirer of Freire. However, at her examinations in the teacher college some years ago it was forbidden to mentioned his name! The competition between theories can be very hard.

As mentioned, it is plenty of interesting theoretical challenges, but the theories should be developed in continuos contact with the grassroot. That is in fact said to have been the case with Hans Skjervheim when he worked out his philosophy on participant and spectator (Deltakar og tilskodar). His philosophy is very relevant to the theory of PLA.

Note 3) ***Norwegian experiences and acknowledgements***

Seven years ago we started a search for principles for how experts and local people could cooperage in order to produce and use what now is named "evidence-based practice" within the whole health field. At the NFU-conference in 1991 we mentioned that the farmer's need for direct influence led to a sustainable alliance with researchers in the experimental groups in Norwegian agriculture (Gedde-Dahl 1991&1992). That interpretation inspired to work out a general model for Local health trials (Gedde-Dahl 1993). Some preliminary projects in Norway according to this model revealed, however, that declaring participation and using questionnaires were far from the practical, detailed, holistic, efficient, and participatory evaluation method we in fact needed. It was an astonishing low interest for finding such approaches.

Then, in November 1993, Robert Chambers introduced us to PRA during his visit to The Centre for Partnership in Development and The Foundation for Local Health Trials in Oslo (cf. Chambers 1994). His ideas were difficult to catch for many of us who were primarily used to the mainstream of medical science. Our needs forced us, however, slowly to realise the power of this methodology.

With the good help from NORAGRIC in the second half of 1995 we began to test the response to the methodology in Norwegian contexts (the EPRA-project). In 1996 the Foundation and Melbukontoret with support from county agencies in Nordland three 3-day introduction seminars were held (PLA-seminar 1996). Two facilitators attended short courses in the UK.

The year 1997 shows that the methodology is sustainable in Norway. Melbukontoret has facilitated one and planned another course in the south of Norway for social security people. Four prospective PLA-facilitators will attend Scottish courses. Vestfold College will start courses in November (for context see Arntzen & Hauger 1996). The use of PLA for evaluations and daily co-operative work is progressing satisfactory at the few places where enough competence is concentrated.

Our Norwegian testing have formally been modest. The response of seminar participants have however confirmed both that many kinds of development activities are taking place all the time in our own society and that astonishing much of the PLA methodology worked out in the South is urgently needed for such activities in the North.

A long chain of bottelnecks have been gone through with the help of largely different people at each neck. All were necessary for the progress made. However, three persons were operating at several difficult bottlenecks: daring, indefatigable Liv Aune, wise Nina Foss and inspiring first facilitator Elisabeth Molteberg. All the participants in our seminars seem to have verified the saying of one of them: any person is a whole fairy-tale, it depends on you listening if you will have a glimpse of the tale. - Who could foresee such an spin-off?

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Parallel Workshops in Development Studies

SESSION C:

Asian Cases
on
Resource Management in Agricultural Communities

Population Pressure, Agricultural Change And Environmental Degradation In The Himalayan Region: A Conceptual and Methodological Basis and some Preliminary Findings

by

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Abstract

This is a background paper providing a conceptual and methodological basis for studying the population-agriculture-environment nexus in one of the Himalayan states of India, namely, Himachal Pradesh. As a theoretical basis, the paper discusses theories on population growth and agricultural intensification and farm household decision making where intensification may or may not lead to environmental degradation. We then outline various hypotheses used to explain the phenomenon of environmental degradation, including the neo-liberal, environmental economics and imperfect information and transaction cost perspectives. We apply a pressure-state-response framework in our analysis. The general features of the study region, and preliminary findings about the institutional structure at community level, the human activities (pressure variables) responsible for deforestation and soil erosion and the responses which have evolved over time to counter these problems, have been outlined. Finally, the methodological approaches, including the methods of sampling and data collection and analytical approaches and models are presented.

Key words: *Agricultural development, agricultural intensification, biodiversity, carrying capacity, deforestation, environmental degradation, imperfect information, land degradation, population pressure, soil erosion, transaction costs.*

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1. Introduction

The population-development-environment nexus has received a renewed attention during the past decade. The relevance and severity of land degradation, particularly in the context of developing countries, has been broadly recognized (WCED 1987). The population pressure hypothesis was advanced to relate land degradation directly to population pressure (Blaikie & Brookfield 1987, Srinivasan 1985). Another school of thought, however, considered increased population density as a precondition to technological innovation and economic development leading to preservation and improvements in the land resources (Boserup 1965, 1981). The empirical evidences in support or against of these two opposing views are scarce, mainly due to lack of availability of reliable and detailed time series data.

According to conventional wisdom (Cleaver & Schreiber 1991, Shanmugaratnam et al. 1992), continued population growth, poverty, environmental degradation and stagnation in agricultural technology points in direction of a Malthusian scenario in a large number of developing countries. Yet, the rapid technological progress in agriculture in many Asian countries, particularly as a result of the Green Revolution that started in the late 1960s, lent support to Boserupian theory and thus gave some hope for an alternatively superior development path. There have, however, recently been some signs of stagnation in agricultural technology partly due to technological limitations and partly due to insufficient investments in agricultural research. This calls for greater concern and renewed research efforts on studying the complex relationship between increasing population density and agricultural development practices, on one hand, and stagnation, involution, and environmental degradation, on the other. In view of rapid population growth in the developing countries in the near future, proper analysis and understanding of such linkages assumes even greater importance. The proposed study represents an effort in this direction. By gathering empirical evidence over a fairly long period of time from the western Himalayas, the study intends to contribute to the ongoing debate on the population pressure - economic development - environmental degradation linkages. Lessons drawn from the study should also be useful for policy makers and development agencies interested in attaining sustainable development.

An estimated $600 m annual damage occurs in India due to flooding and siltation, much of which is caused in Himalayan watersheds (Gribbin 1982, Thompson & Warburton 1982). The specific focus of the study is restricted to the Indian state of Himachal Pradesh which forms an integral part of these watersheds. Here, soil erosion, due to deforestation and/or degrading cultivation practices, is undoubtedly the most important cause of land degradation. The human induced problem of environmental degradation needs to be looked at in a wider context of political economy and environmental economics along with the impact of agro-climatic and social factors. The state of the environment is influenced by various external pressures, like population pressure, market forces, and technological and institutional changes. These external factors affect local decision makers (households and communities) which in turn respond by adjusting their behavior and the utilization of the natural resource base. This implies a need to examine the incentive structures, responses and policy instruments at micro, meso and macro levels by developing models at household, community and government (state) levels to analyze responses and consequences for resource utilization. Cross section data in combination with time series data may be used to understand and predict various development paths for households and communities with respect to resource management. The consequences of the state of the natural resource base and the feedback implications for behavior are then determined by the development path in terms of the composition of the natural resource base and the dynamic balance of the population-economy-environment nexus.

This article presents an overview of theories relevant for the general understanding of the population-development-environment nexus. In this light we give the key characteristics, including the human and livestock population, land use pattern, institutional structures, including market and non-market institutions in the study region in the western Himalayas, namely, the Indian state of Himachal Pradesh. Some preliminary findings from the first rapid appraisal are presented on the state of the environment, the pressure variables affecting it and their underlying causes. The goal is to contribute to the understanding of the relationship between population growth, agricultural change and the environment and identify how policy may most effectively promote sustainable development in the region. An attempt is made to find whether land-use in the hilly state of Himachal Pradesh, India, is on a sustainable development path in line with the Boserupian hypothesis and to assess whether the area will be able to continue along a sustainable path even with continuing population growth. Finally, the methodological approach adopted in the ongoing empirical study has been briefly outlined and tentative conclusions based on preliminary findings presented.

2. Theoretical Framework

We will briefly outline some of the most relevant theories for explaining the relationship between population, agricultural change and the environmental impact and feedback. We will end by outlining a set of hypotheses which may be seen as alternative underlying causes of environmental degradation. Their relevance in each case must be determined empirically. We apply them as a general framework for our case study of Himachal Pradesh.

2.1 The Malthusian Hypothesis

The phenomenon of land degradation and the concerns for it are as old as the human civilization. References to such issues as soil erosion, deforestation and related problems can be found in early Greek and Roman writings. Confucianism in China also showed concerns for the environment (Barrow 1991). Inspired by the ideas initially propagated by the French philosophers like Condorcert, Thomas Malthus examined the interrelationships between population and resources in his famous essay on population, first published in 1798 (Malthus 1926, 1987). He came out with the pessimistic conclusion that little could be done to counter poverty (and implicitly environmental degradation) due to the inability of man in changing the supply of most resources.

An important origin of all theories explaining the relationship between the population growth and environmental degradation can be traced to the Malthusian model of population, resources and development (Malthus 1987) and the «classical» debate that followed. Malthus and his followers approached the problem by explaining the impact of changing agricultural conditions on population growth. Thus, population growth is treated as the dependent variable, determined by preceding changes in agricultural productivity, which in turn is affected by extraneous factors (Boserup 1965).

Malthus thought that population would ultimately be limited by the means of subsistence. Population increases exponentially with the increase in the means of subsistence but sooner or later it has to be arrested due to the operation of the principle of diminishing returns to capital and labor. As such, output declines and the land resource is impoverished. Land degradation could thus implicitly be seen as a result of extreme levels of population pressure. At a later stage, Malthus incorporated Ricardo's view of agricultural expansion in response to increasing population. According to this view, the increasing population will necessarily cultivate on the extensive margin, incorporating more distant and poorer quality land, or on the intensive margin, resulting in lower returns to labor and capital (Boserup 1990; Tiffen, Mortimore & Gichuki 1994). The «Frontier Model» and the «Conservation Model» could be seen as the best explanations for the process of agricultural development borne out of this type of thinking (for more details about these models see Ruttan 1990, Stevens & Jabara 1988).

2.2. Development through Induced Innovation

Schultz (1964) changed the economists' view of peasants from being conservative and inert to being rational and responsive to economic incentives. He pictured a static traditional agriculture in equilibrium where peasants were «poor but efficient». He developed a theory for modernization through induced innovation. A theory which was further developed by Hayami and Ruttan (1971, 1985) in their theories of «induced technological innovation» and «induced institutional innovation». It gave rise to new approach to agricultural and rural development that relied on investment in agricultural research and extension and transfer of modern technologies and knowledge to peasants. This formed the basis for the Transfer-of-Technology approach which was implemented through the Green Revolution. Perceptions of a population explosion, and fears of famines, wars and red revolutions, have often lead to high international investment in the Green Revolution by the western world.
Protection of the environment was never an important argument for the Green Revolution. Still, where it succeeded, as in Asia where land was scarce, it led to intensification through increased productivity on existing land, lower prices of agricultural crops and reduced pressures for area expansion. Intensification had its own environmental problems, however, in form of chemical pollution due to excessive use of fertilizers and pesticides, and salinization of irrigated land in some locations.

Farming Systems Research developed as an alternative paradigm in the 1970s, was fueled by the critique of the Green Revolution and aimed at learning from its mistakes. It had a higher level of environmental awareness and was more concerned with development in (marginal) areas where the Green Revolution did not succeed. It integrated an evolutionary understanding of tropical farming systems (Boserup 1965, Ruthenberg 1980) which leads us to the «Boserupian hypothesis».

2.3 The Boserupian Hypothesis

The Boserupian approach to explaining the population growth and food production relationship is just the opposite of Malthus and his followers. Population growth is treated as an independent variable which in turn is a major factor determining agricultural development (Boserup 1965).

According to her, population increase leads to the adoption of more intensive systems of agriculture in primitive communities that may compel cultivators and agricultural labor to work harder and more regularly. which help them to raise overall productivity. Besides, increasing population density may encourage division of labor and the spread of communication and education. In her view, «primitive communities with sustained population growth have a better chance to get into a process of genuine economic development than primitive communities with stagnant or declining population, provided of course, that the necessary agricultural investments are undertaken. These conditions may not be fulfilled in densely peopled communities if rates of population growth are high» (Boserup 1965).

Due to the operation of the law of diminishing returns, the progress in raising output per unit of land depends solely on the development of new technology. Thus with the land/labor ratio becoming more unfavorable, improvements in technology are seen as the important survival tactics. Unlike Malthus who regarded «new technologies as accidental discoveries, jokers in the pack which could not be relied upon to turn up» (Tiffen, Mortimore & Gichuki 1994), Boserup considered the new technologies as impelled by population growth and made feasible by additional labor (Boserup 1965, 1981).

This constitutes an important alternative hypothesis where technological change is treated as endogenous. Population pressure is seen as inducing technological innovation, causing the farmers to search for new technology or adapt by changing cultivation practices to preserve and improve their land resources. There were hints in Boserup's work that suggest that population growth may not deteriorate the soil quality. In her later work, she went on to suggest that soil erosion caused by increased population pressure may actually induce desirable agricultural innovations for the improvement of soil quality (Boserup 1981, 1990). Simon (1986) like Boserup, also considered technological change as arising from endogenous causes. Boserupians, thus, postulate a positive chain of causation between population growth, intensification of agriculture, increased productivity and reduced environmental degradation owing mainly to the technological change and division of labor that accompany the process.

The Boserupian hypothesis is said to be ambiguous in so far as cases of opposite effects than what was observed by Boserup herself are not hard to find (Cassen 1976). Blaikie and Brookfield (1987) go on to the extent of calling Boserupian «innovation» as «degradation» instead. According to them population pressure may fail to induce technological innovation mainly due to lack of access of agricultural producers to productive resources, and may result in degradation. Moreover, innovation may not always be necessary for intensification. Intensive methods may be known long time before people actually start using them at a larger scale. The evidence of diminishing returns provided by Boserup herself in her works for the periods of growth characterized by pre-industrial and early industrial agriculture makes her a corrector of Malthus rather than his refuter (Blaikie & Brookfield 1987).

More recently Tiffen and his colleagues (1994) witnessed a switch to a more sustainable path during the period 1930-1990 in Machakos district of Kenya which was clearly on a degradation path for a long time before. The study provided an empirical evidence in support of the Boserupian hypothesis. Jointly taken with the role of the market mechanism, population growth was seen as having positive effects on technology and sustainable agricultural intensification. It is, however, very difficult to confirm or refute such conclusions elsewhere in the world, both in the developed and developing countries, mainly due to lack of supporting evidence. All the same, it remains an interesting challenge to researchers and present study constitutes an effort to address it in the context of a developing region in the Asian continent.

Since the concepts of agricultural intensification and development are crucial for the understanding and application of Boserupian hypothesis, it is in order at this stage that we review briefly various theories of farming system evolution.

2.4. Theories of Farming System Evolution (Intensification)

Agricultural growth in history has taken place either through extensification - the expansion of land area under cultivation - or intensification - the increased use of land currently under cultivation. Traditionally the concept of agricultural intensification is associated with changes in land use and fallow periods (Lele & Stone 1989). Following Joosten (1962), Ruthenberg (1980) defines the intensity of cultivation by means of an R-value which is the percentage of all years in the rotation cycle including the number of fallow years during which the land is planted with crops. The R value is thus 100 when crops are cultivated every year. This measure says little about the yield levels or total output, however. Typically, an increase in R-value from a low level, e.g., 10, to a higher level, e.g., 50, is associated with an increase in the labor requirements per unit of output (and a falling marginal product of labor). This in turn provides incentives for maintaining the extensive practices as long as possible. In such a situation, intensification is a process which is only enforced through increasing land scarcity (population driven intensification). Typically this leads to an evolution of farming systems from shifting cultivation (R<33) to fallow systems (33<R<66) and permanent cultivation (R>66) (*ibid.*).

The total production per unit area and time (typically per hectare and year) constitute a better direct measure of agricultural intensity. This measure of agricultural intensity, however, may have some problems due to multiplicity of products, times, and conversion measures, and random variation in yields and prices. An adequate measure requires the standardizing of the entire harvests to a staple-food equivalent or money equivalent. Owing to several complications characterized by paucity of data and the measurement of output, the frequency of cultivation and the type and number of agrotechnologies are frequently employed to measure agricultural intensity (Turner & Doolittle 1978). Frequency of cultivation, calculated in terms of per cent time that a plot of land is under cultivation, is popular because of its broad correspondence with the total land productivity (not yield), particularly under a similar technological regime (Kates, Hyden & Turner 1993).

Another characterization may be based on the extent of use of external inputs, e.g. low external input vs high external input systems as use of external inputs is one way of increasing intensity. Intensification may be sustainable or non-sustainable. Some land may not allow permanent cultivation as a fallow period is required to ensure regeneration of soil fertility. External inputs may also help reduce the fallow requirement for sustainable production and thus support intensification by increasing the maximum sustainable R-value.

We see farming system evolution as the outcome of largely rational decisions made by farm households and village communities given the agro-ecological and socioeconomic conditions they face or perceive to face. We see the land users as utility maximizers who are in general both drudgery adverse and risk averse. The development paths, with agro-ecological and human welfare dimensions, are the outcome of the sequence of multiple decisions made by these land users who are both producers and consumers. We therefore have to go into theories of farm household and community decision-making to come to grips with evolution in the population-agricultural change-environment nexus.

2.5 Theories of Farm Household Decision Making

The farm household is a key unit of decision making in most agricultural based rural economies although some forms of decision making may take place at a higher level, e.g. at village level for management of village property. Through response to government and institutional policies and incentives, the farm household decision making influences greatly the population, agricultural change and environment relations. We present briefly some of the important household decision making models that have evolved over time.

(i). The Chayanov Farm Household Model: In a pioneering effort, A.V. Chayanov (Thorner, Kerblay & Smith 1966) developed a farm household model in the 1920s to explain the allocation of labor between work and leisure on a Russian peasant households. It is a theory of household utility maximization. According to this model, such households were not simply maximizing profits as in the theory of firm, but attained a subjective equilibrium by equating their marginal utility of consumption with that of the marginal utility of leisure. This subjective decision involves a trade off between the drudgery (disutility) of work and the income required to meet the consumption needs (utility of income) of the household.

(ii). Nakajima's Model of Household Behavior: The Chayanov farm household model was popularized by Tanaka (1951) and Nakajima (1957). Nakajima (1969; 1986) gave not only the mathematical formulation to the model, but also proposed a pure commercial family farm model without the existence of labor market. The output, all of which was sold in the market, was assumed to be produced with family labor and fixed land input only. The commodities were purchased from the market in the model. there was also a provision in the model for meeting the minimum subsistence consumption requirements as well as a target income. A variation of the model was also developed to approximate the behavior of a semi-subsistence family farm household.

(iii). The Neo-Classical Farm Household Model: Originally developed by Barnum and Squire (1979), this model was further elaborated by others (Singh, Squire & Strauss 1986). The farm household faces perfect markets for labor, farm output and consumption commodities. Land, however, is available in limited quantity and there is no labor market. Profit in the model may thus be seen as land rent. Production and consumption decisions are recursively separable in this model as production decisions can be made independently from the consumption side of the model. There is a profit effect from the production side having an impact on the consumption side, however.

(iv). Generalized Farm Household Models: de Janvry, Fafchamps and Sadoulet (1991) developed a generalized mathematical version of the utility-maximizing farm household with market imperfections. These models are closer to reality than their predecessors. Separable and non-separable household models have been developed for the analysis of intra and inter-temporal decisions about production, consumption and labor decision problems. If there is only one missing market and the interest is either in the production or consumption side of the household model, use of a separable model may suffice. The consumption side of the household is linked to its production side through profit effects. The separability condition breaks down when market imperfections creep in. Under such conditions, non-separable household models should be used. The gains from modeling the farm household decision making problem is useful only when farm profit effects due to price changes are large or the farm profits make a large share of full income

These theories should be useful for analyzing the process of agricultural intensification when households are the key decision makers and the models reflect in an adequate way the resource access, terms of trade and market access and preferences of typical farm household categories in the area of study. They may have to be complemented by theories of inter-household relations (cooperative and non-cooperative game theories) to incorporate power relations and management of common pool resources (Balland and Plateau 1996, Ostrom 1990). They may also have to be complemented by theories of intra-household relations in cases where decisions are decentralized and not well coordinated in the household unit (bargaining models of households) and this affects significantly their overall behavior and their management of land resources (McElroy and Horney 1981).

In some cases subsistence needs and wants are driving farm household production decisions (subsistence orientation). In other cases market prices and access are driving the decisions (market orientation). In the first case there must be significant market imperfections (high transaction costs causing isolation and uninsured risk) causing production to be affected by the consumption demand of households. This brings us to models with market imperfections (Chayanov/Nakajima/ Janvry, Fafchamps and Sadoulet models) while the second case may require only a neoclassical separable model which makes the analysis simpler. Some of the implications for intensification or extensification are as follows;

The «Subsistence Needs and Wants Theory» explains why total output is increased in response to population pressure experienced by the farmer when there are significant market imperfections. The origin of the «subsistence needs and wants» theory can be traced to the works of Chayanov (1966) and Boserup (1965, 1981). According to this theory the farmers use least effort methods to fulfill the basic needs of the existing population. With an increase in population-land ratio, farmers are forced to employ higher rates of labor and technical inputs to increase output. This generally increases the output per unit of land but lowers the output per unit of labor. Starting with traditional land improvements in the early stages, modern inputs, such as, high yielding varieties and fertilizers, are introduced at later stages. A «stair-step» growth in agriculture takes place (Robinson & Schutjer 1984). Continued pressures on the new agricultural system results in diminishing returns until a new threshold level is reached, which in turn evolves to a new stage in the evolution path.

The «Market or Commodity Theory» has its modern origins in the works of agricultural economists and economic anthropologists such as Tax (1953), Schultz (1964), and Wharton (1969). According to it, the farmers respond to market demand within the constraints faced by them by achieving economic efficiency. The theory has been modified to account for risk averse behavior on the part of such farmers, at least in regard to some minimum production needed for survival (Levi & Havinden 1982). These themes have been linked with a large number of models of economic and agricultural growth, including with the theory of «induced innovation» (Binswanger & Ruttan 1978, Hayami & Ruttan 1985).

According to the «Induced Intensification Theory» the behavior of farmers in the developing countries can be predicted by combining the consumption and commodity rationales of the earlier two theories (Turner & Brush 1987). Agricultural change, including technological and institutional changes, is determined by the joint demands for subsistence and market commodities. Intensification is induced by mechanisms that are endogenous to the farmers, such as indigenous experimentation and accumulated wisdom. On the commodity side, intensification is induced by mechanisms exogenous to the farmers such as technological changes originating from research institutions. Consistent relationships between population density and agricultural intensity have been demonstrated for many parts of the world (Pingali, Bigot & Binswanger 1987; Brush & Turner 1987, Netting 1968, Boyce 1987).

Households are generally risk averse and are therefore willing to pay a risk premium for security (insurance). This may imply a stronger subsistence orientation when households perceive market dependence more risky than subsistence dependence. However, if subsistence dependence appears more risky (e.g. due to uncertain weather and severe pest problems) than market dependence, a stronger market orientation may also provide higher security. Imperfections of risk/insurance and credit markets often cause a non-separable relationship between production and consumption decisions of farm households (Binswanger and Holden 1997). When conservation decisions also become investment decisions and not only rate of extraction decisions, the dynamic decisions of households become more complex and may require a dynamic model for optimal resource management. Such models may become very complex.

2.6 The neo-Malthusian Hypothesis

Malthusian concerns emphasizing negative expectations were once again echoed by a group of economists, called the neo-Malthusians, during the last few decades. One example of such a leading contribution is the widely publicized work by Meadows et al. (1972) entitled: *The Limits to Growth.* According to these models, population growth has the potential to outstrip agricultural growth, inducing land fragmentation and environmental degradation in subsistence-oriented economies (Ehrlich & Ehrlich 1990, Grepperud 1996, Kates, Hyden & Turner 1993; MacDonald 1989).

The outcome of this theoretical tradition is the popular population pressure hypothesis (PPH). According to this hypothesis, growth in numbers causes land to be used more intensively and as the per capita area of arable and grazing land shrinks over time, the sheer necessity of production to meet increased demand forces the farmers to use land in disregard of the long term consequences (Blaikie & Brookfield 1987). Land degradation and other environmental deterioration occur as demographic pressure necessitates either extensification or intensification of agriculture. During the former process, growth in population leads to increase in subsistence demand for foodcrops, fodder and forage for the livestock, fuelwood for cooking, timber for construction of buildings, etc. It necessitates further encroachment on marginal lands that are ecologically more fragile, such as sloping uplands. Increased degradation follows in terms of deforestation that triggers the process of soil erosion, siltation, and flooding in river basins, changes in micro-climate, and loss of habitat. The process of intensification may also occur subsequently or simultaneously to the process of extensification. Fallow periods may be shortened and new agricultural practices adopted. Efforts to intensify production on present agricultural areas may lead to problems, such as, increased soil erosion and runoff, ecological hazards from agricultural chemicals, reduced genetic diversity in plant population, and waterlogging and salinity from irrigation. PPH appears to be quite popular and finds mention in a number of works on land degradation (see for example Ruddle & Manshard 1981, Eckholm 1976, World Bank 1984).

The concept of PPH has been severely criticized by many for being unrealistic. It is difficult to have unanimity on this concept as it depends on the carrying capacity of land, another concept which still continues to be vague. There are areas with large numbers of people and relatively little environmental damage and there are areas with very few people, a short settlement history and much damage (Barrow 1991). «In sensitive areas, or with certain types of exploitation, population need not be high to cause problems. Population stagnation or decline can also be a cause of land degradation» (*ibid*).

A variant of the population pressure hypothesis is that it is not the actual population density which is necessarily causing the problem but rather the rapid pace at which the population is growing. Schultz (1964) made his hypothesis that farmers are «poor but efficient» conditional on the requirement that population growth was slow (less than 1%) as he realized that a more rapid growth would create delays in adjustment as endogenous innovation and adaptation takes time. Rapid population growth may thus undermine the possibilities for optimal endogenous responses as there is a need for experimentation and knowledge generation/learning and dissemination through informal communication channels. The possible long-term effects on the environment in addition to the need for adjustment in a short term perspective, and the need for balancing these concerns, adds considerable complexity to the land use decision-making problems of farm households and village communities.

This lack of trust in endogenous response also provided the basis for high investments in agricultural research and extension - the Green Revolution - from the late 1960s. This was not due to the fear for environmental degradation, but rather the fear for food deficits in the World (which was also a sign of lack of trust in endogenous supply response). Indirectly the Green Revolution may have been environmentally benign, however, as it resulted in relatively more intensification rather than extensification in response to higher demands for food.
In the context of Sub-Saharan Africa, Pingali & Binswanger (1984) and Pingali, Bigot & Binswanger (1987) expressed skepticism in the Boserupian hypothesis in so far as they consider farmer-based innovations «incapable of supporting rapidly rising agricultural populations and/or rapidly rising non-agricultural demand for food». In their opinion, large-scale irrigation systems and industry based technical changes requiring increased policy attention by the state are crucial to speed up the process of farmer based innovations envisaged in the Boserupian model. Expanding on these ideas, Lele & Stone (1989) considered environment as a weak link in the chain binding population densities to autonomous agricultural intensification in low income areas with rising population pressure. Due to the environmental consequences of rapid population growth they recommended complementary policies by the government rather than having absolute faith in the autonomous responses.

2.7 The neo-Liberal Economists' Hypothesis

The Boserupian hypothesis gradually blends into some other views propounded by the neo-liberal economists who emphasize the importance of the market mechanism in explaining resource pricing and management (Grepperud 1996; Kates, Hyden & Turner 1993; Mellor 1966, Shultz 1964). According to such theories, prices respond to factor scarcity resulting in factor substitution by the individual farmers that ultimately stimulates technological change (World Bank 1984). Factor use changes over time may represent increased use of relatively abundant resources (like labor) and conservation of scarce resources (like capital) (Hayami & Ruttan 1971). Thus technological changes with increasing population (and labor force) over time may improve the management of the scarce land resources thereby reducing the environmental degradation. Thus the hypothesis advanced by the neo-liberal economists gives optimistic expectations about the population growth and environmental degradation relationship. This view of environmental degradation is closely related to the «Induced Innovation Model» proposed by Hayami and Ruttan (Hayami & Ruttan 1971, Ruttan & Hayami 1990).

The neo-liberal economists explain economic stagnation and environmental degradation as being caused by policy failures which have resulted in price distortions which again lead to inefficient resource management. The solution to the problems of economic stagnation and environmental degradation therefore are to remove policy distortions and allow markets to work to ensure correct pricing.

From the point of view of the neo-liberal economists, the structural adjustment programs adopted by a number of developing countries in Africa, Asia and Latin America during the 1980s and after under the advice of the two main world financial institutions, i.e., the World Bank and the International Monetary Fund, should prove helpful in initiating favorable trends for the environment by making the markets functional and thereby allowing them to determine the right prices (win-win).

2.8 The Environmental Economics Perspective of Degradation

The environmental economics tradition is firmly based in neoclassical economics. It tends to focus on market failures as explanations for environmental degradation (Baumol & Oates 1988, Papandreou 1994). From the perspective of environmental economics, inefficient operation of the market for land resources is seen as the main culprit causing land degradation. There are a number of sources of market failures (Stiglitz 1979) that need to be addressed for solving the problems of environmental degradation. Presence of externality is the most widely discussed source of market failure. Externalities can be both positive and negative, but it is the latter case that interests most. One party may create an annoyance for others without taking any account of it. Ultimately, the offended parties would find ways to seek compensation from the offending party. The problem of externalities and its possible solutions center around three main ideas: Pigou's exposition (Pigou 1932) of potential market failure in the presence of an externality, the notion of the suboptimal overuse of commonly shared resources and Ronald Coase's (1960) argument that competition and bargaining can solve externality problems regardless of initial assignment of property rights provided the transaction costs are low.

Baumol and Oates (1988) see the typical source of externality to be the absence of fully defined property rights and a possible solution then would be to redefine property rights. Non-exclusiveness or costly exclusion may, however, render the property rights solution infeasible or inefficient (Randall 1983). This is a central issue in relation to formulation of land tenure regimes in developing countries. It is widely believed that insecurity of land tenure hinders conservation activities by preventing farmers from acquiring the necessary credit for the purpose (Eckholm 1976; Veloz, Southgate & Macgregor 1985; Reinhardt 1987) and by reducing their expected benefits from investment. Common pool resources may also be exposed to poor regulation which may lead to over-exploitation and environmental degradation. Whether the solution to this problem lies in dividing the resource among individuals or in developing better communal management systems is an empirical question which has to be assessed in each case as it will depend on the nature of the resource, the pressure on resources, market structures, wealth level and its distribution, power relations, information structures, preferences and cultural norms (Balland and Plateau 1996, Ostrom 1990).

Pigou (1932) argued for the use of taxes or subsidies to correct market failures, e.g. by putting a tax on the use of a resource which creates a negative externality which otherwise is not corrected for in the market. Recent literature in environmental economics focuses more on the use of quantity restrictions (command and control) versus incentive based environmental policies. Use of tradable permits has become a new popular instrument to improve market functioning (Baumol and Oates 1988).

The wealth of a farmer may influence the adoption of soil conservation measures through his ability and willingness to invest. Poverty may lead to inefficiency in several ways; it may lead to poorer access to credit and higher exposure to risk (less buffer stocks) possibly leading to sub-optimal strategies from society's perspective. Poverty may also cause high private discount rates and the possibility of poverty-environment traps (vicious circle or degradation spiral). Poverty also has a negative effect on the human and social capital and may undermine the possibilities for tackling problems through local collective action. The divergence between private and social discount rates may provide a basis for intervention as high private discount rates represent an under-pricing of future benefits or costs. The distribution of resources and transaction costs therefore become essential in the design of environmental policies.

2.9 The Imperfect Information and Transaction Cost Perspective

Economic institutions of the rural sector, particularly in the developing countries, play a vital role in determining the population pressure, agricultural development and environmental degradation relations by affecting allocation and distribution of resources. The standard neoclassical model to explain the functioning of rural institutions was formalized for the first time by Arrow and Debreu (1954). The model assumed that all individuals possessed the same information and that there were no transaction costs. Economic relations can be reduced to price relations and price incentives can be completely relied upon for achieving Pareto-efficient allocation of resources. Thus there is no role for institutions except the property rights system. The challenge to develop efficient policies for economies characterized by imperfect information and the presence of high transaction costs led to the development of the relatively new field «Economics of Rural Organization» (Hoff, Braverman & Stiglitz 1993), which may be seen as a sub-category of «New Development Economics» (Stiglitz 1986) and «New Institutional Economics» or «Economics of Imperfect Information and Transaction Costs». The origin can be traced to the works of Cheung (1969), Akerlof (1970) and Stiglitz (1974). Cheung's work is considered the modern forerunner of the transaction cost approach to economics pioneered by Coase's work (1937).

Stiglitz (1986) developed a «theory of rural organization» as an important application of the new neoclassical «Imperfect Information Paradigm» to get better insights into the environment characteristic of imperfect and costly information faced by the peasants in developing economies. In these economies, markets may be missing, seasonal (partly missing), selectively missing (rationing), interlinked (e.g., share tenancy), or thin (imperfect competition). These phenomena are common in relation to markets for land, labor, credit, risk/insurance, and food. Asymmetric information leads to problems of adverse selections and moral hazards, which may be forms of pervasive externalities. Such economies may be seen as constrained Pareto-inefficient where it may almost always be possible to intervene to improve efficiency (Greenwald & Stiglitz 1986). Following are the five central tenets of Stiglitz's theory:

(i). Individuals (including peasants) in the rural areas of the developing countries are rational human beings.

(ii). Information is costly, hence individuals are unable to acquire perfect information. The resulting asymmetry of information causes a marked departure in the behavior of individuals from what it would have been with perfect information.

(iii). Institutions are endogenous to the system as they adapt to reflect the information and other transaction costs.

(iv). Imperfect information and incomplete markets almost always lead to constrained Pareto-inefficient outcomes even when the individuals are rational and institutions are adaptable.

(v). This suggests a potential role for the government to effect Pareto improvements through a set of taxes and subsidies if the people in the government responsible for making and implementing policies had sufficient knowledge of the economy; possessed as much information as their counterparts in the private sector; and had the necessary incentives.

A major implication of this theoretical framework is that efficiency and equity issues may no longer be separable. The distribution of resources may well matter for efficiency and thus provide the basis, e.g., for land reforms as small farmers often are found to be more efficient than large farmers (Berry & Cline 1979, Prosterman and Riedinger 1987). Political economy issues of power and resource and information distribution may thus be important explanations for poverty, economic stagnation and decline, and environmental degradation (Binswanger, Deininger and Feder 1995).

2.10. A Summary of Underlying Causes of Environmental Degradation

We consider the relationship between population growth, agricultural change and environmental degradation as highly complex. No single explanation may be entirely satisfactory and, therefore, no single hypothesis may be adequate. We, therefore, develop a multiple hypotheses framework (Table 1) providing possible explanations for environmental degradation in the context of developing countries. Some possible solutions to the problem are also mentioned in each case but it should be kept in mind that it may not always be the best or most appropriate strategy, at least in the short run, to attack the problem where the underlying cause is found. It may thus be better to respond to population pressure by developing new technologies rather than by reducing the population. Curbing of population growth may be an appropriate long-run strategy, however.

The relative importance of different hypotheses may, however, vary with region and time. In most cases the hypotheses may be highly interdependent as well as overlapping. In view of this, it is necessary to consider simultaneous and dynamic effects.

3. The Study Region[1]:Geographical Location and Institutional Set up

The study region comprising of the Indian state of Himachal Pradesh provides a good example of dryland agriculture with rapidly increasing population along with fast improvements in the living standards of the people over the past 50 years or so. Deforestation and soil erosion are well known severe environmental problems in the Himalayan region. Proper management of land resources and the socio-economic development of the people from the hills in accordance with The Earth Summit's Agenda 21 (Keating 1993) is, therefore, important. Mandi District with fairly representative conditions in the state, with availability of long time series of relevant data, should provide a good setting for examining the population-agriculture-environment nexus.

3.1 Himachal Pradesh - An Indian State in the Himalayan Region

Himachal Pradesh is a mountainous state of India situated in the lap of the mighty Himalayas in the northern part of the country. It is spread over an area of about 55,673 sq. km with altitudes ranging from 460 to 6975 meters above sea level and has 12 administrative districts. The state is surrounded by the states of Jammu and Kashmir in the North, Punjab in the west and Haryana and Uttar Pradesh in the South. It has its international boarders with Tibet in north-east. The state comprises of lower ridges of the Shivalik ranges in the south east, the Pir Panjal and Dhauladhar ranges in the northwest and the great Himalayas in the north. Southern parts of the state are as warm as the plains and the northern parts have temperate summers and extremely cold winters. Five mighty snowfed rivers, namely, Beas, Chenab, Ravi, Sutlej and Yamuna, flow through the state. Snowy peaks, rugged slopes and wide valleys gives the state a beautiful landscape.

[1] This section draws heavily from Holden & Sankhayan (1996).

Table 1. Set of hypotheses that can be relevant in explaining the land degradation in developing countries

Hypothesis	Explanation for land degradation and its possible solution
Missing information hypothesis	The peasants may be unaware of the consequences of the agricultural practices being followed by them. The solution lies in providing information through agricultural research and extension agencies (Diffusion of innovations model).
Land tenure insecurity hypothesis and open access state property hypothesis	The peasants may be unwilling to invest in land improvements in the absence of secure rights to their land. Implementation of land reforms that ensure the transfer of ownership rights to the tiller of the land reduces the problem of land degradation. Community management as an alternative to state management may be another alternative (requires local collective action).
Poverty hypothesis	Being caught in a poverty-environment trap, the people are unable to invest in land conservation practices. Poverty reduction policies along with redistribution of resources and generating agricultural development and overall economic growth can improve the situation.
Population pressure hypothesis	Population density exceeds the carrying capacity of the land. Policies aimed at controlling the population growth, generating technological change to increase carrying capacity, promoting trade and off-farm activities are helpful solutions.
Rapidly rising population hypothesis	In low income areas with rapid population growth, environmental degradation may occur because of slow pace of farmer based innovations. The solution lies in increased policy attention by the government to speed up the pace of innovations to match with the population growth.
Social unrest and political instability hypothesis	Social and political instability contribute to the insecurity of tenure, destruction of infrastructure, economic stagnation and decline, etc. Promotion of stable democratic regimes and peace-keeping activities can have beneficial effects.
Policy failure hypothesis	Poverty and land degradation are often the symptoms of policy failures that result in economic stagnation and decline. Structural adjustment programs aimed at removal of market distortions, promotion of trade, removal of subsidies, providing secure rights to land, etc., are the possible solutions.
Market failure hypothesis	Missing and imperfect markets cause price distortions that result in the misuse and degradation of land resources. Identification of the causes of market failures (inefficiencies) and use of Pigouvian taxes and subsidies, establishment of private property rights, state provision of public goods, tradable permits, and quantity restrictions are the most important remedies.
Transaction costs and imperfect information hypothesis	Presence of transaction costs and imperfection in information may lead to Pareto-inefficient outcomes which may trigger the process of environmental degradation. All market imperfections do not lead to market failures (inefficiencies). Policy interventions to minimize transaction costs and adverse effects of information asymmetries, such as cross compliance and interlinkages of markets and technologies, by the government may bring about Pareto improvements and internalization of Pareto-relevant externalities.

The total population of the state was about 5.2 millions in 1991. Ninety two per cent of the total population is rural based and depends directly on agricultural and rural industries. The density of population has been witnessing a rapid increase particularly during the past about 50 years. While the density of population increased from 34 to 43 persons per kilometer^2 between 1901 and 1951, the increase was comparatively faster after 1951 and the density of population reached 93 persons per kilometer^2 in 1991 (Government of Himachal Pradesh 1991). Diverse agro-climatic conditions afford excellent opportunities for the production of a number of cereal crops, such as, maize, paddy, wheat, barley, etc., and horticultural and cash crops, such as, apples and potatoes. Annual average rainfall varies from 150 cms to 175 cms in the outer Himalayan zone and from 75 to 100 cms in the inner Himalayas. The Alpine zone above 11000 feet remains snow bound for about 5-6 months during the year. Though there are four well marked rainy seasons, namely, winter (January - February), pre-monsoon (March to May), monsoon (June to September) and post-monsoon (October to December), nearly half of the total rainfall is received only during the monsoon season. About 83 per cent of the total cropped area depends on rains and only 17 per cent is under assured irrigation (Government of Himachal Pradesh 1989).

Terrace cultivation is traditionally practiced on steep slopes which are exposed to large scale erosion of the fertile top soil. The net area sown was only about 10 per cent of the total geographical area (17 per cent of total reporting area for land utilization statistics) of the state and the size of holding is generally small. According to the latest Agricultural Census for which the data are available, 82 per cent of the operational holdings operated less than two hectares of land (marginal and small farmers) and accounted for only 43 per cent of the total operated area (Government of Himachal Pradesh 1989). Forests occupied 31 per cent of the reporting area and the remaining area was either not available for cultivation (10 per cent) or was uncultivated land and fallows (40 and 2 per cent). About 70 per cent of the total net sown area was cropped more than once in 1992-93. This gives an idea about the cropping intensity in the state. The details on land use pattern in the state during the year 1992-93 are presented in Table 2.

Table 2. Land use Pattern in Himachal Pradesh during the year 1992-93 **('000 Hec.)**

Land use classification	'000 Hec	Per cent
Geographical area	5567	-
Reporting area for land utilization statistics	3395	100
Area under forests	1038	30.6
Area put to non-agricultural uses, barren and uncultivable land - Area not available for cultivation.	347	10.2
Permanent pastures and other grazing land, land under miscellaneous tree crops and groves, cultivable waste land - Uncultivated land excluding fallow land	1366	40.2
Fallow land	72	2.1
Net area sown	573	16.9
Gross cropped area	973	-
Net area sown more than once	400	69.9*
Net area irrigated	99	17.2*

Source: Government of Himachal Pradesh, Annual Season and Crop Report for 1992-93. Directorate of Land Records, H.P., Shimla.

* Percentage to net area sown.

The state is generally deficit in foodgrain production and its population has heavy dependence on the adjoining agriculturally rich state of Punjab. Animal husbandry is an important supplementary and complementary enterprise all over the state. Bullocks are used for draft purposes and buffaloes and cows are important milk animals. Sheep and goats are raised for wool and meet. These animals utilize the crop by-products, produce farm yard manure and provide better utilization of spare time for the small farmers of the state. Animals are both stall fed and grazed. The livestock population pressure has been on the increase. For example, it increased from 0.68 to 0.94 animals per hectare during the period 1951 and 1992 (Swarup & Singh 1977, Government of Himachal Pradesh 1995). As compared to the human population, the livestock population appears to have been stabilizing faster due to the scarcity of fodders and grazing land.

The state has a rich natural vegetation ranging from sub-tropical to alpine. With increasing pressure of human and livestock population over the years, the interference of man with the fragile forest ecosystem of this mountainous state has been on the increase. This can be seen by the shrinking of fallow lands, cultivation of newly cleared forest lands for agriculture and horticulture, thinning of woody mass from the forests through extraction of wood for fuel, fodder for cattle, timber for construction of buildings and furniture, etc. Environmentally favorable projects of the state government have resulted in some signs of rejuvenation of forests and wild life. As shown by the records of the Directorate of Land Records, the area under forests as a percentage of total reporting area for land utilization is reported to have increased from about 22 per cent to nearly 29 per cent between 1976-77 and 1989-90. Of late, the rural people have started complaining of increased loss of crops due to an increase in the number of wild animals. For example, wild bears which had become rare some years back are very common now.

3.2 Area for Detailed Field Investigations

From the point of view of socio-economic conditions and the use of policy instruments, the major variation in the state of Himachal Pradesh may be due to differences in market access. In addition, there is large variation in agro-climatic conditions. Considering the time and other resources available for this study, it was necessary to concentrate on a smaller geographical area which could represent reasonably well both the agro-climatic and socio-economic conditions in the state.

The intensive efforts of a detailed field study were, therefore, restricted to a single district with some possibilities of replicating the experiences in most parts of the state. Mandi district was, therefore, taken up for detailed field investigations. Another important benefit in concentrating the efforts to this district is that it has been thoroughly surveyed with revenue records existing practically for all the geographical area. Unlike for the state, the departure between figures for the geographical area given by professional survey and village papers for the district is almost negligible. This makes it easier to analyze changes in land use area over the years. Located in the central part of the state, the district has a total geographical area of 4,193 sq. km with 37 per cent forest cover and altitudes varying from 600 to 3000 masl. (Negi 1993, Sankhayan 1971). Net cultivated area of the district has increased from 85,000 hectares in 1970 (Sankhayan

1971) to about 95,000 in 1994-95. Rapid population growth has been accompanied with technological changes represented by the adoption of high yielding varieties (HYV) of crops, such as wheat, maize and paddy, and greater use of fertilizers and chemicals per unit of cultivated area of land. By the year 1995-96, nearly 80 per cent of the total area under the three main crops, namely, wheat, maize and paddy, was growing HYV and the use of N+P+K nutrients was about 35 kg/hec of cropped area in the state. The increases in area under HYV of wheat, maize and paddy, and fertilizer nutrient use during the last 20 years were 326 and 65 per cent. There is no reason to believe that the district has not performed as good as the state. Intensification of agriculture in the district has been noticeable particularly since the adoption of the Indo-German Agricultural Project in 1962-63. Changes in area and yields of important crops in Mandi district during the past about 25 years are presented in Table 3.

Table 3. Changes in crop yields in Mandi district of Himachal Pradesh since 1970-71

Particulars	Triennium ending		
	1970-71	1980-81	1995-96
Area under major crops (% of total cropped area)			
Paddy	17.8	16.7	14.5
Maize	24.7	26.6	33.3
Wheat	36.6	38.5	44.7
Barley	4.3	3.3	2.9
Yields of major crops (kg/ha)			
Paddy	1266	1037	1290
Maize	2390	1806	2629
Wheat	1196	1168	1431
Barley	1101	1156	1209

Source: Government of Himachal Pradesh, Directorate of Land Records and Directorate of Agriculture, H.P., Shimla.

The area under the two *kharif* crops (paddy and maize) and two *rabi* crops (wheat and barley) increased from 83.4 to 95.4 per cent of the total cropped area during this period. Shifts in area to maize and wheat took place due to comparatively greater technological gains in these crops as compared to their main competing crops, namely, paddy and barley, in the respective seasons

3.3 Institutional Structures

The institutional structure in the study region is discussed under two broad categories of market institutions and other institutions. We may say that market institutions are embedded in a constitutional framework, consisting of laws and legal rules, which we briefly describe first.

3.3.1. State and Government Laws and Regulations

All the farm households in the state have ownership rights and title deeds to their land as provided under the "Fundamental Right to Property" in the Indian Constitution. Detailed records of each field in respect of area, ownership and crops grown are maintained by the Revenue Department. The people are free to sell or buy land like any other agricultural input, with the sole exception that residents of other states of India are not permitted to buy land in Himachal Pradesh. Such a regulation was basically aimed at discouraging absentee landlordism by the outsiders attracted by the climate and scenic beauty of the state. This act, therefore, may not help in increased efficiency only, but may as well be conducive to the attainment of economic growth with equity. In exceptional circumstances, the land can be acquired by the state for public use, such as for construction of roads, dams, bridges, cement plants, public buildings, etc., only after compensating the owners by paying the average market price prevalent during the preceding three years. In some cases, even alternate land area may also be allocated to them. Though, there are no formal restrictions on renting of land, yet practically no official renting of land takes place. Such a phenomenon is explained by the strict land reform acts. For example, the owner will lose the right to any piece of land to the tiller even when the same is officially shown to have been cultivated by the latter only for a single crop season. The compensation received by the owner is often too little. For fear of losing the ownership, therefore, renting of land takes place only at informal level. Some land in the village is a common property of the residents but the area under forests is generally owned by the government. Land is inherited by all the children equally after the death of their father. In this regard there has been an important change in legislation immediately after independence that provided equal rights to the girls. Even now a very few daughters claim right in the property of their father.

In spite of very stringent provisions of the Indian constitution aimed at protecting the lower caste people (*Harjans*), rural society is still divided according to the age old Hindu caste system. A number of legislations and programs brought about by the government have not succeeded fully in giving equal status to the *harjans* due to non-co-operation from the upper castes. In a democratic set up no law can force the upper castes to have marriages in the low castes or to join them in their social ceremonies. The direct benefits given to the lower castes are mostly in terms of reserved quota in educational institutions and jobs in the public sector. *Harijans* still continue to be amongst the landless, small farmers and poor households in the rural areas.

There is a good infrastructure of schools and colleges, hospitals and veterinary clinics. A network of health facilities along with better transport facilities significantly increased the life expectancy and reduced mother and infant deaths at the time of birth. Family planning is affected through education and incentives.

Protection of the environment in the rural areas is carried out through a number of conventions among the communities and laws enacted from time to time by the government.

3.3.2 Structure of Rural Markets and Government/State Interventions

Understanding of the market institutions in the rural areas of Himachal Pradesh is crucial to the selection of appropriate models for economic analysis. These markets have been discussed separately for agricultural inputs, products and risk insurance. The discussion is mostly restricted to the agricultural economy concerned with the growing of field crops only and does not go into the details about the horticultural crops.

High government investments infrastructure, such as, roads, transport, telecommunication, electricity and water supply, etc., has resulted in the development of markets and large reductions in transaction costs in this hilly region with difficult terrain. It has been claimed that the government road building and maintenance programs are highly inefficient and private entrepreneurs have offered to do a better job at a much lower cost to the government. This type of privatization has not started yet, however.

3.3.2(a) Agricultural Input Markets

The discussion of agricultural input markets relates to land, labor, capital, and other farm inputs like fertilizer, seed, insecticides and pesticides, etc.

(i). Land: Since the ownership right to agricultural land is bestowed in the individual farmers, land transactions are common. Except for the ban on the people from outside the state to purchase land, the land market can be considered relatively perfect. Sale and purchase of land is common but renting out and renting in of land and share cropping are quite rare. Other things being equal, the sale price or rent of land is determined by the forces of demand and supply. The suppression of the rental market for land may imply some inefficiencies, however.

(ii). Labor: The labor input used in agriculture is of two types, i.e., human and bullock labor. Because of the small size of agricultural holdings and relatively abundant availability of family labor, hiring of human labor for agricultural operations is quite rare and is restricted only to the seasons in a year when the agricultural activities are at their peak, e.g., sowing, weeding, harvesting, etc. The surplus unskilled labor in the sector has a preference for working on some development projects, like construction and maintenance of roads and bridges, because of fixed hours of work. Hiring of skilled and semi-skilled labor is, however, quite common for non-agricultural activities, like construction of houses. The interference of the government in the labor market is limited to fixing minimum wages, which are difficult to implement particularly in the agricultural sector. Some high caste people do not like to work on others' farms for keeping their pride in the society, therefore, most of the agricultural labor is supplied only by the families belonging to the lower castes and having very small or no agricultural land.

Since most of the draft power is supplied by the bullock labor in the region, it is common for each farm household to keep at least one pair of bullocks. In some cases, like when the farm is operated by a widow or the farm size is too small to afford a pair of bullocks, bullock labor may be hired. The only difficulty in this case is that the bullock labor is often not available in time as those who hire it out prefer to do so after they have completed all the agricultural operations on their own farms. In spite of this, these imperfections in the market for bullock labor input can not be considered very serious due to its negligible size of operation.

Of late, the bullocks are being increasingly substituted by tractors, either own or hired. The tractors are considered useful in so far as they reduce the time of agricultural operations, reduce the demand for fodders and labor for the maintenance of bullocks which generally remain idle for most part of the year.

(iii). Capital: Because most of the crops grown and the cultural practices followed are not very intensive in terms of the commercial inputs, the role of the capital market is rather limited. Many households often receive enough cash income to finance their agricultural activities from off-farm sources either through remittances or by working themselves out side the farm. The credit for purchase of agricultural inputs and draft and milk animals is available both from friends and relatives, the village money lenders, and from the commercial banks at a fairly reasonable rate of interest varying from 12 to 18 per cent per annum. Banks and government may also advance loans for the establishment of subsidiary cottage industries or other economic activities. Because of illiteracy and more stringent conditions attached to the loans advanced by the commercial banks, the farmers have not been able to get full benefit of these loans. Some special long term loans are also available for land improvements, like leveling of fields, development of irrigation structures, etc., from the government at a very low rate of interest. Consumption loans are still not easily available from the banks and hence, the farmers have to depend on friends and relatives and village money lenders for the purpose. The loans advanced by the commercial, co-operative and government agencies use land as a collateral.

(iv). Other Agricultural Inputs: Other agricultural inputs, like fertilizers and seeds of improved varieties of wheat, paddy, maize, etc., have started playing quite a crucial role in the agriculture of the state particularly with the advent of the «Green revolution» in most part of the country since the late 1960s. A nominal government subsidy on these inputs is still available. Fertilizers can be bought from the district and *tehsil* level unions of Himachal Pradesh State Marketing and Consumer Federation (HIMFED), primary cooperative societies and the government authorized private dealers. The payments have to be made in cash. Because most of the area is rainfed, fertilizer application is generally low except for in some valleys with assured irrigation. In most cases the seed used is from the farm itself, except in cases where new hybrid seed like that of maize has to be purchased every year. Distribution of improved seed is undertaken by the department of agriculture. The fact that fertilizers, seeds and insecticides and pesticides are generally available at the right time, place and quantity, points towards the existence of very few imperfections in the markets for these inputs. Some villages are still not connected with roads and hence depend on other means of transportation. It highlights the importance of transportation costs.

3.3.2(b) Agricultural Product Markets

Because the farm economy is mostly of subsistence type, particularly in respect of food grains, the agricultural product market does not play a significant role. The surplus of food grains or fodders are either sold to deficit households in the area or to some traders in the village. It is, however, possible to sell and buy food grains from the village shops. During the years of poor harvest, consumer co-operative societies often take up the responsibility for selling foodgrains to the rural households. There is hardly any interference by the government in the foodgrain market. The conditions are quite close to perfect market where the individual household is a price taker.

It is important to mention here that fruit growing, particularly the crop of apple, is an important activity in the higher elevations of the state. There exists a distinct market for apples, including those of pre-harvest contractors, and the government provides a minimum support price for the crop to safeguard the growers against large price fluctuations over the years.

3.3.2(c) Risk Insurance Markets

As most of the area is rainfed, the biggest risk in the region is due to yield variations. Crops may fail either because the rainfall may not come in time or because of too much rain. There is still no insurance for the farmers to safeguard against this type of risk. The only type of insurance available is either life insurance or animal insurance. It is, however, still not common for the farmers to have formal insurance except when it is made mandatory for the purchase of animals through bank loans. Since the agricultural economy is mostly subsistence oriented, the output price risk does not play a significant role. The traditional way of investment in gold ornaments continues to be used as an important method of life insurance.

3.3.2(d). Markets for information

Agricultural prices in the important markets in the state as well as in the adjoining states are broadcasted every day through an excellent radio and television network still owned by the government. The prices of the receiving sets are very well within the reach of common people and there are no license fees. Thus the information is reasonably symmetric and nearly free of cost.

3.3.3 Other Institutions at Village/Community Level

Apart from the market institutions, the state has a good network of well developed institutions, voluntary, private and government, which have evolved over time for regulating the lives of the rural people. These institutions have great influence on the developments related to the growth of population, agriculture and natural resource management and the environment. The institutional set up is varied and complex and hence difficult to explain fully in a limited space. We, therefore, describe very briefly only a few of the important institutions at the village/community level.

3.3.3(a) Voluntary Organizations

These institutions receive strong incentives from the government.

(i). *Panchayats* - This is an age old tradition in the country to have an elected committee of village elders to look after the common welfare needs of the people, including maintaining the birth and death registers, deciding small disputes, etc. In some cases the decision of the *panchayat* can not be challenged in the courts of law. Because of a relatively small size of a revenue village, there is one *panchayat* for a group of villages. In conformity with the provision of 73rd amendment in the constitution of the country, the state of Himachal Pradesh has established a three tier Panchayati Raj System since 1994, consisting of *Gram Panchayats*, *Panchayat Samitis* and *Zila Parishads* at the village, block and district levels respectively with adequate representation to women and members from the Scheduled Castes and Scheduled Tribes (Government of Himachal Pradesh 1997).

(ii). Primary Co-operative Societies: A primary co-operative society caters to the needs of a small group of villages under a single *panchayat*. These are often multi-purpose societies and their activities include public distribution of essential commodities of mass consumption, such as kerosene and sugar, supplying of agricultural inputs, viz., fertilizers, improved seeds, implements, etc., and marketing of cash crops like seed potato, tea, ginger, apple, etc.

(iii). Mahila Mandals and Yuvak Mandals (Woman and Youth Organizations): These organizations are meant to look after the interests of the women and youths.

3.3.3(b) Institutions in the Private Sector

Institutions in the private sector at the village level include, among others, the following:

(i). Village Shops: They sell most of the requirements of the people living in the rural areas. They may also engage in buying and selling of foodgrains and other agricultural products and selling of agricultural inputs.

(ii). Banks: There are a number of branches of the nationalized banks in the rural areas for mobilizing the savings and advancing the agricultural loans. In a strict sense these banks are not private. Long term finances are being provided to the farmers for various activities by the Himachal Pradesh Agriculture Rural Development Bank, Ltd., Shimla and the Primary Agriculture Rural Development Bank Ltd., Dharamshala (Government of Himachal Pradesh 1997).

(iii). Village money lenders: This a very old and mostly an informal institution in the rural areas from where the people are able to get not only productive but also consumption loans for meeting their social obligations like marriages and death ceremonies. The interest rate charged by the money lenders is often higher but the borrowers do not have to follow the long procedures of the banks for obtaining the loans.

(iv). Transport and Communication: For the transport of men and material, the transport facilities are provided by the well nit private transport sector. A big fleet of buses for the movement of people is, however, still run by the state. The road network is on the increase. A highly developed network of Public Call Offices (PCOs) has proved to be a boon for the difficult hilly terrain of the region enabling quicker communication at very reasonable rates. It saves time and reduces pressure on the transport system.

(v). Health Institutions: There are a number of private medical practitioners, formally qualified and unqualified both, who specialize in treating the local people when they are sick. For more serious cases, however, the patients have to go to government run hospitals and dispensaries. Rural areas have the services of a qualified midwives also.

(vi). Miscellaneous Institutions: These institutions include carpenters, blacksmiths, barbers, potters, shoe makers, weavers, religious leaders, etc., who provide essential services to the rural communities, and are signs of a specialized market based village economy.

3.3.3(c) Government Institutions

Government institutions play a significant role in the day to day life of the rural people in Himachal Pradesh. Following are some such institutions:

(i). *Patwari* (Revenue clerk): He is the revenue clerk who maintains the detailed records of ownership and operation of the land in a «patwar circle», and is responsible for collecting the land revenue from the land holders. *Patwari* is also responsible for recording the details of area under crops grown on each field during different crop growing seasons. More recently, very small land holders have been exempted by the government from paying land revenue. The area under a «patwar circle» may be the same or different from the villages under the jurisdiction of a *panchayat.*

(ii). Post office: It is yet another important institution at the village level catering to the needs of local people. Telegraph and telephone facilities may also be available in these post offices. Besides handling the matters related to communication, the post offices also serve as saving banks for the rural people.

(iii). Other Government Institutions: There are a number of other government institutions at the village and community level, such as, schools, hospitals for men and livestock, government officials belonging to the departments such as agriculture, water and irrigation, electricity, public works, forests, etc.

4. The Problems and Responses: Some Preliminary Findings

We will now present some of the preliminary findings in respect of environmental problems and the policy responses that have emerged over time in the region in general and study area in particular.

4.1 Environmental Problems

Soil erosion causes heavy economic losses annually in Himachal Pradesh, both on-site and off-site. The economic losses due to loss of productivity, sedimentation of rivers and dams, recurring floods, drying up of water sources, etc., may be quite substantial. To the best of our knowledge, however, no one has yet attempted to estimate these losses. As an example of off-site losses, there are reports (Anonymous 1986) that the Bhakra reservoir is getting silted up speedily with half a meter thick sediment layer being deposited in its reservoir annually (Anonymous 1986). At this rate the reservoir will disappear in the next 400 years (Sharma 1997). Some of the human activities accentuating the process of soil erosion and overall environmental degradation in Himachal Pradesh are as follows:

(i). Deforestation: It is probably the single largest factor contributing to land degradation and siltation of the rivers as a result of increased runoff and soil erosion on the mountains of Himachal Pradesh. Not withstanding the moratorium on tree felling by the state government, a great deal of thinning of forests, whether authorized or illegal, is still going on for meeting the increasing needs of timber, fuelwood, fodder, packing cases for horticultural produce, medicine, etc. The average per capita consumption of fuelwood in Himachal Pradesh is 0.6 tonne per year (Singh 1982) resulting in the removal of 1.9 million cu. m. of wood per year mostly from the forests, which is far higher than the prescribed yield of 0.7 million cu. m (Choudhary, Negi & Pathania 1992). The fodder resources of the state are limited to natural grasslands, shrubs, fodder trees, crop residues, straw/agricultural byproducts and some leguminous fodder cultivated in the valley areas. The dry matter yield from the natural grasslands and meadows in the state is estimated at about 25 to 52 quintals/ha and only less than one per cent of the cultivated area grows fodder (*ibid*). The packaging of fruit and vegetable crops in wooden cases is causing a huge strain on the forests. Up to the year 1981-82, 0.2 million m^3 of wood was axed every year to make 20 million boxes for packaging of apples, other stone fruits and vegetables (Stokes 1983).

The regular allotment of trees from forests to local rightholders continues to be made not only at a very low price fixed more than 50 years[2] or so but the same far exceed the genuine needs as well as the annual yields of forests. The recurring forest fires also inflict heavy damage to forests. The figures of total recorded area under forests may often misrepresent the facts as the area under forest cover of desired density is far much less than the total forest area. This is inadequate in view of the National Forest Policy and the policy of Himachal Pradesh Government seeking at least 50 per cent area of the state under «green cover» for the maintenance of proper environmental balance (Sharma 1997).

[2] For example the rate for a fir or pine tree with 70-80 cm diameter is only Re. 0.50 in Mandi district.

(ii). Construction of roads: Himachal Pradesh being a hilly region, the means of transportation have been very difficult. The government, therefore, gave priority for constructing roads so as to connect as many rural areas with the urban centers as possible. While the increase in road length has been phenomenal during the past 40 years or so, still more than 50 per cent of the villages remain unconnected by roads. The construction of roads requires heavy investments due to the necessity of cutting the hills. It often disturbs the topography and acts as a major source of land slides and soil erosion during the rainy season, particularly in view of the weak structure of the sub-soils. The problem is more serious in the Shivaliks and High Himalayan region due to the presence of soft sandstone, alluvium and lacustrine deposits as parent materials. In spite of the commonly used retaining walls on both sides of the roads, there are frequent occurrences of land slides leading to huge loss of top soil.

(iii). Mining Activity: Mining of limestone and slates in the state is yet another cause of environmental degradation in Himachal Pradesh. The problem is getting more serious with the increased demand, within and outside the state, for slates as roofing material over time due to rapidly growing population and incomes. Quarrying for slates at Khaniara, Bhagsu Nag and Yol near Dharamsala in District Kangra, continuing since 1867, cover 650, 60 and 60 hectares respectively (Sharma 1997). The extraction of limestone is carried out in Sirmur, Shimla and Mandi districts. In Sirmur alone there are about 65 active mines spread over an area of 794 hectares. The stone is supplied to cement plants in the state and in the adjoining states. It is also supplied to sugar mills in Uttar Pradesh and Haryana. The local *Panchayats* get some royalty out of the sale which is ploughed back in the development of the area. Being a relatively small proportion of the total area under mining, it may not be considered a serious hazard for the environment when seen in the context of the state as a whole. It is a serious problem only from the point of view of a specific area.

(iv). Overgrazing: The livestock population in the state increased steadily from 4.7 million during 1972 to 5.2 millions in 1992, the latest year for which such estimates are available. The corresponding figures for human population were 3.5 and 5.2 millions (Government of Himachal Pradesh 1995). The number of uneconomical cattle owned by the hill people is not only large but the same has also been increasing over the years. According to one estimate about 90 per cent of the rural households in the state keep some bovine. The livestock pressure (average intensity being 91 and 239 livestock per Km^2 for the state of Himachal Pradesh and Mandi district in 1992 (Chand 1997)), is greatly responsible for the destruction of forests by increasing the incidence of uncontrolled grazing and severe lopping for leaf fodder. The intensity of grazing was estimated at 0.19 ha/per animal unit in 1982 (0.25 ha/animal unit in 1969) as against the recommendation of 0.5 ha/ per animal unit by the Grazing Advisory Committee constituted by the Government of Himachal Pradesh (Anonymous 1970).

Nomadic goat and sheep herders, commonly known as «gaddis» and «Gujjars» as well as the local people often indulge in grazing of their livestock all over the state. The grazing takes place either on government land, common village land or on the land owned by the individuals. Grazing on cultivated fields is common when the fields have no crops, i.e., in between the two main crop growing seasons. This loosens the soil and thus makes it more susceptible to soil erosion due to winds and rains.

(v). Establishment of Fruit Orchards by uprooting Forests: Though data are not available, yet there is a strong belief that quite a large area of forests has been cleared to establish fruit orchards in the state. This was more a pronounced phenomenon during the last 30-40 years in those districts where conditions for apple growing are ideal. Himachal Pradesh has become the fruit bowl of India and the economy of the local people has completely been transformed. This represents only a temporary phase in the destabilization of the existing environment as the horticultural orchards are bound to become environmentally benign in the long run. Though detailed time series data under the horticultural crops for Mandi district are not readily available, a fairly good idea about horticultural developments in the region can be had from what has happened at the state level since 1960-61 (Table 4).

Table 4. Area under various fruits in Himachal Pradesh since 1960-61

Fruits	Area under the crop during the year (Hect.)			
	1960-61	1970-71	1980-81	1990-91
Apple	3025	26735	43331	62088
Other temperate fruits	900	7563	17464	28556
Nuts and dry fruits	231	1745	6892	13009
Citrus	1225	5495	14471	36621
Other sub-tropical fruits	623	2791	10267	22768
Total	6004	44329	92425	163042

Source: Government of Himachal Pradesh, Directorate of Horticulture, H.P., Shimla.

The area under different horticultural crops in the state expanded by more than 27 times during the period of 30 years ending 1990-91. The increase in area under apple was more than 20 times but the production of this important temperate fruit crop increased by about 28 times, i.e., from 1200 to 34071 tonnes during this period (Vaidya 1996). It is indicative of the severity of deforestation suffered due to clearing of vegetation both for plantation and for making wooden boxes for packaging of fruits. The position in respect of horticultural development and environmental damage suffered in Mandi district was no different than that in the state.

(vi). Major River Valley Projects: Construction of major valley projects like Bhakra Dam, Beas-Sutlej-Link, etc., have necessitated the evacuation of a large population from the sub-merged river valleys. Though such a sub-merged area may not be large in terms of the percentage of total cultivated area, yet it had its importance as an usually fertile and foodgrain surplus area in the state. Though the evacuated people were allocated agricultural land in Rajasthan and Haryana states, the beneficiary states in terms of irrigation facilities from the Bhakra dam, most of them preferred to settle on nearby higher elevations in the state after clearing the existing forests. The cultivation was thus extended to steeper slopes with relatively poorer terracing which in turn resulted in increased incidence of soil erosion. Though the Government has all the powers in allocating the new land for cultivation to the «deserving» people with very small size of holding from the forests and other government land, there exist no legislation requiring the new owners of such lands to cultivate only after making proper terraces.

(vii). Agricultural activities: These activities are concerned with the practices followed in the cultivation of land. Since the topography of the state is predominantly hilly, with the exception of a few valleys, it is an important cause of soil erosion on the cultivated land. In spite of a strong tradition of cultivation on bench terraces, in some cases faulty techniques of cultivation, such as ploughing across rather than along the contours, may aggravate the problem. The vulnerability of soil depends on the types of crops and season when they are grown. For example, potato cultivation may cause one of the most serious problems of soil erosion in Himachal Pradesh.

(viii). Establishment of Cement Plants: Because of the availability of limestone and cheap electricity in the state, it is considered an ideal place to establish cement plants. Barmana cement plant in Bilaspur district and Dadlaghat cement plant in Solan district are big commercial producers supplying cement all over the country. The rock and soil requirements being so high that it has lead to a huge environmental damage by aggravating deforestation and soil erosion. No estimates of such losses are readily available, partly this being a politically sensitive subject, but the extent of damage is obvious to any one passing through these areas.

Increasing population and the ongoing process of agricultural development adds further complexity by affecting one or more of the above factors. In the ultimate analysis, this may increase the severity of human activities in affecting environmental degradation.

4.2 Responses to the Problems of Environmental Degradation

In spite of the fact that the state is severely constrained by its fragile hilly topography and lack of market access, the scenario in respect of environmental degradation is possibly not as bad as that in the remaining Himalayan or similar ecologically fragile region elsewhere in the world. Table 5 gives the relative position of Himachal Pradesh vis-a-vis India in respect of population pressure, agricultural change and environmental related variables.

Table 5. Some Indicators of Population Pressure, Agricultural change and Environmental Related Variables in Himachal Pradesh vis-a-vis India

S. No.	Indicators	Period	India	Himachal Pradesh
1.	Growth rate of population (% per annum)	1981-91	2.15	1.91
2.	Population density per sq. km.	1991	273	93
3.	Population below poverty line (%)	1987-88	30	9
4.	Agricultural land per person (hectare)	1990-91	0.288	0.165
5.	Average size of operational holding (hectare)	1985.86	1.68	1.31
6.	Livestock per 100 persons	1982	36	61
7.	Fertiliser use per hectare of gross cropped area (kg)	1991-92	71	35
8.	Crop intensity (%)	1989-90	130	167
9.	Forest land per person (hectare)	1990-91	0.080	0.201
10.	Forest Area as percentage of geographical area	1990-91	22.20	30.90

Source: Chand, R. 1997. Agricultural Diversification and Development of Mountain Regions - with special reference to Himachal Pradesh. New Delhi: M. D. Publications Pvt. Ltd.

Though the state has a far lower density of population per unit of total geographical area as compared to the country as a whole, the population and livestock population pressure is higher. A number of direct and indirect responses, both policy and technological, have emerged over time to the important problems of deforestation and soil erosion that have kept the environmental degradation in check in this region.

4.2.1 Policy Responses

During the early days of the existence of princely states in the region, hardly any serious concerns were shown for the prevention of environmental degradation. Even during the British period there was no improvements in the situation. Since the merger of these states into Union Territory of Himachal Pradesh, however, the government started showing noticeable interest towards containing the severity of the problem. The state government has responded from time to time by way of enacting suitable legislation and by providing incentives to reduce the harmful effects of environmental degradation in the state. Restrictions on grazing, regulating the felling of trees, improved management of forests and afforestation programs, bringing more area under the category of «protected forests», construction of check dams, restrictions on hunting and preservation of wild life, implementation of land reforms and consolidation of land holdings and providing subsidized loans for soil conservation activities, are some of the important examples of such measures. The state has also discouraged the use of wooden cases for packing of fruits. This is quite significant for a state which is the leading producer of fruit crops in India. Awareness has been created by the government among the people to treat forests as a national wealth and prevent losses due to forest fires. Some decisions of the state government, such as, allocation of relatively fragile government lands for cultivation generally in a bid to gain popularity and permitting the establishment of big and small cement plants and allowing continuation of mining activities, particularly for limestone and slates, in the region, have not been quite environment friendly. Such activities have no doubt contributed to the economic well-being of the people. Unfortunately the externalities in terms of deteriorated environment, even though highly localized, may still be worth considering.

The government policies represent a combination of both command and control and incentive based policies. These policies do not have only direct implications for the environment but have positive and negative environmental externalities as well. Some of the important policy responses by the Government to the problems of deforestation and soil erosion in the state are as follows:

(i). Protection of Forests: Historically, forests in Himachal Pradesh were considered as a common property, till the time the individual rulers of the princely states started restricting rights in forests like in most other parts of India. The concept of «the planned management of forests» is believed to have started due to the efforts of Brandis in 1885 (Choudhary, Negi & Pathania 1992). The strategy of the state government for forest management is the conservation of forests combined with rational utilization and expansion of its base. The Notification No. 146-J of 6th December 1950 issued by the Government of India, Ministry of States, continued to govern the management and protection of forests for a long time in Himachal Pradesh. The state affected a major change in forest policy in 1978 by adopting the concept of «three dimensional forest farming». The policy stressed the need for involvement of the masses in the propagation and conservation of forest resources. As per the guidelines of National Forest Policy, two-thirds of the geographical area in a hilly state should be under forests. The state government is working on measures for increasing the forest cover up to 50 per cent by the year 2000 (*ibid*). The Department of Forests with a highly trained Divisional Forest Officer and his subordinate staff in each forest division is responsible for protecting and regenerating the forest resources. Participation by the local communities is considered important in all such plans.

State subsidies for encouraging the use of card board and plastic crates for packing and carriage of fruits and transportation of eucalyptus and popular wood from the neighboring states for manufacturing wooden boxes represents some effort in the direction of protecting the forests.

(ii). Development of Alternate Sources of Energy, timber and draft power: Government policies aim at reducing the widening gap between the demand for and supply of fuelwood, timber and draft power. Such policies aim at exploiting non-conventional and new and renewable sources of energy, such as, biogas, solar cookers, solar water heating systems, fuel efficient «chullahs» (hearths), *nutan* stoves, improved crematoria, utilization of wind energy and afforestation with fast growing fuelwood and fodder species. State and Central subsidies are given as incentives to popularize these fuelwood substitutes. Similarly, use of iron and mechanical power are being encouraged as substitutes for timber and draft power in agriculture. This helps directly or indirectly in reducing pressure on the forests.

(iii). Control of Soil Erosion: Realizing the importance of soil erosion for ensuring sustainable development of the state, the government has established three agencies, namely, the Department of Forests, the Department of Agriculture and the Department of Irrigation and Public Health (IPH) for the purpose. The Department of Forests serves as the nodal agency. Besides allocating the funds to the remaining two agencies, it is responsible to control soil erosion in the forest areas through such measures as construction of check dams and plantations. Department of agriculture has the responsibility to make policies and provide incentives for controlling soil erosion on the cultivated land. The floods and the soil erosion along the rivers and seasonal streams is controlled by the department of IPH through measures such as making of retaining walls.

(a). Leveling of cultivated land: During the period of the last four-five decades, a network of soil conservation offices as well as agricultural extension services has been developed all over the state. As an incentive, government subsidies and loans on easy terms are made available to farmers for undertaking the leveling of relatively steep fields for preventing the losses due to soil erosion. A good provision in such loans is that they can be obtained even to meet the costs of the use of family labor for leveling the fields. Though all the loans may not always be utilized for the purpose for which they are borrowed due to lack of strict supervision, yet such a measure constitutes an useful government policy response against degradation.

(b). Introduction of New Agricultural Technology: New agricultural technology, constituting the high yielding varieties of crops and use of fertilizers has become more popular in the state, particularly after the late 1960s. A large area has been brought under high yielding varieties of wheat and paddy, particularly in the valleys. Intensive agricultural development programs undertaken in the districts of Mandi and Kangra have played an useful role in making the new agricultural technology available to the farmers. The government incentives in terms of subsidies ranging from 10 to 50 per cent on agricultural inputs, such as, fertilizers, seeds, agricultural chemicals, etc., and through co-operative loans, have also been made available. This has enabled more intensive agriculture with greater use of all agricultural inputs per unit of cultivated area. Crop yields have registered a marked increase over time which have ultimately reduced the environmental degradation thereby contributing to sustainable development of agriculture over time.

Induced technological innovation has also occurred in terms of improved breeds of milk animals, mechanization of farm operations and production of fruit and vegetable crops.

(c). Development of Lift Irrigation: Most of the agricultural land area in the state is unirrigated. Only 18 per cent of the gross cropped area received irrigation in 1989-90. Traditionally, irrigation was available only to small areas in the valleys. Here water is diverted from the water streams through small channels called *kuhls*, making use of the principle of gravity. Until recently the scope for expanding the area under irrigation was thought to be limited because of the hilly terrain where most of the agricultural lands are situated at levels higher than the sources of water such as rivers and other perennial sources of water. However, with the availability of surplus electric power in the state during the last three-four decades, efforts have been initiated by the state government to make lift irrigation available in several areas. The local people have enthusiastically responded to such a measure. This has encouraged more intensive use of modern agricultural inputs and adoption of high yielding varieties of crops, leading to further increase in yields and reducing the necessity to encroach upon relatively more fragile lands.

(iv). Poverty Reduction Programs and Land Reforms: A number of programs aimed at reducing poverty and land reforms ensuring land to the actual tiller of the land have been undertaken very effectively by the state government. Out of about 235000, 107000, and 31000 non-occupancy tenants in Kangra, Mandi and Shimla Divisions, 92, 89 and 10% have already been conferred proprietary rights (Government of Himachal Pradesh 1997. Consequently by the year 1987-88, only nine per cent of the population in the state, as against the national average of 30 per cent, remained below poverty line (Chand 1997). In so far as poverty and insecure land tenure are seen harmful to the environment, these measures appear to have benefited the preservation of natural resources in the region.

One of the important poverty reduction programs is aimed at the allotment of village common lands to landless individuals. Under section 3 of the Vesting and Utilization Act 1974, village common land (*samalat*) is being allotted to landless and other eligible persons all over the state (Government of Himachal Pradesh 1997). In Kangra Division alone, nearly 3900 landless/houseless persons had been allotted such land up to 31 December 1996 (*ibid*). How has such a policy measure affected the natural resource management is still not known clearly.

(v). Health, Family Planning and other Programs: Effective implementation of health and family planning programs have helped in keeping the growth rate of population for the state below the national average, i.e., 2.15 and 1.91 per cent as compared to 2.24 and 2.15 per cent during the periods 1971-81 and 1981-91. Under the national family welfare program, 57.73 per cent of the «eligible couples» had been effectively protected with various family planning methods up to 31st march 1996 (Government of Himachal Pradesh 1997). Death and infant mortality rates are also lower in the state as compared to the average figures for the country. The state has also been successful in achieving higher literacy rates both among the females and males in the state as compared to the average figures for the country. During 1991, the literacy rates were 52 and 64 per cent among the females and combined population in the state as compared to 39 and 52 per cent for the country. Such policies may have supplemented the other efforts aimed at protecting the environment in the state on a long term basis.

4.2.2 Technological Responses

The local people in the Himalayan Region are not unaware of the problem of environmental deterioration as evidenced through land degradation due to soil erosion, deforestation and loss of biodiversity. With the passage of time, they have learnt the art of establishing some sort of balance with the eco-system in the region. They often understand their problems better than the outsiders and have also developed appropriate local technological responses over time. The role of outsiders may seldom need to be more than catalysts in the process of minimizing the land degradation hazards. The traditional technological response of the people in the Himalayan region, including Himachal Pradesh, to minimize the effects of soil erosion caused by natural factors can perhaps be seen in the context of the Boserupian hypothesis. What started emerging long time ago perhaps as community responses have now been transformed into individual (household) responses. Such responses have been generally in terms of the following:

(i). Terrace cultivation: There has been a long tradition in Himachal Pradesh to cultivate on terraces so as to minimize the loss due to soil erosion. The history of terracing in the Himalayan region is perhaps as old as the record of human settlement. It is in itself an interesting area for research by anthropologists. With the increasing population pressure, more and more fragile lands with steeper slopes are being brought under cultivation where ideal terracing can not be done immediately. There is thus always an element of disequilibrium in the relationship between man and eco-system.

(ii). Drainage channels: There is a systematic network of temporary man made drainage channels in each village to drain out the water to bigger streams and thus minimizing the soil erosion losses. Though such channels are made of mud, yet the same have permanent location. The maintenance of these channels is carried out either jointly by the village community or by the individuals, holding responsibility for the portion passing through their land. Besides, each individual constructs some small temporary drainage channels in and along the fields and elsewhere on his farm during the rainy season. The impact of running water is more serious in washing away the top fertile soil, particularly at the beginning of the torrential monsoon rain when there is hardly any ground cover left after a long dry season. This practice has been known to the people of this region since time immemorial. Fields where maize and potato crops are grown during the rainy season makes the soil more sensitive to soil erosion necessitating the construction of temporary drainage channels. Thus better farm management practices of this type can considerably reduce the problem of soil erosion.

(iii). Fallowing: This practice was widely followed in the not too distant past to restore the loss of soil nutrients. It is, however, becoming less and less feasible with the increased demand for land area and decrease in the average size of holding due to increased population pressure. Thus the cropping intensity is continuously on the increase and the farmers often take two crops (*kharif* and *rabi* during the rainy and winter seasons) on most pieces of land in a given year. In some places where irrigation is available, even growing of a short duration third crop (known as the *zaid* crop) between the two seasons is not uncommon.

(iv). Increased Intensity of Cropping: Another response that has emerged over time is in terms of higher cropping intensity in the state. The intensity of cropping increased from 153 per cent in 1953-54 to 170 per cent in 1992-93. During the year 1989-90, the cropping intensity in Himachal Pradesh was 167 per cent as compared to the national average of 130 per cent. Thus the state has experienced higher intensity of cropping not only over the years but also as compared to other states.

(v). Use of farm yard manure (FYM): Farm yard manure is generally applied by most farmers at least during one cropping season in a year. Regular applications of farm yard manure compensate for the loss of soil nutrients due to soil erosion. Production of FYM, however, requires the raising of livestock that exert pressure on the vegetative cover and forests thereby enhancing the incidence of soil erosion. Some cow-dung may be converted into cow-dung cakes and used as a fuel, thereby reducing the availability of organic manure for the crops. Grazing of livestock results in harmful effects to the soil.

Ploughing back the crop residues also rejuvenates the nutrient losses. It is, however, still unclear as to whether the positive effects of raising livestock are stronger than their negative effects.

(vi). Mixed cropping: Growing minor crops, such as pulses, with a crop like maize have often been a very effective way of minimizing the losses due to erosion by providing increased soil cover. Commonly used crop rotations also improve the soil structure which in turn reduce the incidence of erosion.

Our findings from the rapid rural appraisal in Mandi district of Himachal Pradesh indicate that this region may already be one of the most well managed and environmentally conscious regions in India due to the foregoing policy and technological responses. There are, however, still some policy failures requiring attention of the government in the future. For example, there is no wisdom in continuing with the allotment of trees from the forests to the right holders in the rural areas at prices fixed more than fifty years ago. Adoption of a currently followed policy like no use of government vehicle on Mondays can lead to clandestine illegal movement of wood within the state. Failure to entrust the ownership of forest wealth in the hands of local communities has also been proving to be a harmful policy for the environment.

5. The Methodological Approach

A number of alternative methodological approaches can be adopted for studying the population growth-agricultural change-environmental degradation nexus. Most of the available studies have generally used one or more of the following approaches:

1. Historical review of past and present policy instruments adopted by the government of a country/region. It may include the examination of the incentive structure as it affects degradation and conservation of natural resources.

2. Modeling exercises, such as regression and system analysis can be used to establish quantitative and qualitative relations. Household models, dynamic bio-economic models (e.g., Barbier 1996) and computable general equilibrium models at micro, meso and macro levels can often provide useful insights into the phenomenon under investigation. Lack of readily available data on environmental variables in the developing countries, such as on soil erosion may, however, pose some significant problems in applying such approaches to develop good guidelines.

This study makes use of both primary and secondary data to apply a combination of the above approaches for gaining insights into the population growth, agricultural change and environmental degradation relationships in western Himalayan state of India, namely, Himachal Pradesh.

5.1. Collection of Secondary Data

The relevant secondary data for the state and district levels have already been collected by visiting the offices of the Economic and Statistical Advisor, Principal Conservator of Forests, Director of Land Records, etc., in Shimla, the state capital of Himachal Pradesh. Some secondary data on land use classification, human and livestock population, etc., for the selected villages over the years were also collected from the offices of District Agricultural Officer, District and Sub-divisional Revenue Officers, Divisional Forest Officers, etc., in Mandi district.

5.2 Selection of Study Sample and Collection of Primary Data

The primary data are being collected from a suitably selected sample of villages and households in Mandi district of Himachal Pradesh.

5.2.1 Sampling Procedure

Following sampling procedure was adopted for selecting a representative sample of villages (communities) and households:

(i). Community Survey: Inspired by the International Food Policy Research Institute (Pender & Scherr 1997), the community survey tries to combine the benefits of usual economic surveys and participatory research methods (Chambers 1994a, 1994b). It is useful for investigating local notions on the causal relationship among the population growth, agricultural development and environmental degradation in each of the communities/villages over time. A sample of 68 villages, with at least 20 villages from the relatively plain, mid hill and high hill zones, has been randomly selected from Mandi district. Some of the selected villages are extremely remote requiring hours of climbing mountains.

(ii). Household Survey: From the list of selected villages, 20 villages have been selected for detailed household survey at a later stage. From each of these villages, five to 10 farm households will be selected randomly. Because of relatively small variations in the farm size, it may not be necessary to classify the households in more than two farm size categories, i.e., small and large.

5.2.2 Developing the Questionnaire

A set of two questionnaires with flexible design have been developed for collecting information at village community and individual farm household levels.

5.2.3 Collection of Primary Data

The primary data on various parameters of interest, i.e., population, agricultural change, environment, etc., are being collected by trained field investigators, with sufficient familiarity with the local agro-climatic and socio-economic conditions. A village level questionnaire is administered at the level of community, such as, the village *panchayat*. It generally requires 4-5 visits to each of the selected villages. All the actors, namely, individual cultivators, local leaders, government functionaries, local bodies, etc., are given full opportunity to express their perceptions of the problem of environmental degradation and how or whether it should be dealt with. What roles have been played by each, what can the local communities and individuals do themselves, what do they need assistance for from outside and what is expected of the government? The work is likely to be completed by the middle of August 1997.

The work of administering comprehensive questionnaire to the sampled households is likely to begin towards the middle of August 1997.

6. Summary and Conclusions

This study outlines various concepts and models relevant for studying the population, agricultural change and environmental degradation in general and the Indian Himalayan state of Himachal Pradesh in particular. Some of the preliminary findings based on secondary data and rapid rural appraisal relating to the state and the perceptions of people in the study region, namely, Mandi district, suggests that in spite of increasing population pressure over time, agricultural change in the area has been reasonably consistent with sustainable management of natural resources. This points towards essentially a Boserupian development path. The people seem to have responded over time by way of introducing technological improvements like terracing, drainage channels, mixed cropping, etc. The government has introduced a number of policies aimed at protecting the environment. The Green Revolution has had positive indirect effects on the environment as it has stimulated intensification and reduced the pressure on the environment. There are hardly any visible negative effects of the Green Revolution in the region so far. It provides a basis to defend investment in agricultural research and development on environmental grounds. Deforestation and the resulting soil erosion originating in the degraded forests rather than in the cultivated fields, appear to be the most important environmental concerns in the region. In spite of some policy failures, the performance of the state in protecting the environment appears encouraging that may serve as a model for similar areas in the Himalayas and elsewhere in the world.

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Gender and Resource Management in Northern Pakistan: The Relevance of Studying Gendered Power Processes

by

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I. Introduction

Development initiatives in Northern Pakistan[1] have for the past 15 years promoted changes in resource management systems, particularly in terms of forest development, animal husbandry and agricultural production[2]. Results of these efforts have in many ways been impressive, both in the scope of human resource development (training and village institution-building) and the purported doubling of real incomes in the area since the project was initiated. Despite these broader successes, however, household food insecurity continues for many households in the late Winter and early Spring months (World Bank 1995; Clarke et al. 1996), and migration of family members to down-country Pakistan is a common coping strategy.

Why is this the case, and what does it really mean? Are people better-off with rises in incomes or worse-off because they are induced to migration, or are Western concepts of well-being leading to misinterpretations of local processes? Do we have, for example, an adequate understanding of local processes of food security as they are experienced by women and men? Western ideas of food security are based on the concept of enough food for all people at all times for an active and helthy life (World Bank 1986). How is this concept, however, understood by people who may have been experiencing annual cycles of plenty and scarcity as the norm for centuries (Agarwal 1991)? Would people always choose to use income on food, or continue to follow earlier annual dietary patterns and use income for other purposes (Davies 1996) Likewise, assuming migration is only a negative indicator of well-being may not consider people's own perceptions of viable strategies.

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[1]Northern Pakistan in this case refers to the Northern Areas (Pakistan-occupied Jammu and Kashmir) and Chitral (part of Northwest Frontier Province). This area forms the upper limits of the Indus Basin, at the intersection of the Hindu Kush, Karakoram and Himalayan mountain ranges. It covers an area of ca. 70 000 sq.km can be characterized as a mountain desert. The population is ca 1.2 million, most of which live between 1 200 and 3 000 m, and is comprised of equal numbers of Shia Ithnasheri, Shia Ismaili and Sunni Muslims.
[2]The Aga Khan Rural Support Program is a Pakistani NGO supported by 7 donors, including NORAD . It was established in 1982 and has had a significant influence on the direction of development in the NAC.

Local strategies are far from static, and are chosen precisely to cope with a constantly changing social, economic and natural environment (Laier et al. 1996). Do we, however, have an adequate understanding of the processes of change at the local level in light of the rather dramatic changes in social and economic relations over the last 15 years? How do different groups and individuals experience change? Gender aspects are particularly important, in that they often lie at the very heart of how social relations are organized within a community. In Northern Pakistan, anecdotal evidence cited by development staff attests to a great diversity in the roles women and men play in resource management and food security. Knowledge of these roles, however, remains static and descriptive; there has been little work in studying the dynamic, interactive nature of men's and women's strategies within food security and resource management in the face of change. How do, for example, changes in gendered patterns of access to and control over resources affect food security and environment? Through what mechanisms are access and control determined, and how are they socially constructed?

In order to answer these questions, gender must be conceptualized in terms of process rather than category. Do we, however, have the analytical tools necessary for such an endeavor? This paper will begin by presenting an overview of the development of the concept of gender, and how significant changes have been made in the way we might approach the topic. This will be followed by a discussion which relates gender to issues in resource management in the specific context of Northern Pakistan. The paper concludes with a focus on the study of process and change as a possible approach to issues in gender and resource management.

II. Conceptualizing Gender

While gender has long been a part of anthropological and social analysis, its significance as a concept in development became apparent during the 1970s when the UN Decade for Women began to document how development efforts, particularly in rural areas, had fallen short in terms of positive impact for women in low-income countries. In an attempt to improve the situation, efforts over the next ten years focused on women through special projects either within or independent of mainstream development programs. When at the close of the UN Decade for Women in 1985 it was found that conditions for women had not significantly improved using this strategy it was clear that one had to look at the challenge anew. What was the problem? Why hadn't efforts been able to make a difference? While there were certainly problems in general approaches to development (i.e. top-down, non-participatory), were there as well flaws in our conceptual understanding of gender which had an impact on how change is promoted? Particularly in resource management, there are extensive examples of how both theoretical and practical approaches have ignored women as resource users, managers and owners with disastrous results, both socially and environmentally (Carney and Watts 1991; Mearns 1994; Horowitz and Jowkar 1992; Rochleau 1991). This is not necessarily due to a lack of attention to social dimensions of resource management; analyses of for example class, caste and ethnic aspects of resource management are well documented. Instead, it is evidence of a broader and more serious lack of understanding of how social relations defining resource access and control are inherently gendered. It is thus critical to develop a concept of gender and social change in terms which are relevant to systems of resource management.

Theoretical perspectives

Gender Theory from the North

Studying social relations such as gender in rural settings involves choices of both units and approach. Views on which choices are best are based on how we "view the world" in general. Thus, how theoretical underpinnings of gender reflect different "views of the world", have consequences as to the choice of units and approach.

Feminist theories from the North have previously dominated the definition of approaches within gender studies. These theories can be grouped into two main strains; liberal feminism and Marxist feminism, which are again based in the traditions of liberalism/neoclassicism and Marxism. These two strains have differing views on both the reasons for women's subordination and the remedies to improve their position.

Liberal theorists believe in the viability and goodness of capitalism and that social inequalities can be corrected through legal procedures and attitudinal changes (Bandarage 1984:495). Liberal feminists (and modernizationists) follow along these lines and see the subordination of women as a flaw in a basically egalitarian system. In this view, correcting the flaw would involve directing resources to women who have been "left out" in the past. In analyzing gender in this tradition, the focus is on defining the roles of men and women to see where support should be directed within existing social structures It is within this school that the term "women in development" or WID emerged.

Marxism, on the other hand, focuses on the structural roots of poverty where the social system is based on economic exploitation of disadvantaged groups (op cit.). Solutions to poverty within this view are structural, and therefore political. Marxist feminism follows along these lines by viewing women's suppression as structural. There are two main branches of feminism stemming from Marxist thought. Socialist feminism bases its view on the division of labor between men and women. For this school the solution lies in redefining women's economic roles i.e. changing the division of labor in households and societies. Radical feminists, on the other hand, feel that subordination emerges from the sexual exploitation of women by men, which is a result of the dominance of a patriarchal culture. In their view it is not enough to change the division of labor, sexual domination must also be addressed (Sachs 1996:15). Patriarchy will be discussed in more detail below when addressing the more specific concerns of the planned study in Pakistan.

New Directions in Gender Theory

The theoretical approaches outlined above attempt to give "all-encompassing" explanations of women's subordinate position in society and general solutions as to how this position could be improved. Several critics (see Sachs 1996: 16), however, are rejecting the validity of these schools and are pointing to new approaches.

Why is this the case? Sachs (1996) point to several reasons. One is the fact that feminist theories to date have not been able to agree on one unified approach to the question of women's subordination, as we have seen above in the case of liberals and marxists. Another and more fundamental reason is that feminist theories are not seen to be immediately derived from women's experiences. Both of these, but particularly the second one, may be rooted in a more general realization that women's experiences are considerably more diverse than anticipated and it has been difficult to define a theoretical basis encompassing this diversity. Feminist theory has been seen as being the brainchild of "white, upper-middle-class, heterosexual, Western women" incapable of representing women of different classes, ethnicities, and nationalities (Sachs 1996:20). Anzaldúa (1990, in op cit.) refers to how white feminists strive to de-emphasize differences between women in an attempt to support the notion of the universal woman, whereas other women i.e. women of color live in "multiple worlds with multiple identities" and try to make these differences visible. In addition, there is a reaction from the South to the implication that women are only passive victims of subordination (Sachs 1996:25). Social structures, which by Marxists are seen as constraining women, can also be enabling (Felski 1989 in op.cit: 25), and women may have several types of strategies with which they resist male domination which may not be immediately apparent (Aptheker 1989, in op.cit:26).

On what, then, should a new approach be based? One option is a focus on situated knowledge (Haraway 1991 in op cit.). This is a post modernistic approach which rejects top-down all-encompassing feminist standpoints and embraces diversity, emphasizing location, positioning and situation. The focus in post modernism is on deconstruction of society; a multitude of voices from the grassroots and the rejection of one, universal, 'truth'. Emphasizing difference has been a particularly central theme in discourse by Third World feminist scholars who reject the Western feminist assumption of a common women's interest by questioning the degree to which women can be considered separate from their class, ethnic, and racial identities (Anzaldúa 1990 in op cit.:21). Critics of postmodernistic discourse, however, warn against the dangers of focussing too much on difference, claiming this leads to a focus on the individual and precludes discussions of power, oppression and political agendas (Sachs 1996). Zita (1989 in op cit:19) questions its ability to deal with gender issues since it was not specifically developed to . Others, however, would disagree. Parpart (1993) argues that the postmodern 'focus on localized, subjugated knowledge/power systems would encourage development planners to pay more attention to the concrete circumstances of Third World and minority women's lives'(p 262). Situated knowledge thus does not confine analysis to the individual, but rather allows for an interpretation which considers local context. Despite fears of too much focus on the individual, Sachs (1996:18) does, however, concede that situated knowledge has particular promise as an approach to exploring women's connection with the environment since it puts the rural woman's experience in the center of the analysis.

As one moves from the broader philosophical arena towards more pragmatic discussions of gender, we see that gender remains a special interest which mainstream academia has only just begun problematize. Originally an anthropological concern, the concept of gender has spread to other disciplines where attempts have been made to integrate it into mainstream thinking. While this is an important part of developing the concept, much of the newer thinking on gender has benefited from an interdisciplinary approach, both within the social and natural sciences. This has enabled researchers to enrich their understanding of how gender permeates all aspects of society, including people's relationship with their natural environment. The following section looks at what might be considered the springboard from which a newer understanding of gender has been possible- the reexamination of the relevance of the household as an analytical and methodological unit.

Household as a Unit - a Help or a Hindrance?

One of the most central issues addressed in much of the recent literature on gender is the relevance or irrelevance of the use of the household as an analytical and methodological concept in studies of rural development, and in particular, resource management (including agricultural development). With firm roots in Chayanovian peasant theory, the household has often been regarded by researchers as the definitive unit of analysis. Considering the Western or European ideologies of family and models of households developed during the spread of capitalism and industrialization in the 19th century, this may not be so surprising (Moore 1988). A focus on the household as a unit of analysis, however, has proven to be misleading in that it conceals gender differences within the household[3], and does not consider how individuals in the household might link with other individuals or groups outside of the household. Is the conventional idea of household, thus, still considered the appropriate focus in studying rural development, and in particular resource management? Are there other options available which can be used in addition to or instead of a conventional household focus?

Fallacies of aggregation[4]

The view of the household as a conflict-free unit where the members cooperate towards a common goal (as defined by the household head) is fast becoming obsolete. Even in the field of economics, where the concept of household has been the basic unit of analysis for rural development studies for the past 30 years, views on the nature of the household are changing. Empirical evidence has shown that interests within households cannot be aggregated, and households are in reality arenas in which there are competing interests between its members (between and among women and men, young and old etc.). Examination of a critique of the use of the household concept within economics gives an overview of some of the problems of aggregation of the household.

Economics is perhaps the discipline which has relied most on the Chayanovian view of the household in its analyses and methodological approaches[5]. Within economics, New Household Economics (NHE) developed by Becker (1965) combined concepts of the economic rationality of the household with neoclassical economic theory of the firm.

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[3]The same could be said for, for example, generational dimensions of the household.
[4]term adopted from Kabeer (1994)
[5]c.f. Theory of a Peasant Economy (1965) translated by Thorner.

NHE conceptualizes the household as both a producer and consumer, where decisions are made as a unit represented by the head of household. The assumptions in this model, however, have been seriously criticized (Kabeer 1994; Evans 1991). Evans systematically shows how each of the main assumptions of the NHE model deviate so significantly from empirical data that the model as it stands is of little use in analyses of rural society. Box 1 summarizes Evans' critique.

Box 1. Critique of New Household Economics (NHE)

Assumptions	Critique
the socio-economic unity of the household	- variations in hh consumption - flexible structure of the household
substitutability of factors and the hh division of labor	- imperfect markets - low substitutability of factors (gender, age, status and the interdependence of labor reduce substitutability) - non economic ideological factors that discriminate between men and women's labor in the marketplace
hh as a unit of consumption and production	- production and consumption units can be heterogeneous - decisions about consumption are made simultaneously with production decisions rather that after
Joint utility function - hh head's utility function same as hh - individual will maximize total hh welfare - individuals in hh make free and voluntary economic choices	- removes the possibility of unequal exchange and exploitation between family members.
Benevolent dictator	- not empirically supported - no guarantee of trickle-down to other members
Pooling and sharing in the household	- ignores possibility of relations other than pooling and sharing - ignores the possibility of changing relations of production may modify the nature of the household as a decision-making unit

based on Evans (1991)

Acknowledgment of dissent within the household has led to the development of new theories which try to capture the ways in which decisions are made within the household. Within economics, New Institutional Economics (NIE) sees the household as an institution where contracts are negotiated between its members. In this model, however, contracts are seen as stable and long-term, and not open for negotiation periodically (Kabeer 1994). Theories of intrahousehold bargaining, however, in general allow for greater diversity in decision making and have the potential for accommodating the idea of gender asymmetry. Sen (1990), with his theory of cooperative conflict, made issues of gender and power more explicit in the bargaining process by acknowledging the fact that men and women have different degrees of bargaining power within the household. He develops a theory of what constitutes bargaining power, and what might contribute to changes in bargaining power.

While on the one hand, household bargaining models such as Sen's (op cit.) have contributed much to the understanding of processes of dissent/consent within the household, the theory stays within the confines, again, of the household which is still conceptualized in a somewhat conventional matter. Sen (op cit.), while stressing the importance of women's "visibility" outside of the household in determining part of their bargaining power, does not explore the aspects of power relations which might exist between households[6]. This leads us into a discussion of the nature of the household and intra-household relations.

Changing views on households and society

If households are not the homogenous unit they previously appeared to be, what constitutes a household, and how do individuals relate to those outside the household? On the form of the household, empirical evidence shows an immense variation in the composition and form of households, particularly in Africa. With such diversity, attempts at typology may not be fruitful and may even be misleading, as has become evident in the case of female headed households (FHH) . Rather clarifying the situation of a particular type of household, use of the term FHH resulted in unwarranted generalizations of the socio-economic positions of this diverse group of women, as well as the marginalization of married women in rural analysis (Peters 1995). This does not mean that no attempt should be made at defining the household; there are still challenges in finding units of analysis which adequately deal with household level issues[7]. There has, however, been a clear shift in emphasis from defining the household unit to discovering the processes by which household members compete for resources.

While the form of the household has become less of a focus, the interactions of household members with the rest of society has become a topic of increasing attention. The treating of households as bounded units within society is related to the earlier discussion on aggregation of interests within the household, but has other implications as well. Such a view can hinder the understanding of important processes at work between households, and particularly between women and their wider networks (Kabeer 1994). The focus of the household as a bounded unit can, again, be seen in Chayanov's (flawed) description of peasant households, where the household unit was defined in economic terms. Economists following Chayanov distinguish between the domestic mode of production, where goods and labor circulate within the household, and the market, where goods and labor circulated between households (Harris 1981; Roberts 1991).

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[6]Guyer and Peters (1987) in contrast to Sen, point to the processes of transactions, exchange bargaining and negotiation as being a common thread which can be used to link levels of organization (individual, hearthhold, household, compound, village, province, nation, region, world).
[7]Ekejiuba (1995), for example, suggests the concept of hearthhold as appropriate for some African areas. With hearthhold, the focus of analysis is put on "a woman with all her dependents" or a woman and all those for which she is fully or partially responsible for securing food(p 6). She basis this concept on empirical evidence from Nigeria where a male spouse, son or lover can, depending on his degree of presence, either be a full or partial member of the household. The use of hearthhold as a unit of analysis can be helpful in avoiding the marginalization of women in sampling, data collection, analysis, development planning and project implementation.

There is also a tradition in anthropology to distinguish between the domestic domain and the politico-jural unit. Whereas in theory both of these areas are gendered[8], there are historically myriads of examples of male bias in research where women have been addressed only in the domestic sphere, and men have constituted the public world based on descriptions of kinship systems. This bias illustrates some of the danger in using the concepts of domestic and public as two distinct spheres - what women do is treated by definition as belonging to the domestic sphere, simply because women do it, which renders invisible what women do outside i.e. wage labor (Harris 1981). It also ignores women's social and political systems and networks which may be distinct from conventional views of male-based kinship systems[9]. Further, inherent in this view is the belief that the domestic sphere is 'unimportant' or less important in political contexts than the public sphere. This has led to presuppositions about the workings of community institutions which do not consider the domestic environment as a political arena, or the influence the domestic environment has in public affairs.

Changing views of the household are based on a growing mound of empirical evidence, a good deal of which is based on how men and women manage their resources, be they labor, capital or natural. The next section looks at the relationship between gender and resource management, and gives examples of how changing views of the household are relevant to issues of capital, labor and land with particular reference to Northern Pakistan.

III. Gender and Resource Management

To understand how gender relates to resource management, it is useful to look briefly at how resource management itself has evolved and branched into areas of study which differ concerning their understanding of how people interact with their environment.

Resource management is a broad term which can encompass a multitude of disciplines(ecology, economics, political science, sociology, anthropology), and combinations of disciplines (political ecology, political economy etc.). Nevertheless, one can trace how resource management is addressed today back to two main schools of thought on the relationship between people and environmental degradation: ecocentricism and anthropocentricism. Ecocentric views place the environment as the paramount concern, and focus on the importance of conservation. They are in line with in a Malthusian understanding of human-nature interaction where increasing population not only leads to pressure on the natural limits of the resource base, but also to the adoption of land degrading practices by those pushed onto marginal land. Anthropocentric views, however, prioritize people within the human-nature system. These views are more in line with a Boserupian understanding, where technology and management are important determinants of how people interact with their

[8]and there is now ample example of this in recent anthropological work.

[9]see Leach 1991 for an excellent example of how anthropological analysis can be gendered when looking at resource management.

environment[10]. Figure 1 shows resource management as a field influenced by ecocentric and anthropocentric schools, and manifested in various interdisciplinary approaches.

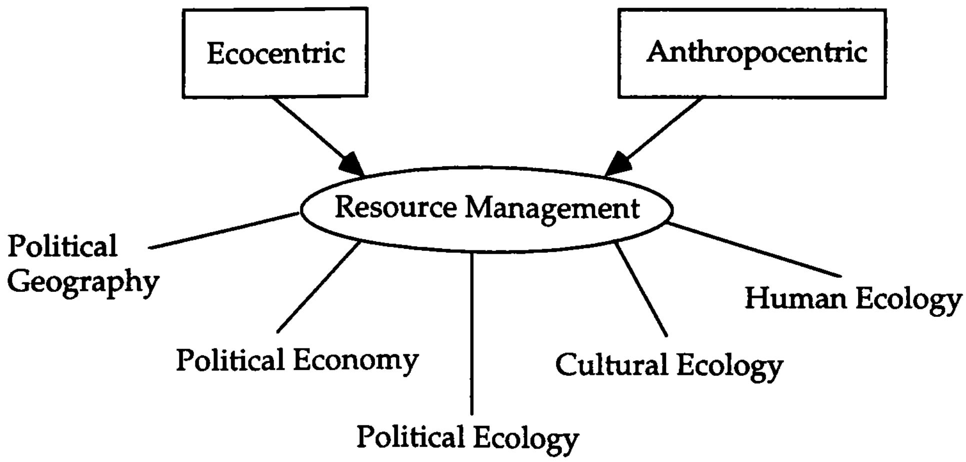

Figure 1. Resource Management, as influenced by Ecocentric and anthropocentric thought and addressed in selected interdisciplinary approaches.

The last ten years have seen an increase in attempts to see resource management in interdisciplinary terms. Blaikie and Brookfield (1987), working within the spheres of political ecology/economy, raise a number of central interdisciplinary issues i.e. the social origins of degradation, the plurality of perceptions and definitions of ecological problems, the need to focus on the land manager and the pressure of production on resources (Peet and Watts 1993: 239). Blaikie (1995) goes further by offering practical ways of addressing land degradation issues. He suggests a shift in focus from the resources' degradation (study of symptoms) to changes in patterns of distribution (symptoms of change) These symptoms are defined as mainly economic i.e. for soil erosion and fertility changes he suggest looking at falling crop yields, changes in biomass and diversity of economically useful plants from forests, and primary and secondary production from rangelands (Blaikie 1995:20).

It is clear that Blaikie and Brookfield's attempts to address both social and natural science aspects of land degradation represent an important contribution to dealing with issues of resource management. Nevertheless, they have been criticized on several points[11]. For our purposes it is important to note that despite the attention to social

[10]For a more complete discussion of how these different schools of thought compare in terms of resource management and ecology, refer to Grimble 1996.

[11]For example, there is little attention given to how control and access of resources are defined at different levels, from within households to the State or even global levels (Peet & Watts 1993:239). In addition, Zimmerer (1991 in op cit.) claims Blaikie and Brookfield have an old-fashioned view of ecology rooted in stability, resilience and systems theory rather than in newer ideas of chaotic fluctuations, disequilibria, and instability. Peet and Watts (1991) point to several directions within which political economy is moving as a reponse to these critiques. These include addressing more closely political economy, politics and civil society, the plurality of discourses on sustainability, environmental history and ecology. All of these are introduced in more detail in Peet and Watts 1993:240.

aspects of resource degradation, Blaikie and Brookfield remain within an ecocentric understanding of resource management issues which uses economic and social terms merely to define resource degradation caused by population pressure on the land. Ecocentric views, in insisting that population pressure is the most important factor determining land degradation, ignore empirical evidence showing positive correlations between population growth and improved resource management systems, as well as the role of access to resources in determining patterns of degradation and resource improvement (Mortimore and Tiffen 1995; Grimble 1996). This is a particularly relevant point when considering gender issues in resource management, as it questions the adequacy of ecocentric frameworks in addressing issues of power. How issues of power, and particularly gendered power, affect people-nature interaction requires perhaps more anthropocentric approaches to resource management.

New Directions in Resource Management

One approach used increasingly in recent years has focused on institutional aspects of resource management. While the study of institutions *per se* is not new, the way in which institutions are defined has undergone changes which make this approach compatible with an interdisciplinary understanding of resource management. Post-modern influences in this field have not, as is sometimes feared, led to the total disintegration of collective functions, but rather to a view of institutions as permeable rather than rigid. Mearns (1995:103) defines institutions as "regular patterns of behavior between individuals, and groups in society," and emphasizes the importance of understanding the institutional arrangements that surround peoples natural resource management practices. Mearns gives an example of fuelwood in Kenya, where he shows that fuelwood shortages were not merely the result of overfelling, but of the lack of women's access to trees and tree products. Women did not have the institutions necessary to exploit the resources needed to fulfill their expected tasks. Thus, Mearns claims it was institutional factors (institutional scarcity), and not the physical supply level, that determined the scarcity of fuelwood. A focus on institutions , therefore, allows for analyses of the power dimension of resource management, and may explain how other forces than population may be involved in determining how people interact with their environment.

Merging gender and resource management

The trends described above in both gender and resource management have made a merging of the two concepts easier in conceptual terms than previously. Both have moved towards the realm of interdisciplinarity. Likewise, both have been influenced by post-modernistic thought and have incorporated power and access issues into their analyses. Gender studies, often based on empirical evidence on peoples' management of resources, stress the importance of situation specificity and differences of power between women and men. Institutional approaches to resource management, which allow for permeable, socially constructed institutions (including intra and inter-household relations) and address issues of access to resources, make it more possible to embody gender aspects in resource management analysis.

Development activities in the Northern Areas of Pakistan provide a useful backdrop to examining gendered aspects of resource management. Development activities have focused on enhancing the productivity of the resource base, within a framework of institution-building at the village and inter-village levels. Most of the institution-building has been gender segregated, for example the formation of village organizations for men and women's organizations for women. Recently, committees have been formed at the village level to deal with issues involving the management of common property resources (high pasture, wildlife and forest resources). While some attempts have been made to include women in these natural resource management committees, they are basically male-dominated. These committees are responsible, however, for the management of some of the most important resources available to villagers at the higher altitudes where pastoral activities are an important part of their farming system. The question thus arises concerning the effect these newer institutions have had on men's and women's patterns of access to and control over resources. How have the mechanisms which determine access to and control over resources changed? How have they remained the same? What is the effect of these changes on, for example, household food security?

Capital Resources

While the emphasis of the proposed study will be on the management of natural resources, this can only be understood if natural resources are seen in relation to the flows of other resources as well i.e. capital and labor, and their combined effects on food security. The literature is also very clear in that capital and labor issues often are central themes in gendered power relations both between and within households.

Conventional studies of, for example, food security have been concerned with the amount of money coming in to the household, assuming that it then becomes available for the purchase of food where production has been either too little or concentrated on crops for sale. The amount of money, however, is only part of the picture. There are at least two other dimensions of capital which are of importance when seeking a gendered understanding of the role of capital. One dimension is the management of money within the household. In the case of segmented households where capital resources are usually not pooled (as in many societies in Africa), the use of income may be so gender-specific that studies of food security not considering gendered capital control would be seriously flawed. Studies in corporate households more common in South Asia have a more difficult time discerning gender dimensions of household money management as it may appear that all income is pooled and controlled by the household head. Kabeer (1995), however, offers an interesting framework for looking at the control of money in apparently corporate households in Bangladesh. The framework, after Pahl (1989), typifies money management arrangements, and looks not only at overt control over money resources, but the role which management of money plays in gaining control, sometimes covertly, over the use of the money. In the Bangladeshi example, female management systems 'tended to occur in households where their adoption did not threaten established gender hierarchies' (p17). In Northern Pakistan, studying the introduction of separate credit opportunities for men and women can offer an opening for a more in-depth look at the way capital is managed within the household, as it did in the case of a study on credit programs in Bangladesh (Goetz and Gupta 1994). In both studies it was clear that income earned or credit received by women was not sufficient to ensure their control over the money - structural relations within the household were also important. In Pakistan it would be important to explore which structural relations exist between men and women in the management of not only credit resources, but of savings resources as well. Does this structural relationship have a bearing on the types of investment can be made with credit resources, or has the availability of credit and savings changed how women and men relate to each other concerning the management of money? How has the availability of credit provided through institutions such as the women's organizations altered existing networks of power between women in the community, and has this had a bearing on the power relations at the household level? Answers to these questions could give insight into structural relations involved in the management of other types of resources.

The other dimension of capital is the role it plays in the relations between individuals at the community level. Leach (1994) examines how money fits into kinship and patron-client relationships. In her case study from Sierra Leone, she shows how money has not lead to the disintegration of social networks and patron-client relations, but is instead an 'input' into these relations '[m]oney has, however, altered the opportunities for certain groups of people to acquire independence from others' control, and acquire clients for themselves' (p206). In Northern Pakistan, it would be interesting to see how money, both earned through income generating activities in the village (by men and women) and sent from relatives migrating down-country, has altered systems of claims within the community, and how this may differ by gender.

Labor Resources

Labor issues in the study will also likely have two dimensions, one linked to the migration of men down-country, and the other linked to productivity changes in the production systems. By focusing on agropastoral systems, the study will likely be facing some of the same gender issues which have become apparent in pastoral societies of Sub-Saharan Africa (Horowitz and Jowkar 1992). In Africa, for example, migration of men to cities offering waged employment has often led to women being the sole managers of animals, as well as managers of any permanent crops grown, representing an increased burden of work as well as control over resource management decisions. In Northern Pakistan, while migration of male household members is an important part of a households overall survival strategy, gendered changes in the patterns of animal management is not well-documented. Have the migration of male family members lead to increased women's involvement in the management of pastoral resources, or has it forced them to find other solutions i.e. hiring others to herd animals, increasing their dependence on non-animal production activities, or shifting from an extensive grazing system to stall-feeding for longer periods of the year. How have changes in labor availability affected men's and women's relative power over decisions concerning their natural resources? Have losses in control been matched by gains in control in other areas of resource management i.e. non-animal-based activities?

Another aspect of labor is how changes in productivity in agriculture affect men's and women's ability to call on each other's labor, both within the household and through other social networks. This dimension of labor has been well-documented in Africa, with particularly illustrative example provided by Carney and Watts (1991) on rice farming in the Gambia. They describe how swampland was appropriated from women for the development of irrigated rice farming and re-allocated to male farmers for production. The project had counted on the labor of the women for weeding and harvesting in order to meet production targets, and has assumed that the men would be able to mobilize the labor of their wives for this purpose. To the contrary, local custom did not give men unlimited control of women's labor, and the women refused to work on these plots without compensation. In the end, men were unable to produce the expected yields due to lack of the strategic labor expected of the women[12]. This example emphasizes the importance of not only the gendered interdependence of labor activities in resource management, but also how labor can reflect complex arrangements of power between women and men, amongst women and men, along different lines at the community level. The gendered interdependence of labor activities, however, is not so well-documented in systems which involve both grain production and extensive animal grazing, as those which will be included in this study. As these systems change in the face of changes in productivity, migration, and changing access to and quality of common property pasture, there is need for a gendered analysis of labor relations. What is important is to go beyond gendered task specification (Guyer 1991), which only give static view of what is done, but not an understanding of the control over labor resources (Carney and Watts 1991). Some of the ways to analyze labor could include looking at dowry systems, which is still very common in the Northern Pakistan. Dowry arrangement, in addition to material payment, may also define labor relations between the bride and groom, as well as between their respective families (Moore 1988). If this is the case in the Northern Areas of Pakistan, it may give an idea of how decisions on resource management are made on the inter-household level. How important are marital arrangements in determining the extent to which women and men can call on labor for, for example herding in high pastures. Do these arrangement represent powerful networks equally useful to men and women - or have they changed in light of changes in the patterns of labor required as resource management systems change? Are these relations dominant over time, or do younger couples face different conditions than earlier generations in terms of the role marriage and dowry plays on structural relations within and between households?

Land Resources

Much of the work on gendered aspects of land resources is based on the African experience, where there has been an increasing trend towards the privatization of government and communal land. Historically, it has been difficult for women as individuals to obtain title to land, despite their dependence on access to land for ensuring household food security. The main thrust of gender research on land resources has been to document gender-differentiated user rights within customary land rights systems. How user rights within customary systems are understood, however, will very likely depend on who has the power and opportunity to present the workings of these systems. Berry (1993) and Mackenzie (1995) question the validity of our current understanding of customary rights by examining the process of private land-titling in Africa during the

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[12]This is a simplified account of a much more thorough analysis done by the authors, where, for example, labor and land relations are also explained with respect to ethnicity, showing that responses to the project differed depending on ethnically determined land and labor relations.

colonial period. Mackenzie, through a re-examination of historical acounts of land commission proceedings in Kenya in the 1930's, finds that discourse on what should be considered customary law was dominated by well-situated male members of the local community. These men, in an attempt to serve strategic interests and support land claims vis a vis the colonial government, emphasized particular aspects of the land tenure system which privileged male authority. The voices of other interests in the community (women, tennants) were not heard, and thus their user rights not brought into the general discourse.

Mackenzie notes that while these groups were not excluded, and the male-based system that was presented to the commissioners was a legitimate part of the customary system, 'the flexibility and negotiability of previous practice were masked in order to present a unified response to the Commissioners'(p180). The significance of this observation lies not merely in the fact that certain interests were masked. Mackenzie's example provides insight into the flexibility and negotiability of user rights inherent in customary land tenure systems. Rather than based on a set of static customary traditions, access to land is conditional upon how individuals interpret the system of rights, as well as the degree to which a person can call on support for claims from other members of the community. Likewise, statutory law is not necessarily absolute, and is often negotiated in a manner similar to customary law. Mackenzie shows how, for example, both men and women call upon different aspects of both customary and statutory law to serve their purposes, their success dependent on their ability to mobilize support within the community. How these networks of support work thus becomes central in understanding gendered land tenure issues. Berry (1993) also focuses on networks, and the significance changes in land use patterns have on how these networks operate. She stresses that people, in order to cope with uncertainty in access to resources, multiply their memberships in networks, shifting attention from one network or relationship to another as circumstances change.

While issues of gendered land tenure have been presented here in the context of Africa, they are nevertheless relevant in analyzing land tenure systems in Asia, and more specifically Northern Pakistan. In Northern Pakistan, cultivated land is already under the control of individual households, with title given to the male household head. How is the actual use of the land, however, determined? Which mechanisms define who has control over which plots, and who makes decisions for their use? Are these mechanisms flexible? negotiable? changing? What happens to control over land resources as development initiatives offer new uses for land by men and women? In Northern Pakistan, women have become interested in the use of cultivated land for the establishment of tree nurseries, as well as in the commercialization of horticultural crops. How are some women able to gain access to this land? Is this decided at a household level, or are women able to mobilize support outside of the household to gain to additional household resources? Since not all of this land is within the family plot, influence in community level decisions is also appartent. Newly developed land is considered under the control of the community, and in a few cases community leaders have allocated communal land specifically to women's groups. How do women's access to this land differ from access to household land? It has been observed that on land allocated to households men and women both contribute labor to for example tree plantation development, but it is the men who decide what should be planted. This is evident in that on land allocated specifically to women, the women have chosen completely different tree species than on their household plots.

Concerning common property resources, the government has official ownership or control of all area above the irrigation channel[13] Because of limited staff, however, they are unable to manage these resources. In reality, the local community exercises control over these areas. Little is know about the gender aspects of common property resource use apart from that they vary widely from valley to valley throughout the region. Hewitt (1989) describes a system in the where women are completely excluded from high pasture, whereas Knudsen (1994) describes a nearby area where women have access to lower pastures in the summer. What is this pattern in higher areas? Where women do have access to pasture, their roles could include the management of small animal herds, processing of animal products, collection of fuelwood, collection of wild foods and medicines. This is an important potential area of study, in that there is currently a strong focus on the formation of local natural resource management committees to make decisions concerning the use of common property resources. What is the significance of these committees in relation to existing or evolving mechanisms for access to land resources? How do processes of access to cultivated land reflect processes of access to common property resources? Are they related? Have there been shifts in these mechanisms as land use systems change in the face of male out-migration and new market opportunities?

Animal Resources

Essentially all of the farming systems in Northern Pakistan are mixed systems, of which animals are an integral part. The majority can be classified as agropastoralists, with animals herded at progressively higher altitudes during the summer as crops are cultivated in the lower lying areas. In the higher altitude areas of Northern Pakistan where the climate normally allows for only one cultivated crop per season, animals comprise a relatively more important part of people's livelihood systems. Little is known, however, of gender aspects of this animal-based system. How do women and men gain access to animals, and how are they managed? Do women and men both own animals? Are there cultural restrictions as to the type of animals men and women can manage, and are these absolute, flexible or negotiable? What is the gendered relationship between animals managed intensively (at the farm) and those grazed extensively in pasture? Do men and women use animals for differently, and does this reflect gendered strategies for, for example, food security?

Knowledge of animal-based systems is, in general, poor. Horowitz and Jowkar (1992) point to the almost universal failure of pastoral-focused development efforts in Sahelian Africa. This was due, in their view, to a lack of understanding of socio-ecological aspects, of which gender was central. Their comprehensive review of the albeit limited literature on pastoral women provides a useful starting point for understanding agropastoralist in Northern Pakistan. One important issue touched on throught the review is that of control of animal resources. Studies from both Africa and Central Asia

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[13]This refers to highland pasture and forests.

reveal that gendered restrictions on the inheritance, purchase, sale, gift exchange and mangement of animals are often, as in the case of customary land tenure, highly negotiable, and changing as processes of marketization and sedentarization expand (op cit.). Ensminger (1984) provides an example from Kenya of how changes affecting access to animals and their products reflected broader changes in men's and women's relative positions, and affected women from different classes differently. Ensminger describes how sedentarization processes in Kenya separated women from their animals and their main economic base of milk processing, decreasing their economic position vis a vis men. Labor also became an issue, as poor women lost their animals they also lost their sons to waged herding. Wealthy women, however, were able to hire labor for herding and use their sons to gain access to the political arena through meetings held in their homes. It will be interesting to explore the extent to which the more important dimension of animals in these higher altitude systems might dictate gendered relations of power differently than in more crop-based farming systems.

This section examined how studies of gendered access to resources can be enriched through an analysis which opens up the concept of household as a unit to include issues of gendered power between household members and among members of different households. The next section will look more closely at how a focus on process adds a dynamic dimension to the study of gender and resource management.

IV. Focus on Process

Much of the recent literature dealing with gender has shifted from trying to define the unit of the household (Guyer and Peters 1987), to understanding the gendered *processes* involved in the interaction between people, whether it be between men and women, among women and men, within the boundaries of households or between them, or along the lines of age, caste, class, ethnicity etc. As we have seen above, this shift in emphasis is particularly relevant for studies in resource management, as the processes which define who has access to and control over resources do not necessarily stay within the conventional bounds of the household, but rather follow more complex routes in the wider social system.

Several authors offer frameworks which would be useful in studying gendered processes of change. Guyer and Peters (1987) suggest a gendered analysis of the processes of production, consumption, accumulation and distribution, where studying differential power and resource control between men and women can act as a common thread which can be used to deal analytically with separate but interdependent levels of organization. Moore (1994) takes this idea a step further by accentuating the centrality of mechanisms which determine systems of redistribution. This integrates analysis of ideology and power into how processes of production, consumption, distribution and investment are determined. Thus, it is the mechanisms of redistribution in society rather than the processes above that are important. These mechanisms involve the negotiation of the terms of resource distribution, and shares some common ground with the broader discourse on bargaining models.

Bargaining models are a type of game theory, where scenarios on how decisions are made within the household are modeled. Most of these models, however, have not adequately addressed a) the dynamic nature of "contracts" negotiated; contracts are seen as stable or non-negotiable over time, nor b) the significance of gender-based differential power relations within households (Kabeer 1994). Sen (1990) contributes significantly to bargaining theory by acknowledging the existence of such power differences within the household, and the effect this will have on negotiations. He introduces several concepts to the bargaining process, such as the importance of perceptions, both of one's self and how one is perceived by others. For example, he shows through an empirical example from the lace-making industry in India how visibility of women in the workplace improves men's perceptions of women's contribution to the household and thus their bargaining base is improved. He also makes an important point concerning the cyclical dynamics of bargaining - how the starting position is influenced by previous outcomes, and how if a women is less well-off after one round of negotiation she starts a new round from an even more disadvantaged position.

Despite the improvements Sen has made to household bargaining models, he still bases his analysis on bargaining within a well-defined household setting, and does not incorporate influence outside of the household. The significance of Moore's (1994) approach is that is can be used to look at interactions between levels as well. In terms of resource management, Leach (1994) through an example from Sierra Leone, suggests how one can apply this type of approach. By looking at the flows of resources between men and women, she has been able to discern changing patterns of conflict and alliances between men and women which would not be apparent only through a mapping of their respective roles, particularly within a framework based on a bounded household unit.

Mechanisms of redistribution in corporate households

Should an analysis of the mechanisms of systems of redistribution be, however, devoid of all reference to household categories? Literature exploring different forms of household organization and resource management has often distinguished between corporate and segmented households. Are these categories still relevant, or should they be replaced with newer concepts based on process and change?

Corporate households are characterized by cultural rules which focus on the male responsibility for the protection and provisioning of women and children (Kabeer 1994). This view of household organization, while in the past consistent with views of the unity of the household discussed earlier in this paper, does not assume unified gender interest. Often used to describe the Asian situation, corporate household organization differs markedly from segmented household organization common in Africa. In segmented households there is an emphasis on the significance of lineage rather than the conjugal contract in the management of resources. Thus, men and women may sometimes be seen as more closely tied to their wider networks than to each other.

Analytically, the distinction between corporate and segmented households has offered a framework for presenting newer empirical evidence on the gender specific or separate control of resources in households in a mainly African setting. It also offers insight into how households negotiate control over resources. In segmented households overt conflict over resource control is common, and women pursue separate enterprises from their husbands as insurance against divorce. In corporate households, however, conflict is more covert, controlled by strong systematic sanctions which do not encourage women to openly express dissent. In these households women may choose different strategies for ensuring access to resources i.e. getting others to conduct business for them, engage in secret lending and borrowing of money, and negotiate on the meanings of, for example, purdah and motherhood (op cit.).

While one may be able to distinguish between segmented and corporate households on a more general level, there is certainly much variation both between and within these categories. Women in segmented households, for example, also use covert strategies to gain access to resources (Leach 1991). Is there then such a thing as, for example, a "pure" corporate household? While corporate households are not exclusive to Asia, the literature refers to South and East Asia (including Pakistan) and the Muslim Middle East as the areas where corporate households based on patrilocally extended households have a particular stronghold. Kandiyoti (1988) addresses these areas in terms of the concept of classical patriarchy, which could be said to represent an extreme form of corporate household organization. Is this concept a useful one in a study of gendered resource management in Northern Pakistan?

In addition to offering a description of classical patriarchy and its reproduction[14], Kandiyoti introduces the concept of the patriarchal bargain. The patriarchal bargain, or the evolving relationship between women, men and their families, is defined by the strategies chosen by men and women within a set of concrete, structural constraints. Kandiyoti stresses how changes in society in general can lead to a breakdown in the reproduction of patriarchal systems (and the existing patriarchal bargain) leading to a 'crisis phase'. When the patriarchal bargain is in crisis, new strategies by both men and women can be identified. For example, extended households experiencing loss of property and wealth may not be able to provide for the livelihood needs of younger couples. These couples are forced out on their own, without the support inherent in the extended system, and the husband's role as economic provider becomes a myth. Not only does income from women become necessary, other processes effecting the patriarchal bargain are also at work. Sons become independent of their fathers, and women from their mother-in-laws, and the terms of their own relationship are negotiated in what might be less restricted conditions.

The question now arises, how do we interpret these processes? The concept of patriarchy itself is based on a radical Marxist emphasis on the centrality of structural issues in society where the relationship between men and women is one of male dominance and female subordination. The Marxist school would thus interpret changes in the patriarchal bargain as either structural changes, or adjustments within a more fixed structural framework. A more fundamental question, however, is whether this change in the terms of negotiation still reflect a corporate household structure, or are new mechanisms emerging which will dictate how resources are used and controlled? And

[14]The elements of classical patriarchy include aspects of dowry, inhertiance and cycles of dominance within the household, and are addressed in detail in Kandiyoti (1988).

are we certain that earlier household arrangements were, indeed, corporate to begin with?

Thus, while Kandiyoti's patriarchy bargain is somewhat interesting as an analytical starting point and introduces the dynamic element of bargaining into the understanding of corporate households, it's applicability to study in Northern Pakistan is limited. First, it presupposes a Marxist view of structural constraints as the determinent of gender relations, while current trends in gender theory have moved away from Western feminist approaches towards postmodern approaches emphasizing situated knowledge. Second, its use may imply that household organization in Northern Pakistan is comparable with that of Pakistan proper, which was defined as within the patriarchal belt of Asia. This may, however, not be the case. Historically, the Northern Areas has been rather isolated from Pakistan-proper, but is at the same time at the crossroads of several ancient trans-Asian routes of trade and thus an area of extensive ethnic diversity. This diverse cultural setting requires fresh attention to both existing processes of negotiation, and processes of change as a result of newer developments i.e. the completion of the Karakoram Highway through to China. Rather than base the analysis on preconceived ideas of gender relations, it may be more useful to open analysis to the possibility of completely different gendered systems of redistribution within and between households.

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Parallel Workshops in Development Studies

SESSION D:

African Cases
on
Animal Husbandry and its Relations to Other Activities

Intensification and Agricultural Expansion in Boulgou Province, South-eastern Burkina Faso

by

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Abstract

Boulgou province has favourable conditions for animal husbandry but is experiencing a rapid expansion of agricultural areas at the expense of grazing resources. The expansion is initiated by rapid population growth and introduction of the ox-plough. The population growth has only partly initiated an intensification process, but a.o. due to the marginal agricultural potential of the region and the low market integration, expansion is the dominant development characteristic. A comparison with areas where such population growth has led to autonomous intensification, reveals that important preconditions for such a development are not present in Boulgou. The expansion therefore leads to increased competition between agriculture and animal husbandry, and not, as would be an expected consequence of an intensification process, to further integration of the two activities.

Introduction

The Boulgou province can be characterised as a transition zone. To the north is found the arid and semi-arid Sahel, dominated by extensive grazing systems and cultivation of millet during the rainy season. To the south is found the sub-humid to humid Guinean zone with longer agricultural season, more favourable dry-season cultivation, and animal husbandry either more intensively based with little migration or absent because of disease prone areas.

The Boulgou province situated in the semi-arid Soudanian zone has, with its mean annual precipitation of 761 mm (1983-1993) a growing season between 150 and 180 days (McMillan 1993) long and wet enough to allow millet, sorghum and to a lesser extent maize to be important cultures in a semi-intensive production environment with animal husbandry as an important aspect of the agricultural potential. The region offers favourable conditions for animal husbandry due to relatively stable water accessibility, the existence of grazing resources allowing for some degree of transhumanche and selective utilisation of the natural resources. Advantages of interaction with the crop-farming systems of the Bisa/Mossi farmers in terms of manure supply, residue grazing and animal traction are important aspects hereof.

The region is undergoing changes that renders the future of the animal husbandry uncertain. High population growth rates based in elevated birth rates and immigration has, together with the general regression in the precipitation, led to deforestation, degradation of the natural resources and declining yields. Reinforced by the introduction of animal traction the agricultural areas are expanding rapidly, and elements of an intensification process in the form of more consistent use of manure and crop residue and to a minor degree abolition of fallow has begun to show.

The development trends that may be identified in Boulgou point to increased use of the natural resources available. Evidence from other regions in Sub-Saharan Africa has shown how such a process may lead to the development of sustainable agricultural systems based on market integration, technological innovation and adoption and diversification. In the following will this so-called intensification process be discussed with special reference to the necessary preconditions and how this relates to the reality as it is found in the Boulgou Province. Some of the data in this paper are based on two fieldwork in the region of altogether 5 months duration that will form the basis of the authors Ph.D. dissertation.

Short description of main characteristics of the province

The Boulgou province is one of the south-eastern provinces of Burkina Faso sharing it's borders with Togo and Ghana. This part of the country is characterised by relatively favourable agro-climatic conditions and higher population densities compared to the northern parts of the country. However, though the southern location is relatively advantageous as will be shown later, it is still a marginal region compared to the large and densely populated south-western provinces where the bulk of agricultural development has taken place.

The province of Boulgou is dominated by several important rivers braiding through the landscape. Several rivers have been dammed up, creating reservoirs increasing the potential for both animal husbandry and irrigated agriculture. In 1992 one of the country's largest dams was finished, damming up the White Volta river, creating a huge reservoir shaped into elongate branches by the former river valleys, planned to sustain vast irrigated zones. However, only a fraction of the envisaged irrigation management schemes have been realised due to lack of funding.

Onchocerciasis, riverblindness transmitted by the black-fly (*Simulium sp.*) that thrives in running water (Pedersen 1996), made large areas of the region unsuitable for permanent exploitation until in the seventies when the effects of the WHO Onchocersiasis Programme were manifested. Therefore large areas surrounding some of the riverbeds are still only sparsely exploited and densely vegetated.

The soils are generally poor in organic matter, nitrogen and phosphor, impeding the agricultural potential. The region is generally considered unsuited to moderately suited for agricultural development (McMillan et al. 1994).

The vegetation is bush savannah with interspersed trees. The relief is rather flat with a few inselbergs breaking the horizon.

The population density of the Boulgou Province is in average about 55 inh./km^2 with an annual growth rate of 2,7% corresponding to a doubling of the population in approximately 26 years. The population density is very unevenly distributed in the province and reaches its maximum at around 138 inh./km^2. Half of the population is under 15 years of age.
The most important ethnic groups are Bisa (58%), Mossi (30%) and Fulani (8%) (1985 figures, Danida 1995, p280).

Cultivation

Cultivation is considered the most important activity in the province. It is practised by almost all of the population and is the most time, space and labour consuming activity.

The cultivation in the area is dominated by subsistence production. The only significant cash-crop cultivated is groundnut which, according to local and not very reliable statistics, makes up almost 30% of the surface cultivated (DSAPS - Direction des Statistiques Agro-Pastorales du Ministère de l'agriculture in Danida 1995, p149). Major subsistence crops are sorghum, millet and maize with sorghum and millet taking the lead interchangeably.
Rice is cultivated in association with dams and riverbeds, but is still a minor crop in the region. However, with the expected developments bordering Lake Bagré, rice may very well become an important crop in the near future. Cowpeas, soya, potatoes and woandzou (bambara groundnut) are cultivated mostly for sale and on a very modest scale.

Yields are low compared to theoretical test results. In general and in all parts of the region the harvest does not suffice for the needs of the household until the next harvest (ibid., own data).

It is estimated that around 35% of the total area in the Boulgou Province may be cultivated, of which 10% is suitable for irrigation. It is further estimated that around 70% of the potential agricultural area is already under cultivation (Danida 1995).
Mossi and Bisa farmers are the major cultivators. Most often they possess several manured and well laboured fields under permanent cultivation close to the compounds, while the "bush-fields" are holdings often several kilometres from the village, permanently cultivated without regular application of manure. According to own data, fallow is practised by approximately 40% of the farmers but mostly due to lack of manpower, illness or age, and not because of a deliberate application of a fallow rotational system. There are only weak signs of an actual abolition of fallow as farmers generally are reluctant to use fallow in fear of loosing the usufruct rights to the land. As no fertilisation of the fields far from the households is practised regularly, the fields are in a low-level steady state yielding poor harvests.
The Fulani normally maintain only one well manured and high yielding field surrounding their camp or village.

Land preparation and to some extent weeding is often done with the hoe or the *hiler*[1] on lighter soils. Animal traction is according to own data being used by up to 40% of the farmers and since 6 years in average. The practice is spreading, which also has had influence on the price formation of good quality oxen on the markets (own data). The deployment of the ox-plough is an important instrument in the expansion of the cultivated areas as it improves the working productivity of the farmer. Around 3/4 of the ox-plough users in the research area had expanded their fields after deployment of the plough.

Commercial inputs like chemical fertiliser and insecticides are very seldom used due to the unavailability and prohibitive prices.

Animal Husbandry

Animal husbandry is considered the second most important activity. The region has for a long time been an animal husbandry zone with the Fulani from the Mossi plateau in the north arriving in the dry season to exploit the grazing resources on the free land along the rivers, deserted due to onchocerciasis (Faure 1990). During the last two decades the region has received a large number of pastoralists migrating from the northern more densely populated regions like Namentanga, Kouritenga and Ganzourgou to settle in a more favourable environment (Delgado 1979, Delgado 1978a p3, Danida 1995, UNSO 1992, Faure 1990, McMillan 1993 p90). This has, in the second half of the eighties, lead to an annual cattle growth rate of 11% resulting in a 70% increase from 1983-89 (Danida 1995).
According to statistics from the regional veterinary services (SPRA 1992), the province has a general charge of animals well superior of the national average (3 ha/TLU against 7 ha/TLU national) and one that, when compared to provincial averages, places it among the most densely animal populated provinces in the country. Though such rough data neglect the very uneven geographical distribution of the natural resources, they do indicate a relatively animal husbandry dominated region.

Figures from the same source from 1992 show that cattle and sheep are almost equally numbered (each around 35% of the total) while goats are slightly less with around 24% of the total. If, however, the crude number of animals are transformed into tropical livestock units (TLU), cattle will make up around 74% of the total[2]. Again these figures are only to be considered rough indicators, but do nevertheless point to the significance of cattle compared to other species.
The reasons for the considerable growth in animal husbandry shall probably be found in the success of the vaccination programmes, but also the general trends towards agro-pastoralism where farmers increasingly are acquiring animals to be used for draught, savings, or as an actual economic activity are important growth factors (Speirs 1992, Graaf 1994, own data).

[1]The *hiler* is a halfmoon-shaped tool that allows a faster weeding compared to the hoe. However, the soil is not turned over why the soil structure not is being improved. It is only suited for light soils, and may be seen as a typical instrument in an expansion process. (Guillaud 1989, 1995)
[2] TLU conversion factors: Horse 1; cattle 0,7; sheep 0,12; goat 0,12; dunkey 0,53; camel 1,18.

Animal husbandry in the region may be divided into three forms:

1) Animals held by the sedentary Fulani who often "belong" to a Bisa/Mossi village and who herd both their own and the farmers' animals.
This is the most widespread form of animal husbandry in the region. The Fulani is a common name for the ethnic groups Fulani Blancs and Rimaibé and probably several other less represented groups.
The Fulani have generally lived in the area for many years, often having arrived simultaneously with the neighbouring Bisa/Mossi farm's. They seem to have very close relations to the Bisa/Mossi farmers, and regard themselves as a part of the village society. An often used expression is "our Fulani" or visa versa "our Bisa" indicating a sort of ethnically based intra-village specialisation.

The herding of the animals is dependent on the available natural resources. Grazing distances are normally of a moderate magnitude (less than 30-40 km). The grazing pattern is determined by the availability of pasture and water and the forced exclusion from cultivated areas. During the cultivation period in the rainy season, the herds are taken to distant pastures and led to the watering points following more or less permanent pistes. However, as the pistes are few and badly fenced off if at all, divagation can be hard to avoid leading to damaged crops, disputes and claims for compensation. After the harvest the herds are brought back to the village fields to graze on the crop residue. During recent years the Fulani have been forced to move the animals to distant pastures often permanently, as the grazing resources left between the fields are too few. The elders stay behind in their old settlements.

It is common that the sedentary Fulani tend the animals of the Bisa/Mossi farmers in an entrusting system. According to Faure (1990) 40% of the cattle in the region is owned by the Bisa/Mossi farmers and entrusted to the Fulani. Up to 2/3 of the cattle of the Fulani may be owned by the Bisa/Mossi farmers and it is further estimated that between 1/6 and 1/3 of the Bisa/Mossi farmers have at least one head of cattle entrusted to the Fulani (Delgado 1978, Delgado 1979a).
The entrusting is an important factor in the productivity of the farmers as it allows him to use his man power entirely on the cultivation while ensuring the most skilled herding of his animals. It was showed in a 20 year old study from the region to be the economically most feasible way for the Bisa/Mossi farmer to keep cattle, mainly based in the elevated opportunity costs of labour especially in relation to the critical weeding period (Delgado 1979).
As the remuneration of the Fulani for taking care of the farmers animals is rather modest, and as the animals entrusted often are males used for draught that do not yield milk and often are more difficult to guard, the Fulani are reluctant to take the farmers' animals unless they have so few themselves that they are forced to. In times of increased competition and many instances of crop damage by the animals, the trust that the farmer necessarily must have in the Fulani is being undermined, and the relationship between the two groups is close to being hostile.

2) The animal husbandry of the sedentary Bisa/Mossi farmers is on a much more modest scale compared to the previous two forms. Small ruminants and poultry are

more important and cattle though widespread, probably only common among the better off farmers. It is estimated that around 1/3 of the Bisa/Mossi farmers have cattle (Danida 1995, own data).
The cattle are primarily used as draught animals but also as saving or fattening with the object of profitable sale in the near future. With the emergence of the cart the donkey has gained importance.
Farmers who have only few animals for draught normally have their children tend the them on fields and pastures close to the household.

3) Animals of transhumant Fulani passing through the area from distant villages in the north towards the south in search of pasture, residue grazing and water. They come with large herds often consisting of more than 100 heads and may very well outnumber the local stock.

Commercialisation

The region's proximity to the two important export markets, Ghana and Togo, constitutes relatively favourable conditions for local market development with respect to animal husbandry, under the precondition that the infrastructure is established and reliable.
The Fulani and the Bisa/Mossi farmers sell their animals either to traders who come to the Tenkodogo or other commercial centres, and hire Fulani to escort the herds on foot to the neighbouring countries where they are sold on the large markets. The most common markets are Ghana and Togo, where Ghana seems to have taken the lead after the devaluation. The devaluation of the CFA had a very positive impact on the profitability of the animal husbandry, and the export of live animals from Boulgou have risen six fold since then, although data are somewhat unreliable[3](DSAP 1995).

Intensification

In previous chapters has been stated that elements of an intensification process can be found in the study area. These elements take the form of more consistent use of manure and crop residue, technological adoptions like animal traction for ploughing, weeding and transport, abolition of fallow, introduction of new and improved crop varieties, and fodder cultivation. It is however, questionable to which extent these new practices have been established in the region, what the driving forces behind them are, and what the rate of change over time may be. The following is a discussion of the process of intensification, its origin and characteristics, and how it is related to the Boulgou Province.

Intensification is a term very central to the character of a given agricultural system. In fact, the term has often been used as basic criteria for classification of land utilisation systems (Christiansen 1992 p55; Ruthenberg 1980 p14).

[3]Only exports that the traders themselves report to the SPRA are registered. It is well known that much export never is being registered, but the magnitude hereof is unfortunately not known.

Intensification implies an increase in expenditure on units per area cultivated in order to attain higher productivity per unit area (Hiernaux 1994 p23). This may also be paraphrased to a measure of the total output per unit area and time (Kates et al. 1993 p12), that is, it is closely associated to the productivity of the land.
The problem with using this measure is related to the complicated nature of the African rural household. The output of different crops is not readily comparable as it depends on whether the variable is decided to be economic value, nutritional value i.e. calories, or pure weight of the harvest. The fields may have multiple functioning's i.e. staple crops, trees and livestock stubble grazing, mixed cropping may be used, and the timing of the cultivation may be inconsistent. A possible solution to this problem could be to standardise the output to i.e. a staple-food equivalent, however, seldom will the data needed to make an assessment on intensification based on this criteria be present (Ibid.).

Another measure of agricultural intensity was presented by Boserup (1965 p43) as she redefined the concept to focus on *"the gradual change towards patterns of land use which make it possible to crop a given area of land more frequently than before"*. This should be seen in context with a general perception of the evolution of farming systems, where shifting cultivation with forest fallow evolves into bush fallow and later on grass fallow, as the frequency of cultivation of the fallow fields increases and eventually only grass vegetation is able to establish itself (Pingali et al. 1987 p26; Boserup 1965 p20). The final stage in this evolution is the annual permanent cultivation, multiple cropping and the further increased investment-levels of work, capital and auxiliary inputs.

It should be noted, that when increased frequency of cultivation can be seen as a measure of intensification, it is because also fallow land is included in the calculation of land cultivated by the farmer. That is, his total area comprises both currently cultivated and fallow land, and therefore the cultivation of i.e. one more fallow field results in an increase in the labour input and total output of the total land available to him.
The calculation of arable land in relation to fallow was treated by Ruthenberg (1980 p15) who used the R-value to determine the frequency of cultivation and thus classify the farming systems. The R-value was defined as the proportion of the area under cultivation in relation to the total area available for arable farming and more specific as the number of years of cultivation (multiplied by 100) divided by the number of years of cultivation plus fallowing. Hereby shifting cultivation would have a R-value around 10, while permanent cultivation systems are found at R-values of more than 66. With multiple cropping systems the R-value will exceed 100 i.e. 300 for three crops a year.
If fallow land was not seen as an integrated part of the arable land, then increased frequency of cultivation could be seen as expansion. However, a clear distinction between fallow and virgin land should be maintained, at least with respect to the individual farmer.

Despite the complications that may arise from the application of multiple cropping, the use of different fallow practices simultaneously, and the presence of perennial crops not requiring planting or harvest within a normal cultivation cycle, frequency of

cultivation is an often used measure because of the relative ease with which data can be obtained (Kates et al. 1993 p14).
Another possible measure is the combination of technologies being applied. This must again be seen as an acknowledgement of the above-mentioned succession, where technological innovation is part of the autonomous intensification. However, technology in African rural context is not unambiguous as highly intensive systems with elevated labour-input may in-fact be very low-tech. Besides, many creative adaptations of technologies or procedures are common, that may not be defined as technological innovations (Ibid.).
A combination of the above-mentioned indicators may also be applied as demonstrated by Michael Mortimore (1993a p42) who for a study in Northern Nigeria used both frequency of cultivation, labour intensification per hectare and capital intensification per hectare as indicators of the intensification process.
This definition is coherent with the more commonly used indicators changes in crop rotation, reduced fallow and new technologies like ox-mechanisation and improved seeds as listed by Bassett (1994 p15).

Intensification and population growth are often spoken in the same breath. Though intensification may be driven by other factors, increased rural population density is what normally is considered as the trigger for intensification. An increasing population in a given area invariably leads to greater demand for food, leading to inclusion of more agricultural land and more intensive use of the land already under cultivation.

In this process the labour productivity or the output per man-hour is an important factor to consider. As more work is invested into the same land, the output per working hour will decrease because of diminishing returns to labour, or with other words, the farmer has to work more than 10% harder or longer in order to gain a 10% increase in harvest. The same is to some degree valid for the expansion onto new land, as this land most often will be of marginal character. In order to compensate for this diminishing return to labour, investments in improvement of the fertility of the soil and labour-saving technologies may be sought. A typical example is the ox-plough. However, a certain population density has to be reached before the extra costs of acquisition of the animals and the plough, training of the animals, cost of destumping and levelling the fields, and the cost of feeding and maintaining the animals are justified (Pingali et al. 1987 p33).
Boserup saw adoption of new technologies as compelled by the population growth and made feasible by additional labour. Technological change was therefore seen as an endogenous process (Tiffen et al. 1994 p264). As the soil productivity will be improved by the adoption of the yield-enhancing activities the value of the land will rise which also will change the tenure status from commonly owned to privately property and thereby give the farmer the security necessary for further investments in conservation and other productivity-enhancing improvements.

Intensification and expansion, conceptual discrepancies?

When faced with increased demand for agricultural production the first reaction of the farmer will probably not be to invest in new technology, soil fertility improvements or shift to cash crops. Rather he will cultivate the land he already uses more frequently or he will seek new land upon which to expand his agricultural production. The more frequent cultivation of fallow land can be defined as the beginning of the intensification itself as discussed in previous chapters, whereas the agricultural expansion is a common process that does not seem compatible with a sustainable development of the agricultural system. As can be seen in the diagram below, it is a process that to some degree counteracts the intensification process.

	Output/work-hour	Output/area	Input/area	Work-hour/capita
Expansion	down	down	down or nil	up
Intensification	down	up	up	up

Both processes will result in a fall in output/work-hour because of diminishing returns to labour, the cultivation of marginal land and an increased workload for the farmer. However, when the output/ha increases with intensification due to technical and agro-ecological improvements, it decreases under expansion because of declining soil-fertility on old fields and the inclusion of new fields often of inferior quality. The same goes for the input/area that under expansion may be expected to remain unchanged or go down as the farmer may have difficulties applying the same amount of labour to new fields as well as to the old. For both processes the work-load per person will increase.

It is estimated that about 80 percent of the growth in African agriculture originates from expansion of land under cultivation (Kates et al. 1993 p.7). This will be the most economic response to increased demand for production unless the virgin land is in such a state that clearing and preparation becomes too arduous. A certain threshold for the rentability of clearing new land will determine whether or not alternatives will be considered. This of course, will be very locality specific, as it depends on the "resistance" of the land i.e. the vegetation that must be cleared, the soil conditions, the previous use if any, the usufruct rights, the distance etc. The expansion onto virgin land may be followed by new settlement seasonally and later on permanently.

Increased frequency of cultivation and eventually abolition of fallow is likely to take place simultaneously or before the expansion until declining yields forces the farmer to expand or to intensify i.e. by means of manure or fertiliser application and more elaborate land preparation techniques. This is also where draught animals and ploughs may be introduced as a labour-saving technological innovation or change that can offset the diminishing returns to a single input like labour (Tiffen et al. 1994 p264). Ox-mechanisation therefore also may be seen as part of the expansion process as it allows the farmer to cultivate a larger area per work-hour.

Expansion and intensification are therefore interrelated in the way that they both signify the agricultural development, however at somewhat different stages in the process. Expansion may be seen as forerunner for intensification should the necessary preconditions be present as will be discussed later on (page 227).

Population growth or market incentive as driving forces

It was mentioned previously that intensification may not be driven by the population growth alone. Population growth gives rise to increased consumption-based needs leading to intensification as an endogenous process. However, demand of commodities from markets is a factor that also may influence the intensification process and then largely through exogenous mechanisms associated with technological changes from public and commercial experimental institutions (Kates et al. 1993 p10).

In a rural African context it will be very difficult if not impossible to distinguish between the population pressure and the market incentive as driving forces behind intensification as the farmer normally produces for subsistence and the market alike, and often in a very responsive and flexible farming system combining an array of technologies each appropriate for the exploitation of a specific environmental and socio-economic setting.

What can be done though, is to try and define the direct effects the market forces will have. Increased market integration will translate into higher prices for the crops cultivated and a consequent higher return to labour, leading to larger areas being cultivated (Pingali 1987 cited in Mortimore 1993 p17). Also the need for income in the household will increase when more of the basic goods are acquired through the market. Eventually the higher value crops may substitute lower value crops and the income from the market be invested in more efficient equipment, leading to an amplification of the effect of the population pressure on the intensification process (Ibid. p17).

However, such a high market integration is not likely to be found in Boulgou-like environments, why the needs of the growing population must be expected to be the determining factor.

New life to the intensification paradigm?

Boserup's thesis originally was based on empirical findings, and new empirical studies have revitalised her findings by confirming the ability of the local population to improve on their situation through counter-erosive measures and increased market integration (Tiffen et al. 1994; Meertens 1996; Kates et al. 1993).

New optimism is therefore arising instead of the general fear of the calamitous consequences of the population growth. However, empirically based examples of a "Malthusian" outcome or the downward spiral ending at a low-level steady state can also be found (Ruthenberg 1980; Webber 1996). The environmental constraints may simply be so strong, that they impede agricultural growth, or the high levels of input may result in an intensification that is not justified by the population density (Kates et al. 1993 p18).

The intensification when started does not necessarily lead to measures to counter the increased frequency of cultivation. Geertz (1963) describes for Indonesia the process of involution where the increasing demand is met with decreasing marginal returns to inputs. The fertility of the soil may deteriorate, erosion may become more pronounced in case the intensification is not followed with appropriate counter-measures. The social relationships may also change towards a more unequal society where the better-off farmers are the ones that gain most from intensification as they are ones who can afford the investments, a process known from the "green revolution" of Asia, but also from introduction of animal traction. The farmer may be burdened with extra work which easily could lead to even more pressure on the women and worsening of their situation.

Competition and conflicts will almost invariable be part of the intensification process, as the usufruct rights to the land in Africa most often are rather obscure, and as the value of the land will increase with increased population growth. Besides, an intensification based on technological innovations and market integration, will with little doubt lead to increased dependence on external factors upon which the farmer has no influence. This could be the prices on input supplies, tools, fodder resources and the prices on the products produced.

Thus, serious uncertainties are associated with the intensification process in sub-Saharan Africa which is rather well framed with the words of Kates, Hyden and Turner (1993 p21):
"Long-term population growth and economic development usually do not take place without intensification and agricultural growth, although intensification and agricultural growth do not inevitably follow population growth and are not necessarily beneficial or sustainable"

Livestock in the intensification process

Livestock will become more integrated into the crop-farming as the intensification progresses. At low population densities it will be cheaper to specialise in animal husbandry as fallow makes manuring and the need for animal traction superfluous. The extensive agriculture creates few interactions, and those that occur mainly take place through markets or contracts among specialised groups (McIntire et al. 1992 p24).
When population density increases the competition over and the value of the land increases, and the need for manure and animal traction will also increase. At the same time the expansion of agricultural land will provide more crop residue usable as fodder and the costs of livestock integration will therefore be lowered thus reinforce the integration (Ibid. p36). The former pastoralist will also become part of the integration process as the land available for grazing decreases and he therefore becomes increasingly dependent on access to crop residue for fodder which will give him the incentive to cultivate himself.
Accordingly, the cost of having animals is likely to decrease with intensification and the crop-livestock competition should therefore also diminish, at least temporarily.

As the intensification process progresses, livestock will according to the Boserup model become increasingly dependent on labour-intensive feeding systems like fodder cultivation, cut grass and browse and crop residue. Their value will increasingly be seen as suppliers of draft power, manure and milk rather than accumulation of capital value as would be typical under less intensive systems (Mortimore 1993 p17). Actual intensification of livestock may consist in feeding on cultivated fodder, stable feeding, or to a higher degree being fed with purchased inputs. It follows that low input livestock systems are likely to disappear when faced with land scarcity and increased resource competition between livestock and crops (Kaufmann and Shapiro 1994 p2).

A similar succession of livestock intensification has been described by Mary Tiffen (1994a p4) partly with reference to the Machakos study (Tiffen et al. 1994). Here five stages are used to distinguish the different intensity levels:

- Pastoralist system where population density is low, commercialisation difficult and labour and capital scarce.
- Ranches where labour remains scarce but capital for fencing systems and water points is more readily available.
- Agro-pastoralism where subsistence cropping near a fixed home is combined with extensive management of livestock over a large area.
- Commercialised mixed farming where animals on private enclosures are fed by a combination of grazing and crop residue.
- Further stage of intensity where animals are tied or penned, and fed with crop residues and cut (and often grown) fodder.

A recent study by Bourn and Wint (1994) showed a statistically significant positive correlation between livestock biomass, intensity of land use and density of human populations. These findings indicate that animal husbandry is part of the intensification process itself. The authors propose that the findings may be seen as consistent with the Boserup hypothesis of autonomous intensification through initial co-existence and gradual integration of animal husbandry within local farming systems (Ibid. p12). The attractions for animal husbandry in connection with agriculture are better access to fodder resources on fallow land and crop residues, proximity to markets and services and in some cases the availability of water (Bourn et al. 1994a p32).
An interesting questing also raised by Ian Scoones (1994 p13) then would be from where all these animals in the closely settled areas get their feed? If the animals get their feed from natural grazing then large areas must be set aside for grazing as noted by Boserup (1965 p35) in connection with introduction of draught animals under short fallow. Crop residue may provide a better grazing resource than natural grazing (McIntire 1992 p43), but then careful management of these and other key resources becomes imperative (Scoones 1994 p13). A consequence hereof may be a need for a relatively high degree of mobility, especially during the rainy season when the animals must be kept well away from the crops in order not to induce serious damage.

There are therefore both empirically and theoretically reasons to believe that animal husbandry has an important role to play in the intensification process. Both as investment object and production asset, but also as supplier of manure and draught power.

Before relating these findings to the Boulgou province where some of these processes may be expected to take place, it would be interesting to consider what kind of condition that most likely must be fulfilled for the intensification to take place.

Preconditions for intensification

The rather ambiguous consequences of the population growth has been revealed through several studies that also comprise different preconditions. For an autonomous intensification process to take place, the area must have some initial potential. Without this development potential in the form of some market infrastructure, some agro-ecological potential of the natural resources and some knowledge of or tradition for exploiting this potential, it seems unlikely that population growth would lead to anything but migration.

An interesting case in point of a positive intensification process is presented by Tiffen, Mortimore and Gichuki (1994) from the Machakos district in Kenya. Here high population growth recorded since 1930 has led to a remarkable agricultural growth and investments in conservation. The systems have been so successful that the agricultural production has been able to keep up with the population growth, and has done so through ecologically sustainable practices.

One of the most important measures applied has been terracing of the sloping fields. In some places up to 100% of arable land has been terraced. Other factors have been introduction of improved maize varieties back in the 1960s and ox-ploughs introduced in 1910 and adopted by 62% by the 1980s. Altogether 35 field and horticultural crops, 5 tillage technologies and 6 methods of soil fertility management were adopted by the Machakos people (Mortimore et al. 1995 p76). The introduction of ox-ploughs had the consequence that cultivated area increased, shifting cultivation came to an end, and row planting together with better weeding replaced broad-casting seed (Ibid. p81). Livestock are for the major part kept in stalls or pens and fed with cut grass, residue and fodder grass cultivated on terrace banks. The manure is collected in the pens and transported to the terraced fields. Though livestock numbers have not kept up with the remarkable agricultural growth, integration of crop and livestock production played a crucial role in ensuring the efficiency of the nutrient cycling system (Ibid. p87). Total livestock production has increased, but cattle per person has declined considerably. Where cattle before primarily were held for investment or savings purposes, they gradually gained additional importance as suppliers of manure and draught power (Tiffen et al. 1994 p89).

Though the Machakos case can be seen as a confirmation of important parts of the Boserup thesis[4], due attention must be given to the preconditions on which the development rests. Especially when the results from Machakos is seen in West African perspective and the question is asked whether a similar development path might be expected here.

Machakos district is relatively advantageously located only 50 km from the capital Nairobi which provides for good market access. Cash crops like coffee is dominating, and fruit is sold to the canning industry. It's possible here to talk of "*opportunities provided by the market*" (Mortimore et al. 1995 p77), a precondition seldom found in semi-arid West Africa.

[4]Though Tiffen et al. places more emphasis on external markets and inflows of new ideas from external sources (Tiffen et al. 1994 p267).

The agro-climatic range from sub-humid to arid environments within the same district, imply that highly potential areas are present that may function as catalyst for general agricultural growth and provide an important basis for diversification. With two rainy seasons it is possible to have two annual crops, another advantage not present in West Africa, and altitude and moderate temperatures in some areas limits evaporation and increases the efficiency of the bi-modal rainfall regime (Tiffen et al. 1994 p275).
Population densities are relatively high with more than 400 persons/km^2 in some areas, and what is very important and rather unusual in an African context, the land title has been secured, based in local customs already established in the 1930s and registered since 1968.
On the other hand, circumstances that Machakos has in common with other African semi-arid regions are "*...low and variable rainfall, low average soil fertility, increasing population densities, and rapid socio-economic change...*" (Tiffen et al. 1994 p.276).

Many factors therefore have had an influence on the positive development of Machakos that may not be found in more "normal" semi-arid environments.

Hyden; Kates; and Turner (1993) have tried to define the conditions under which population growth leads to agricultural growth through intensification. Selected case studies from especially Nigeria but also East Africa showed that factors that most often were related to the two mentioned conditions were surface changes including deforestation, introduction of new cultigens and biotechnological inputs like fertilisers and pesticides, increased market integration, diversification into alternative economic activities especially in relation to migration of young males, and expansion and an overall increase in agricultural production (Ibid. p404). It was furthermore shown that the local population had a larger workload that often became the burden of the women, who was the population group that did not migrate, but stayed behind. Increased social differentiation expressed in increasing discrepancies in access to land and other resources, also formed part of the intensification process. Concerning environmental degradation, it was shown that except under extreme population densities, especially vulnerable areas, or where organisational or socio-economic factors impedes the implementation of conservation activities, the environment could indeed sustain relatively high population densities without decreasing the agricultural potential. Agricultural involution was not apparent until very high population densities were reached. An overall assessment of the effects on the well-being of the population, roughly translated into the availability of food and improvement in general material standard, could not yield an unambiguous picture (Ibid. p408).

On the basis hereof, they identified a set of conditions that could be associated with a successful outcome of the intensification process:

- Favoured environments, basically understood as good soils and staple rainfall that provide least resistance to production or alteration for production.
- Promising location, meaning good market access, infrastructure and accessibility to capital inputs.
- Regions of refuge, that basically consists in a population feeling secure in the location or cultural affiliation.

- Supportive socio-economic organisation and structures, with the most important aspects being flexible tenure rules and arrangements, government policy and functioning markets.

It should be noted, that the cases upon which the above conclusions have been drawn, all had relatively high population densities around or above 200 persons/km^2, which therefore renders direct comparison with the Boulgou province difficult. However, the findings of Hyden et al. does confirm pretty well the findings of Tiffen, Mortimore and Gichuki (1994) from the Machakos meaning that some important preconditions have to be present in order for a successful autonomous intensification process to take place.

Intensification and the Boulgou Province

The discussion on intensification provides the basis for an assessment of whether and what sort of intensification would be expected to have happened and may happen in the Boulgou Province. As described in previous chapters the region is characterised by a relatively high population density, and growth and in-flux of both pastoralists and peasants. However, the population densities are still not as high as have been observed in the successful cases.

The agricultural potential is low, and also the location points to a region with only marginal agricultural growth opportunities. The usufruct rights of the farmers and especially the pastoralists cannot be considered secure, and the official tenure policy is neither clear nor tested out. Therefore, the most important preconditions for intensification as listed by Hyden et al. (1993) and Tiffen et al. (1994), namely a favoured environment, promising location and a flexible tenure system, cannot be said to be present in Boulgou.

However, as described in previous chapters, a certain potential for animal husbandry is present in the form of nearby markets and a favourable environment. Besides, the future irrigation management plan envisaged for the Bagré Lake, does nevertheless point to some positive circumstances.

It therefore can be concluded that the preconditions are not as favourable as they have been in areas where a positive "Boserupian" development have taken place.

The Kusasi area a bit further downstream of the Nakambe (previously White Volta) in the northern Ghana may serve as a case giving some clues as to the prospects of Boulgou.

This region neighbouring Boulgou to the south, is environmentally very similar. The population density as well as the precipitation is slightly higher than in Boulgou, but agricultural practices, agro-ecological potential and the recently opened onchocerciasis areas are similar. The governmental influence or support may however be lower than in Boulgou, as this northern-most part of Ghana officially has been regarded as marginal and primarily as supplier of labour for Ghana's southern core cash-crop and mining areas (Webber 1996 p444). In Burkina Faso, the southern parts of the country represent the highest potential, and more official interest may therefore be expected to be invested here.

Paul Webber (1996 p437) describes the Kusasi area as being more typical of the densely settled areas of the semi-arid trans-Volta region of West Africa than the Machakos area. His study of this region concludes, that in spite of a 20% adoption of the ox-plough, which enabled the farmer to cultivate a larger area, the region is so marginal economically and environmentally that the intensification has not been able to start, with the consequences that the fertility of the compound fields has declined so drastically that they no longer can provide necessary subsistence for the households. As in Boulgou, the farmers have begun to clear the dense savannah woodland in the recently opened river-valleys, and have begun to move to the valleys on a semi-permanent basis as a response to the declining fertility and outcome of the compound fields. The petty trade present in the area and the remittances from migrated family members have not been able to provide the necessary capital for investment, and government support has been insufficient. Webber therefore concludes, that the population growth alone has not been sufficient to trigger the intensification process in the Kusasi area.
Livestock is very little described in webber's study, and only in relation to provision of draught power and manure supply as in the classical mixed farming model. Therefore Boulgou may have an advantage not present in Kusasi.

According to the standard intensification models described in previous sections several changes would be expected to occur in the Boulgou province should the preconditions be fulfilled. Concerning crop-cultivation, the intensification would result in increased frequency of cultivation, increased mechanisation in the form of the ox-plough, privatisation of land, introduction of higher yielding cash-crop varieties and increased use of manure, fertilisers, herbicides and pesticides.
For the animal husbandry this intensification would lead to use of fodder cultivation, changes in herd-composition towards higher proportion of reproductive cows, more intensive use of crop residue and manure, increased market integration and possibly less mobility.
These things have only, as discussed previously, partly taken place in the Boulgou Province. Some of them like fodder cultivation has been introduced by the local agricultural services, but not yet gained momentum. This may be explained by the fact that not all the enabling conditions for an autonomous intensification are present, or at least are not sufficiently influential. Factors that here come into mind are the modest agricultural potential of the region. The climate too dry and the soils too poor to sustain larger capital investments in tools, draught oxen, improved varieties or appliances. The market incentive for the cultures are not sufficiently important to justify a shift from subsistence cultures to cash-crops.
Concerning animal husbandry the fodder cultivation is too arduous when alternative natural pastures are still available, while the other mentioned factors can already be identified however, at differing intensities. This confirms that some modest sort of autonomous intensification has taken place within the animal husbandry, but that the crop-cultivating part of the activities in the region are predominantly characterised by expansion rather than intensification. Also in the light of the Kusasi example it therefore seems likely, that the lack of intensification in agriculture means that expansion will continue with opening of the riverbeds at the expense of grazing areas with nearby water-resources. Important grazing resources therefore disappear with

negative environmental and economic consequences as it lowers the economic potential of the animal husbandry. The animal husbandry (and the Fulani) will become increasingly dependent on access to residue grazing on the farmers' fields and become even more dependent on cultivation themselves. Instead of mutual benefits of the animals develop as the intensification proceeds, the expansion leads to increased competition as the need for traction and manure will be less pronounced. The animal husbandry, which in these areas represents an economically and ecologically sound strategy, is therefore becoming increasingly marginalised forcing them to emigrate, thus exposing the Fulani as an ethnic group to a very uncertain future.

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Investing in Wildlife - Can Wildlife Pay its Way?

by

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Abstract

The paper analyses economic and ecological mechanisms determining wildlife investments in the context of pastoral exploitation of the semi-arid African rangeland. We consider a group of pastoralists practicing two production activities, cattle herding and wildlife harvesting. Livestock and wildlife interact with each other as there is competition for grazeland. A bioeconomic model is formulated to analyse this interaction and the pastoralist's optimal degree of investments in livestock and wildlife. The factors working in the direction of threatening the wildlife are identified. Next, the management problem is analysed in a conservation perspective where CITES-polices are imposed, and where there is international payment for conservation of endangered species.

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1. Introduction

African wildlife is today threatened from a variety of sources. This threat is particularly severe in regions with dense and fast growing human populations, where expanding settlements, crops, and livestock are displacing wildlife at an ever increasing rate. The last decades observed decline in wildlife abundance has called for actions to protect wildlife. Nationalization and privatization of local wildlife resources has become common, and traditional hunting practices have been subject to various regulations. To a large extent, wildlife has been appropriated by the state through establishment of national parks and protected areas (Bardhan 1993; Marks 1984).

The above description is todays stylized facts situation of sub-Saharan Africa, and reflects a land-use and wildlife management policy based on *protection* rather than on *utilization* (for further details, see Skonhoft 1997). For local human populations, formerly relying on natural resources for subsistence, this policy has often implied criminalization of their traditional rights to harvest as well as loss of land for cultivation and pasture. Prevented from utilizing the wildlife as well as eliminating 'problem' animals to protect their crops and livestock, the local people often bears the costs of conservation without obtaining any benefits from it. A rather negative attitude towards wildlife conservation has therefore emerged, and resentment of legal regulations are frequent (Marks 1984; Swanson and Barbier 1992; Wells 1992)[1]. Combined with limited capability of the governments to finance their large protected areas and enforce wildlife laws, the expediency of the present conservation policy is therefore seriously questioned (Martin 1993; Marks 1984; Kiss 1990; Swanson and Barbier 1992)[2].

When considering the problem of wildlife conservation in wildlife areas not already under protection, the importance of analysing alternative conservation policies therefore emerges. Land areas not under crops or permanent human settlement and not protected, constitute about 85 percent of the African continent (Martin 1993). These areas of arid and semi-arid land are habitats for a great variety of wildlife and plant species, but also here the humans constitute an increasing threat to the wildlife. Land tenure is mostly communal. Access to land is therefore generally determined by presence and traditional rights, and the rural people are constantly bringing their production activities, basically domestic livestock, deeper and deeper into these wildlife habitats (Martin 1993). The productivity of livestock production here is generally low, but the process of rapid human population growth give rise to shortages of high-productive land and thereby forces humans to bring their specialized production activities into ever more marginal areas (Eltringham 1987)[3]. For sub-Saharan African wildlife, the process of land-use conversion is devastating. Firstly, because it directly degrades wildlife in

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[1] African rural people also lack knowledge of the legal system, and those familiar with often disregard it (Martin 1993).

[2] Martin (1993, p.6) writes that 'Africa may have already made the mistake of accepting a conservation legacy beguathed to it by its former colonial governments: it has too many and too large a system of protected areas to be able to meet their minimum levels of operating costs...In the case of African conservation areas, more and bigger is not necessarily better: less and fewer would result in better conservation by the state'.

[3] The extent and speed of this process of land-use conversion is well illustrated by the fact that between 1960-1980 the proportion of land areas dedicated to specialized species in developing countries alltogether increased by 37.5% (Brown et al. 1993).

these areas without any status of protection. Secondly, it threatens wildlife even in the protected areas because buffer stocks degrade.

In these vaste areas of low productive arid and semi-arid communal land, it is argued that wildlife has a significant potential as an alternative, or complementary, land-use option to domesticated species. If this potential is realised, it is believed that *wildlife utilization* could be a viable land-use option, thus creating incentives for humans to *invest in wildlife* and thus reversing the trend of land-use conversion and species decline (Barnes 1996; Martin 1993; Brown et.al 1993; Swanson 1994; Swanson and Barbier 1992; Swanson 1993; Holdgate 1992; Eltringham 1987; Kiss 1990). This will be the perspective in the subsequent analysis of wildlife utilization and conservation. The focus will be on the rural population's incentives to invest in *wildlife* compared to *domestic livestock*, and in particular, we will study factors affecting the choice of wildlife and cattle stocks made by a group of pastoralists having sole access to a fixed area of semi-arid rangeland[4]. The land is supposed to be communal and there are no formal regulations of the pastoral activities. However, there will be informal structures present regulating individual grazing and harvesting rights within the group of pastoralists. Hence, we are looking away from any problems of the 'tragedy of the common' type so the pastoralists are treated as a homogeneous group[5].

As it is well known, pastoralism takes several forms of economic and social organization. In what follows, we will think of pastoral nomadism in its pure form; that is, pastoral nomads not involved in agricultural production at all (Konczacki 1978). The group of pastoralists considered in the following is therefore cattle herders. In addition, they are involved in wildlife utilization in the form of hunting. The livestock provides consumptive benefits in the form of meat and skins. But the livestock also provides products, such as milk, when not beeing slaughtered. The livestock, but also the stock of wildlife, will be considered as assets for the pastoralists, where the harvesting determines the investment activity. However, investing in livestock will influence the wildlife stock, and vice versa, because all species compete for the scarce factor grazing land. It is therefore an ecological interdependency between the stocks which also translates into an economic interdependency.

We start in section 2 to present this ecological system of livestock and wildlife. The benefit function of the pastoralists is also formulated here. In section 3, we solve the model and find the pastoralist's optimal investment in livestock and wildlife. Factors working in the direction of threatening a viable wildlife population are also analysed here. In section 4, we discuss some policy implications and analyse the model in a conservation perspective. Particularly, we analyse the introduction of a stock value of the wildlife, representing existence value,

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[4] Pastoralism is widespread, and the pastoral economy is still dominant in large parts of sub-Saharan Africa (Prins 1992). About 25 percent of the region's human population are relying on domestic livestock for their primary dietary and exchange needs (Smith 1992). Moreover, pastoralism has its greatest economic significance for those living in the least developed areas of the region. In these areas livestock holding is the main production activity, and because the land is basically of the arid and semi-arid type, pastoralism is the principal mode of livestock production (Konczacki 1978).

[5] This means that we have a setting in which individual conformity to group norms is prevailing among them. In line with traditional reasoning, it is supposed that the elders are in charge of their activities (Marks 1984).

biodiversity and so forth. This will be the public good value of endangered species. The effects on the ecological system and the harvesting activity of imposing the stock value through international payment for conservation are analysed. Moreover, the effects of the policy recommandations of the Convention on International Trade in Endangered Species (CITES; Barbier and Swanson 1992) are analysed.

2. Population dynamics and the benefit function of the pastoralists

As already noted, there are two production activities practiced by the group of pastoralists, namely cattle herding and harvesting of wildlife. Both activities are constrained by the population dynamics of the livestock and wildlife, where one stock is assumed to represent the whole wildlife population. The dynamics are given by equations (1) and (2), where (1) is for wildlife and (2) for cattle. X (wildlife) and Y (cattle) are the biomasses at a given point of time (the time index is omitted), F(X,Y) and G(Y,X) are their accompanying natural growth functions and f and g are the rates of harvesting[6]. Natural growth are assumed to be density dependent following humped curves increasing to peak values for intermediate values of the own stock size ($\partial F/\partial X = F_X > 0$ for $X < X_{msy}$, $F_X \leq 0$ for $X \geq X_{msy}$, $F_{XX} < 0$ and $G_Y > 0$ for $Y < Y_{msy}$, $G_Y \leq 0$ for $Y \geq Y_{msy}$, $G_{YY} < 0$). In addition, the stock growth decreases with the size of the other stock ($F_Y < 0$, $G_X < 0$). In what follows, we will all the time assume that the natural growth functions obey the properties of logistic growth as given by equations (1') and (2') with K and L as the carrying capacities in the absence of the other stock, r and s as the maximum specific growth rates and α and β as the interaction coefficients. Thus, αXY represents the biomass of wildlife lost per unit of time because of the competition from the livestock while βYX gives the biomass of livestock lost because of the competition from the wildlife. The specific functional forms (1') and (2') will also be used in parts of the analysis.

(1) $dX/dt = F(X,Y) - f$

(1') $F(X,Y) = rX(1 - X/K) - \alpha XY$

(2) $dY/dt = G(Y,X) - g$

(2') $G(Y,X) = sY(1 - Y/L) - \beta YX$

The ecological system with the specific functional forms (1') and (2') represents therefore the Gause model of interspecific competition (see, e.g. Maynard Smith 1974). It can be easily confirmed that the model without harvesting ($f = g = 0$) does not cause oscillations. The equilibrium is either of the unstable saddle-point type or it is a stable one. That is to say, if the system is perturbed away from equilibrium, an equilibrium with both species present or an equilibrium with just one of the species surviving will be the outcome. The actual outcome depends on the degree of competition between the two populations. The degree of ecological competition will also be crucial for obtaining a meaningful economic solution of the model (see below).

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[6] It is therefore assumed that the pastoralists do not influence the natural growth of their cattle, say, through selective harvesting.

The current benefits of the pastoralists are given by equation (3). The first term represents the harvesting benefits related to the wildlife with p as the fixed price of the offtake. The second term gives the harvesting benefits of the livestock where q is the offtake price[7]. In addition, there will be stock benefits from the cattle as given by W(Y). As already noted, it can represent various animal products (e.g. milk). In addition, it can represent a measure of status as well as an insurance motive (Konczacki 1978; Smith 1992; Perrings 1993; Walker 1993; Livingstone 1991; Collett 1987; Dasgupta and Mäler 1995). It will therefore be assumed that more cattle means more benefits so $W_Y > 0$ holds, Furthermore we assume that $W(0) \geq 0$ and $W_{YY} \leq 0$, so the stock effect has strong similarities to the so-called 'wealth effects' in models of optimal growth (Kurz 1968). To shed some further lights on the results, the linear functional form $W(Y)=wY$ will be applied in parts of the analysis.

(3) $\quad U = pf + qg + W(Y)$

Equations (1) - (3) are the basic equations of the model which we now are ready to analyse. We start by analysing what will be termed the market solution of the model. In section 4 we add a public good effect to the benefits of the wildlife and analyse overall optimality.

3. Optimal production and stock sizes of the pastoralists

Due to the biological competition between the two populations, the pastoralists face a trade-off between keeping livestock and wildlife as assets. In what follows, we assume that the behaviour of the pastoralists is steered by long-term considerations and that they seek to maximize the present-value benefit stream[8]. The optimal stock investments are then found by maximizing of equation (4) where δ is the rate of discount, subject to the ecological constraints (1) and (2).

(4) $\quad PV^* = \int_0^\infty [pf + qg + W(Y)]e^{-\delta t}dt$

The current-value Hamiltonian of this problem is $H = pf + qg + W(Y) + \mu[F(X,Y) - f] + \lambda[G(Y,X) - g]$ with f and g as control variables, X and Y as state variables and μ and λ as the shadow prices (costate variables) of wildlife and livestock, respectively. Equations (5) and (6) yield the reduced form necessary conditions for maximum when an interior solution is supposed to be present (positive stock sizes, and positive harvesting rates at the steady state, see also the Appendix). These equations represent a 'double singular' jointly determining the

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[7] For simplicity, it is assumed that the stock sizes do not affect the harvesting costs. It is also assumed that the costs are linear in the offtake. Analytically, these two assumptions come down to the same as assuming that there is costless harvesting so p and q can be interpretated as offtake prices.

[8] Instead of long-term utility maximization, Walker(1993, p.80), among others, argues that the behaviour of pastoralists in semi-arid regions is directed to 'maintain the maximum number of animals (livestock, A.S and J.T.S) which satisfies a number of subsidiary aims, such as drought and status in the community'. This is a rule-of-tumb-type of behaviour where the size of the livestock plays a crucial role. Because a stock effect also is included in the present benefit function, parts of Walker's argument is captured in our model.

long-term equilibrium stocks as X^* and Y^*. In addition, the steady-state offtake rates follow from equations (1) and (2) as $f^* = F(X^*, Y^*)$ and $g^* = G(Y^*, X^*)$ when $dX/dt = 0$ and $dY/dt = 0$, respectively[9]. The stock equilibrium is depicted in Figure 1. As indicated, (5) will intersect with (6) from above when X is measured along the horizontal axis. This will be so because of the second order conditions for maximum (again, see the Appendix).

(5) $F_X(X,Y) = \delta - (q/p)G_X(Y,X)$

(6) $G_Y(Y,X) + W_Y(Y)/q = \delta - (p/q)F_Y(X,Y)$

Figure 1 about here

Equations (5) and (6) are the present version of the Clark-Munro rule (Clark and Munro 1975). The equilibrium condition of an optimal harvesting strategy of the livestock in equation (6) is extended with the marginal non-consumptive benefit component W_Y/q which partially works in the direction of driving the size of the livestock up. In addition, there is the competition effect $(p/q)F_Y$ from the wildlife here, and this effect works in the opposite direction. A competition term is also present in the long-term equilibrium condition for the wildlife (5) and $(q/p)G_X$ works also partially in the direction of driving the stock size down. Because of the absence of a non-consumptive benefit component here, the wildlife stock size will always be at a point where $(\delta - F_X) < 0$ holds. On the other hand, we will have that $(\delta - G_Y) > 0$ holds if W_Y/q dominates $(p/q)F_Y$, while the opposite will be true if the non-consumptive stock effect is small and the marginal value of the biomass loss at the same time is large.

By taking the total differential of equations (5) and (6), we can demonstrate the effects of permanent changes in the economic environment and see what factors are working in the direction of threatening the wildlife (cf. the Appendix). An increased price of the wildlife offtake has unambiguous effects, and contrary to the standard harvesting model (Clark 1990), we will have $\partial X^*/\partial p > 0$[10]. This will be the result because the wildlife has no non-consumptive utility while there is a nuisance to the livestock. The marginal benefit of increasing the stock will therefore be above that of the marginal costs of doing so when p shifts up. Consequently, the effect on the size of the livestock is unambigiously negative, $\partial Y^*/\partial p < 0$, because the livestock face more competition for grazeland when the wildlife stock increases.

The long-term stock effects of a permanent shift in the offtake price of cattle are, however, unclear. This will be so because the stock effect W_Y/q and the nuisance term $(p/q)F_Y$ in the livestock equilibrium condition work in opposite directions. If the nuisance term dominates the non-consumptive stock effect so that $(\delta - G_Y) < 0$ holds, we will have $\partial Y^*/\partial q > 0$ and hence, $\partial X^*/\partial q < 0$ because of more competition. On the other hand, if the non-consumptive stock effect dominates the nuisance from the competing wildlife, the marginal benefit of decreasing

[9] Contrary to a one species model, it seems difficult to find the optimal trajectories of the stocks when originally beeing outside equilibrium. The so-called Most Rapid Approach Path (the MRAP-strategy) does not generally apply to a 'double singular'. But as Clark (1990, ch. 10.3) notes, the MRAP-strategy will be the 'practically acceptable approach' in a two species model.

[10] However, in the absence of stock-depending harvesting costs (as here), the price effect is zero in the Clark-model.

the livestock will be above that of the marginal costs of doing so, and we arrive at $\partial Y^*/\partial q < 0$ and $\partial X^*/\partial q > 0$.

A permanent increase of the rate of discount δ also has unclear stock effects. The reason is that it, first of all, motivates for stock disinvestments due to an increased opportunity cost of the biological capital. Secondly, the grazeland competition for both stocks will be reduced as a result of this first round effect. However, it should be clear that if the competition among the two stocks is relatively low so that the first round effect dominates, the effects of a more myopic view of the future will be that both stocks decrease, $\partial X^*/\partial\delta < 0$ and $\partial Y^*/\partial\delta < 0$. The valuation of the non-consumptive livestock benefits can change as well. This can be analysed by adding a shift parameter $\gamma > 0$ on the left hand side of equation (6) (see the Appendix). The effect on the livestock is obviously $\partial Y^*/\partial\gamma > 0$, while $\partial X^*/\partial\gamma < 0$ will hold because of more competition for grazeland. Hence, a higher marginal livestock valuation will therefore always shrink the wildlife stock.

While the general functional forms of the population growth and the benefit functions have given some insight on the economic forces determining the long-term stock sizes, more clear-cut results can be obtained, at the cost of generality, by using the specific functional forms. When introducing F(X,Y) and G(Y,X) from equations (1') and (2') together with the benefit funcion $W(Y) = wY$ (cf. also section 2), the long-term stock equilibrium conditions (5) and (6) changes to (7) and (8) after some few rearrangements.

(7) $(2r/K)X + (\alpha + (q/p)\beta)Y = r - \delta$

(8) $(\beta + (p/q)\alpha)X + (2s/L)Y = s - \delta + w/q$

These equations represent straight lines in the XY-plane and both lines have negative slopes. Again, because of the second order conditions, equation (7) should be more negatively sloped than equation (8). This also means that the determinant of the left-hand side of equations (7) and (8) must be positive, $D = (4rs/KL) - (\alpha + (q/p)\beta)(\beta + (p/q)\alpha) > 0$. Moreover, the conditions for obtaining an interior solution so that both species will be present in the long-term, $X^* > 0$ and $Y^* > 0$, are that equation (7) must intersect with the Y-axis above that of equation (8), and that equation (8) must intersect with the X-axis to the right of that of equation (7). See Figure 2.

Figure 2 about here

The interpretation of the above conditions for obtaining a meaningfull economic solution to the maximization problem, $D > 0$, is that there must be a restriction on the degree of competition between the two stocks, i.e. the interaction coefficients α and β must be constrained in magnitude. Moreover, there must also be restrictions on the relative price of the offtakes if the degree of competition is biased. If, say, the interspecific competition is largely biased in favour of the wildlife so that $\beta \gg \alpha$ holds, q/p must be constrained in magnitude.

Suggested that both $r - \delta$ and $s - \delta + w/q$ are positive, it is also seen (cf. Figure 2) that the condition for obtaining an interior solution also will be satisfied if the interaction between the stocks is not too heavy, i.e just as in the ecological model without harvesting. However, if equation (8) intersects with the Y-axis outside that of equation (7) so that $(s-\delta + w/q)/(2s/L) > (r-\delta)/(\alpha+(q/p)\beta)$ holds, there will be no wildlife in the long term. Hence, if α and β are large (but small enough to satisfy the condition of $D > 0$), there is optimal for the pastoralists to keep only livestock. This will also be so if q/p together with w/q are large, and if the wildlife is slow-growing, r is small, while the livestock at the same time is fast-growing so that s is large.

When applying the linearized model, we are also able to get some clearer comparative static results. The effects of a permanent shift in the price of the livestock are still unclear. However, it can be shown (cf. the Appendix), that we will have $\partial Y^*/\partial q > 0$ and hence, $\partial X^*/\partial q < 0$, if $w < p\alpha X$ holds. This is a simpler version of the same condition above, and says that if the value of the wildlife biomass lost due to competition is above that of the marginal non-consumptive value of the livestock, the pastoralists have incentives to shrink the wildlife stock when the offtake price of the livestock shifts up. The effects of an increased rate of discount are also unclear, however it can be shown that at least one of the stocks will decrease (see the Appendix). Moreover, if a positive shift in the rate of discount affects one stock positively and the other negatively, the stock that is most likely to increase is the one being the weakest competitor in combination with having the lowest offtake price.

4. The conservation perspective and a minimum standard

Summing up the above results from the market solution, i.e. when only the cost and the benefits of the pastoralists influence the stock sizes, we can conclude that a low price of the wildlife offtake always will be a threat to wildlife in the present setting. In the linearized model this threat is also identified as a high offtake price ratio q/p. When the value of the non-consumptive benefit of the livestock is high there will also be strong incentives to shrink the wildlife stock in the long-term. In the linearized model this threat is also identified as a high marginal benefit ratio w/q. Ecological factors also play a role. Consequently, the wildlife will be threatened if there is a high degree of grazing competition among the two stocks and the wildlife is slow-growing species while the livestock cattle is fast-growing.

The degree of utilization and stock sizes in the market solution will, however, differ compared to what is social optimal because there generally will be present a stock value of the wildlife as existence value, biodiversity and so forth, not taken care of by the pastoralists. In particular, this will be so if the wildlife belongs to a relatively rare and threatened species (Krutilla 1967). We therefore now introduce a public good value of the wildlife as given by equation (9). B(X) is also assumed to be non-negative and concave, $B(0) \geq 0$, $B_X > 0$ and $B_{XX} \leq 0$. The public good value can be recognized through national and international conservation groups etc., or it can be recognized by the government.

(9) $\quad B = B(X)$

Current overall benefits are therefore given by $[pf + qg + W(Y) + B(X)]$. Overall optimal stock investments are then found by maximization of (10), again subject to the ecological constraints (1) and (2)[11].

[11] It is usually argued (see, e.g. Markandya and Pearce 1988) that the rate of discount of people living in semi-arid

(10) $PV^s = \int_0^\infty [pf + qg + W(Y) + B(X)]e^{-\delta t}dt$

It can be chequed that equations (6) and (11) give the reduced form long-term necessary conditions for maximum. These two equations therefore determine the long-term overall optimal stock sizes as X^s and Y^s (superscript 's' denotes social, or overall optimality). It can be easily confirmed that we now will have $X^s > X^*$. Moreover, because of increased competition for the livestock as a result of more wildlife, it also follows that $Y^s < Y^*$ will hold in the long term. See also Figure 1. The general conclusion when introducing a non-consumptive good of the wildlife is therefore that the market solution, i.e. the situation when the public good nature of the wildlife is disregarded, will give too little wildlife and too much livestock.

(11) $F_X(X,Y) + B_X(X)/p = \delta - (q/p)G_X(Y,X)$

It is therefore room for economic policy and interventions to move the outcome of the market solution in direction of the social optimal stock sizes. Generally, there will be two types of policy options; direct regulation of the offtake and indirect regulations through economic incentives. In what follows, it will be assumed that the pastoralists feel no obligation to behave according to regulations through the legal system, and that there is no law enforcement to ensure that they do (cf. section 1). The only way considered to direct the investment decisions of the pastoralists will therefore be through economic incentives. The economic incentives may come from foreign policy interventions like CITES or other trade interventions, or by international conservation efforts taking place through direct payment for conservation. But the government may also pursue policy interventions.

The first policy option to be considered is a tax-cum-subsidy to wildlife products, giving a permanent shift in the producer price of the offtake of wildlife. This may be implemented nationally, or by international regulation of wildlife trade, both aiming to adjust the misallocation of the market solution. Because an increased offtake price shifts the wildlife stock up, a subsidy which increases the producer price on harvesting will therefore work in the right direction[12]. It is also clear that the recommendation of the CITES convention to impose restrictions on trade with wildlife products in order to reduce the profitability of wildlife harvesting and reduce the offtake price, will work counterproductive in the present setting. The outcome will namely be less wildlife and more livestock compared to the market solution, and therefore stock sizes that are even farther from what is social optimal[13].

Another policy option is to change the price of the offtake of the livestock. As demonstrated in section 3, such a policy has unclear stock effects in the long-term. However, if the non-

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regions in Africa will be high and well above that of the social rate. In what follows, however, this discrepancy is disregarded.

[12] However, it should be noted that if the right wildlife stock is reached, it is not generally possible to reach the social optimal size of the livestock. There are namely two targets and only one policy variable.

[13] This result rests to some extent on the assumption that we disregard stock-depending harvesting costs. If, however, marginal harvesting costs from reducing the stock is present and large so that the long-term equilibrium is at a point where $(\delta - F_X) > 0$ holds (cf. section 3), we would have arrived at the opposite conclusion.

consumptive stock effect dominates the nuisance from the competing wildlife, a subsidy which shift the producer price on the livestock offtake up will work in the right direction as the size of the wildlife population will increase. If the non-consumptive stock effect is weak, however, we arrive at the opposite conclusion and the corrected market solution will be even farther from what is social optimal.

A third policy option to achieve overall optimality is to impose a subsidy related to the stock of wildlife. In what follows, we will basically think of this as an international transfer reflecting a direct payment for conservation[14]. When the public good value of the wildlife is reflected through a stock transfer related to the stock size as $T = T(X)$, the objective function of the pastoralists then changes from (4) to (12). The long-run stock equilibrium conditions will now therefore be equations (6) and (13).

(12) $PV^T = \int_0^\infty [pf + qg + W(Y) + T(X)]e^{-\delta t}dt$

(13) $F_X(X,Y) + T_X(X)/p = \delta - (q/p)G_X(Y,X)$

By comparing with overall optimality, the conditions (6) and (11), it is seen that the international transfer rate $T_X = B_X(X^s)$ ($ per wildlife animal per unit of time) and hence, a total transfer of $T = B_X(X^s)X^s$ ($ per unit of time), will bring the market solution in accordance with overall optimality[15]. So using a stock related transfer, it is therefore possible to safeguard the wildlife and reach overall optimality[16].

The above reasoning builds on a cost-benefit analysis framework. As in most cost-benefit analysis there are valuation and distributional problems. The basic problem here is obviously the valuation of the existence value term B(X), recognized internationally by conservation groups etc. However, instead of linking the international conservation interests directly to monetary flows, it can be attached indirectly by setting a *minimum standard* to safeguard the threatened wildlife. For the given economic and ecological environment, a minimum standard $\overline{X} = X^s$ therefore implies an imposed marginal stock value $B_X(X^s)$ of the wildlife and an international transfer of $T = B_X(X^s)X^s$ per unit of time.

More generally, we can think that there is a minimum standard $\overline{X} > X^*$ as in Figure 3. For the given economic environment of the pastoralists, this standard therefore implies a marginal

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[14] See Simpson and Sedje(1996) for a general discussion. They make a distinction between direct and indirect payment for conservation. Indirect payment is efforts intended to commercialize natural products.

[15] This reasoning can also be interpretated in light of the Coase-theorem (Coase 1960) given that the property rights to the wildlife and its habitat is recognized belonging to the pastoralists. In the present context, this implies that the most efficient way to reach overall optimality is that the conservationists should compensate the pastoralists not to deplete the wildlife stock below X^*.

[16] So introducing only one stock related transfer it is possible to reach two targets. The reason is obvious, it hinges on the structure of the equations characterizing the market solution and the social solution. It is namely only one discrepancy which is linked to the size of the wildlife stock. In Figure 1 this is identified as the same long-term stock equilibrium condition for the livestock (6), while the stock equilibrium condition for the wildlife (5) shifts according to the size of the non-consumptive stock effect.

stock valuation like $B_X(\overline{X})$ and a direct transfer for conservation to the pastoralists as $T = B_X(\overline{X})\overline{X}$. The cost of achieving the minimum standard $\overline{X}$ will obviously vary according to economic and ecological circumstances. For example, as noted in section 3, an increased stock valuation of the livestock gives incentives for the pastoralists to bring the long-term wildlife stock down. In Figure 3 this is associated with a shift outwards of equation (6) resulting in a larger wedge between $\overline{X}$ and X^* in the long-term. Consequently, the transfer per wild animal has to increase in order to maintain $\overline{X}$, $\partial B_X(\overline{X})/\partial\gamma > 0$. From the analysis in section 3, we also know that a lower market offtake price of wildlife motivates for depleting the wildlife stock and this is associated with a shift inwards of equation (5) in Figure 3. Hence, a permanent lower offtake price also implies that the transfer pr. wild animal must increase in order to maintain $\overline{X}$ in the long-term, $\partial B_X(\overline{X})/\partial p > 0$.

Figure 3 about here

5. Concluding remarks

In this paper we have, from a theoretical point of view, analysed economic and ecological mechanisms determining wildlife investments in the context of pastoral exploitation of the semi-arid African rangeland. The pastoralists, treated as a homogeneous group having sole access to a fixed area of pasture, is practicing two production activities, cattle herding and wildlife harvesting. Livestock and wildlife interact with each other as there is competition for grazeland. Because of the ecological interdependency, there will also be an economic interdependency. The livestock provides consumptive benefits when being slaughtered (meat, skins etc.) and non-consumptive benefits (milk, status, insurance etc.). Wildlife represents only consumptive benefits for the pastoralists.

It is assumed that the pastoralist's livestock and wildlife investments are steered by long-term considerations and that they seek to maximize present-value benefit. In this setting, referred to as the market solution of the model, the factors working in the direction of threatening the wildlife are identified. It is demonstrated that, unlike the result of the standard harvesting model (Clark 1990), a low price of wildlife products will be a threat to the wildlife. When the value of the non-consumptive benefit of the livestock is high there will also be problems for the wildlife to pay its way so there will be strong incentives for the pastoralists to shrink the wildlife stock in the long-term. The consumptive value of the livestock has an ambiguous effect, but under certain conditions a high consumptive value will be a threat to the wildlife. Brown et al.(1993) recommend increased profitability in agropastoral and pastoral activities to safeguard wildlife populations. This contrasts the results of Schulz and Skonhoft(1996) which find that improved profitability in agropastoral activities always is a threat to wildlife as it triggers land conversion. So even when the land-use is fixed, as in the present model, the effect of improved profitability can be less wildlife in the long-term. Furthermore, it is shown that a high non-consumptive value of the livestock constitute a threat to the wildlife. To the extent that cultural changes and 'modernization' lower this stock value, the threat is therefore reduced.

In a next step, we consider the social optimal stock investments when adding a public good value to the wildlife, as representing existence value, biodiversity and so forth, not taken care of by the pastoralists. The public good value can be recognized through international conservation groups or it can be recognized by the government. The result will be more wildlife and less livestock compared to the market solution. Policies to change the market solution in the direction of overall optimality are then analysed. Efforts used to commercialize wildlife products will work in the direction of safeguarding the wildlife. Hence, policy interventions like CITES will in our setting work counterproductive as reduced profitability in wildlife harvesting will give less wildlife in the long-term. A policy option to increase the offtake price through subsidies of the livestock can also work counterproductive, while an international payment for conservation linked to the stock size of the wildlife will give the pastoralists incentives to increase the wildlife stock and therefore bring the market solution more in accordance to what is social optimal. This last policy option is also analysed in light of setting a minimum standard to safeguard the threatened wildlife, and we demonstrate that the international transfer costs of attaching the minimum standard will vary according to ecological and economic circumstances.

Appendix

Necessary conditions for maximum of the problem in section 3 are $\partial H/\partial f = 0$, $\partial H/\partial g = 0$, $d\mu/dt = \delta\mu - \partial H/\partial X$ and $d\lambda/dt = \delta\lambda - \partial H/\partial Y$. When eliminating the shadow prices, we arrive at equations (5) and (6) which represent a singular system.

The second-order conditions require that the Hamiltonian should be jointly concave in the state and control variables. Concavity of the Hamiltonian means that the Hesse matrix should be negative semi-definite in optimum. It can be easily demonstrated that this requires $F_{XX}+(q/p)G_{XX} \leq 0$, $[F_{XX}+(q/p)G_{XX}][G_{YY}+(p/q)F_{YY}+(1/q)W_{YY}]-[F_{XY}+(q/p)G_{XY}][G_{YX}+(p/q)F_{YX}] \geq 0$ and $G_{YY}+(p/q)F_{YY}+(1/q)W_{YY} \leq 0$. The second of these conditions imply that equation (5) will be steeper than that of (6). Hence, at the optimum (5) will intersect with (6) from above (cf. Figure 1). Increased marginal valuation of the non-consumptive benefits of the livestock is introduced by adding a shift-factor $\gamma > 0$ to (6) as in (A1). The effect of increased marginal stock-valuation is then demonstrated as $\partial X^*/\partial\gamma$.

(A1) $\quad G_Y(Y,X) + W_Y(Y)/q + \gamma/q = \delta - (p/q)F_Y(X,Y)$

The comparative static results are found by taking the total differential of (5) and (A1). (A2) shows the result.

(A2)

$$\begin{bmatrix} F_{XX}+(q/p)G_{XX} & F_{XY}+(q/p)G_{XY} \\ G_{YX}+(p/q)F_{YX} & G_{YY}+(p/q)F_{YY}+(1/q)W_{YY} \end{bmatrix} \begin{bmatrix} dX \\ dY \end{bmatrix} = \begin{bmatrix} (q/p^2)G_X & -(1/p)G_X & 1 & 0 \\ -(1/q)F_Y & (1/q^2)(pF_Y+W_Y+\gamma) & 1 & -1/q \end{bmatrix} \begin{bmatrix} dp \\ dq \\ d\delta \\ d\gamma \end{bmatrix}$$

The determinant of the left-hand side of (A2), $N = [F_{XX}+(q/p)G_{XX}][G_{YY}+(p/q)F_{YY}+(1/q)W_{YY}] - [F_{XY}+(q/p)G_{XY}][G_{YX}+(p/q)F_{YX}]$, will be strictly positive in optimum due to the second order conditions for maximum, $N>0$.

For the specific functional forms of equations (1') and (2') and $W(Y) = wY$, it can be verified that the second order conditions now will be $-2r/K \leq 0$, $(4rs/KL)-(\alpha+(q/p)\beta)((p/q)\alpha+\beta) \geq 0$ and $-2s/L \leq 0$. It is also seen that N boils down to D, as given in the main text.

The comparative static results of the linearized model are found by taking the total differential of equations (7) and (8). (A3) gives the result.

(A3)

$$\begin{bmatrix} -2r/K & -(\alpha+(q/p)\beta) \\ -(\beta+(p/q)\alpha) & -2s/L \end{bmatrix} \begin{bmatrix} dX \\ dY \end{bmatrix} = \begin{bmatrix} -(q/p^2)\beta Y & (1/p)\beta Y & 1 & 0 \\ (1/q)\alpha X & -(1/q^2)(p\alpha X - w) & 1 & -1/q \end{bmatrix} \begin{bmatrix} dp \\ dq \\ d\delta \\ dw \end{bmatrix}$$

From (A3) it can also be demonstrated that a least one stock will decrease when the rate of discounts shift up. It turns namely out that the second order condition for maximum, $D > 0$, will be contradicted if both stocks increase.

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Figure 1
Long-term stock equilibrium under the market solution (X^*, Y^*) and overall optimality (X^s, X^s).

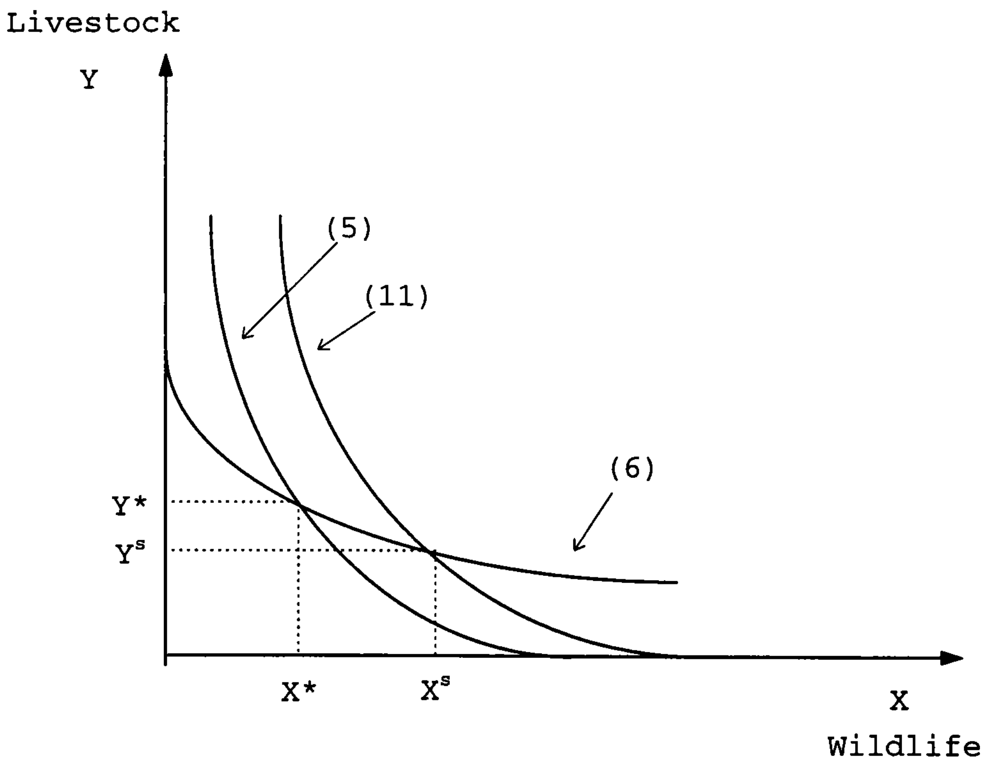


Figure 2
The linearized model. Long-term stock equilibrium under the market solution.

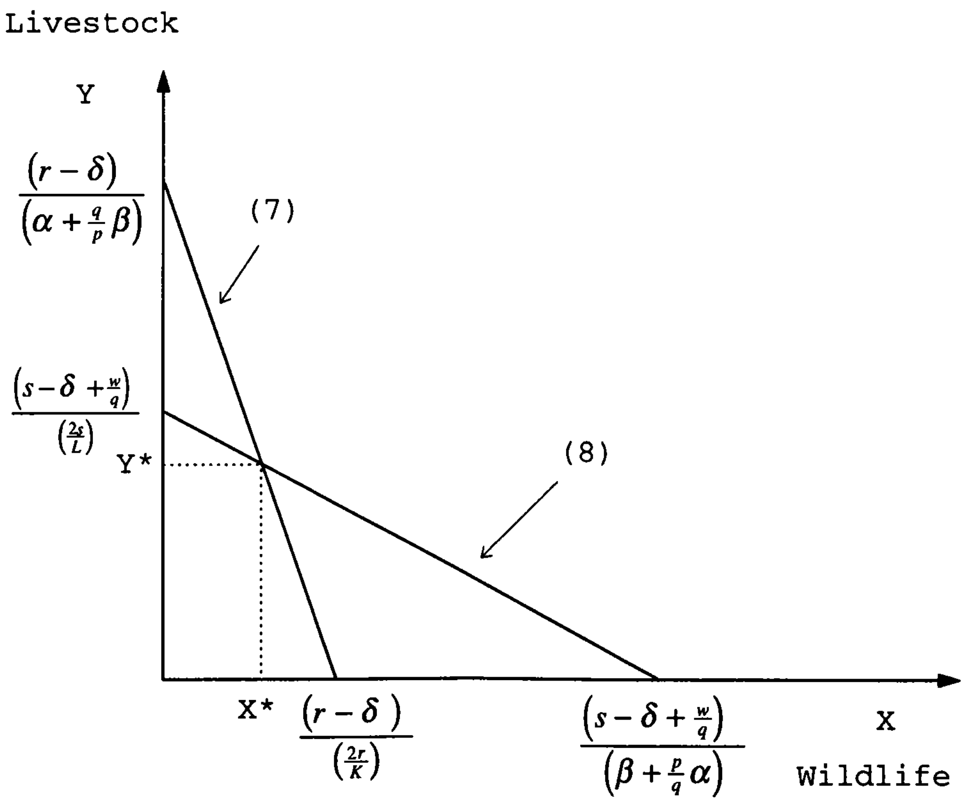
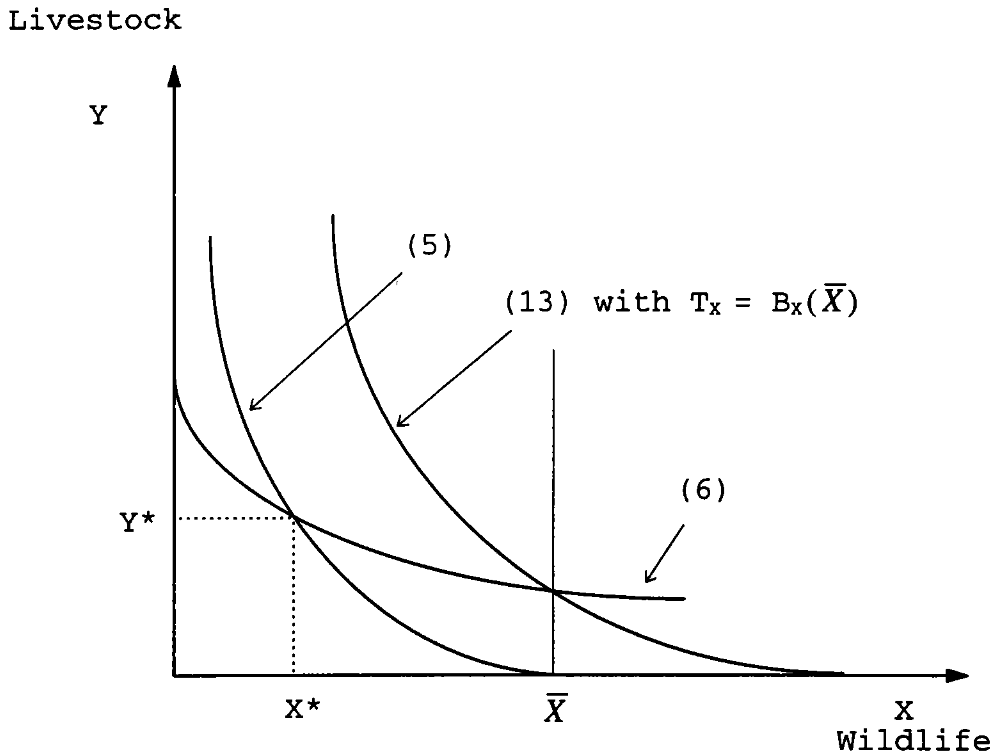


Figure 3
The minimum standard ($\overline{X}$) and the international payment for conservation $B_X(\overline{X})$.



7. The Poverty - Environment Thesis: Was Brundtland Wrong?

by

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Summary

The poverty-environment thesis suggests that the poor are both the agents and victims of environmental degradation. Even though the thesis may have been necessary to avoid a North-South confrontation on environmental issues, the its validity can be questioned. The article argues that the coexistence of poverty and environmental disruption could more appropriately be seen as the joint consequence limited opportunities for some groups, uneven processes of development, an unequal distribution of rights and power, and misguided policies. It also shows that higher income in many cases increases the pressure on the environment. This will in particular be the case when investments and purchased inputs are used to increase the capacity to exploit natural resources, and for pollution related to the use of fossil fuels.

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1. The poverty - environment hypothesis

"Many parts of the world are caught in a vicious downwards spiral: Poor people are forced to overuse environmental resources to survive from day to day, and their impoverishment of their environment further impoverishes them, making their survival ever more difficult and uncertain" (WCED, 1987: 27).

Over the last decade or so the poverty-environment hypothesis has become a major concern of international development agencies and policy makers. Environmental degradation and poverty reinforce each other; the poor are both the *agents* and *victims* of environmental destruction. This is one of the main tenets in the report of the Brundtland commission (WCED, 1987), the World Bank's main report on environment and development (World Bank, 1992), and the one on poverty and the environment by the United Nations Environment Programme (1995). "The fundamental premise of mainstream SD [sustainable development] thinking is the two-way link between poverty and environmental degradation" (Lele, 1991: 613).

The poverty-environment hypothesis is part of the ruling development paradigm. While the debate of the 1970s was heavily influenced by the 'Limits to Growth' thesis, the poverty-environment hypothesis suggests that economic growth is needed to break the poverty-environment downward spiral. The slogan of the World Bank (1992) and others is 'win-win': policies which promote economic growth also benefit the environment, partly because economic growth is supposed to reduce poverty, and therefore enhance environmental conservation.

The preoccupation with the poverty-environment linkage has emerged from two different camps. Those concerned with poverty studies have increasingly realized the importance of the state of the environment in determining the magnitude of poverty. More than other groups, the poor depend on the income derived from the use of the natural resource base. In spite of this fact, "if there has been a single thread running through forty years of investigation into the poverty of poor countries, it has been the neglect of this resource base" (Dasgupta and Mäler, 1995: 2373).

On the environmentalists' side, the role of poverty in resource degradation has become a major concern. Whereas environmental NGOs previously were preoccupied with pure conservation projects, they are increasingly engaged in integrated rural development programmes. Typically, such programmes attempt both to conserve the natural habitat and provide alternative income opportunities for the local community, thereby reducing the dependency and pressure on environmental resources. The experience of such programmes is mixed. 'Buffer zone development', for example, is clearly an attractive idea. "In practice, however, buffer zone development activities seem to be designed basically to decrease local opposition to the establishment and expansion of parks and reserves, rather than to offer sustainable livelihood alternatives" (Ghimire, 1994: 225, based on case studies from Thailand and Madagascar).

Poverty reduction and environmental conservation represent two of the main global challenges. The question is not whether they should be linked or not, but how they are linked. Whereas it is rather indisputable that the poor, because of their heavy reliance on the resources provided by natural environments, often become the victims of environmental destruction, the opposite linkage is far less obvious and open to debate. In some situations short term survival needs give little scope for taking long term environmental effects into account. 'Environmental thinking starts after breakfast', and with no or insufficient meals there will be little environmental thinking.

One needs, however, to go beyond such simplistic explanations. First, one could question whether low income does indeed cause environmental destruction, and - as a corollary to this - higher income (economic growth) will reduce the problem. Second, the relative importance of poverty-driven degradation could be questioned. Should one instead focus on, for example, degradation resulting from exploitation by powerful (rich) groups and misguided government policies? Third, the coexistence of poverty and environmental disruption could be understood as the outcome of the same process and as having similar root causes. A key word in this connection is environmental entitlements or *resource rights*. Insecure or lack of rights to natural resources may create both a situation of poverty and give small incentives for sound resource management.

Yet another argument against the thesis is found in the 'indigenous people' and agroecology literature, which in many ways represent a different research paradigm. Traditional agriculture, practiced by people living close to a subsistence level of material consumption, is highly diversified and therefore more in line with natural eco-systems. People live in intimate contact with the nature, and this creates cosmologies which stress ecological balance. An alternative explanation is that farmers diversify due to risk aversion and lack of market integration (production only for own consumption). Higher income will often be associated with a breakdown of the diversity of traditional practices, and may therefore result in environmental degradation. I will not deal much with this argument in the article, partly because I believe the poverty-environment thesis can be questioned more directly without resorting to a different paradigm.

The sub-title of this article is: was (the) Brundtland (report) wrong? Before embarking on the critique, I should state that the report is diverse and many views are represented (including six different definitions of 'sustainable development'). Indeed, many of the points raised in this paper can be found more or less explicit in the report. It is fair, however, to say that the linking of poverty and environmental degradation is *a* or *the* key message of the report.

This article attempts to give a brief overview of some of the basic issues in the poverty-environmental degradation debate. The paper is structured as follows. Section 2 presents a simple conceptual framework for the discussion of resource use in a resource dependent, rural society. We discuss three different vicious circles that may be operating: resource degradation, entitlement degradation, and population growth Section 3 discusses how the coexistence of poverty and environmental degradation can be explained within this framework. Section 4 presents some macro level evidence on the linkages between higher income and environmental problems, particularly related to pollution. Section 5 summarizes and concludes.

2. The causal linkage: a theoretical framework

There is a rapidly growing literature on the linkage between poverty and the environment, yet there is relatively little theoretical work linking the variables together in a consistent manner. Leach and Mearns (1992) and Reardon and Vosti (1995) provide two examples of quite wide conceptual frameworks. These authors focus particularly on how local level resource use is influenced by conditioning factors (Reardon and Vosti) or structuring processes (Leach and Mearns). In contrast to such wide frameworks, formal economic models typically focus on the unilateral links from poverty induced high discount rates or short time horizons to overuse of environmental resources, possibly also with a feedback from a deteriorating resource base to lower income in the future.

The suggested framework in this paper, inspired from systems analysis, provides a middle ground: it includes factors normally excluded in economic models, while at the same time suggesting more explicit linkages between the various variables than the wide frameworks do. Obviously, there is a trade-off between being explicit and general. We believe there is a need to bridge the simple unilateral relationships of economic models and the very wide frameworks suggested by the above mentioned authors.

The framework, which is sketched in *Figure 1*, has been made with a poor, resource dependent, agriculture-based rural society as the reference point, and may be useful for discussing the degradation of natural resources such as forests and soil. Starting with the resource base, the development of the *resource stock* is determined by four factors: the resource use (extraction) and the resource investments, either by local or external users. The level of *poverty*, which in this framework is the inverse of income, is a function of the local use of natural resources and external (off-farm) income, as well as population, technology and market prices. Local resource use is also affected by the population size. Poverty affects resource use according to the standard poverty-environment hypothesis discussed above. The effect of technology and market prices on local resource use is ambiguous, as discussed below. Local resource investments are determined in a similar manner as the local resource use.

A key variable in the framework is local environmental entitlements, which is also central in the framework of Leach and Mearns (1992). This represents an application of Sen's (1981) entitlement approach to the environment-poverty complex. Of particular importance are institutional arrangements in the form of the property rights regime governing the resource use: who has access to natural resources, what are the rules for their use, how effectively are the rules enforced, etc. The local resource rights are functions of, *inter alia*, the use and claims made by external users, and the level of poverty. Environmental entitlements in turn affect both the local resource use and investments (with opposite effects on the resource base).

(Fig. 1 about here)

Underlying the framework in *Figure 1* is a set of political, socio-cultural and economic factors which are not made explicit in the figure, and space does not permit a detailed discussion of these.

Vicious circle I: Resource degradation through lack of investments and overuse

The figure contains a number of causal loops. The conventional argument of the poverty-environment connection is the first vicious circle between poverty and the resource base, working through the effect on local resource use and local resource investments. Low income forces the users to increase the resource use in order to survive, which again diminishes the natural resource base. A lower resource base then reduces the flow of services generated, which further augments poverty. Poverty would be reflected in a high valuation of the present versus the future, i.e., high discount rates. Holden *et al.* (1996) presents empirical evidence on this linkage from Ethiopia, Indonesia, and Zambia.

Poverty will, for example, leave peasants with little surplus for investments that could enhance the long term productivity of the resource base. In fact, Reardon and Vosti (1995: 1496) argue that "the criterion for poverty in environment-poverty analysis should be the ability to make minimum investments in resource improvements to maintain or enhance the quantity and quality of the resource base, to forestall or reverse resource degradation". This 'investment poverty' is a stronger criterion than the conventional focus on 'welfare poverty', as households above a welfare determined poverty line can still be investment poor.

Whereas the operation of this vicious circle has some intuitive appeal, it can be challenged on several grounds. It is by no means certain that higher incomes lead to more resource conserving/enhancing investments. First, insecure property rights (environmental entitlements) will make such investments risky. Second, the collective good nature of many environmental resources (and thereby also resource investments) will reduce the individual incentives for investments, and create problems of free or easy riding. Third, higher incomes can also be used for capital investments which increase the pressure on natural resources. We return to this in section three.

Vicious circle II: Entitlement degradation

A vicious circle of entitlement degradation may be at work in *Figure 1*. Poverty influences the environment entitlements negatively, which in turn affects the access and possibility for making use of the resource base, and then the level of poverty. This vicious circle may therefore strengthen the first vicious circle discussed, even though this may not necessarily be the case: the loss of environmental entitlements could well exclude the poor from the use of the resource, in which case the development of the resource base is determined by other users.

There are several mechanisms through which poverty may reduce local environmental entitlements. Property rights to land in the form of land titles are costly, and poor farmers rarely can afford to obtain titles. Tenure security also depends on the investments in land made and the farmer's ability to enforce his or her rights, two factors which are positively correlated with the income level.

At a more general level, poverty is closely linked to vulnerability, which describes individuals' position in the society rather than the relation to the physical environment. Within our framework, vulnerability is associated with a lack of environmental entitlements.

Poor group's lack of access and control of natural resources often refers to their disadvantaged position in political processes. Conflicts between the nation state and poor, resource dependent groups is well documented (e.g., Colchester, 1994, on forest resources in Asia). Their weak position is also reflected in local processes. Romantic views about egalitarian traditional, pre-capitalist societies still exist. There is, however, an increasing documentation of how local elites gain control over resources and use them to their own advantage and at the expense of poor groups, often with the backing of (their interpretation of) customary law (e.g., Berry, 1989).

Vicious circle III: Poverty and population growth

The third vicious circle within our framework is the link between poverty and population growth. Poor families tend to have more children than richer families, and 'development is the best contraceptive'. However, the poverty-population-environment nexus is far more complex than such simple hypotheses suggest. Whereas the link between family size and poverty is a widely accepted issue, the impact of population growth on the environment is not. Many argue that data does *not* support the thesis that environmental degradation is largely due to population growth (e.g., Shaw, 1992).

3. Explaining the co-existence of poverty and environmental degradation

The framework allows for several different explanations of how poverty and environmental degradation are linked. A key element in most of them is that these two phenomena should be seen as the simultaneous outcome of the same process rather than as a unidirectional link from poverty to environmental degradation. The framework also provides a number of routes for how to break the vicious circles where they exist.

Higher non-resource income: 'employment for environment'

The most obvious way of breaking the circles is to provide alternative sources of income which reduce the dependence on the resource base and therefore reduce resource extraction. The principle of "substituting employment for (degradation of the) environment" (Leach and Mearns, 1992: 65) is central on development agencies' agenda for poverty alleviation. The World Bank (1990) emphasizes that the most effective policies to combat poverty are those which increase the demand for the most valuable asset of the poor - labour. Malaysia and Indonesia are examples of countries where labour intensive economic growth has contributed to a significant reduction in the proportion of the population below the poverty line.

Poverty and environmental degradation can both be viewed as a result of limited income opportunities (or limited human capital). Consider migration to marginal agricultural land or the forest frontier. This may have harmful environmental consequences, which is not to be viewed as a result of the poverty in the area, *per se*. Rather, poverty and land degradation/deforestation are the joint outcome of the poor in come opportunities in the area the migrants came from.

"Poor people are poor not so much because they live in ecologically vulnerable

areas, although environmental degradation may mean they get poorer: it is more often the case that they live in or move to ecologically vulnerable areas because they are poor" (Leach and Mearns, 1992: 23).

According to the poverty-environment thesis higher income should improve the management of natural resources. We need, however, also to consider the possibility for higher income contributing to more degradation. Surprisingly, this is largely ignored in the literature, e.g., the overview by Learch and Mearns (1992). The following examples provide an illustration of this possibility:

- *Overgrazing:* In pastoral communities livestock is commonly the main object for asset accumulation, and the potential for overgrazing is proportional to herd size. In some contexts, the poor cause less pressure on grassland as they cannot afford to own many animals. Higher income will therefore increase the environmental stress. Failure to recognize this link may lead to unintended effects of development programmes, as has been the case of aid projects in the Turkana district of Northwest Kenya. Income generating activities (fishing) were supposed to provide an alternative source of income for the nomads in the area, and thereby reduce the herd size. Instead, the surplus from fishing was invested in more animals which increased the environmental pressure (Johan Helland, pers.com.).

- *Deforestation:* In a similar manner as for pasture, higher income can be used for investments in, for example, chainsaws which makes forest clearance easier for local farmers. More generally, investments which increase the profitability of frontier farming will contribute to more deforestation under a quite wide range of assumptions (see Angelsen, 1996).

- *Overfishing:* Investments in more efficient fishing gear could increase both the fishing efforts and the efficiency, putting the fish stock under increased pressure and thereby increasing the likelihood of unsustainable levels of catch.

Poverty reductions may be most environmentally beneficial in agriculture in situations where lack of any surplus (capital) results in inappropriate technologies (Reardon and Vosti, 1995). In particular, capital-led (as opposed to labour-led) intensification may be a sustainable path in resource poor areas as fertility-enhancing inputs can make the farmers avoid nutrient depletion and soil erosion. Purchased inputs then become direct substitutes for natural resources.

As a general working hypothesis for empirical investigations on the environmental effect of poverty reduction (income increase) in resource dependent economies, we suggest the following:

If the environmental effect is mainly determined by the scale of the activity, with limited scope for substitution between man-made and natural capital, then income increases will increase the pressure on the natural resource. If, on the other hand, man-made capital can replace natural capital relatively easily, and the main constraint is the farmers ability to purchase man-made inputs and undertake investments, then income increases will reduce the resource pressure.

Technology and prices

A second factor we need to consider is the role of technology and prices in establishing, maintaining or breaking vicious circles. Generally, it seems fair to assume that higher output prices and improved technology will both reduce poverty, and increase the incentives for resource investments as the future value of the resource is augmented. This will contribute positively to breaking the vicious circles.

The effects on present resource exploitation is, however, ambiguous. There are a number of different effects to take into account. Consider the decisions about how much to work and produce in a relatively isolated community, basing their livelihood on resource dependent activities. Improved technology or higher output prices will have two opposite effects on the scale of the activity and thereby the resource use. First, better technology or prices imply that the community can maintain the same income by reducing resource extraction - it gets more income per resource unit exploited. This is known as the income effect in economics. On the other hand, the resource dependent activities will become more profitable, and this will stimulate the people to work more and hence increase their resource use (the substitution effect). The net effect is ambiguous. Angelsen (1996), applying this approach to deforestation, argues that for poor economies the income effect will dominate, thus an output price increase will be positive for the environment.

If one includes the effects of migration, this conclusion is likely to be reversed. When economic activities based on resource extraction become more profitable, this will attract new migrants and increase the pressure on resources. We may then have an unpleasant conflict between, for example, poverty reduction in frontier agriculture and conservation of rainforests.

Population control

Any discussion of poverty-environmental linkages is incomplete without discussing the role of population growth. As already alluded to, the role of population in environmental degradation is a controversial area.

Poverty is related to lack of assets, and "the range of types of poverty is the range of lack of the various assets" (Reardon and Vosti, 1995: 1495): natural, human, physical, and financial capital. Whereas poverty is often thought of as lack of physical and financial capital (and possibly also natural capital), there may be situations where labour shortage is the problem. "It appears that underpopulation as a source of environmental degradation is a phenomenon common in the highlands of Latin America where rural-urban migration is intensive... [It] has generated labour scarcity which is not compatible with adequate highland resource management" (Lopez, 1992: 1140).

For Sub-Saharan Africa, however, there appears to be some consensus that population growth is a major contributing factor to the ongoing processes of environmental deterioration, see particularly Cleaver and Schreiber (1994). The region lags behind other regions in its demographic transition, with fertility rates in excess of 6.5 children per woman remaining virtually unchanged for the past 25 years (page 32). Population control programmes are still a controversial issue (e.g., Shaw, 1992), but there is hardly any doubt that stabilization of the population is a key to the region's long term development.

Empowerment (environmental entitlements)

The poor are not the only resource users. Possibly the most serious challenge to the poverty-environment thesis is when we include issues of resource competition and conflicts, resource rights (entitlements) and power. The loss of entitlements appears to be the key factor in common explanations on why poverty environment degradation coexist. A review of some 30 case studies by Kates and Haarmann (1992) tells the following story, as summarized by Lopez (1992: 1138-39):

> *"The key source of rural environmental degradation is the disruption of the traditional institutions of the poor, which until recently had permitted an efficient and sustainable use of resources. The collapse of traditional systems leads to a vicious circle of environmental degradation and further impoverishment. ... What causes the institutional collapse? Here the case studies differ and tell different stories. Studies in Asia, and particularly Latin America, report displacement and loss of entitlement of resources originated in factors external to the communities, while those in sub-Saharan Africa emphasize internal factors. Large scale agriculture, export oriented forestry operations, and major public infrastructure projects are repeatedly mentioned among the external factors. ... The population expansion issue is central in case studies that emphasize internal factors."*

The role of external *v.* internal factors must be subject to case by case investigations. Normally these factors will also interact, as exemplified in a study of deforestation in Sumatra, Indonesia (Angelsen, 1995): external factors and loss of entitlements have been important in initiating a 'land grabbing' race, but the race is now largely maintained and magnified by internal factors.

Empowering local communities and poor groups is one of the most recent slogans in the development debate, possibly as a reaction to an underestimation of its importance in the past. Within our framework empowerment of poor groups (more access to and control over the resources) will contribute to higher income and thereby reduce or break the vicious circles. Equally important, it will improve the incentives for resource investments and long term management of the resource. Issues related to property rights, respect for traditional user rights, tensions between customary and statutory law, etc. are central in the debate on local environmental entitlements. A positive example on how transferring rights (a share of the income) to the local population may contribute to both poverty reduction and forest conservation is the CAMPFIRE programme in Zimbabwe.

External resource use and investments

A final point for intervention is external resource use and external resource investments, which affect the amount of resources that can be extracted by local users without degrading the resource base. External resource use is also closely related to loss of local entitlements as discussed above, but it may be useful to distinguish between the effects on physical resource degradation and those on entitlement degradation.

Physical investments in the resources can in some cases be a policy option to break the vicious poverty-environmental degradation loops. Reforestation projects are examples of such projects, which will have both local and global benefits.

4. Macro level evidence on income-environment linkages

So far the discussion has dealt with problems of resource management, that is, the use of natural resources as *inputs* in economic activities. This section summarizes some of the macro level evidence on the relationship between income and environmental problems related also to pollution, that is, the use of the environment as dust bin for *waste* from economic activities.[2]

I have some reservations about the usefulness of such studies, but they have a role to play when the findings are interpreted carefully and combined with micro level studies. The studies discussed below use income rather than poverty as an explanation of environmental quality and degradation. Whereas the linkage between economic growth and poverty reduction is a matter of some controversy, one can, on balance, conclude that higher average income in a country tend to reduce the extent of absolute poverty.

The *I=PAT* identity has for some time been used as framework for discussing the effect of income or economic growth on the environment: *I*mpact equals *P*opulation times *A*ffluence times *T*echnology:

$I = P * I/Y * Y/P$

I Impact on environment

P Population

Y Gross National Product (GNP)

I/Y Environmental coefficient (*e.g.*, pollution per GNP unit, as determined by technology and other factors)

Y/P GNP per capita (affluence)

This is no theory, but a simple, and useful, decomposition of the impact on the environment of human activity. Higher income per capita means more production and consumption which, *ceteris paribus,* will lead to more use of natural resources as inputs in the production process, and more pollution from production and consumption (*Y/P* up). This is the *scale effect* of economic growth. At the same time, higher income will change the environmental coefficient. Economic growth may (1) change the *composition* of production and consumption, (2) reduce poverty-related environmental degradation, (3) increase the ability to undertake environmental investments, and (4) induce policy changes. Higher income may also dampen population growth.

The empirical question is: can these modifying effects dominate the scale effect such that higher income overall improves the natural environment? The studies show that there is

[2] This section is based on Angelsen (1997).

no simple 'yes' or 'no' answer to this question; it depends on the type of environmental problem and partly also on the income *level.*

Water and sanitation

If the severity of an environmental problem is measured by the number of deaths, lack of access to clean water and sanitary facilities is probably the largest environmental problem today. 3 million children die from diarrheal diseases annually, and more than 62 % of all deaths in Africa are related to polluted water (World Bank, 1992).

Polluted water is a typical poverty related environmental problem. Shafik and Bandyopadhyay (1992), in a background paper to the World Bank's 1992 report on development and environment, concludes that "access to clean water and to adequate sanitation are environmental problems that are essentially solved by higher incomes". The dramatic urbanization taking place in many countries, however, increases demand on planning and investments to improve the conditions.

Local air pollution

Local air pollution, mainly an urban phenomenon, is related to emissions from industries and from energy production and consumption. The most dramatic change in the environmental problems of developing countries is due to an expected sharp increase in energy consumption, as illustrated in *Figure 2.*

(Fig. 2 about here)

In 1990, developing countries consumed about ¼ of global commercial energy. By 2030 their share is expected to increase to more than 2/3. The energy use will, according to this scenario, be almost six times higher than the 1990 level. The increase is partly due to anl almost doubling of the population, and partly due to a threefold increase in per capita consumption. The latter is mainly caused by higher incomes (economic growth), combined with high income elasticities for energy (engery use grows faster than income).

It is technically possible and economically feasible to reduce a number of emissions from energy use, such as SO_2, NO_X and SPM. The empirical evidence, comparing both countries at different income levels and the historical development of individual countries, have given rise to the hypothesis of an Environmental Kuznets Curve (EKC), i.e., an inverse U-shaped relation between income and local air pollution, and also some other environmental problems. It gets worse before it gets better. At early stages in the development, the scale effect dominates. Eventually, higher priority is given to a clean environment, more investments in purification and clean technology are undertaken, and the industrial growth levels out. The apex is reached at income levels somewhere between USD 3 000 and 10 000, depending on the type of pollution, the data, methodology and functional form used, etc.[3]

CO_2 emissions

[3] Examples of studies of EKC include Grossman and Krueger (1992); Shafik and Bandyopadhyay (1992); Shafik (1994); Panayotou (1993); Seldon and Song (1994); see also Pearson (1994) and Stern *et al.* (1996) for critical reviews of such studies.

Unlike many local pollutants, there is very limited scope for delinking the level of CO_2 emissions from the level of fossil fuel use. The only way to reduce CO_2 emissions is either by reducing the total energy use, and/or by substituting renewable energy sources for fossil fuels. Fossil fuels today account for 90 % of the commercial energy supply. It is technically possible to replace a significant share of this with, for example, biomass and solar power. Unfortunately, the costs of solar energy is still too high to make it competitive, and the same is true for using biomass in the production of ethanol. Biomass in electricity production is more attractive in terms of costs of production, but the heavy land requirements will limit its adoption (Anderson, 1992).

Both total energy use and its composition is sensitive to energy prices. A high CO_2 tax could reduce the absolute level of emissions in the rich countries, and lower the global CO_2 growth. At least for the next one to two decades, however, it seems likely that increased energy demands will be met by mainly fossil fuels. The unavoidable conclusion is therefore a significant increase in the global CO_2 emissions over the next few decades. If the emissions follow the total energy use in the scenario, which is not an unreasonable assumption, the global per capita emission in 2030 will be about 50 % above the present level. This will give a 2-3 fold increase in the CO_2 concentration in the atmosphere, which implies that 'the heat is on'.

Deforestation

Whereas the three environmental problems discussed above relates to pollution, the last two concerns the use of natural resources as inputs in the production process. Deforestation is partly caused by smallholders' land expansion, and partly by larger commercial, often state sponsored, projects (logging, plantations, mining, etc.). Considering the first group, how is the extent of deforestation related to poverty and income level?

First, deforestation and poverty could be seen as the joint outcome of the underlying economic and political conditions, rather than one causing the other, as illustrated by the previous example of migration to the forest frontier. Second, to many farmers deforestation is a form of investment in land. The problem of deforestation, unlike many other environmental problems, is *too much* investment. Some smallholder expansion contains certain speculative elements: forest may be cleared to establish a claim to the land (property rights), or it may be cleared for later sale to get a capital gain. In this perspective higher income could be expected to increase forest clearing.[4]

The share of deforestation related to more wealthy groups, such as large cattle holders in Latin America, as well as state sponsored projects are also likely to be positively linked with income.

The macro level evidence on the link between income and deforestation is rather inconclusive, suggesting that the links are indirect and contradicting effects of higher income. To the extent that a significant relationship is found, the studies indicate a positive correlation between higher income and deforestation. This relationship could, for example, be due to the fact that economic growth is associated with improved

[4] See Angelsen (1996) for a further elaboration of the deforestation-as-an-investment view.

infrastructure and roads, which improves access to primary forest.[5]

Soil erosion
The problem of soil erosion can be viewed both as a side effect of agricultural production, and as a lack of investments in soil conservation. Thus, one key difference between deforestation and soil erosion is that the former is related to *too much* investments, whereas the problem of the latter is *too little* investments. Thus there are reasons to believe that higher income will reduce the problem of soil erosion and land degradation, even though one could argue for the possibility of effects in both directions.

Unlike the case of deforestation, there are (to my knowledge) no comprehensive surveys linking the extent of soil erosion to the level of income. A number of location specific studies exist, which lend some support to the poverty-environment thesis. One may, however, question the relative importance of the poverty explanation. Cárcamo *et al.* (1994), for example, suggest in a study from Honduras that soil loss declines with income, but that changes in planning horizons have very little impact on the outcomes. Other factors such as the relative profitability of different crops were found to be much more important.

5. Some conclusions

Poverty and environmental degradation often coexist, but does poverty creat environmental degradation?
Some 60 % of the world's poorest people live in ecologically vulnerable areas, a figure which suggests a strong correlation between poverty and environmental degradation. The main reason is that poor people live in or move to these areas because they are poor, rather than the poor causing the destruction of the environment, or even the poor environment causing the poverty.

A simple poverty-environment hypothesis gives a very incomplete characterization of both the existence of poverty and environmental degradation. Poverty-environment vicious circles often exist, but it is more important to focus on the factors which create and maintain these. The coexistence of poverty and environmental disruption could more appropriately be seen as the joint consequence limited opportunities for some groups, uneven processes of development, an unequal distribution of rights and power, and misguided policies.

The popular debate often focus on vicious circles related to degradation of physical or biological resources. An important conclusion deriving from case studies is that loss of *entitlements* may be equally or more important (entitlement degradation). The poor's access to natural resources is a function of their (lack of) access to political resources and their (limited) power to enforce their rights.

Is higher income good for the environment?
This brief tour through a few of the most critical environmental problems suggests that a

[5] See Brown and Pearce (1994) for a collection of such studies, and Kaimowitz and Angelsen (1997) for a summary and critical review.

general statement about higher income leading to improvements in the environmental quality is wrong. In fact, it appears difficult to draw any general conclusions about the effect of poverty reductions, higher income and economic growth on the environment. When one consider more specific problems and contexts, we get more unambiguous conclusions. Higher income appears to be good for the environment in some cases:

- when purchased inputs can be a direct substitute for natural resources (e.g., in agriculture);
- when economic growth is associated with growth in off-farm income opportunities which reduce the pressure on, for example, migration to marginal agricultural areas and the forest frontier;
- for problems related to clean water and adequate sanitation, which is a result of lack of investments.

In other situations the empirical evidence suggests the opposite link:

- when investments and purchased inputs are used to increase the capacity to exploit the resources;
- for local air pollution, at least for income levels relevant to developing countries;
- for CO_2 emissions (the greenhouse effect).

The political necessity of the poverty-environment thesis

When the Brundtland Commission started its work, the South feared (and to a lesser extent still does) a green constraint on their economic development. The risk of a (new) North-South confrontation was very real. It was therefore necessary to link environmental issues to economic development in a positive way (Brundtland, 1997). The poverty-environment thesis became the link: poverty is a or the major cause of environmental degradation, and higher income (economic growth) is therefore compatible with environmental conservation.

The article has questioned both the validity and usefulness of the thesis. The politically relevant question is not whether we should reduce growth in developing countries to minimize the disruption of the environment. Nevertheless, it is important to be aware of conflicts between higher income and environmental conservation in some areas. Development (in terms of economic growth) often implies higher pressure on the environment. We should not assume an harmonious world where unpleasant conflicts do not exist. Both the development process and the environment would in the long term suffer from policies based on that assumption.

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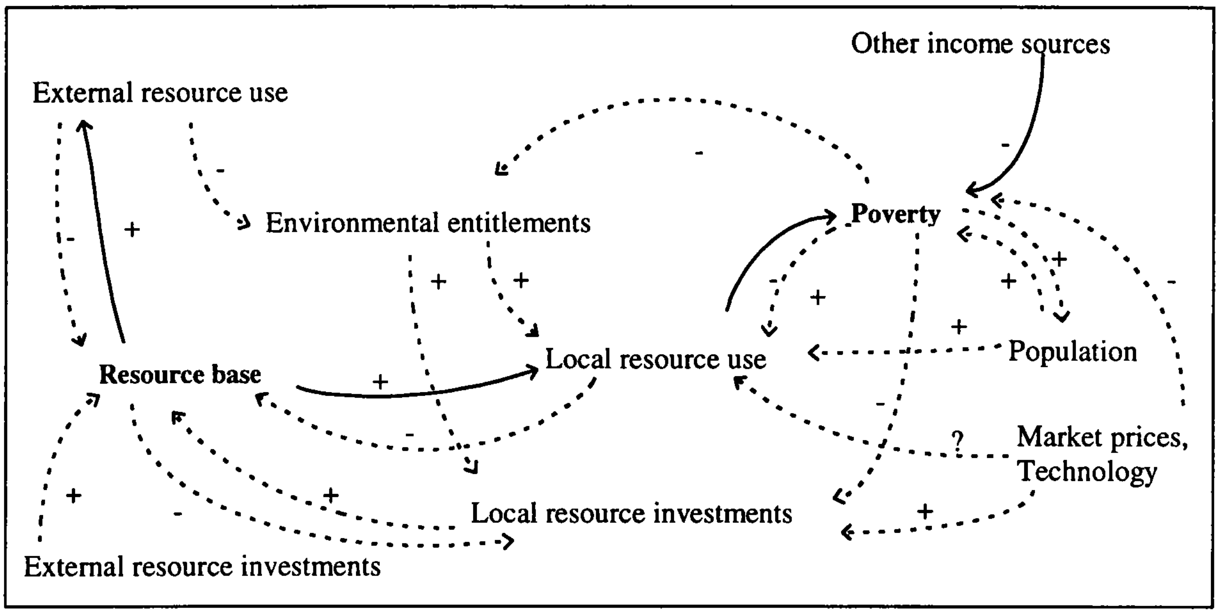

Figure 1. Causal linkages between the natural resource base and poverty. (Dotted arrows indicate that a variable affects another; solid arrows represent physical or income flows. If the sum of the signs in a loop is negative, we have a reinforcing loop. If the sum is negative, we have a stabilizing loop.)

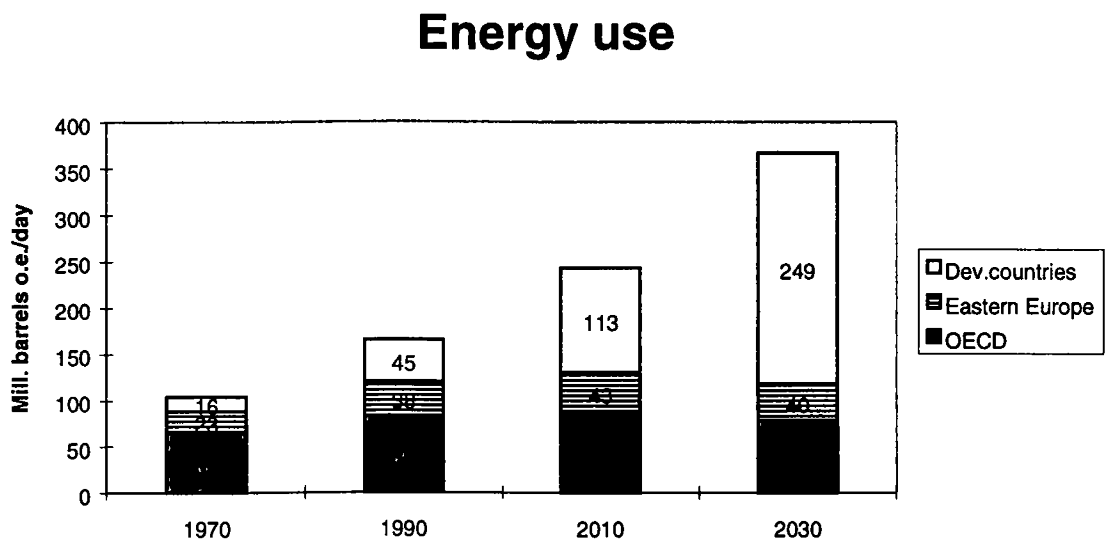

Figure 2: Global energy scenario (Source: Andersson, 1992).

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8. Analysis of Economic Incentives for Soil Conservation: The Case of Highland Smallholders in Ethiopia[1]

by

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1. Introduction

The problem of land degradation and loss of food production potential in poor rural economies with fast growing populations has received increasing attention in recent years (Southgate, 1988; Anderson and Thampapilai, 1990; Scherr and Yadav, 1996). Soil and water conservation (SWC) has, therefore, become an important area of public intervention. In many less developed countries (LDCs), various SWC programs have unsuccessfully tried to mitigate the land degradation problem. Design of appropriate institutions and policy incentives that efficiently internalize the land degradation problem is, therefore, urgently needed in many countries that suffer from deterioration of their resource base.

In a world without market failures[1], farming practices and conservation investments undertaken by individual farmers also maximize the discounted value of social net returns in land use. Thus, government intervention, on efficiency grounds, is unnecessary. The necessary conditions for the social efficiency of private land use require that markets be perfectly competitive and that prices of all resources relevant for the well-being of all individuals reflect their social scarcity values. However, rural economies in LDCs are often far from being competitive and face pervasive impediments (high transactions costs and imperfect information) and weak enabling conditions (incomplete property rights) (Hoff *et al.*, 1993). Although the underlying factors behind excessive land degradation in rural economies of LDCs await detailed investigation, the divergence between private and social paths of soil use may be attributed to imperfect information, high transactions costs, imperfect insurance and capital markets, incomplete property rights, and misguided government policies.[2]

The interlinkages between poverty, population growth, and environmental degradation further complicate and reinforce the potential impact of market imperfections. Smallholders may, therefore, base their land use and investment decisions on distorted price signals and the resulting allocations may fail to mimic the socially optimal path (McConnell, 1983; Shiferaw, 1996). Soil conservation investments that would increase social efficiency may thus fail to be undertaken by individual users and excessive degradation of land may ensue as is reported in

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several case studies. However, from the efficiency perspective, the existence of market failures per se is not a sufficient condition for government intervention into market processes. The efficient level of land conservation that equates marginal social benefits and costs of abating degradation can result in a soil erosion level either lower or higher than the natural rate of regeneration. Thus, the mere existence of the land degradation externality does not necessitate policy intervention. The likelihood of a policy failure (inefficient intervention) and a net social welfare loss further strengthens this point. Thus, an economic efficiency justification for augmenting the "invisible hand" mechanism with a "visible hand" approach requires that (a) the existence of market failures be demonstrated, and (b) evaluation of costs and benefits of intervention indicate a net gain to society. Intervention is thus justified when the cost of conservation, including direct costs of countering soil erosion and indirect costs of regulators and regulated farmers, is shown to be sufficiently larger than the on-site and off-site soil erosion damages averted.

The incentives approach, based on voluntary behavior of resource users, is also likely to be more successful than a coercive or regulatory approach to resource conservation (Chisholm, 1987; Panayotou, 1993). The non-point nature of the soil erosion externality and the high cost of monitoring individual levels of input use, make first-best policies difficult to implement. Thus, in countries like the United States, soil conservation policy emphasizes an approach based on cooperative behavior in response to positive incentives (Reichelderfer and Kramer, 1993). In LDCs, regulatory standards and user charges on degrading inputs or soil loss are even more difficult to implement due to weak institutional capability, scarcity of information, high transactions costs, and adverse distributional impacts on poor smallholders.

The purpose of this paper is, therefore, to evaluate the role of various policy incentives for soil conservation and examine the rationale for moderating land use and investment patterns resulting from the unfettered market mechanism using data from the Ethiopian highlands. Emphasis is given to positive incentives, like cross-compliance and cost-sharing policies, expected to have positive distributional benefits to poor farmers while also providing the impetus to adopt sustainable land use practices. Moreover, the role of output pricing policies in relation to the erosivity of the crops grown is also examined. The rest of the paper is organized as follows. Section 2 presents the conceptual framework. Section 3 provides description of the Ethiopian case study and methods. Section 4 presents and discusses the results. The summary and policy implications are given in the final section.

2.0 Conceptual Framework

2.1 The economic incentives approach to soil conservation

Once the existence of socially excessive levels of land degradation is known, governments may resort to various policy instruments for mitigating or internalizing the externalities. Some policy instruments specify quantity standards on the level of emission of the externality that can not be exceeded by generators of that externality. These type of command-and-control regulations fix inflexible limits or technological requirements and stipulate a range of penalties for non-compliance. In contrast, the economic incentives approaches utilize market-based instruments designed to modify the behavior of the generators of the externality through their effect on the prices of resource inputs used in economic activities. In soil conservation the approach uses price-based incentives to curb the soil erosion problem.

The choice of policy instruments, however, depends on (a) efficiency of use of scarce information, (b) contracting, monitoring, measurement, and enforcement costs, (c) distributional effects, and (d) political preferences. An ideal instrument may be the one satisfying the goals of efficiency, equity, and simplicity (Chisholm, 1987). Accordingly, due to the lack of information on land-specific optimal levels of soil erosion, and prohibitive costs of monitoring the production activities of millions of scattered smallholders, the standards approach as a policy instrument has very limited relevance for soil conservation. A mix of regulatory and incentives approaches may, however, be useful in some cases. For example, past soil conservation programs in Ethiopia used a mix of coercive and incentives approaches. In some food deficit areas, soil conservation structures were installed on lands perceived to be erodible through food-for-work (FFW) incentives. Peasants were forced to keep the structures although maintenance was mainly done through FFW incentives. Enforcement of these type of policies was possible mainly due to (a) absence of the need for monitoring soil loss levels, and (b) strong local state power since peasant associations were entrusted with overseeing compliance. However, when the FFW incentive stopped and coercion was relaxed since the late 1980s, many farmers selectively or totally dismantled structures (Shiferaw and Holden, 1996).

The economic incentives approach to soil conservation may use a range of instruments. Provision of secure land rights, price support and reduction of export taxes to less erosive crops, resource pricing (e.g. irrigation water), input taxes (subsidies), and credit subsidies are some examples. Secure land rights may extend the planning horizon and vest with the owner the benefits of investments in land improvement and conservation and serve as institutional instruments that act as economic incentives (Panayotou, 1993). Besides, macropolicies, like devaluation of overvalued exchange rates and interest rate adjustments, can be used. The effect of a general increase or decrease in commodity prices for soil and water conservation is unclear (Barbier, 1991; LaFrance, 1992; Pagiola, 1996). It is argued that depressing agricultural prices may reduce profitability of farming and dampen land-improving or soil-conserving investments, whilst increasing commodity prices through its effect of raising farm returns may encourage cultivation of marginal lands (Southgate, 1998). It may also be argued that in the presence of a suitable land use policy and where rights to land are clearly defined, increased profitability of farming through higher prices may make conservation attractive to the farmer. The impact of price changes on land management also depends whether the conserving input has beneficial or adverse impacts on yields (Shiferaw, 1996). Changes in relative prices, however, can have predictable impacts depending on the crops and inputs that are promoted or discouraged and the farmers' ability to respond to such price changes. A rise in the profitability of less erosive crops relative to more erosive crops can, for example, be expected to encourage soil-conserving land use and cropping patterns, and conversely (Southgate, 1988; Barbier, 1991; Panayotou, 1993).

The Pigouvian approach to internalizing externalities calls for taxes to degrading inputs and subsidies to conserving inputs in proportion to the external damages or benefits resulting from the use of each input (Baumol and Oates, 1988). In the first best case, this requires information on the level of use of each type of input on each land type. Thus, governments prefer taxing the use of degrading inputs or subsidizing conserving inputs. When farmers have sufficient economic incentives to adopt soil-conserving practices on profitability grounds, the best policy is not provision of subsidies, rather removal of constraints that deter adoption. When significant external effects of soil erosion exist, subsidies may be justified although on-site productivity loss effects are minimal.

However, designing and running a suitable subsidy scheme presents several incentive and targeting problems (Chisholm, 1987; Lutz *et al.,* 1994): (a) production subsidies for inputs with significant external effects artificially boost profitability of activities using these inputs and encourage resource depletion and degradation, (b) conservation subsidies may create perverse incentives to farmers to increase rates of soil erosion to qualify for subsidies or encourage planting on marginal lands made profitable through subsidies, and (c) subsidies as incentives may modify farmer behavior only as long as they continue to be paid. This implies that subsidies may have to be paid for maintenance as well. Therefore, a subsidy scheme should be designed carefully and often entails a heavy strain on the economies of poor countries unless external assistance is made available.

2.2 Cross-compliance for targeting economic incentives

One mechanism for targeting economic incentives for conservation is based on cross-compliance strategies that employ a mix of regulations and incentives approaches based on voluntary behavior in response to positive economic incentives (Holden and Shanmugaratnam, 1995). Cross-compliance means that conservation requirements are linked to access for a vital input (e.g. irrigation water) or access to certain program benefits is maae contingent upon compliance through installing conservation practices.

Cross-compliance policies for resource conservation under peasant farming may offer the following advantages.

(i) Whilst direct subsidies for productive inputs may distort price signals and erode the incentive to economize and conserve scarce resources, subsidies linked to conservation can help mitigate the land degradation externality. Removal of input subsidies through adjustment programs and currency devaluation may also cause soaring prices for ameliorative inputs (like fertilizer) that may encourage soil mining and diminish the income of the poor. However, production subsidies linked to conservation can have positive effects on both the environment and the welfare of the poor. Subsidies for productive inputs linked to conservation can enable poor households comply with conservation requirements without adverse impacts on their welfare, especially when the latter do not provide quick benefits. The increased production through such subsidies may boost national food security that may also benefit the urban poor and rural net buyers through lower prices resulting from increased surplus. In food deficit countries, like Ethiopia, increased production can also contribute to self-sufficiency and reduce food imports. If improvements in efficiency, environmental quality, and equity can be achieved, such policies represent a win-win-win strategy.

(ii) Where asymmetric information and transactions costs lead to market failures, despite differing distributional impacts, interlinked contracts may result in more efficient outcomes than could be achieved through isolated transactions (Bose, 1993; Hoff and Stiglitz, 1993). This implies that when the regulating agency lacks full information on plot-specific erosion levels, on-site and off-site effects, and the profitability of new conservation technologies, interlinkages between markets may represent efficient institutional innovations for meeting environmental targets through effective use of scarce information.

In what follows, we analyze the effect and efficiency of various economic incentives for soil conservation based on our case study in the Ethiopian highlands.

3.0 Case Study in Ethiopia

3.1 Agriculture and land degradation: past and present policies

By all accounts, agriculture is the predominant sector of the economy. The sector is primarily dependent on smallholder farming. Smallholders cultivating fragmented micro-holdings produce more than 90% of the annual agricultural output. Despite its pivotal role, the performance of the sectors has remained largely unsatisfactory. Food self-sufficiency remains to be an unattained objective. Between 1979/80 and 1993/94 food production grew by 0.5% per year while population grew by 3%, implying a per capita food production decline of 2.5% (Zegeye and Habtewold, 1995). Another serious concern coupled with the stagnation of the sector has been the degradation of the resource base mainly due to soil erosion (FAO, 1986). The problem of degradation of the soil stock and loss of production potential is severe in the highlands that harbor 88% and 75% of the human and livestock population, and constitute 95% of the cultivated lands. FAO (1986) estimates that 50% of the highlands are significantly eroded, while 25% are seriously eroded, and 4% have reached a point of no return. Hence, soil erosion induced productivity decline is estimated to average 2.2% per annum from that of the 1985 level. Estimated annual rates of soil erosion on croplands at national level average 42 t/ha (Hurni, 1993). In a country with a fast growing population vulnerable to frequent famines claiming millions of people, the rapid loss of food production potential is a concern not only for future generations but also for the present generation of Ethiopians.

The stagnation of the agricultural sector and degradation of the resource base can be attributed to several interrelated factors: misguided policies and neglect of the sector, technological stagnation, weak institutional support, insecure land rights, high population pressure, drought, political instability, and frequent wars (Shiferaw, 1994). Consistent with the general neglect of the sector in development theory, prior to 1974, policy support to the sector was very poor. Some of the reforms that followed the 1974 revolution, like "land to the tiller", were later liquidated by misguided policies and ardent socialist orientation. Until the late 1980s, agricultural input and output marketing remained under state monopoly while pan-territorial prices were fixed below the free market level. Policy support for credit, input distribution, output marketing, and extension was mainly targeted towards cooperatives and state farms that jointly accounted only 10% of the agricultural produce. Excessive surplus extraction and discriminatory policies discouraged private smallholder production and land-improving investments.

As a result of such misguided economic polices, the 1975 land reform policy also failed to provide impetus to boost production and enhance sustainable land use. Although the reform policy enabled many landless farmers to gain access to land, the state ownership of land and the insecurity of usufruct rights hindered consummating the full potential of the reform. Land still remains under state control while farmers only possess insecure use rights that can be terminated by the government without compensation. Land markets are outlawed and land does not have an asset value. Moreover, rural infrastructure is poorly developed, agricultural research is rudimentary, and new technologies for production or resource conservation are largely unavailable. Recent data indicate that improved seeds, irrigation, and fertilizer are used only on 0.71%, 0.97%, and 25% of the cultivated fields (CSA, 1996). Information on the productivity impacts of land degradation or control measures is scanty and unavailable to farmers. Formal credit is available only for short-term loans for fertilizer, while long-term loans for investment in land or livestock are lacking.

The data for this study comes from a detailed survey of a stratified sample of 120 farm households in Ada district of the central highlands of Ethiopia in 1994/95. The production system in Ada is typical of the mixed crop-livestock system in the highlands. Informal short-term land contracts are common although such practices lack legal basis. Formal credit was available for fertilizer at a rate of 12%, but the informal rates reach as high as 100%. Estimated real rates of discount (discrete rate) among the surveyed households average 54% (Holden *et al.*, 1996).

3.2 Analytical methods

Land use and conservation decisions of farm households are conditioned by their dual engagement in production and consumption which will in turn be shaped by the policy environment, institutional arrangements (market structures, land tenure, extension, credit, infrastructure), population pressure, asset endowments, household characteristics, access to new technologies, and off-farm employment opportunities (Reardon and Vosti, 1992; Shiferaw and Holden, 1997). When production and investment decisions are conditioned by consumption preferences and household characteristics, a farm household approach is need for analysis of land use and investment decisions of smallholders.

This study develops a non-separable farm household model for analysis of the role of economic incentives for soil-conserving land use. The full description of the model is given in Shiferaw and Holden (1997). The linear programming (LP) model identified a production plan that maximized annual net returns defined as current net returns less the present value of future income loss caused by land productivity decline due to soil erosion (on-site user costs) subject to various farm-level resource supply and behavioral constraints. The condensed structure of the LP model is given in Table 1. The model included crop production activities on two land types (upland and lowland) with three levels of fertilizer use, two technological options (improved and traditional varieties), and two land management options (with and without conservation) and livestock production, sale and consumption activities. Labor use activities (leisure, on-farm, off-farm, and hiring options) were defined seasonally, and activities for crop sale and consumption were included. The constraints included limits on owned and rented land, labor (including leisure), oxen power, subsistence needs, animal feed requirements, restrictions on credit, crop rotations, and cash income.

Soil erosion levels for each production activity on two land types and two management options were estimated using the modified USLE adap.ed for Ethiopian conditions (Hurni, 1985). Actual measurements also provided values for the slope length and slope gradient factors of the USLE. The effect of soil erosion on productivity was estimated econometrically based on time series data (Shiferaw and Holden, 1997). The marginal user costs of soil (discounted perpetual productivity losses per unit of soil erosion) were assessed on the erosion activities. The optimized value thus maximized the returns to farming and non-farming activities less the user cost of current soil erosion. Activity budgets and resource supplies were specified for a representative household reflecting the average of 120 households surveyed.

The cross-compliance policies analyzed include differing levels of input subsidies (for fertilizer, improved seeds, and a mix of fertilizer and improved seeds) offered only when upland cereals are grown on land treated with conservation. The cost-sharing policies considered were differing subsidies per unit of labor used for installing conservation structures (soil bunds) on erodible slopes. The incentives were given at varying levels per unit of labor used in conservation activities. The cost-sharing is provided for subsidizing the initial high costs of installing conservation structures. The net cost share to the farmer may, however, be zero if the initial incentive is larger than the total construction and maintenance costs. The cost-shares are thus computed as a share of the total discounted cost of construction and maintenance of structures. Since soil conservation is assumed to be undertaken between January and May, before the planting season that starts in June, labor costs are computed using the shadow value of labor during this seasons.

The subsidies are specified for cases where conservation does not provide immediate economic benefits to the farmer (when short-term crop yields with conservation are the same or less than without conservation). However, subsidies may still be necessary when the yield-improving effect of conservation is not sufficient to cover the full cost of conservation even if yields may initially be higher with conservation. Since surveyed farmers indicated that available techniques, for various reasons, tend to depress immediate yields or do not show appreciable changes at best, our focus is on the evaluation of incentives that may be employed to increase the adoption of the existing techniques.

A benefit-cost analysis of cross-compliance and cost-sharing policies was done by computing the net present value of soil productivity loss prevented over the lifetime of conservation practices when the incentive is provided less the flow of all real social costs of conservation as given in (1).

$$\sum_{t=1}^{T}\Big(\theta(E_t^i - E_t^{wi}) - (\lambda(1-\gamma)(I_t + M_t) + S_t + A_t)\Big)(1+\rho)^{-t+1} \tag{1}$$

Where, E^i and E^{wi} are, respectively, soil erosion levels with and without the incentive, I is the initial labor requirement for installing conservation structures ($I_{t>1} = 0$), M_t is the annual labor requirement for maintenance of structures ($M_{t=1} = 0$), S_t is the cost of the subsidy in year t, A_t is annual administrative costs (assumed 10% of the subsidy cost), θ is the marginal user cost (the shadow value) of soil, λ is the shadow value of family labor, and γ is the cost-sharing covered by the incentive (for the cost-sharing policy only). The incentive required in subsequent years ($S_{t>1}$) to induce the farmer maintain structures once built through the starting incentive ($S_{t=1}$) was estimated by computing the income level that would equalize the flow benefits with conservation to that without conservation as given by:

$$\sum_{t>1}^{t^+-1}\left(\Pi_t^c-\Pi_t^{nc}\right)(1+\delta)^{-t} \qquad (2)$$

Where Π_t^c and Π_t^{nc} are farm profits with and without conservation, respectively. When production costs are similar in the two regimes, this can be represented as:

$$\sum_{t>1}^{t^+-1}\left(P(Y_t^c-Y_t^c)-C_t^c\right)(1+\delta)^{-t} \qquad (3)$$

Where P is the output price, Y is the yield per ha, $C=\lambda M_t$ is the shadow value of conservation labor, and δ is the farmer's rate of discount. The incentive is needed until the discounted net benefits of switching to the soil conserving practice are positive in year t^+. Using (3), the level of the incentive required after the first year was directly estimated to be Birr 430 ha^{-1} of conserved land. The benefit-cost analysis was done at differing social rates of discount (ρ = 0.1, 0.05, 0.2) for T=15 years. Thus, the incentive is considered to improve social welfare when (1) is positive or the benefit-cost ratio is sufficiently greater than 1. Finally, the effect of changing the relative prices of erosive and non-erosive crops on land use and conservation decisions was examined through a 20% decrease (increase) of the price of teff or pulses, respectively.

4.0 Results and Discussion

4.1 Effect of cross-compliance policies

The effect of cross-compliance policies for fertilizer and improved seed inputs on land use and conservation investment are presented in Table 2. When conservation reduces immediate benefits, no conservation of erodible lands occurs until about 50% of the (1993/94) price of fertilizer is covered through the subsidy. Even at 50% subsidy, only some 20% of upland cereals (17% of the uplands) are grown on conserved land. The increase in the level of the subsidy to 75% and 90%, respectively, raise adoption of conservation to 45% and 62% of the upland area[3]. The benefit-cost ratios (BCR) for 50% to 90% fertilizer subsidies show that, considering the on-site effects of soil erosion alone over the 15 year period, provision of the incentive will not improve net social benefits unless the social rate of discount is close to 5%. The incentive is also unlikely to be socially profitable even if one assumes that structures may form terraces and have a longer lifetime. Only an increase in the user costs of soil or a lowering of the social rate of discount could make the incentive socially pareto-efficient. Since switching into a conserving practice lowers immediate income, it requires more than 90% subsidy before the incentive could have a significant impact on smallholder land use and investment behavior. The soil loss (t/ha) declined progressively from 35.6 without the subsidy to 25.7 with 90% subsidy, respectively. Since the subsidy for fertilizer relaxes the credit constraint and allows the farmer use recommended levels of the input, the returns to the incentive increase with the level of the subsidy. But, more conservation also brings higher subsidy costs from the second year and hence makes profitability difficult to attain. Thus, at ρ=0.1, it requires more than a 90% subsidy before the incentive becomes socially attractive.

When yields are 20% less with conservation, an improved seed (assumed to be 30% more productive than the traditional cultivars) subsidy for cereals is, however, socially profitable even at ρ=0.1. When technological change allows a 30% rise in productivity, a shift into the soil-conserving practice allows a 10% increase in yields over traditional cultivars grown without conservation thereby allowing adoption of conservation practices without severe impacts on meeting subsistence needs. Moreover, compared to the fertilizer subsidy, the seed subsidy has a lower average cost per area conserved (also compare total average costs). Thus, although it requires up to 90% subsidy (the price of improved seed considered 30% higher than traditional cultivars) to induce some conservation, at ρ≤0.1, both 90% and 100% seed subsides are socially efficient. In this case, a subsidy for a new technology (improved seeds) linked with conservation that sufficiently counteracts the yield-depressing effects of structures and induces conservation at lower cost is likely to be socially more attractive than a high cost fertilizer subsidy. However, even with the 100% seed subsidy, the level of conservation achieved in the short-term is very low. Soil loss (t/ha) only decreased from 37.3 without the seed subsidy to 36.2 with the 100% subsidy.

When conservation leaves yields unchanged, even a 10% fertilizer subsidy activates some 24% of upland cereals to be grown with conservation. An increase in the level of the fertilizer subsidy to 25%, brings all the upland cereals (84% of the upland area) into conservation farming. A further increase in the level of the fertilizer subsidy to 50% encourages slightly more conservation and cropping of cereals on uplands (86% conserved). Further increase in the level of the subsidy does not spur much conservation as land hiring and rotational constraints begin to be binding. Besides, the higher demand for conservation labor and the parallel increase in the opportunity cost of labor as the level of the subsidy increases, reduce the marginal conservation effect of the incentive. However, the 10%-50% subsidies are socially efficient. Thus, a policy that would bring all cereals grown on erodible slopes into conservation farming is also socially efficient. Soil erosion (t/ha) progressively declined from 33 without the incentive to 20 with the 50% fertilizer subsidy.

With a yield-neutral conservation, the improved seed subsidy will also have a comparable level of socially efficiency as the fertilizer subsidy. Again this is related to the lower cost of the seed subsidy per unit of land conserved. A policy that plans to transform all cereals on uplands to conservation farming is also socially efficient at ρ≤0.1. However, BCR increase initially, reach a maximum between 10% and 50% levels, and start to fall thereafter. As in the case of the fertilizer subsidy, the fall in BCR after the 25% level is related to the differences in the erosivity of the crops (and hence user costs) that compel conservation on the most erosive crop (teff) first, and a rise in the opportunity cost of labor in farming with the increase in the level of the subsidy. This is observed in the larger decrease in the soil erosion level possible from 10% to 25% subsidy compared to that after a 25% subsidy. Similarly, the decrease in soil erosion per unit area conserved is larger for the subsidy below the 25% level than those above this level. This implies that although the area under conservation increases with the subsidy, after some level, the marginal change in soil erosion falls as less erosive crops come to be grown on treated land. The incentive decreased soil erosion (t/ha) successively from 37.3 without the incentive to 22.2 with the 75% seed subsidy.

The effect of a mix of fertilizer and seed subsidies is presented in Table 3. For the case of yield-depressing conservation, a 50% seed subsidy was combined with differing levels of fertilizer subsidies. Although a seed subsidy of 50% alone brought no conservation, adding a fertilizer subsidy of 25%, 50%, and 75%, respectively, raised the upland cereal area conserved to 13.5%, 99%, and 100%. The first two combinations are economically efficient at $\rho \leq 0.1$, but the 50-50 scheme was only marginally so. If soil conservation is a preferred social goal, a policy that enables all cereals on uplands to be grown with conservation is socially efficient at $\rho \leq 0.1$. The rise in the profitability of farming following the increase in the subsidy, raises the opportunity cost of labor used for conservation. This, combined with the differing erosivity of crops, introduces decreasing returns to the subsidy at least until the fertilizer subsidy reaches 75%. If the subsidy increases above this level (not shown), the farmer will continue to grow all cereals on uplands with conservation, but the upland cereal area will be reduced as the high subsidy allows intensive cropping on lowlands using high levels of fertilizer (recommended fertilizer use and associated yields are higher on lowlands). Until the lowland area is binding, this permits a reduction in the cost of conservation and increased use of fertilizer and new seeds on the less-erodible soils thereby reducing the level of soil erosion further. In this case, BCR seem to follow a U-shape. The incentive progressively reduced soil erosion (t/ha) from 38.7 without the incentive to 20 with the 50-100 seed-fertilizer subsidy.

For the case of yield-neutral conservation, a 10% fertilizer subsidy was combined with differing levels of seed subsidies. Table 2 shows that a 10% improved seed subsidy led to the adoption of conservation technology on 12% of uplands. Adding a 10% fertilizer subsidy raises adoption to about 14% of the upland area operated. Similarly, mixing a 10% fertilizer subsidy with 25% and 50% seed subsidies raises adoption, respectively, from 39% and 66% to 67% and 80% of the cultivated upland area. Thus, a 50% fertilizer subsidy is almost equivalent to a mix of a 10% fertilizer subsidy with 25% seed subsidy. This implies that, depending on the availability of the incentive and anticipated impacts on government budgets, the fertilizer and seed incentives can be combined in different proportions without a loss in their effectiveness to induce conservation. At $\rho \leq 0.1$, the mix of seed and fertilizer subsidies is also socially efficient. Conservation can be extended to 80% of the uplands without loss of efficiency. The BCR of the incentive seems to be increasing first and decreasing later mainly due to the differences in the erosivity of cereals and a rise in the shadow value of labor. The most efficient incentive level is to be reached between the 10-10 and 50-10 mix of seed-fertilizer subsidies. The incentive system reduced soil erosion (t/ha) successively from 37 without the subsidies to 23 at the 50-10 seed-fertilizer subsidy.

4.2 Effect of cost-sharing policies

Analytical results for the cost-sharing incentive system are also given in Table 3. When conservation is yield-depressing, none of the uplands would be conserved if the initial cost-sharing is less than 120% (4 Birr/laborday (B/L)) of the total discounted cost of construction and maintenance of bunds. Increase in the cost-sharing to 220 % and 280% (7 and 9 B/L) increased the adoption of the soil-conserving technology to 17% and 30% of the upland area. Soil erosion decreased progressively from 38 (t/ha) without the incentive to 32 with the 280% cost-sharing. Although the area conserved increases with the level of cost-sharing, the incentive is inefficient and the BCR falls as the public cost-sharing increases.

With a yield-neutral conservation, even a 20% (1 B/L) cost-sharing could propel some conservation. If the cost-sharing is raised to about 60% (3 B/L), all uplands would come under conservation. Under the current situation where improved seeds are unavailable for all upland crops and fertilizer is used only on few crops, the cost-sharing policy may, therefore, be an effective means of achieving a wider adoption of conservation structures. All levels of the labor subsidy are efficient at $\rho \leq 0.1$. Soil erosion (t/ha) declined successively from 38 without the subsidy to about 18 with a 60% cost-sharing. Like the case of other incentives, there are both increasing and decreasing returns to the incentive scheme. The most efficient level of cost-sharing seems to be achieved between 20% and 60%.

4.3 Effect of pricing policies

Taxing the price of an erosive crop (teff): The incentive effect of depressing the price of an erosive but a major cash and staple crop (teff) by 20%, relative to other crops, is given in Table 4. In response to the relative price change, smallholders adjust their land use and cropping patterns. The area under teff is more than halved while the area under wheat is more than doubled, while area of pulses increases by about 60%. Household income falls by up to 12% as a result. When the farmer begins to incorporate the user costs of current soil erosion into decision making, teff ceases to be grown on erodible lands. Even when user costs are unaccounted (in the basic model), soil loss decreases by 12% (5 t/ha) although bunds have not been installed on the uplands. Similarly, soil erosion decreases by 16% without adoption of bunds when user costs are accounted at high rates of discount ($\delta=0.54$). When user costs are accounted significantly, soil erosion levels come closer to that before the price change. The fall in income resulting from internalizing user cost and the price policy itself prevent wider conservation, but the change in the cropping pattern allows reduction of soil erosion to (often below) levels attained with higher conservation before the price change. For example, while it requires 50% upland conservation to reduce soil erosion to 25 t/ha, with the price policy, a 39% conservation achieves a similar level of erosion reduction.

Due to the fall in income, the consumption of leisure decreased by up to 23%, while the consumption of teff waned by up to 14%. Since wheat is not a substitute for teff and due to the fall income, the consumption of wheat also decreases by up to 10%. The price policy also prompts farmers to be only self-sufficient in teff. Thus, wheat largely substitutes for the marked decline in the marketed surplus of teff. Although this partial analysis does not reveal the general equilibrium effects, the policy is likely to have substantial impact on the marketing of teff and wheat. The decrease in marketed surplus of teff may have an eventual effect of driving up the its price. The increased supply of wheat may also depress its prices. In our model, prices are exogenous and such second-round effects can not be traced. Future research should investigate such effects in a multi-market or general equilibrium framework.

Supporting the price of non-erosive crops (pulses): Table 5 presents, the incentive effect of supporting the relative price of less-erosive crops (horse beans, field peas, lentils, chick peas, and rough peas) by 20%. These pulses together account for about 20% of the cropped area. Despite the very low yields, farmers do not use fertilizer on these crops. Pulses are often used for replenishing soil nutrients and they precede cereals in the rotation cycle. They are also mainly produced for own consumption. Thus, the responsiveness to the prices of these crops is likely to be limited. Results also indicate that, unlike the case of the teff price-tax policy, the relative increase in the profitability of pulses does not decrease the area under teff to bring a significant reduction in soil erosion. Teff planted on erodible slopes does not also show a significant decline. The area under wheat also remains about half of that under an equivalent tax on the price of teff. The pulse area also increased only marginally or remained the same. As a result, the desired effect of the price policy to stimulate soil-conserving land use and cropping pattern did not succeed. Hence, the soil erosion level remained comparable to that before the price change. Due to limited impacts on the cropping pattern, inclusion of user costs also required comparable levels of upland conservation to mitigate soil erosion. Since household income showed only a slight increase, the effect on consumption was limited. Marketed surplus of teff declined by up to 20% in the basic model, but the effect disappears when user costs are considered. The overall outcome of the pulse price-support policy does not differ much from the case without the policy. The low relative prices of pulses and their low current yields limit the effectiveness of the policy[4]. Under the current low productivity of pulses, it requires a much larger pulse price-support before significant changes in cropping patterns occur to have an effect on soil erosion. Thus, the pulse price-support policy did not bring a comparable change in behavior as the teff price-tax policy.

5.0 Summary and Policy Implications

The problem of land degradation and productivity decline in countries with fast growing populations that are also suffering from poverty and malnutrition has become an important area for government intervention. From the viewpoint of economic efficiency alone, the mere existence of land degradation does not, however, necessitate public intervention to mitigate the problem. An economic rationale for public intervention to conserve the soil stock requires, first, that the existence of market failures leading to a socially excessive land degradation be verified, and second, intervention to reduce the degradation problem should bring a social welfare improvement. In the context of peasant agriculture, divergence between private and social efficiency of land use may occur due to: incomplete property rights, imperfect/incomplete rural input/output markets, imperfect information, transactions costs, and policy failures. Market failures when they exist, may impair market signals received by smallholders and encourage socially sub-optimal land use and investment patterns. This study analyzes some incentives that can be employed to justify public intervention to mitigate the soil erosion externality using farm household data from Ethiopia, where a severe problem of land degradation and policies that discourage sustainable land use have been documented.

Where rural poverty is widespread, cross-compliance policies that link production incentives with soil conservation can provide opportunities for countering productivity decline from soil erosion without adverse impacts on the welfare of the poor and the marketed surplus of food. Such policies may thus represent improvements in efficiency, equity, and environmental quality. However, when conservation technologies significantly reduce immediate household income, as is reported by farmers in our case study, fertilizer subsidies linked to conservation do not improve social efficiency unless the social rate of discount is close to 5%. Seed subsidies and a mix of seed and fertilizer subsidies were, however, more efficient since they enable sizable reductions in erosion damage at low cost. If the social rate of discount is as high as 20%, such economic incentives also become socially inefficient. When structures leave immediate benefits unchanged, the cross-compliance policies for fertilizer, and a mix of seed and fertilizer inputs were able to reduce erosion-induced productivity loss efficiently. The efficiency of these incentives also drastically declines as the social rate of discount rises above 10%, and become inefficient at the 20% rate. The efficiency of incentives also decline after most erodible crops have been grown on treated lands, indicating a point of maximum efficiency in the level of the incentive. The cross-compliance approach is also found to be more effective to counter the soil erosion externality than unlinked input subsidies. When unlinked input subsidies are provided, the enhanced profitability of farming obliterates the need to invest in conserving the soil stock and thus conservation disappears as the subsidy increases.

Furthermore, at low rates of discount, the cost-sharing policy was not efficient when conservation is yield-depressing. Cost-sharing, however, enabled complete conservation of erodible uplands efficiently when conservation is yield-neutral in the short-term. Utilizing the farmer's own labor for conservation during periods of slow farm activity through incentives, like food-for-work programs that also provide employment opportunities for the poor, may therefore be an effective approach for soil conservation. If such incentives are made available through external assistance, the loss of production potential of agricultural land and expansion into marginal lands and clearing of forest cover can be mitigated without imposing a heavy strain on meager government budgets of poor countries.

The efficiency of the incentives depends on the user cost of soil erosion, the social rate of discount, and the life time of conservation structures. An increase in the user cost, a decrease in the rate of discount, and an increase in the life of bunds improve the efficiency of the incentives. The user costs depend on the productivity impact of soil erosion, output prices, and the social rate of discount. A decrease in soil depth and technical change raise the productivity impact of soil erosion. Increase in prices and a decrease in the discount rates also raise the user costs. If user costs increase by 50%, from 11 to 16.5 Birr/t of soil erosion, all the incentives analyzed will be socially efficient at the 10% rate of discount. Moreover, taxing the most erosive crop (teff) is more effective in abating soil erosion than supporting the prices of less erosive crops (pulses). The limited success of the latter approach was mainly due to low prices and productivity of pulses. Since general equilibrium effects of price policies were not captured, results need to be interpreted cautiously until such effects are investigated in future work.

End Notes

[1] Despite its common usage in economics, the market failure concept is subject to controversies (e.g. see Papandreou, 1994). Some also ascribe the instances of market failures (e.g. externalities, public goods, monopolies, etc.) as the fundamental causes. We define market failures in the broadest sense to mean the failure of the market system to achieve social pareto-efficiency in the allocation of resources. Market failure thus implies the existence of potentially mutually beneficial exchanges or profitable production decisions that can make some group better off without making any other group worse off.

[2] Kirby and Blyth (1987) provide a good treatment of sources of market failures in relation to land degradation in industrial agriculture (in Australia).

[3] The corresponding ratio of the upland area conserved is different from the cereal area conserved since fertilizer is only used for cereals (teff, wheat, and barley) and at present local improved varieties of pulses are unavailable.

[4] The 1993/94 average yields (kg/*kert*) of teff and pulses were 280 and 200, while average prices (Birr/kg) were 2.38 and 1.60, respectively. *Kert* is approximately a third of a hectare.

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Table 1. An aggregated structure of the inseparable farm household model[1].

	Produce crops	Sell crops	Consume crops	Use own seed	Buy Seed	Buy fertilizer / animal feed	Hire in/out land	Soil erosion	Family labor on farm	Family labor off-farm	Labor hiring	Leisure	Keep breeding stock and oxen	Sell livestock	Consume livestock	Income	Relation	R
Objective	+C				-C	-C	-/+C	-C		+C	-C		+/-C	+C				M
Land	1						-/+1										<=	B
Soil erosion	+A							-1									=	0
Income identity	+C				-C	-C	-/+C	-C		+C	-C		+/-C	+C		-1	=	F
Labor on-farm	+A								-1		-1		+A				=	0
Family labor supply									1	1		1					<=	B
Leisure demand												1				$-\beta$	>=	B
Oxen power	+A												-A				<=	0
Fertilizer	+A					-1											=	0
Seed use	+A			-A	-A												<=	0
Production	-A	+A	+A	+A													<=	0
Consumption			+A												+A	$-\beta$	>=	B
Cash income		+A								+A				+A			>=	B
Credit constraint						+A											<=	B
Rotations	+/-1																<=	0
Crop residue	-A					-1							+A				>=	0

[1] The C, A, B, F and β's represent, respectively, sets of objective function coefficients, input-output coefficients, available resource supplies or requirements, farm fixed costs, and the marginal propensity to consume estimated from a system of Engel equations. Allocation of labor and oxen power was specified over seven periods in a year.

Table 2.
Incentive effects of a cross-compliance policy (fertilizer and improved seed subsidies linked to conservation).

	Conservation 20% less productive					Conservation equally productive						
	Fertilizer subsidy (%)			Seed subsidy (%)		Fertilizer subsidy (%)			Seed subsidy (%)			
	50	75	90	90	100	10	25	50	10	25	50	75
Net Income (Birr)	4408	4590	4718	5278	5289	4432	4598	4937	5285	5309	5436	5628
Hired labor (*Manday*)	93	97	127	71	71	94	161	181	72	69	164	212
Leisure	164	176	185	221	221	166	176	199	222	223	231	244
Area conserved (*kert*)	0.80	2.15	2.91	0.53	0.55	0.96	3.89	4.07	0.57	1.76	3.33	4.14
Upland conserved (%)	16.5	45	62	11.6	11.9	19.5	84	85.8	11.9	38.8	66.0	83.8
Upland cereal area conserved (%)	20.0	52.8	71.6	13.3	13.7	23.6	100	100	14.4	49.9	79.0	100.0
Soil loss (t/ha)	33.8	29.3	25.7	36.4	36.2	31.5	20.9	19.8	35.4	29.4	25.5	22.2
Total damage prevented[1] (Birr)	***172***	***583***	***914***	***211***	***227***	***382***	***1352***	***1460***	***177***	***726***	***1085***	***1393***
Cost of the subsidy[2]	130	449	622	90	95	7	77	196.1	3	23	81	159
Installation and maintenance costs	92	246	332	61	63	182	743	776	110	336	635	790
Cost of conservation[3]	***235***	***741***	***1017***	***160***	***167***	***190***	***828***	***991***	***113***	***361***	***724***	***965***
Average costs	293	343	350	299	304	199	212	243	196	205	217	233
Benefit/Cost[4]												
$\rho = 0.1$	**0.73**	**0.79**	**0.90**	**1.32**	**1.36**	**2.01**	**1.63**	**1.47**	**1.57**	**2.01**	**1.50**	**1.44**
$\rho = 0.05$	1.77	1.92	2.19	3.19	3.28	4.36	3.58	3.30	3.41	4.39	3.30	3.21
$\rho = 0.2$	0.27	0.29	0.33	0.49	0.50	0.86	0.69	0.60	0.68	0.86	0.63	0.59

[1] The sum of the present value of annual yield losses prevented due to conservation over the life time of conservation structures (15 years) discounted over perpetuity.

[2] In addition to the first year investment incentive, this includes the subsidy (430 Birr/ha) for subsequent years that would equalize the net benefits with conservation to that without conservation. The latter is an estimate of the additional subsidy required to persuade the farmer to maintain bunds computed according to (3). Under the estimated rates of erosion in the area, when conservation is 20% less productive, it takes about 11 years for yields under the conserving and degrading practices to equalize. When conservation is yield-neutral, no such subsidies are needed after the first year.

[3] The cost of conservation includes the total costs of the subsidy, administrative costs (assumed to be 10% of the subsidy cost), own construction and annual maintenance costs over 15 years.

[4] Total damages prevented/Cost of conservation. All other calculated values are for $\rho = 0.1$.

Table 3.
Incentive effects of a cross-compliance policy (a combination of improved seed and fertilizer subsidies linked to conservation) and cost-sharing policy for conservation labor.

	Conservation 20% less productive (I)						Conservation equally productive (II)					
	Seed and fertilizer subsidy (%)			Labor subsidy (Birr/manday)			Seed and fertilizer subsidy (%)			Labor subsidy (Birr/ manday)		
	50-25	50-50	50-75	4	7	9	10-10	25-10	50-10	1	2	3
Net Income (*Birr*)	5274	5350	5645	5253	5285	5338	5306	5382	5557	5260	5277	5356
Hired labor (*Manday*)	71	196	216	70	91	106	69	165	193	70	145	221
Leisure	221	225	245	219	221	225	223	227	239	219	220	226
Area conserved (*kert*)	0.54	4.11	4.34	0.28	0.84	1.47	0.63	3.34	4.11	0.58	2.64	4. 58
% upland conserved	11.7	84.3	86.7	6	17.2	30.3	13.7	66.6	80.4	12.7	57.7	100
Upland cereal area conserved (%)	13.5	99.2	100	6.9	20.7	36.2	17.1	79.2	100	14.7	69.7	113
Soil loss (t/ha)	37.2	21.7	21.1	37	35	32.5	35.3	25.3	23	35.2	24.7	18.2
Total damages prevented[1] (Birr)	***206***	***1570***	***1614***	***82***	***296***	***565***	***181***	***1103***	***1316***	***249***	***1211***	***1814***
Cost of subsidy[2]	91	717	948	75	315	660	8	70	138	21	191	497
Installation and maintenance costs[5]	103	783	827	0	0	0	145	763	940	90	312	375
Conservation costs[3]	***204***	***1572***	***1870***	***83***	***346***	***726***	***154***	***837***	***1091***	***113***	***522***	***922***
Average costs	376	382	430	295	414	494	243	251	266	194	198	235
Benefit/Costs[4]												
$\rho = 0.1$	**1.01**	**1.00**	**0.86**	**0.99**	**0.86**	**0.78**	**1.17**	**1.32**	**1.21**	**2.21**	**2.32**	**1.97**
$\rho = 0.05$	2.39	2.35	2.06	2.57	2.23	2.03	2.55	2.88	2.66	4.77	5.03	4.28
$\rho = 0.2$	0.38	0.38	0.32	0.33	0.29	0.26	0.50	0.56	0.50	0.95	1.00	0.84

[1], [2], [3], [4] See the description given under Table 2.
[5] When immediate yields with conservation are 20% less, all installation and maintenance costs are covered by the cost-sharing and thus the farmer's costs are nil. The farmer receives Birr 9, 116, and 311, respectively, under each level of the labor subsidy above the total social cost of labor used for construction and maintenance of bunds. This is, however, part of the social cost of conservation.

Table 4.
Effect of taxing the price of teff (an erosive crop) by 20% on resource use and conservation decisions of highland farm households in Ethiopia (as % of the before price change).

Issues considered	Basic model (without user costs)	All user costs accounted (δ=0.54)	All user costs accounted (δ=0.1)		All user costs accounted (δ=0.05)	
	I&II	I & II	I	II	I	II
Net income	89.2	89.1	88.7	88.3	88	88.3
Teff[2] (*kert*)	53.3	42.9	44.2	43.6	68.4	53.7
Wheat	266.9	291.0	254.6	265.2	153.5	221.5
Barley	45.0	43.2	60.1	59.6	85.0	60.6
Pulses	167.9	176.7	203.4	77.5	128.1	153.8
Teff area upland	26.9	0.0	0.0	0.0	0.0	0.0
% upland conserved	*0.0 (0)*	*0.0 (0)*	*0.0 (0)*	*86.7 (39)*	*56.4 (22)*	*100.0 (100)*
Soil loss (t/ha)	*88.5 (33.7)*	*84.1 (31.8)*	*87.8 (31.6)*	*96.5 (26.3)*	*104.1 (28)*	*87.7 (15.7)*
Family labor supply (manday)	103.3	103.2	100.0	114.2	93.4	110.7
Labor off- farm	150.0	144.4	139.6	98.2	191.4	106.9
Leisure	83.4	83.3	81.0	81.0	76.9	79.8
Hired labor	75.9	64.4	75.6	38.8	0.0	64.2
Teff consum. (kg)	86.0	93.2	93.2	93.0	92.9	93.1
Teff market. surplus(kg)	19.3	0.0	0.0	0.0	46.9	22.8
Wheat consumption	90.1	90.1	90.0	89.5	89.6	89.5
Wheat marketed surplus	501.5	513.0	372.9	406.6	174.2	305.4

[1] The scenarios analyzed are:
I = Immediate yields with conservation are 20% less than conventional farming,
II = Immediate yields with conservation are equal to conventional farming, and
δ is the farmer's real rate of discount used in computing the present value of lost production.
The numbers in parentheses refer to actual values after the price change.
[2] Sum of cultivated area of white, mixed and red varieties of teff. All area units are given in the local unit *kert*, approximately a third of hectare (ha).

Table 5.

Effect of supporting the price of pulses (less erosive crops) by 20% on resource use and conservation decisions of highland farm households in Ethiopia (as % of that before price change).[1]

Issues considered	Basic model (without user costs)	All user costs accounted (δ=0.54)	Six year user costs accounted (δ=0.1)		All user costs accounted (δ=0.1)	
	I & II	I & II	I	II	I	II
Net Income (Birr)	102.1	102.2	101.7	101.6	102.0	101.7
Teff (*kert*)	92.6	92.7	100.1	98.9	97.6	100.4
Wheat	133.1	131.9	98.7	103.5	105.0	98.7
Barley	77.5	74.9	102.0	99.0	95.0	100.0
Pulses	113.2	119.5	100.2	109.0	100.5	100.6
Teff area upland	88.4	88.3	107.2	105.0	88.8	101.1
% upland conserved	*0.0(0)*	*0.00(0)*	*0.00(0)*	*119(53)*	*94.9(37)*	*100.0(100)*
Soil loss (t/ha)	*98.2(37.4)*	*98.6(37.4)*	*100.6(36.2)*	*95.4(25)*	*99.3(26.7)*	*100.6(18)*
Family labor supply (mandays)	98.1	98.6	98.3	98.1	98.4	98.3
Labor off- farm	93.8	93.1	98.9	100.0	98.3	100.0
Leisure	102.9	103.5	102.6	102.6	103.5	102.3
Hired labor	105.1	105.5	114.6	125.9	106.3	101.4
Teff consumption (kg)	101.4	101.6	101.1	101.0	101.2	101.1
Teff market. surplus (kg)	81.4	84.4	97.8	95.3	94.2	99.9
Wheat consumption	102.0	102.1	101.3	101.6	101.9	101.4
Wheat marketed surplus	175.2	164.7	96.6	104.8	105.6	96.7

[1] For additional descriptions, see the note under Table 4.

9. VILLAGE POLITICS AND PUBLICS
Leadership and Management of Resources Among Fulani of Mali

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Abstract

The paper focuses on capacities for collective action among Fulani agro-pastoral village communities of the Inland Niger Delta of Mali. It addresses the population-environment-development nexus from a critical angle. The paper finds that the following factors are important for explanation of successful collective action and self-management of common-pool resources (CPRs). Increase in human and animal populations is only one among several factors to this effect. These factors include:

- the presence of social capital at community level, measured in human resource capabilities, shared belief systems and norms, networks and trust - expressed through social and political engagement of wider social groups of the community
- the capacity of local leaders to overcome heterogeneity in economic interests and to coordinate action, particularly between noble pastoral groups and subordinate cultivators
- the history and patterns of resource use of political elites and degree of rivalry among them
- the capabilities of leaders to acquire knowledge of contingent circumstances, to mediate in conflicts, and to give timely concessions in a manner perceived fair by wider groups
- the degree of autonomy acquired by leaders from imposition of solutions from state officials in order to ensure that management is perceived legitimate; leadership must be anchored in the community.

When community leaders are confronted by engaged and organised opposition from among wider political elite groups, women networks, youth movements, and occupational associations they seek sources of authority "from below". Such political engagement foster stable political economic conditions, robust resource regimes, and improved management of CPRs. Village politics matters. There is evidence that stable village polity enhances economic progress, more equitable and sustainable livelihoods. The paper finds that local, self-organised property-rights regimes are important, but not sufficient, in achieving sustainable natural resources management. There are important differences in economic success within social categories accross the villages studied. Most individuals and social groups face problems in producing a surplus required to cover basic family needs, re-invest, and re-produce community institutions and resource regimes. Hence, explanation of social and economic differentiation requires a focus on a set of networks and associations which condition individual capabilities, access to resources and entitlements. Individual agency matters too - at all levels of social organisation. Relationships to external markets and the state are central. The state has important functions to fulfil in fostering local autonomy, infrastructural support, social services, and enforcement of property rights. Given relative poverty, low entitlements, and weak economic conditions, the drough and variably resource productivity remain critical factors for survival. Recognising the close interlinkages that exist between actors, organisations, and leadership, and that actors actively create and change institutional structures, an "interdependency theory of institutional change" is suggested to inspire **further thinking.**

What capacities do village communities have for co-ordination and management of common-pool resources (CPRs)? Will common-property regimes for management of natural resources in the Sahel exist well into the next century? Or will these institutions dissolve - as remnants of a dying past? The paper uses a political interaction framework in order to explain the interplay between the attributes of dynamic resources, the characteristics of the community in which a situation occurs, and the external political economy. The interactional framework focuses on patterns of domination and dialogue, persistence and change of these encounters within different arenas (political, administrative, legal, cultural).

"In the political interaction framework, political factors account for many social and economic realities but are themselves informed by historical, demographic, cultural, ecological, ideological, and international factors. Politics are, therefore, perceived as a set of transactions, the manifestation of the exercise of choice by multiple actors within existing parameters. This perspective, unlike the managerial view of the modernization school, the exploitative emphasis of the dependency approaches, and the instrumental notions of the statist writers, highlights the fluidity of politics and attempts to trace the vacillating political course" (Chazan et al 1992:23).

The use of the framework requires first of all an examination of the key parties of politics (bargaining parties). Explanation of the political interactions among local leadership groups and political elites is central, placed in a cross-pressure between loyalty to wider community groups and state officials. The framework is presented within a rudimentary "*interdependency theory of collective action*" , conceptualised in order to stimulate further thinking about collective action and institutional change.

The "naive" property rights theory

Conventional or "naive" property rights theory is often used to explain an inevitable dissolution of communal property regimes due to mismanagement and evolution from common property to private property rights (Hardin 1968, Demsetzt 1967).[1] In short, the theory claims that if land scarcity arises under a common property regime (due to rapid population growth), there is likely to be increasing rivalry in consumption, more frequent disputes and higher enforcement costs. Under "communal" ownership structures, users have no direct incentives to internalise social and/or environmental costs. Exclusive private tenure for crop land and more secure rights is assumed to foster less rivalry and conflict, better resource management, higher productivity and land markets. Common-property regimes are *a priori* regarded as inefficient and 'backward' systems.[2] Privatisation gets rid of ineffective common property regimes, ineffective producers, and undermines customary leaders and authority, which inhibit land transactions (cf. review by Baland and Platteau 1994a, 1994b, and 1996).

But who supplies and enforces private property rights and why? An at whose costs and whose benefits? This paper addresses issues of cultural, political and economic

[1] Property rights are the terms and conditions for control, access- and use-regulationThe theory is conceived "naive" since it does not attempt to explain why property rights are supplied, only why they are demanded (Eggertson 1990, Alston, Eggertson, North 1996).
[2] This argument overlooks that land is a particular commodity that in *most countries* cannot freely be sold in a market. This is also so in Western developed countries. There are always different non-economic factors, reflected in social customs and laws, that put restraint on the use and alienation of land.

nature that question a direct causal link between population increase, environmental degradation, and agricultural decline within common property regimes. The context is stratified communities critically dependent on common-pool natural resources (CPRs) of highly variable productivity. The paper reveals complex and interdependent relationships between resource attributes, community factors, and external state and market conditions. Population and demographic factors remain important for explanation of capacity for collective action, but not decisive.[3] At community level, there are factors related to heterogeneity, status-hierarchies, power, and leadership that condition land and factor markets substantially. There are critical constraints set by state laws, policies, investment priorities in infrastructure, and enforcement systems.

Comparison of two Sahelian village communities

The paper is based on insights from field-work among a few selected Fulani villages of the Inland Delta of Mali between 1992 and 1995 (about six months in the field) (cf. Vedeld 1997). The Delta represents the largest rangeland and flood-fed crop land system of West Africa. More than 1 million cattle and 2 million small-stock depend on its resource productivity. The ecosystem productivity depends critically on rainfall and flood-levels in the Niger River. About 6-8 000 sq. km are flooded annually, which is about 1/3 of what was flooded in the late 1960s. The presence of water and herbage in the dry season is its comparative advantage. The recorded population increase in the zone is slightly less than 2% per year, but with a substantial degree of out-migration of young men and women.

How do the local multi-ethnic villages resolve problems related to population pressure and change in resource attributes under communal property regimes? Focus is on degree of autonomy for creation of social capital, and capacity to overcome heterogeneity and foster collective solutions to "common" problems. Social capital is defined as trust, networks, sharing of values, norms, and knowledge. It is important that the common property regime is embedded in community institutions, whose functions are broader than management of CPRs.

The comparison involves two common-property regimes of Kakagnan and Dialloubé villages, located about 15 km apart i.e. within a zone small enough for ecological conditions, social norms and belief systems, taste, technology, and access to markets to be fairly constant. The most important factors for understanding differences in robustness and institutional change is the *particular dynamics of the encounters* between communal groups, customary leaders and state officials. These encounters involves a complex network of personal relationships between influential individuals and wider interest groups to resource users. The political bargaining processes over competition for resources and power is necessary for an explanation of changes in property rights institutions. These bargaining processes are conditioned by the particular history and composition of influential elites and wider social groups, struggles among them for power, and control with the Chieftainship. Differences in economic interests and entitlements shape conflict lines. Resource politics, normally regarded as struggles

[3] One should recognise that demographic change takes place within a pre-existing institutional and demographic setting. Demographic patterns have their historical path dependence, but can be changed or influenced by deliberate action at family or higher levels of social organisation. Hence, it is in part exogenous factors, in part endogenous factors of a framework explaining collective action.

between interest groups about shaping the future, is also about conflicting perspectives on past systems of rights. Historical claim-rights are used to defend present claim-rights. The role, representativity, and legitimacy of leadership turn out as key factors in the shaping of robust polities and institutions. High degree of autonomy from state officials foster higher trust among community groups, and more robust management regimes.

Leadership, collective action and access to state power

The papers illustrates that leadership, to be efficient in the longer term, needs to be firmly anchored in society. Leadership can serve various functions in relation to collective action and institutional change (see earlier chapter). Leaders can initiate co-ordinated action, determine sequences of action, mediate in conflicts, and serve as role models for honest or correct behaviour. They can take on costs beyond what is expected of normal villagers, due to gains in prestige or wealth. Good leaders are likely to enhance people's trust in other people's action regarding co-operation or fair dealing. They may shape people's sense of duty and what is 'right' behaviour (adherence to norms and conventions) (cf. Baland and Platteau 1996:141). Perhaps particularly in stratified societies, the leadership become important for building social capital, and enhancing capacities for collective action. They have thus importance well beyond the share management of CPRs. But political elites and leadership can also block co-ordination efforts and successful institutional change at all levels of social organisation.

Categories of property rights conflicts

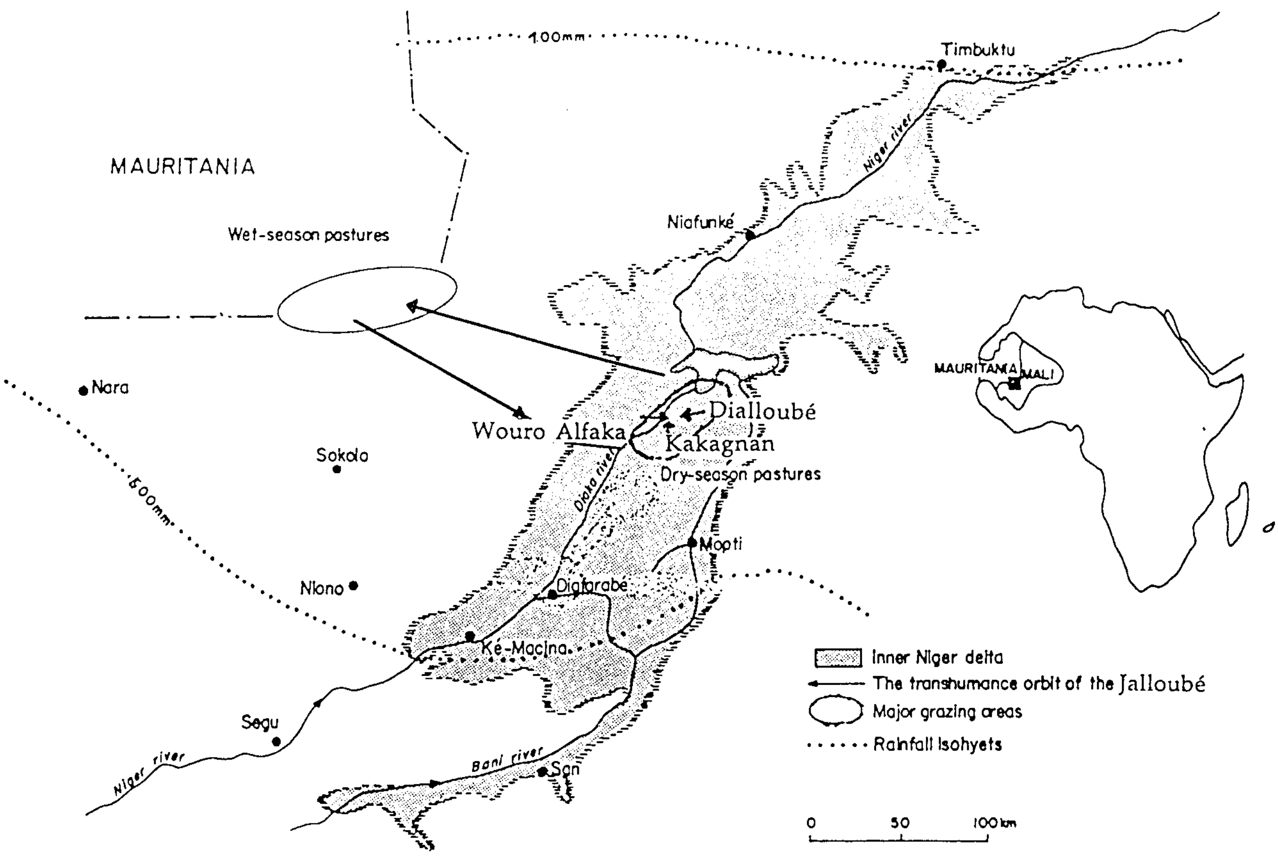
Among the Fulani and neighbouring ethnic groups, the conflicts over common-pool resources occur in two major types of resource systems and arenas. One resource-arena concerns conflicts over point resources or more limited zones, such as crop land fields, cattle tracks or pastures. The other arena concerns conflicts over the management of a larger ecozonal resource systems (Cissé (ed.) 1996, cf. Blench 1997). The categories of conflicts and corresponding arenas are shown in the Box 1.

Box 1. Categories and frequencies of conflict

	point resource	**resource system ecozonal**	**frequency**[4]
1. Pastoralists/herders vs. cultivators (access to CPRs, conversion, crop devastation)	x	x	35%
2. Pastoralists vs. other pastoralists (territorial conflicts, boundary disputes, overgrazing)		x	6%
3. Cultivators vs. cultivators (access to floodfed land, tenure limits)	x		42%
4. Agro-fishermen vs. cultivators/pastoralists	x	7%	
5. Local users vs. pastoral leaders concerning allocation of use rights to non-community members	x	x	n.a.
6. Absentee herd investors vs. local pastoralists	x		n.a.
7. Large scale state-subsidised agriculture vs. local pastoralists and cultivators (water and land)	x	x	n.a.
8. Local users vs. external state regulation and infrastructural projects	x	x	n.a.

[4] Frequencies of property rights conflicts is measured in 75 villages in the flooded zone of the Delta (source: Cissé (ed) 1996. Interestingly the researchers found slightly *higher* number of tenure conflicts outside the Delta (180 versus 148 conflicts in 102 villages outside and 75 villages inside the Delta). A sign of higher social capital among diverse communities within the Delta?

Map 1. Annual migration pattern of the herds of Jalloubé
(adapted from Breman et al. 1978 and Wagenaar et al. 1986)



The user groups or bargaining parties involved in each of the conflict types are indicated. The key land use conflict addressed by the communities is whether to use floodplain CPRs for grazing or for flood-recession rice cultivation. This is foremost a conflict between noble pastoral groups and subordinate cultivators. But former pastoral groups, following 30 years of drought, have also started to cultivate in order to enhance food security. Livestock losses was about 40-50% for many households in 1972/72 and 1984. When the herd is depleted, re-allocation of household labour from livestock to crop cultivation makes economic sense. Hence, the resource conflict is partly internal to households. The conflict type between pastoralists and farmers have ecozonal implications.[5]

Now, are property-rights conflicts resolved within the community realm? When using resources, does people's behaviour represent an adaptation to access-rules and use-regulations? Or does it reflect conformity to routines embedded in past experience, status, and power hierarchies?

Environment, people and social capital of Kakagnan village

The two villages regimes of Kakagnan and Dialloubé are presented in sequence. The village of Kakagnan is politically dominated by the "founding" lineages of clergymen (Marabouts), supported by groups of craftsmen (Nyéebé).[6] The village and its village common was established in it present form in 1821.[7] The leadership of Kakagnan plays a key role in economic and political affairs of the region, reflecting an important historical position. Along with the clergymen groups settled also families of other noble Fulani groups (transhumant pastoralists, traders, craftsmen) and their agricultural slaves (Rimaybe). The Somono and Boso fisher folks, located at the village site at the time of settlement, became subordinated the Fulani of Kakagnan. Today the village of Kakagnan consists of two main quarters: the 'Kakagnan Peul' (1200 people) and the 'Kakagnan Saré' (800 people, mainly Somono and Boso).[8] The political elite groups of clergymen and craftsmen constitute each about 15% of the population of 'Kakagnan Peul'.

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[5] The figures on frequency refer to a paper of 75 villages within a broader zone of the Delta (Cissé (ed) 1996). The most frequent types of conflicts, according to that paper, occur between cultivators (42%) and between cultivators and herder (35%). Only 6% of the conflicts occur between herders. Local conflicts have been enhanced by the provision (smuggling) of Kalashnikov machine guns made available at low cost to different social groups (coming from Eastern Europe).

[6] There are however two opposing clergymen lineage-groups competing for the Chieftainship. Marabouts or clerics/clergymen is taken from the French litterature. In Fulfulde the term is Moodibo/Moodibaabe (sing./pl.). I use it as a social category as here. Several of the clergymen have studied Islam for a considerable period of time and are in posession of a certain recognised knowledge. If they, in addition, come from highly regarded marabouts lineages they may exclusively live from this.

[7] This was three years after the establishment of the theocratic Dina-state based on Islam - the Hamdullahi Caliphate (1818-1864). The state was established after a local holy war in which the combined forces of clergymen and former slaves won over the Bambara Kingdom and local aristocratic Fulani groups (the Ardobé). The Ardobé were more nomadic pastoral groups - mostly non-Muslim. Their descendants are common among the transhumant pastoral groups of the Delta, and dominate in Dialloubé..

[8] Ka-ngnan literally means 'the property of the father' in Somono. The Somono chief claim that 'they brought the Boso as captifs' and founded the village.

Numerically, the group of transhumant pastoralists is the largest with about 40%, while the subordinate cultivators (Rimaybé) is the second largest (about 20%). The village is centrally located regarding the management of rangelands and controls an important crossing on the cattle tracks leading to the large pastoral zones of Lac Debo. The village was the sub-section centre for the UDPM party (out of 12 villages), and village authorities have been active in politics during the period of UDPM.[9] The village is a local centre of Islamic learning (three Coranic schools), and people come from neighbouring villages to join the Friday prayers. Village authorities are scholared in Islam and Islamic law.

Table 1. Socio-economic determinates of Fulani villages (Kakagnan and Dialloubé)

Determinates	**All respondents (N= 200-220)**	**Kakagnan (N=91)**	**Dialloubé (N=100)**	**Village Council (N=10-15)**
Occupation				
Pastoralist	30%	31%	31%	33%
Agro-pastoralist	13%	13%	13%	33%
Cultivator	30%	33%	24%	13%
Trader	27%	23%	32%	20%
Socio-ethnic ('caste')[10]				
Clergymen	11%	25%	1%	7%
Trans. pastoral	31%	29%	32%	33%
Traders	12%	1%	27%	27%
Craftsmen	13%	13%	17%	13%
Cultivators	25%	24%	23%	7%
Tawreg/Others	8%	8%	0	n.a.
Tenure security				
High: village only	74%	53%	93%	83%
Mixed: mix	19%	38%	2%	
Low: outside village	7%, N=170	8%, N=73	6%, N=68	
No education (formal)	74%	77%	65%	60%
Migration (> 5 years)	18%	14%	29%	33%
Crop value (gross)	70 000 fcfa	62 000 fcfa, N=62	100000fcfa,N=45	60 000 fcfa, N=15
Field size	2,9 hectares	3,3 hectares	2,3 hectares	3,1 hectares
No field	25%	20%	31%	13%
Land-rich >4,5 hectare	21%	25%	18%	20%
Field expansion (5yrs)	29% expanded	38% expanded	23% expanded	33% expanded
Crop production (1991/92 + 1992/93)	mean: 1396 kg N=137, 138	mean: 1209 kg N=62, 64	mean: 2018 kg N=47, 46	mean: 1604 kg N=10, 11
Cattle-rich hh	13%	7%	21%	33%
Medium-rich	22%	31%	15%	
Cattle-poor hh	31%	27%	30%	
No livestock	35%	34%	34%	N=15
Participation in NRM				
did no acts of NRM	46%	31%	71%	20%
two or more NRM acts	19%, N=222	33%, N=91	2%, N=100	20%, N=15

[9] The village aspired to become the centre of the arrondissement at independence, but lost to Dialloube, who had closer ties to central powers.
[10] Due to a slight bias in the sample, the number of persons interviewed in each social category do not correspond to the actual numbers in each of the villages of each category (according to local demographic data). This makes comparison at village level less reliable.

Resource use strategies: Livestock and crop production

Regarding main occupation, the people categorise themselves as follows; 31% transhumant pastoralists, 13% agro-pastoral, 33% cultivating, and 23% as traders (basically according to own perception of identity) (data from the formal survey, N=99).[11] The village controls flood-fed pastures and crop land around the village, and a larger village territory with important CPRs, such as dryland rangeland, woodland, and wildland resources (about 100 sq. km). The village is relatively well endowed with cattle and livestock. A wealth ranking exercise indicates that 32% are medium-rich in cattle (between 30-100 heads of cattle), while 7% are cattle rich (above 100 heads), and 27% are cattle-poor (below 30 heads). The political leadership group of clergymen is not particularly rich in cattle or land.[12] At the same time 34% of all groups claim to have no livestock. Only 20% report to have no fields (while 25% are land-rich; above 4,5 hectares). The average household covers only about 60% of its reported annual consumption needs of grain from own production.[13] Many migrate in search of piece-work or are involved in handicraft, herding or trading. It is mostly the Rimaybé who cultivate outside the village common (defined as "low tenure security").

Social and political organisation of village regime

The group of elders among the five 'founding' lineages of clergymen form a distinct religious and political group ('les familles dirigeantes'). They control most aspect of the management of the resource regime. The families of Kakagnan are in important ways united at community level, accross ethnic groups, lineages, castes, gender and generations under the "council of elders" or suudu-baaba of the village community (cf. Lewis 1979).[14] [15] It is first of all **the elders** of these 'founding' lineages that dominate village politics. The authority structure is paternalistic and hierarchical. Egalitarity is mostly observed within the same age-group. These elders are all those men who are married and have the 'right to speak in public' and who are 'listened to'. There is a traditional association of **young men**, who has acquired social and political significance, inspired by the youth movements in the capital. This association is headed by a designate leader. A main task of this 'association' is to provide readily available labour for communal work. A young herder must be prepared to participate in a Surveillance Committee for the pastures. A young cultivator (Dimajo/Rimaybe) can be called for collective work in de-silting canals for the flood-fed irrigation systems or for regeneration of pastures, or for agricultural work of some sort. A third type of village

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[11] The main local diet consist of rice or other grain types (maize, sorghum, fonio, bourgou grains), fresh milk, occasionally yogurt, chicken, fish and goat meat. The cultivators (Rimaybé) rely more on grain and less on animal products in their diet, while the fisherfolks (Somono and Boso) use mostly rice with relish made from spice and sauce cooked from fish.

[12] The craftsmen are most frequent among the cattle-rich group (25% among them). It is among this group and a few members of the Village Council, that the highest frequency of cattle-rich persons is found.

[13] This figure can be compared to 34% coverage of annual grain consumption for Dialloubé village and 48% average for the total sample of 229 households in four villages.

[14] Suudu baaba literally means 'fathers house'; all descendants of the same forefather (Ba and Daget 1962:76). It is also used as an expression for all members of the (Fulani) community.

[15] There are also other similarities between the the social and political organisation described here for Fulani village communities and village communities of other ethnic groups of the western Soudano-Sahel (Bambara, Marka, Somono, Boso, Maninka) (Kassibo in ORSTOM 1994).

association is constituted by the groups of **women and young girls**. There are four of these women groups, one for each of the main castes (the clerics, the traders, the craftsmen, and the former slaves). The women groups have different functions related to communal tasks such as taking care of visitors, organising, and preparing food during ceremonies. Networks related to production are relatively loose. The Fulani lineages are, as indicated earlier, united in endogamic socio-ethnic categories ("castes"), which in the past involved fairly strict occupational functions (e.g. clergymen, traders, craftsmen, slaves).

Box Age and gender in the social organisation

Regarding decision-making in village affairs, the separation in age-groups and gender is important. The **women and young girls** hold a separate position in the social hierarchy. They are subordinate men in patriarchal rather than corporate marriage institutions and social systems. Individually they normally have an *indirect* say in management of CPRs and crop land. They can however have substantial influence on creating conditions for cooperation, also among the men. Women hold no inheritable usufruct rights to land. They do own livestock. The Fulani women work little on the land, and less than in many traditional pure cultivating societies of the Soudano Sahel. There are several women associations, but the activity level at present is low. The women blame this on the drought, lack of food and milk. "We are tired", they say. Each woman needs to fend for herself and her family; creating less room for collective initiatives. **Young men** will normally be accepted as decision makers; i.e. 'listened to' only after they have reached a certain maturity related to his age class (normally after passing 40 or 45 years).

Patterns of interaction: evolution in the political economy of the regime

The patterns of interaction between resources, community groups, and external arrangements reflect the mutual choice of strategies by members of a group or of a property regime. How does the community authority structure operate? Can joint bargaining stands of interest groups and pressures to change arrangements be identified? The patterns of interaction between these stakeholders in CPRs shape important conditions for behaviour within the village-common. Are there interdependencies and reciprocities that foster collective action? Or do asymmetries in distribution of rights and heterogeneity hinder collective action?

Authoritarian regime (1960-1991): territorial expansion and conflicts[16]

How has the village common-property regime evolved in Kakagnan village in relation to changing physical and technical attributes and socio-economic conditions? Initially, the village-common was 'formally' set aside as grazing-common (under the Dina in the 1820s). Local informants say that it was used already then for both rice cultivation and grazing. At independence, the village authorities represented by the new Village Council, formally decided to divide the village-common in one zone for grazing land and one for crop land, as a simple land use plan. The large and relatively wealthy Somono/Boso

[16] First republic under Modibo Keita (1960-1968); Second Republic under Moussa Traoré (1968-1991).

Hadi Bory Sangho alias "Henry Kissinger"
- the First Councillor of Kakagnan village

groups were first denied access by the village leaders. They then chose to bypass the leaders. They obtained the support of the local Chef d'arrondissement for usufruct rights to crop land in the western part of the village-common (in 1963/64).[17] This support by the state administration might be seen as part of the independent Malian government's policy to suppress customary authorities of 'feudal' character. State officials did provide support to subordinate groups. Agricultural expansion was probably rather fast in the 1960s, reflecting good rainfall and rapid introduction of ploughs and oxen. This allowed each household to cultivate more land in a shorter period.[18] A slow, but steady rise in population, combined with the first drought years at the end of 1960s, enhanced rather fundamental structural land use changes in the village-common. People started shifting sites for cultivation of rice, and took into use the village-common more intensively for cultivation. New social categories of people became more reliant on crop production, also pastoral and fisher folks' households. These land use changes are part of a deeper structural change that started long before the drought.

With the extreme drought and low flood in 1972 and 1973, the village leadership (Village Council) agreed to take a larger zone of the village-grazing common into use for cultivation. Some areas became agronomically better suited for rice cultivation since flood levels dropped by one meter compared to earlier levels. The old maize and millet fields were left due to lack of rain or exhaustion.

Even if the village authorities agreed to increase the crop land area at the expense of CPRs, they did not satisfy the land demands of the Rimaybe group. Since fish catches had started to drop, the Somono and Boso also sought new crop land. The first wave of Rimaybe cultivators now moved and cleared crop fields in a a depression zone 20-30 km to the south, where flooded land was accessible (Kootiya). To meet increased demand, the village authorities decided to employ a rather ruthless strategy of *territorial expansion*, rather than adjusting use to internal resource scarcities. This happened at the expense of several, in part less powerful neighbouring Fulani groups. The village soon faced territorial and property-rights conflicts with all its Fulani neighbours. In this period, the First Councillor Hadi Bory Sangho, significantly contribute to the shaping of the village regime. He is a charismatic personality, widely known for his strength in external relations and management of internal affairs. In this way he acquires the distinction: "Henry Kissinger") (cf. Box).

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[17] This is in a period of state *engagement*..It shows how the state has the potentials to support the claims of weaker groups (for good or for bad regarding access rights to resources.

[18] The increased use of oxen for ploughing is used both for cultivating more land per household and/or for liberating time for other tasks (labour migration).

Box The First Councillor: Hadi Bory Sangho alias 'Henry Kissinger'

Hadi Bory Sangho (65 years) is a wealthy and charismatic personality. He is a craftsman, a 'tisseran', from an influential and powerful lineage originating in Maasina. He is a former youth leader, lion hunter and warrior, skilled in witchcraft, and with influential relationships within and outside the community. He has only a some Coranic education, but has travelled extensively as a weaver, transhumant herder and trader in livestock to Burkina Faso and Côte d'Ivoire. With the surplus from these activities, he established a cattle herd. Throughout the 30 year period 1963-1995 he holds the position as First Councillor. He survives five Village Chiefs, and is instrumental in creation and enforcement of the a firm and authoritarian regime for management of the village CPRs. In everyday surveillance of the village-common, as well as in all major resource use conflicts with external groups, he is present and takes a lead role; writing letters to state officials, requesting military police, and punishing people. As he says: I promised myself to do everything for the village, even if it meant I would be killed..". In this way he obtains the acronym: 'Henry Kissinger'. He plays a variety of leadership roles in the conflicts that arise; independent decision-maker, negotiator, mediator, diplomat, inspirator, judge and prosecutor. He has fought against interventions by state officials, and been taken in for interrogations in Mopti. He is a ruthless fighter, who is admired and respected, but also feared. He admits that the military police did not always treat infrictors nicely. These ties have benefited the village in its struggles over claim-rights vis-à-vis potentially hostile neighbours. He has served the village, but also gained himself.

A strong and charismatic personality of Henry Kissinger's' calibre matters in building a strong village regime. But his mandate and strength in important ways depends on the combined social capital of the wider Kakagnan community from which he operates. In expanding its territory and defending village interests, the combined village leadership is instrumental in organising action and carrying costs of enforcement. There are also costs carried by ordinary villagers (e.g. crop devastation, injuries, fines). Since the village is allowed access to military police to defend their claim-rights, state agencies also carry costs (military police, administrative intervention, court handling). The losers in serious group conflicts are those with weakest access state power. State access requires a minimum of community wealth and co-ordination in order to cover bureaucratic rents to the police and higher state officials. With the onset of the extreme drought in 1984, the village leadership met new land demands of the Rimaybe to a level that avoided direct confrontation, but not fully. The Somono and Boso of Kakagnan-Saré were denied access to new land by the Fulani leadership. Much of the land they obtained in 1963/64 had now fallen out of production due to lack of flood-water. As a group they had low political bargaining stands. They did not get renewed support from the state administration or from UDPM for claims to land in this period. They had no channels to voice demands outside the village community.

Box Authoritarian rule of the village common-property regime (1960-1991)[19]

Regarding external relations, the village leadership established a policing regime with a combination of own guards and military police. Outsiders that happened to touch the zone were rather ruthlessly chased or taken to the village and punished (outside control of police and legal authorities). The leadership obtained access to military police of the cercle that assisted in the 'policing' of the boundaries of the village-common. The military police was (informally) detached from the state administration and made operational under the First Councillor; Henry Kissinger. He was the main executor of this policing regime. The payment for the police was whatever fines they made 'violators' of the rules pay. Outside herders caught inside the village-common without authorisation would be prosecuted locally and forced to pay daily rates of 16-18 000 fcfa per herd per day. According to village authorities confiscated sums could vary from 10 000 fcfa up to 150 000 fcfa according to degree of violation (number of animals, length of stay, possible crop devastation). The funds were kept by the village authorities and the military police group. The villagers of Kakagnan also benefited from the regime, however, through a 'low-cost' policing regime financed by the infrictors. They also gained from the expansion in territory and total resource endowments. In this regard they gave the regime support, though more and more half-heartedly. The price was hostile neighbours, crop devastation, injuries, and conflicts.

The fall of the one-Party state: 1991

With the fall of the one-Party regime in 1991 an immediate dismantling of the local and regional UDPM party structure took place. A broader group of villagers, headed by the young men, inspired by the youth of Bamako, and the clergymen in opposition to the Chief, demanded a regime change. They reacted against abuse of power, and the role played over time by UDPM and state officials. Old UDPM cadres of the village leadership stepped back for a while. Due to the relative firm power position of the leaders (sources of power from customary-, state administrative-, and Party- channels), they had relatively unchallenged engaged in different types of 'deals' with foreigners for access to grazing in the village-common. Neither in law nor in practice were there clear distinctions between administrative, political affairs, say personal affairs during the UDPM period. Questions were raised about the use of military policy.[20] One particular internal conflict with herders from the village of Douenza further north, triggered the internal reactions that lead to a new regime for the village common.[21]

Multi-partism: Broadening the governance basis

The externally initiated processes of creating multi-parties and more democratic forms of rule have substantial and direct implications for relationships between leaders and wider social groups. In general, people seem to choose political parties locally, according to traditional rivalries and socio-ethnic differences (if feasible). It is striking that the family

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[19] The use of external state support for local surveillance and policing purposes goes back to the period of the Dina state (1818-1862). The French colonial administration would also support Chef de Canton military wise if deemed opportunt.

[20] As put by a government official of Dialloube: "Why should the gendermes (military police) protect this harrima (village-common).

[21] In 1991 a large group of Douentza herders negotiated access to village pastures with key village leadership persons. Such 'deals' had commonly been done in the past. Now the villagers of Kakagnan no longer accepted this. They attacked the Douenza herders violently, and chased them away. Many men were injured.

heads of the two opposing clergymen families eligible as Chief select different parties. How do these political changes affect the regime of the village-common? Perhaps the most significant change is the joint generational reaction among the younger men to the old cadres of UDPM and former authoritarian practices. As observed by the village Chief, the young men, initially joined the political parties of their elders - as a sign of respect. Then when the option came, they shifted to CNID and used this party as a platform for demanding local institutional changes, inspired by what happened at national level. They negotiated access to the Village Council (three new members). These included one Marabout, one Sossobe, and one Rimaybe (a combination of age, socio-ethnic, and personal criteria). The young men also took an active role in working for better relationships between the two opposing groups of Marabouts. The two groups were re conciliated in November 1993, almost ten years after the conflict over the Chieftainship arose. The actual reconcialiation was triggered by an elderly female 'la Presidante' (the head of the Diawambe/trader women group). She made the Chief shake the hand of his rival and meet to "drink tea". [22] The young men demanded direct representation and broader community control. They wanted to impose stricter access-regulation. The new constitutional rule of the village common - at least in rhetoric - was formulated by an outsider (a state official of Dialloube): "They now want the harrima (village-common) to be for all". The new surveillance committee consists of 15 young men selected according to political party affiliation and socio-ethnic belonging representing goals of maintaining balanced opposition.[23] The authority structure is now more firmly attached to the Village Council, and less to the Chief and First Councillor alone. The leadership to this end gave timely concessions.

Destability and rushing in the village common of Dialloubé

Dialloube is the centre of the arrondissement and the most powerful Chiefdom in the zone, with historic roots back to the time of the nomadic Ardo (1500-1818), the non-Muslim Fulani 'war lords'. Dialloubé was selected the centre of Canton de Jalloube during the French colonial period (1893-1960), perhaps to counter the dominant position held by the more "unruly" clergymen villages e.g. Kakagnan. The present population of Dialloube proper is about 4000 people (twice that of Kakagnan). About 85% of the population lives in Dialloube proper, and the rest is distributed on three key 'satellite' villages with many ex-slave families (Tiayde, Mino, Boya). Gobbe and Tebbi are two important Rimaybé villages independent of Dialloubé situated 5 km west and east of Dialloubé respectively. Closely situated is also Saba, a large village of Marka cultivators and traders. There is also an important settlement of Twareg agro-pastoralists settled in the forest areas 15 km south of the village (Wassi). All these groups compete for resources in the zone, and contest each others claim-rights and territorial boundaries. The noble Fulani families of Dialloube control vast territories of high potential rangelands, crop land, fisheries, and wildland resources.[24]

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[22] This reconciliation came as a relief to the whole village community. This resulted among others in the election of the opposing candidate to the Chief as President of the newly formed Pastoral Association. This Association unites the cattle owners in an attempt to gain better access to state livestock services.

[23] As President of the Surveillance Committee they selected a compromise candidate between the two key rivalling groups.

[24] Several of these wetland zones have high global conservation interests attached to them.

Resource use patterns and strategies

Resource use patterns are basically the same as in Kakagnan. But compared to Kakagnan there are more cattle-rich people, some of which own 1000 - 2000 heads of cattle. Besides the Chief himself, the group of traders (Diawambe) are rich in cattle. As in Kakagnan, overgrazing leading to degradation is not perceived as a main issue. Out of 100 households, 66% claim to have livestock. The traders are most cattle rich; 48% was classified as cattle-rich (more than 100 heads of cattle) (13 persons out of N=27). 25% of the transhumant pastoralists fell in this category (8 out of N=32).[25] Among 27 households of the trading group, 25 household (93%) report to have crop fields (of which 14 household have 2,5 hectares or above). There are less land-rich people (above 4,5 hectares) than in Kakagnan (18% against 25% in Kakagnan). As indicated also by a local state official: "The largest cultivators are the largest herd owners"in Dialloubé.[26] Among 32 transhumant pastoralists, only 11 household (34%) report to have fields (of which 10 household below 1,5 hectares). Among the 23 Rimaybe households, all have crop fields. 10 Rimaybe household have above 5,5 hectares (44%). Only the transhumant pastoralists, including the lineage of the Chief, has a clear-cut *economic* interest in pastoralism and in protection of CPRs for grazing. This is reflected in investment strategies. The trader group (Diawambe) is the only other group that has made strategic investments in crop cultivation technology, besides the Rimaybe: 41 % report one or more oxen (one with 8 oxen) and 30% report one or more ploughs.[27] Many Rimaybe cultivate fields for noble Fulani families under patron-client relationships. Some are paid for this, others do it as part of a subordinate obligation.[28]

Compared to Kakagnan village, Dialloube stands out as a larger and more heterogeneous community that controls considerably more pastures and crop land, and which as community is less dependant on the village-common for grazing. It is, however, more dependant on the village common for crop land, in the sense that almost 70% of the heads of households have crop fields and 93% of the households cultivate only inside the borders of the village-common.[29] A main problem regarding enforcement is related to the lack of clearly defined boundaries of the village-common, both socially and geographically. It is especially vis-à-vis the neighbouring official villages that the boundaries remains unclear and/or contested. The boundary conflicts of concern below include those with Gobbe, Tebbi, and Tiayde. But there are also conflicts with Kakagnan, Wouro Alfaka, Saba, and Wassi. The establishment of the village-common was probably 'authorised' by the state administration in the early 1970s (according to a retired state official). Exactly how this was done is uncertain.[30] If it was *not* formally established by the Dina in the 1820s, it carries less legal authority embedded in customs.

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[25] Only 3 households (13%) out of 23 Rimaybe households own livestock (all below 10 heads).

[26] The group of craftsmen (Nyeebe) are basically in the category non-land based (traders and marabouts) (12 non-land based out of N=17 (71%), 4 out of N=17 are agro-pastoralists (6%)).

[27] Regarding investment in and access to technology for cultivation, ploughs and oxen, the data show that 61% of the Rimaybe posses one or several oxen; 70% one or several ploughs.

[28] The Rimaybe often first cultivate the land of the patron. Then they cultivate their own fields. As said by a state official: "If you have no means you have to accept such conditions".

[29] Out of the 100 households, 69% claim to have crop fields - and 93 % report to have fields only in the village-common. Many of the Rimaybé of Gobbe, the neighbour village, however, cultivate outside the village-common.

[30] Contrary to this, the village leadership claim that the 'legal' approval of the village common dates back to the early years of the Dina (1818-1862). This is also supported by a paper by

Social and political organisation of village regime

The Dialloube community is organised politically and socially along patrilineal lineages and families - following similar principles as Kakagnan. While Kakagnan is politically dominated by clergymen (Marabouts), the Chiefdom of Jalloube has been secured by groups of Fulani transhumant pastoralists ('Woodaabe or 'Peul rouge').[31] They constitute a large and little organised group. Although fairly cattle-rich, the group has on average low political represenation, little formal education, few command the French language, and they have to little degree been exposed to urban environments through migration, wage work, trading. They to lesser degree share Islam as a common belief system. The Village Chief heads the only 'founding' lineage. There are three 'power centres' in the village community. Apart from the group of transhumant pastoralists around the Chief, there are two influential groups of Diawambe (traders) which are heavily involved in political affairs and management of the village-common (the Haali and Abba lineages). The Diawambe are mainly traders and rich cattle owners. They form two small, well educated, and concentrated groups with close networks and internal cohesion. The traders constitute close to 15% of the population. Decision-making is strongly influenced, at times completely dominated by the two Diawambé lineages (even if they are in internal factional rivalry). To this effect, one might say that 'numbers counts, but resources decide'.[32] Apparently 8 out of the 13 members in the Village Council are Diawambe (which is not considered an appropriate representation by many in the village). The Rimaybe cultivators, for example, represent 26% of the families, but have no real representative in the Council. There is one representative of the craftsmen (Nyeebé). The distribution of representatives among different groups in the Village Council reflects an attempt by the Chief and the influential personalities to balance power between the two most powerful groups (the Haali and the Abba), both being represented with key spokesmen. The group of Village Councillors is not representative of the wider social groups of the community in economic wealth, economic interests, and socio-ethnically. The Village Councillors are both richer in cattle and have larger areas under cultivation than average.[33] They combine relative richness in cattle, with above average hectares and relative capabilities to engage in crop cultivation (well equipped with work oxen, ploughs, control with labour).

CIPEA (1983:vol III). The motive for the reference to the Dina (and later legislation) is probably to enhance the bargaining stands of the Fulani nobility regarding rights to exclude foreigners from access, as well as of local Rimaybe cultivators.

[31] Here the Woodaabe are termed transhumant pastoralists. They constitute about 45% of the population of Dialloube proper.

[32] The conflict between the two Diawambe groups, the Haali and the Abba, is an old conflict, which is important to understand. It is mainly a conflict over access to power and control with resources: livestock, livestock sales, people and land, and local trading markets. Political prestige and personal rivalry related to positions within the Chiefdom is important.

[33] Among six surveyed members of the Village Council (out of 11 members), 3 persons were classified as cattle rich (50%). The average number of hectares among the Council members were 3,5 hectares compared to 2,3 hectares in average for the households. Five of the Council members claimed to have 2,5 hectares or above. One member among the traders of the Council for example has 7 hectares. He is also a rich cattle owner. He has 4 oxen and plough. He controls many Rimaybe of the village of Tiayde, who carries out agricultural work on his land.

Community management under the First Republic (1960-1968)

Present conflicts have their history. At independence several changes took place. First of all, an unknown number of the Rimaybe slaves left their former masters (and established themselves in other locations e.g. Gobbe). But many also remained within the village. The Chef d'arrondissement became a key person in management of local affairs, including matters of relevance to CPR management.[34] The Chef de Canton, who was the 'paramount' Chief of the Jalloubé Fulani, was removed from office and imprisoned. (He is the present Village Chief of Dialloubé). A new Village Chief was installed from the group of Diawambé (from 1960 to 1969).[35] Fairly soon after independence, in 1964, the liberated slaves (Gobbe) demanded to cultivate outside their normal village territory. They were finally granted a limited access-right.[36]

Tightening elite elite control: The Second Republic (1968-1991) and UDPM

After the military coup d'état by Moussa Traoré in 1968 the present Village Chief was reinstalled.[37] He became active in local politics. During the UDPM period (1979-1991) political connections were used to support a more ruthless regime for governance of local CPRs in the interest of the ruling elite of Dialloube. In 1973/74, with the first serious drought and lower flood levels, the villagers met and demanded the Chief for additional land. At this stage an increasing group of the noble Rimbe, in particular among the group of traders, who had access to capital and labour, expanded their cropping area. Apparently the Village Council jointly agreed to allocate high potential zones for the nobles, and lower potential areas to Rimaybe (including cultivators of Tiayde). In this process, the Chef d'arrondissement was actively involved. He sanctioned a "land use plan".[38] The cultivators of the villages of Gobbe, Tebbi and Saba were however denied to cultivate these new zones (since they were not members of the Dialloubé community). The actions in defence of the village-common by the ruling elite of Dialloube became firmer (under UDPM) (cf. complaints by the leaders of Gobbe). The leaders used the "legislation" of the village common to exclude outsiders.[39]

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[34] The Chefs d'arrondissement were often recruited from the military service. In Dialloube the post has been filled with persons of different ethnic origin, both Fulani and non-Fulani. Mostly they have had little prior knowledge of the zone and been foreign to the local culture.

[35] This Village Chief was a compromise candidate between the two rivalling Diawambe groups, but closest to the Haali and the Chief (which was then ruling coalition). The recruitment of a Chief outside the recognised lineage was part of the government policy to suppress local 'feudal' leaders.

[36] Their demand was initially turned down by the leaders of Dialloube. The cultivators engaged the Commandant de cercle and later the Governeur of Mopti. No solution was found until the Chef d'arrondissement proposed a floodplain south in the village territory.

[37] This was done even if the Chief had been Chef Canton and an "ally" of the French. Such re-instalments have not been common, and is an indication of the Village Chief's influence at regional and national levels at this point in time.

[38] Ref. interview with the this former Chef d'arrondissement.

[39] Cultivators of Gobbe and Tebbi therefore sought land outside the zone. Out-migration from Tebbi and Saba increased. Marka cultivators of Saba managed to obtain a credit in the bank

In 1984, with the on-set of the second major drought year, the demand for deeper lying crop land zones increased again.[40] Even if an increasing number of households, including the fishermen, engage in crop cultivation there is no rapid increase in total hectare under cultivation. It is mainly the *shift in location of fields* and encroachment of CPRs that cause land use and local disputes problems, not an expansion in total hectares (as in Kakagnan).[41] Despite increasing demand for deeper lying flood-fed land, the Village Chief and the Council at this stage did not officially agree to allocate more land to the Rimaybé cultivators.[42] Unofficially, the Village Council did, however, give permission for selected members of the wealthy noble families to cultivate in some of the best remaining arable zones. Some of them were part of the village leadership and the Village Council, supposedly in charge of the management of the CPRs. There were members among the traders and of the Chief's own lineage.[43] State officials remained passive, quietly accepting this cultivation. They never attempted to follow up the "semi-official" land use plan approved in 1972/73 (which also granted access for the Rimaybe). The relative monolithic power of the village leaders through control of the Party (UDPM), blocked channels for sub-ordinate groups to voice claim-rights beyond the village realm. More land was taken into use in the late 1980s and early 1990s by cattle-rich traders and pastoralists. The Rimaybe of Dialloubé joined in association with cultivators of neighbouring villages. They forwarded common claims to land, which were not met. In 1989, the Village Council instead decided to exclude all the Rimaybe cultivators from non-authorised zones of the village-common.

(BNDA) for establishment of a modern rice irrigation scheme with a diesel driven pump (with the help of World Food Programme). It meant higher yields. But new problems arose through market integration. The participants faced problems in producing enough to repay loans for fertilisers, diesel and maintenance of the diesel pump and the canal system. Due to relatively low rice price, marketing constraints, high fertiliser price, high diesel and spare part price, the participants met severe problems in producing a surplus to repay loans. Management problems constrain double cropping. Yields are reported at 1500 sacs on 40 hectares (=1 750 kg/hectare). As the Chief said: "The irrigation scheme is more a problems than a solution".

[40] The period 1983-1993 had low flood and rainfall (except for the years 1985 and 1988).

[41] This is confirmed by studies of satellite data for the zone, and supported by population data which indicate only a slow population increase. .

[42] Through their close association with both UDPM and the state administration, the village leadership was not challenged by subordinate groups. The relationships of the Jowro to UDPM/state was however ambiguous in this period, partly because the state attempted to make the Jowro pay part of the grazing fee as tax to the Local Development Committee (Committee Locale de Development). The Jowro never agreed to this and revolted in 1985/86. The practice was stopped, although the tax for crossing the river into the Delta remained as a tax payable in part to the state administration (Notebook 7:2).

[43] The global conservation issue related to protection of the large wetlands of the zone, are fairly irrelevant for local decision-making. People consider the birds that breeds in these wetlands as a nuisance and real threat to crop harvests. Birds have traditionally been hunted. Now they are protected by law, but still illegally hunted. The conservation issue has been raised by the World Bank, IUCN, and recently by FAO related to a local project.

The fall of the UDPM one-Party regime

In 1991, right after the coup d'état and dissolution of UDPM, groups of traders and noble pastoralists started converting larger pasture zones to crop land, without prior approval by the Chief and the Village Council. By simply ignoring the Chief, in a provocative manner, the traders gave a blow to his political authority. This gave the Rimaybé a push to follow. Locally it was said that they were encouraged by the traders.[44] Now, the Rimaybe from all villages entered in various zones - from Dialloube, Gobbe, Tiayde and Mino. The Gobbe brought all their ploughs, collectively rushed to the zone, and started to clear pasture land for cultivation. This made the Chief and the Council react. By using old contacts through UDPM and the administration, the village leadership was able to request military-police from the Commandant de cercle of Mopti to imprison and fine close to 20 Rimaybe, mainly from Gobbe. The Rimaybe did, however, refuse to give up their fields or pay the fine.[45] In 1992, the Commandant de cercle united people from all concerned villages. The joint meeting agreed to protect five zones from cultivation.[46] But realising that this decision worked against their personal interests in cultivating, the ruling elite apparently later 'convinced' the Commandant to change the decision. An official declaration was issued protecting only two of the wetland pasture zones, in which the majority of the Rimaybé cultivated.[47] The Rimaybe objected to this: "Why did the letter have another conclusion than the meeting." "On a grasse la pâte" ("Someone has buttered the cake").They demanded a redistribution of land, if they should accept to protect the two zones only. The Rimaybé continued to cultivate the two zones. As angrily claimed by the Gobbe: "Until they cut our heads we will continue to cultivate!" (notebook 3:18). The noble groups also refused to give up their fields. The Village Chief again mobilised his relationships to the Commandant de Cercle, who sent military policy and brought in 10 Rimaybe for interrogation, accused of 'illegal' 'land grabbing'.

Destabilisation and 'rushing' (1991-1995)

Underlying this conflict there is a long history of competition and factional rivalry between noble lineages for control in different domains (over the chiefdom, over access to resources, over groups of Rimaybe, over access to high potential crop land). This conflict plays out in different political arenas, in particular within UDPM, which affect outcomes after the dissolution of the UDPM Party in 1991.

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[44] There is a tendency both locally and within the administration to blame arable encroachments and state of affairs on traders/Diawambe. But such land use changes take place accross the Delta (e.g. in Kakagnan) without traders being much involved.

[45] "We will only accept (to pay) if all who cultivate in the harrima pay", say the village leaders of Gobbe.

[46] The technical services prepared a 'land use' plan that proposed five particular wetland zones to be protected.

[47] Ref. Declaration no. 16 CM Reglementation de la Plaine denommé Pondori, signed by Commandant de cercle, Mopti, 2 Nov. 1992. The Commandant was then about to leave office for another post. People say he may then have not been too careful in how the matter was handled. The Governeur of Mopti Region was also at this time about to leave his post. This was a consequence of regime change at national level. None of them belonged to ADEMA.

Box "Village politics is at the base of the problems" (views by Village Chief and cultivators)

The Village Chief comments on the situation: "Now there is conflict. All people think there is democracy and do not respect the village authorities. Everywhere people grab fields in an anarchic way. People do not ask. Even if punished they continue to cultivate. There is no more agricultural land available now. People have cultivated everywhere". "It is no longer possible to carry out the degal (free-grazing in the common after a certain date)". The Chief sees a solution in more firm zoning of land for crop versus grazing. The cultivators have oxen that need fodder. "Soon we need to buy fodder". "The pastoralists have less animals and weaker animals. They do not have sufficient milk. They are tired", he says. On the other hand the Rimaybe are not happy with the situation either. As one of their representatives (in Gobbe) says: "It is not a good thing what happens. But what can we do? We are only cultivators and have no animals. If hungry the Rimbe can drink milk, I need food (grain)! The Jowro have sold a lot of land in Kootiya. They cannot come here and chase us. We have the same rights to cultivate as the Rimbe (nobles). The village-common is for the community and surveyed against foreigners". At present they experience much more frequent crop devastation and are required to spend more time guarding their fields. He adds: "*Village politics* is at the base of the problem. All work to have command of the village."

The rules of the political game change rather quickly at local level. The local leaders, that had based their power and social position on the Party, entered a more low key position. This created a temporary political vacuum. Representatives of the newly established local ADEMA party (under the Director of the School), now in opposition to the party of the group around the Chief, engaged in the affair and provided support to the Rimaybé.[48] The new ADEMA Governeur in Mopti had the imprisoned Rimaybe promptly released. The Rimaybe are now all claimed to vote ADEMA.[49] In the subsequent years, the Rimaybe have cultivated without being disturbed. The multi-party system opens for 'one-person-one-vote'. But even if votes count, resources and power seem to remain decisive for outcomes of decisions. The ageing Village Chief, derived of political power and capabilities to control village leadership, admits he is in a very difficult position, and that the state of affairs in the village-common is alarming. The village regime is out of control, temporarily. Dialougue is blocked. There are few signs of reconciliation and genuine institutional progress. The interest coalitions around those appropriators who want a relatively open access for crop cultivation have become more powerful and numerous compared to those who are in favour of protecting the CPRs. Numbers count more than before. The Chief can no longer use the joint UDPM/administrative channels and call for military-police. He sees the only opportunity out through appeals to the court system. He says he will pursue the case there, but as local people say: 'it will cost him a lot'.

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[48] They also receive assistance by an ADEMA-loyal lawyer in Mopti. Apparently, party contacts were made to Bamako, which contacted the Governeur of Mopti. The former Governeur had now been changed with a pro-ADEMA person by the new Malian government; ADEMA being the Presidential party.

[49] People act collectively in choosing political parties. They follow strong ethnically likeminded leaders or patrons, which are strong in part because they lend sufficient support to local groups' economic and political interest in local resource use matters. People are little concerned about differences in party programmes, except perhaps within the CNID (the "youth" party).

Comparison: Social capital and capacity for collective action in Kakagnan

A main factor that explains the evolution of the regime and relative successful collective action in Kakagnan, is the fact that the two political elite groups of clergymen and the craftsmen, are both agro-pastoral in economic orientation. Hence, they share political *and* economic interests. There is also little cultural difference and antagonism between the two leadership groups. The leaders of Kakagnan have a common economic interest with the Rimaybé cultivators in a gradual conversion of CPRs to crop land. The clergymen constitute a small, concentrated, well educated, and well organised group (despite a certain rivalry). Islam is a common religion for all groups, and Coranic education provides a common socialisation. The leadership is conservative, and benefits from the support of powerful craftsmen, in particular from the charismatic personality of Mr. Hadi Bory Sangho (alias 'Henry Kissinger'). The craftsmen, due partly to their cultural 'traits', do not aspire to take over local rule as the groups of traders have done in Dialloubé. The ruling coalition is powerful enough to deny the Rimaybé and the Boso/Somono access to crop land beyond a certain level. Each group conform to status-hierarchies. The only large group with a firm interest in protecting the CPRs as grazing is the transhumant pastoralists. But this group is little organised and "outsmarted" by the ruling elite.

During the rise of UDPM (after 1979), the leadership of Kakagnan increasingly had recourse to state and Party officials and military police to assist in enforcement of the CPR regime. The recourse to military police was a deliberate *choice* by the leadership, given increased pressures on the village common and ambitions to expand the territory. It became a strategy possible for the leadership to employ under rent-seeking state officials at the level of the cercle.[50] The only groups in open opposition to the leadership is the Somono and Boso agro-fishermen. But they have no power to set behind claims. The village-common of Kakagnan is managed by the people, says Salmana Cissé (pers. comm. 1992). The leadership never became co-opted by the state, as in Dialloubé.

"The Marabouts have *managed* the village-common", according to one of the traders of Kakagnan. "All pass by them. People are afraid of challenging their power, since they know the right is delegated from the Dina". "Kakagnan has people with the capacity to think, who consult each others, and know the Islamic law. Nobody can do what he wants. If you deviate from the rules, you will be isolated".

There still emerged a general dissatisfaction with the village regime in the early 1990s, due to perception of internal abuse of power and misuse of funds collected by the leaders from external users of pastures. When the UDPM regime fell in 1991, the village leadership, who had all been Party members, was derived of this external support. After the reconsiliation of the two Chief lineages, triggered by a charismatic and influential woman, the village leadership agreed to a establish a more "democratic" regime, in part at the request of the young men of the village. The social integration and capacity to unite competing groups in Kakagnan, can probably be explained by external pressures in combination with internal capacities and high dependence on the village CPRs for

[50] The use of military police in access-control is not regulated in administrative rules, but is not uncommon in the Delta. Unofficial use of military police took also place in other zones, even under private access-control by Jowro families (Jalloubé Jenneri and Lac Debo).

survival.[51] Changes in power constellations, triggered by changes in the external political economy and new ideas about governance, are key factors explaining the new regime in Kakagnan. In studies of similar village regimes in India, Wade is also open for power and leadership being crucial for formation of resource regimes (1988, 1992).[52]

Fragmentation of social networks and destabilisation in Dialloubé

In Dialloubé on the other hand, nothing of this sort happened. External pressures from villagers in Gobbé, Saba, and Tebbi split the internal groups and networks further, rather than uniting them. The leadership and political elite groups were split according to economic interests in use of the CPRs and not able to resolve internal rivalry and competition for resource access. There was little trust among internal groups to meet changes in the external polity and foster social integration. No networks united the young noble men, or the women, or the cultivators for collective interaction with the leaders and establishment of new compromises and rules for co-ordinated use of the CPRs. The compact, better educated, organised, and wealthy groups of traders outmanoeuvred the Chief and his group of transhumant pastoralists in the management of the CPRs. "The traders even hold meetings without informing the Chief", as some informants claimed. A key problem is the co-optation of the Chief by the state administration, while he seeks power among one group of the traders only (the Abba).[53] In the early 1980s, he is President of the local UDPM party. This post he looses in 1988 to the candidate of the opposing group of traders (the Haali). When the UDPM regime falls in 1991, his ties both to external state and Party officials are eroded. He is also ageing, and tired of fighting, as he says. His "own" group of transhumant pastoralists lack both individual and group capabilities to meet "modern" requirements as leaders, such as basic education, knowledge of French, exposure to outside impulses and values, and organisational capacity. They are to less degree united by Coranic education and Islamic beliefs. The Chief is no longer able to take a lead role in organising the split group of community members and leaders. He lost the local elections for Presidency, while the traders acquired control with the key party and close allience to the other main

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51 The village common of Kakagnan is much smaller than that of Dialloubé, and the common is located between potentially hostile neighbours competing for resources at the territorial margin. In Kakagnan, crop devastation by *outsiders* is, for example, a frequently perceived problem (50% of all crop devastations, as against 6% in Dialloubé). About 60%of the cultivators of Kakagnan experienced crop devastation over the last three years (1991-1993).

52 But Wade claims that the presence or absence of village-level organisations for resource management was primarily related to variability and risk in production i.e. an economic rationale. If many or most of the village producers faced ecological uncertainty in production, a village was found to be more likely to form co-ordinating institutions for management, risk-aversion and check on free-riding. The establishment of an efficient regime is by Wade seen to be primarily demand driven, and to less degree a function of the village having capacity to supply such management. Wade studied forty one village-based regimes and draws upon a much lareger material than this paper.

53 During the 1980s, the Chief increasingly has recourse to state officials and UDPM for power in order to manage village affairs and keep the Rimaybé out of the CPRs. The recourse to state officials today reflects historic relationships between the present Chief, being Chef de Canton, and the French colonial administration. The Village Chief today lives accross the street of Chef d'arrondissement.

party (ADEMA).[54] The traders remain with majority representation in the Village Council. Hence, they control both the formal and informal political arenas of the community. But the relationships established between the traders and the cultivators are based on dominance and interdependence, rather than on mutuality and reciprocity. There is clearly cultural antagonism and distrust between the two groups. The traders are interested in investments, the cultivators in survival. The traders have alternative income sources to use of CPRs for grazing, and contacts with outside trading networks. Their loyalty is not firmly based on community goals.

Comparing regime robustness and performance

The regime of Kakagnan is *reasonably* robust (compared to an "open access situation").[55] Reasonably, means that the appropriators and their leaders have shaped a regime that have *fairly* clearly defined boundaries and *relatively* good-fitting rules and enforcement systems. There are clear differences in robustness between the village regimes. There are certain factors that should be highlighted which make management of CPRs more difficult in Dialloubé than in Kakagnan. The resource system is large. The physical and social boundaries of the regime are not clear. There is a lack of historic recognition of the village-common in customary law. The leaders of Dialloubé are located 10 km from some of the key resource conflict zones. Hence, it is difficult and costly to physically defend these resources. The size of the group of resource users is also large, more diverse, and with more articulated demands for land than in Kakagnan. These factors combined have made the recourse to state officials for the Village Chief an 'easy' way out.[56] Although slightly less pronounced, similar types of problems are handled in Kakagnan. When they are not handled in Dialloubé, it is mainly a result of capacity problems among the leadership groups.

Despite the problems described in Dialloubé, the regime has existed for 175 years and some solution to the present crisis is likely to be found with time. The key question is rather at what cost and for whom. Despite signs of low trust in village leadership, about *90-95% of all persons who experienced a resource-use conflict over the last three years, found solutions to the problem within the community realm both in Dialloubé and Kakagnan* . In both villages, people claim that the Chief can do little on his own. His authority is not like that of a "monarch". He has no "sweeping powers". If he fails to meet expectations of influential groups, they are likely to establish new decision-making centres. Hence, authority structures of Fulani communities have a fairly strong anchorage in the community, although not in a Western "democratic" sense.

What do these regime differences mean in terms of outcome related to social and **economic performance**? Comparing livelihoods and economic progress in the two villages, is difficult because the distribution of cattle-rich and cattle-poor, land-rich and

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[54] Many of the subordinate Rimaybé in this process leaves former Rimbé families, and attach to new 'patrons' among the traders.

[55] Robust (= strength in Latin). It is here used as solid, persistent, resilient, adaptive in face of dynamic changes in internal or external pressures.

[56] The numbers of appropriators are likely to be relatively small and relatively stable in both villages; approximately 200-300 appropriators in Kakagnan (up to 4-500 if women are counted as separate users from their men). In Dialloubé the comparable figure is about 400-600 appropriators (depending on how many members are included of the 'satelite' villages and the villages Gobbe, Saba, Tebbi, which also use the resources).

land-poor varies accross villages and social categories. Production and yield data are not very reliable. The household data suggest greater economic differentiation in Dialloubé than in Kakagnan, exposed by cattle-rich groups among the traders and the transhumant pastoralists. Among Rimaybé cultivators, there is, however, a higher percentage of land-rich households in Kakagnan (but they cultivate more for the noble groups).[57] The successful group of traders aside, there are important indicators, supported by the qualitative survey, which suggest that *progress* in the livestock and cropping economy has been better in Kakagnan than in Dialloubé over the last few years. The expansion of crop land and general increase in the livestock herd, are two important indicators to this effect. **Ecologically**, the conversion of CPRs are likely to be faster in Dialloubé than in Kakagnan (based on crude analysis of remote sensing data/maps). But average crop land area is larger in Kakagnan (3,3 hectares against 2,3 hectares in Dialloubé). The conversion of CPRs in Kakagnan is also more planned and regulated without open conflicts and destabilisation. The conversion of the wetlands represent a loss foremost to the pastoral economy. But also to global conservation interests. There is also more participation in various collective resource management activities in Kakagnan than Dialloubé.[58]

"Stretching" the conclusions from the empirical findings a bit, one might say that strong leaders provide strong societal groups and favourable economic conditions. Or; strong societal groups breed strong leaders, which again foster economic development on a broad scale. The denser networks and co-operation in Kakagnan enhance trust and shared values among heterogeneous societal groups, facilitate better resource management, and economic progress. To this effect, there is general support at community level for Putnam's hypothesis; "strong society, strong economy; strong society, strong governance system" (1993).[59] But we need to ask: progress for whom? The subordinate Rimaybé and Boso/Somono groups are not particularly satisfied with the state of affairs in Kakagnan. There is also indication from the survey material that the Rimaybé of Dialloubé, who to less degree work under share tenancy than in Kakagnan, are able to acquire higher yields and higher income.

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[57] Provided the figures on hectare and yields are reliable, the crop producers of Kakagnan have larger average field size (3,3 hectares against 2,3 hectares). But yields and total production are lower in Kakagnan. Yield data indicate higher efficiency in the crop economy of Dialloubé, which is based on paid labour to a larger degree than the clientage-based crop cultivation system of Kakagnan (but figures are not reliable).

[58] In Dialloubé, only 2% participated in two or more natural resource management acts, compared to 33% in Kakagnan.

[59] Putnam operates at higher levels of social organisation, however. He compares the performance of local government in two regions of Italy, the northern and the southern.

State-society relationships and collective action

Ambiguous interventions and enforcements of property rights

As indicated through the case studies, state officials and agencies do not operate as ordered, coherent, neutral and strategic actors of a state. The *state administration* is by local people perceived as control-oriented, authoritarian rather than as a client-oriented service institution. Officials of the state administration are perceived as powerful, but ambiguous and corrupt at different levels. This in part reflects the difficult cross-pressures state officials face within an authoritarian and rent-seeking bureacratic culture. Even for officials with the best intentions, it is difficult to assist in strategic and fair management of resources. On the other hand, officials of the *livestock service* are generally appreciated through their support for pastoral resource regimes, vaccination and advice on animal husbandry.[60] The ambiguity in interventions is particularly obvious in the case of the village common of Dialloubé. In 1973, the Chef d'arrondissement intervenes and sanction a land use plan, which opens a zone for cultivation by all groups, including the cultivators (Rimaybé). In 1984, when new land is demanded, the local state officials do nothing (in the one Party/UDPM period). Later the state official at arrondissement level sanctions the cultivation of new zones. But in the next round his superior Commandant de cercle orders military police to remove and imprison the same cultivators. Then the Commandant, at the request of the village leaders and against the will of the people, issue a declaration that goes against what he as state officials has just decided in a meeting with several villages. State officials play with different groups at different stages of the conflict, behaving in a rent-seeking way. Decisions have been made and changed again. People have been imprisoned and released by the same administration and the same officers.

Societal disengagement under the one-Party regime

The period under UDPM (1979-1991) can be seen as a period of general societal disengagement vis-à-vis the state in Dialloubé. Following the toppling of the Moussa Traoré regime in 1991, movements and organisations among cultivators (ex-slaves) as well as among the noble pastoral Fulani have emerged, representing attempts to engage the state and enhance stands vis-à-vis neighbours (e.g. political parties, association of pastoral leaders, associations of cultivators, new forms of resource regimes, Pastoral Associations, and the Amis de Peul (friends of Fulani/Tabital poullakou) organised to defend the interest of the Fulani). These community organisations, as representatives of the broader society, embrace heterogeneous social actors and interest coalitions that differ substantially in size, scope, action space, form and resource capacities for political bargaining. Many organisations are 'mixed' i.e. in part state-sponsored, in part private, for example Herders Co-operatives or Pastoral Associations.

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[60] The Forest and water service is preoccupied with fining and levies of permits. Forest officers are feared and disliked. The Agricultural extension workers have no office or transport and are mostly not seen by villagers. The few health officers present have no funds and medicines, but are viewed positively. Infrastructural services are absent. The court system is seen as ambiguous and costly, due to rent seeking judges (although improvement are perceived).

Lack of infrastructural support

External factors are assumed away in the "naive" property rights theory, while in fact external infrastructural constraints are key to understanding the local economy and resource management dilemmas. Key labour constraints cannot be met due to limited access to capital, technology and markets. This means that environmental degradation cannot easily be met by technology investments. The main change in technology is oxen and ploughs, which increased by about 6% annually (in the period 1955-1975). Due to lack of local alternatives, young men and women seek employment outside, temporary or more permanent (wage labour). In the whole period since independence, the Fulani of the Delta have been exporting labour and livestock, and imported grain and consumer goods. Due to drought, low flood, inefficient national and local property rights regimes and infrastructure, there are serious resource conflicts and decline of resources going-on.[61] This decline takes place under common-property rangelands, private property crop-land and state-owned irrigation schemes. Hence, the property regime type cannot alone explain why degradation takes place. Coordinated investments in social and physical infrastructure represents more difficult constraints for local communities to overcome than coordination in common property regimes.

"Community" and creation of property rights regimes

The consequences of heterogeneity for co-operation and conflict have been little explored by students of property rights, but has long been a concern in general sociological and anthropological studies. More recently, has heterogeneity caught interest in theoretical and empirical work in relation to collective action in an African context.[62] Neither Ostrom (1990) nor Bromley (1989) or Oakerson (1992) address the issue explicitly in relation to their frameworks of analysis, even if it is an underlying concern. The present hypothesis seems to be that *there are situations in which heterogeneity can facilitate cooperation, although "community" is often an advantage in the longer-term* (Ostrom 1992b, Putnam 1993 and 1995). In a fairly recent article, Singleton and Taylor (1992) suggest that a group of actors possesses the relevant capacities for endogenous collective action to the extent that it approximates a *community* of mutually*vulnerable* actors.[63]

Community is defined as a set of people: "(i) with some shared beliefs, including normative beliefs, and preferences, beyond those constituting their collective action problem, (ii) with a more-or-less stable set

[61] The low flood is by people of the Delta perceived to be in part a consequence of upstream deviation of flood water for the irrigation schemes of Office du Niger. This view has support in research (ORSTOM 1994).

[62] Cf. in Africa Bates 1988, Berry 1989a and 1989b, Cousins 1992, Moorehead 1991, Baland and Platteau 1995, and 1996, Shanmugaratnam et al. 1992, in Asia (Mearns 1995), and in general literature (Knudsen 1995, Ostrom 1992 and 1997, Singleton and Taylor 1992, Hacket 1992 and Hacket et al. 1994). And in relation to global resources management (Keohane and Ostrom 1995, Young 1995).

[63] "Community" as defined here puts less explicit emphasis on "mutual trust" than this study does with ref. to the term "social capital" (cf. Putnam (1993) building on Coleman (1990)). Putnam proposes that social capital, which encompasses civic or socio-political engagement, strongly condition the creation of efficient democratic local government and enhancement of efficiency and social welfare.

of members, (iii) who expect to continue interacting with one another for some time to come, and (iv) whose relations are direct (unmediated by third parties) and multiplex. *Mutual vulnerability* is the condition of a group of actors each of whom values something which can be contributed or withheld by others in the group and can therefore be used as a sanction against that actor.

They claim that "community" is a necessary and sufficient characteristic for voluntary co-operation and self-enforcement. "Community" characteristics are by several observers assumed to lower transaction costs of monitoring and enforcement of exchange and management contracts (e.g. less risks and lower costs of acquiring information). Singleton and Taylor add two important conditions to their argument. First of all they claim that "community" is weakened or undermined by heterogeneity and inequality i.e. "great economic and social differences" within the group; defined as differences in income, wealth, social class position, ethnicity, race, caste, language or religion. They use a reassessment of Ostrom's case studies to substantiate their arguments (cf. Ostrom 1990). Secondly, they add that *'specialists'* might be beneficial to organising; a community will not necessarily manage a CPR in a wholly decentralised fashion, even if 'community' characteristics are prominent. They argue that "it may pay the group to create institutional roles and appoint people to them, with special functions" (Op cit.:316). Such functions can be to resolve conflicts, monitor and administering sanctions. I interpret them to include customary leaders (Chiefs) in this category. They claim that such specialists are present in many CPR settings, including all the successful cases reviewed by Ostrom (1990). They argue:

"But it is important to see that they are not *critical* to the solution: the community has the capacity to monitor and enforce a solution without them, but (we suggest) it creates these institutional roles because there are efficiency gains from the division of labour and from centralization" (Op cit.:316).

The findings from the two Fulani villages counter this view. The leaders of the Fulani communities and resource regimes play fundamental roles in all spheres of life and management of CPRs. Ostrom critisizes the two authors and finds that they place to much of explanatory power on "community" (and endogenous factors) alone. She sees the *"specialists" as critical* to the monitoring and enforcement of the regime, which is a stand taken. She also points to other explanatory variables that are important, including attributes of the resources (ecology), and impacts of external economic markets factors and the larger political regime in which the community is nested (Ostrom 1992:346). The larger political economy is normally considered exogenous to conventional property rights theory, which is what Singleton and Taylor are close to do here.[64]

Individual agency, structure, and processes

Is "community" structures and policy processes simply an aggregate outcome of individual choices and strategies? I do not believe so. Among Fulani, people conform to and are conditioned by different collective references carried by custom, social structures, and leaders. People conform to status-positions, cultural norms, values and ideologies. People often see no other alternatives than to follow local meaning systems and authority (cf. Scott's 1995). Still, they also react in *opposition* to custom and

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64 Ostrom claims that community is not necessary (but facilitating) for initial negotiations around the resolution of a CPR problem, but it is necessary in order to sustain a robust regime over time.

authority. The village communities are not basically closed, homogeneous, stable and reciprocal systems. But they differ in degree of organisation around common social, political and economic activities. Barth in his early studies of Swat Pathan in northern Pakistan, shows that the system was generated and maintained mainly by individual actors seeking to advance their power by strategic choices and coalitions (cf. Barth 1959). Empirical studies of pastoral societies of the Sahel also focus on political structures and leadership as critical to maintenance or change in political structures and property rights (e.g. Baxter and Hogg (eds.) 1990 including cases by Hogg among Borana of Kenya, Storås among Turkana of Kenya, Mazonde among pastoralists in Botswana). There are also many cases from stratified societies of Asia (e.g. Bardhan 1993a and 1993b India/Nepal). But making a model of collective action and institutional change from the strategic motives and actions of leaders, nobles or ruling elites is easily misleading, as this paper shows.

As suggested by Keesing (1981:294): "Viewing individual strategies to maximize and preserve power and reputation as generating "the system" has been highly revealing. We have been lead beyond assumptions about stability, led to see how individual motives make sense of collective behavior, led to see informal strategies as well as formal ideologies and rules. But while this reveals one side of politics, it can hide another side" (Keesing 1981:294).

Keesing urges us to consider the political systems, local and central, as part of a wider system and in long-range historical perspectives (matching Douglas North (1990) and others); to consider power as rooted both in control over resources (property rights), and means of production (labour, technology, capital) (exchange theory of power). Power also arise from capacity to control people and to co-ordinate social behaviour (coordination theory of power). Successful coordination can create extraordinary power, which may lead to robust or progressive regimes. But it can also lead to destabilisation, stagnation and decline.

To this effect, Russel Hardin puts forward an important claim: "Coordination power is similarly a function of reinforcing expectations about the behaviour of others ... successful coordination of a group may radically reduce the groups cost of action in important ways simply because its coordination induces others not to oppose it (1990:368) ".

Co-ordination power among compact leadership groups enhances both their ability to control internal groups, and to exclude external would-be users. If accepted, this perspective explains important relationship between power, general norms, conventions, status and conditional behaviour. It raises the issues of both "community" and *social capital* (interpersonal trust, networks, knowledge and shared norms), and *legitimacy* of the group of the leaders controlling a resource regime. It is fruitful to conceptualise legitimacy as something leaders do not necessarily have. But as something they need to earn, through various not always acceptable means, even if part of the legitimacy is really derived through genealogical status and devined rights to rule. Legitimacy of leaders emerges through fulfilment of certain obligations determined in part by history and custom, in part by meeting demands from influential and wider social groups exposed to continuously changing circumstances. Customary obligations of a leader include local "Fulani" norms of honour, integrity, pride, obligations and duty. Charismatic and customary leadership matters in village politics (authority embedded in person cf. Weber).

"Interdependency theory of collective action and institutional change"

The paper attempts to show that population density is only one among several factor to consider regarding resource management. In fact, one could argue that higher population densities are required to create more efficient markets for livestock and crop produce necessary for surplus production and re-investements in resource enhancing technology. The case studies suggest that common-property regimes are rational and *reasonably* effective systems of land management, in combination with individual tenure to crop land, given the dynamic resource systems and contingent circumstances. They are more efficient than "open access" conditions. But the regimes are more concerned about *access-regulation* than internal *use-regulation.* Both regimes may face accellerated problems in co-ordinating actions*if* populations of humans and animals rise faster and reach much higher levels - *and* the drought continues. The paper reveals important "cultural strings" attached to land ownership. It exposes interdependencies between actors with different economic interests and social status in struggles over access rights. Individual behaviour and collective action are critically conditioned by paternalistic leadership, status, norms and culture. Application of the "naive" property rights becomes difficult in such a setting since it builds on certain unrealistic assumptions regarding local culture, as well as on the financial and operational modes of the state, and economic conditions related to market exchange (cf. Baland and Platteau 1994a, 1994b, 1995). Local resource security is not likely to change character by a simple "top down" introduction of formal private titles to land sanctioned by a state with little local legitimacy. Private ownership would be be ill-adapted to local custom and resource dynamics, which require mobility and reciprocity in order to foster optimal utlisation of the resources. Privatisation would also imply high cost to the state in terms of registration and enforcemnt. The conventional property rights theory disregards equity concerns arising as commons become privatised.

Only more recently have researchers within the property rights tradition acknowledged the structure of *different* and *interdependent* collective action problems.[65] Little attention has been accorded wider collective action problems faced by groups of community actors, and how solutions to "narrow" issues depend on how wider political issues are addressed. Processes of collective action at higher levels of social organisation affect processes at lower levels and vice versa.

Trust in leadership, for example, depends largely on what sources authority emanate from. A community leader can either choose to anchor decisions on sources that emanate from "below", from the community, or he can choose to lean on access to power emanating from state officials/agencies ("from above"). Whatever strategy chosen, it must be anchored on the legitimacy of wider community groups. This means that different layers of institutions are interpreted and carried by various interacting organisational levels, regimes and cultures. Meaning systems within each of these organisational levels, enforcement processes, and activities are interwoven and *interdependent.* Recognising the reciprocal relation of structure and action in all social interaction at different levels of organisation (Scott 1995, Giddens 1984), I suggest preliminary elements for an*"interdependency theory of collective action and institutional change"*. Drawing upon Scott (1995), this implies a theory that recognises both "bottom-up" and "top-down" processes and explanations of institutional creation, transmission,

[65] Cf. Young 1995 comparing theory development on local and global commons.

and diffusion. The two directional flows link actors, networks, organisations, arenas, and social structures (cf. Scott 1995:141). Sociologists, and more structurally oriented economists often view common institutional formation processes as being "top-down", emanating from models that already exist at some level or arena of social organisation. New institutions represent the "copying of an already existing form" (Scott 1995:140) . Institutional models are borrowed and transplanted in a new context (cf. the new more "democratic" regime in Kakagnan). While early research focused on the *diffusion* of structural forms, more recent work has emphasised organisational strategies (e.g. imposition, enforcement, power, as well as socialisation and identity formation. "*All* organisations are institutionalized organisations" (Scott 1995:136). This implies a close connection between institutional explanations and the structure and behaviour of organisations. Wider system ideas and cultural beliefs operate in the environments of organisations and influence their creation directly.

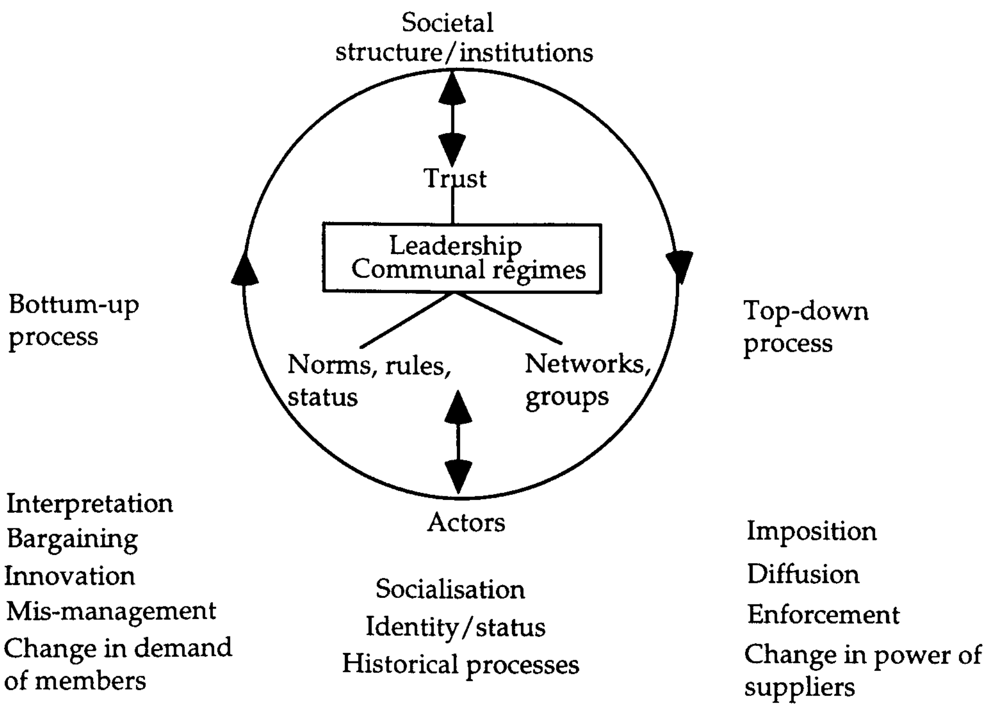

Fig. Interdependency theory of institutional change
- Top-down and bottum-up processes (inspired by Scott 1995:142)

The paper provides ample evidence of invention and adaptation by individual organisations and regimes (as indicated for example by the diversity of pastoral regimes presented). What is focused through an *"interdependency theory of institutional change"* is the close interlinkages that exist between actors and organisations, and that actors are actively involved in developing institutional structures. It is important that different organisational arenas (fields) and sectors at different levels of society interact, create particular networks and mediation systems, between social structures and individuals. Each actor operate within the logic of his/her particular interests.

"(O)rganizations provide institutional contexts within which particular actors are located and take action. Generalized models - beliefs, norms, menus, and scripts - flow "down" through the various levels, carried by socialization, social construction, and sanctioning powers. These models are carried and reproduced, but also modified and reconstructed, by interpretations and interventions of subordinate actors: individuals, organizations, and fields" (Scott 1995:141).

This places more explanatory power for collective action on learning, knowledge, cultural rule systems, and networks, and less on resources and exchange processes external to organisations and individuals. Neo-institutional economists tends to focus on these latter aspects and "bottom-up" explanation of institutions through technology change, interest group involvement in the political market, and rational design through "agreements" between entrepreneurs, managers and Chiefs (states) (Alston, Eggertson, North 1996). There are also sociologists and anthropologists who stress such "bottom-up" unfolding of non-rational process through which particular cultures are created as an adaptation to particular (charismatic) personalities or as solution to internal or external pressures. As suggested by Scott, whether "top-down" or "bottom-up" processes dominate, can be an object of empirical enquiry. It may also be that explanation for change in *property rights* institutions in some situations, for example in the context of rapid agricultural commercialisation, is likely to rest more heavily on regulative pillars than cognitive (status) and normative (power). But contingent circumstances among the Fulani of the Delta are not (yet) of that sort.

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10. Closing

by

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On behalf of the Agricultural University of Norway (NLH) it was a great pleasure for me to be invited and to get the honour of closing the conference of The Norwegian Association for Development Research.

I have only had the opportunity to follow partly the conference, but during my presence I have listened and learned. Listened to the multiple voice of the participants, learned about the complexity of the issues discussed in a very relaxed atmosphere. Listened to theoretical hypothesis and local experiences. Learned the importance of the knowledge of local people. Learned to listen.

Universities and researchers have the culture and ideals of criticism and open discussions in order to have more insight, to test their own thoughts and to be further developed.

But the Universities and researchers have also the reputation of concentrating their research into narrow sectors without the capacity of looking around or over the walls to the neighbour. Conferences like this contribute to tear down the walls and stimulate the researchers to communicate across disciplines. The discussions have been open-minded and free from prestige and religious or political convictions.

We have discussed important and serious matters, issues that concern us all. Problems connected to poverty, food and environment will not be stopped at the boarder, but challenge every country. Again we have been reminded of the importance of a sustainable agriculture for further development and also useful definitions and examples of the term sustainable have been given.

In the context of sustainable agriculture the NLH has knowledge and will contribute to a more sustainable use of all nature resources as this is today the overall goal in all disciplines at the NLH.

Other characteristics of NLH are in their specific fields, to cover the whole research area from basic to applied. One example is mathematics research applied to modern breeding principles and transmitted from one species (cow) onto others (like fish), which has been further developed into new aqua-cultured species like Tilapia in Asia.

I would in this connection like to say a few words of NLH strategy to meet the challenges towards developing countries and internationalisation within 4 statements.

1. Firstly, internationalisation is a priority area at the university. Good results in internationalisation are best attained by making the university's scientific environment and the university as an institution attractive as a co-operating partner and to show quality in all our activities. Secondly, internationalisation is founded in three main areas: in graduate education, which also includes relatively comprehensive student exchanges, in research and research education.

2. When establishing international co-operation, it should be emphasised to give the co-operation a concrete context. The number of such institutional agreements should be increased. They ought to be signed by institutions and quality assured by the institution management. They ought to be built on a clear understanding and a reasonable concrete possibility to establish research and education co-operation and have a built-in requirement for evaluation after a certain time.

3. Next, the university ought to be reasonably selective in its choice of co-operation partners. Certain quality requirements should be made of the co-operating university in question for our university. Thereafter, it would be fruitful if our research corporations are with the universities we also wish to have teaching co-operation with, thus making it easier to couple teaching and research. We think that a reasonable geographical concentration of activities over a given period would probably yield the best results. Here, it would be wise to be guided by the Norwegian Parliament's White Paper No. 19 on the changing world.

4. And finally, NORAGRIC is the natural unity to employ and co-ordinate our efforts to emerge as a united and interesting professional milieu for our co-operation partners and also for our granting authorities and other allocation unities.

As I said, the environment at Ås is characterised by a distinguished and applied competence in a number of fields. The same environment has a high international reputation and keeps itself informed of international changes. Internationalisation has been, and is still, a clear assumption for the activity of a scientific college.

The fact that the research centre at Ås is well known for its competence covering a wide range of fields is favourable concerning granting of aids. This will be further intensified by increasing emphasis to promote competence in a number of fields. The reality in the undeveloped countries is very complex, and therefore we have better chance to do a good job by planning a multidisciplinary approach towards the challenges we wish to work with.

Finally, I would like to thank all contributors to this conference, especially the key notes speakers, and also a special thank to NORAGRIC, the organiser of this well organised conference. I would also like to thank all our supporters.

I will then declare the conference of the N. Association for Development Research at Ås and NLH closed with the words: Continue to listen and learn - and good luck in your further work.

Thank you.

11. Conclusion

We will be badly misled if we believe that Malthus was right after all (Desmond McNeill, NFU 1997).

Two hundred years after Malthus presented is iron law, his ideas are still alive and receive strong support. However, despite of a six fold increase in human population since 1798, there is enough food in the world for all who have the required purchasing power. Unfortunately, the current grim picture is that 800.000 people do not have this purchasing power and consequently are chronically undernourished. We appear to be too concerned about the wrong issues by focusing on different forecasts for food production and population growth rather than the role of poverty. What we should concern ourselves with is not what happens when the world runs out of food, which will probably never happen, but what happens when food becomes more expensive and/or environmentally more risky. Hence, the priority should be how to secure everybody stable access to cheap and safe food produced within sustainable food systems as well as food security at community and household levels. Global food security is meaningless in food deficit communities with households lacking the necessary purchasing power. Thus, discussion and action should be oriented towards increasing production in the South not only through intensification and diversification but through processes of change which are sustainable, equitable and empowering as well.

Hunger is the inseparable companion of the poor, is the offspring of the unequal distribution of the wealth and the injustice of the world. 35.000 people -- half of them children -- are starving to death every day. If the world is rightly moved by accidents and natural or social catastrophes that bring death to hundreds or thousands of people, why is it not equally moved by that genocide which is taking place every day in front of our eyes (Fidel Castro Ruz, World Food Summit, 1996)

Throughout the world there has been and still is a common perception that local people in the rural areas are mis-managers of natural resources and that increased population pressure leads to further environmental degradation. However, empirical evidence shows that increased population pressure may itself induce technological and institutional improvements in the area of environmental management. In relation to these two conflicting views, the question emerges whether it is possible to measure environmental degradation? Is degradation a perceptual term guided by our norms and values? A local farmer might perceive environmental degradation totally different from a western conservationist. If we recognise that increasing population pressure leads to induced innovation, or improvements in how people manage their environment, the important question is whether the pace of innovation is too slow relative to population growth and hence, threatens long-term sustainability. Public policy, apparently, is the crucial factor when determining whether population growth and intensification lead to degradation or to land improvements. Policies will have to arise in a new way which contribute to speeding up the innovation process. The human dimension must be emphasised, in which participation is considered as a fundamental right which will lead to mobilisation for collective action, empowerment and institution building.

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