Rural Energy Assessment And Potential Alternative Energy Resources & Technologies In Rural Areas Of Abbottabad, Pakistan

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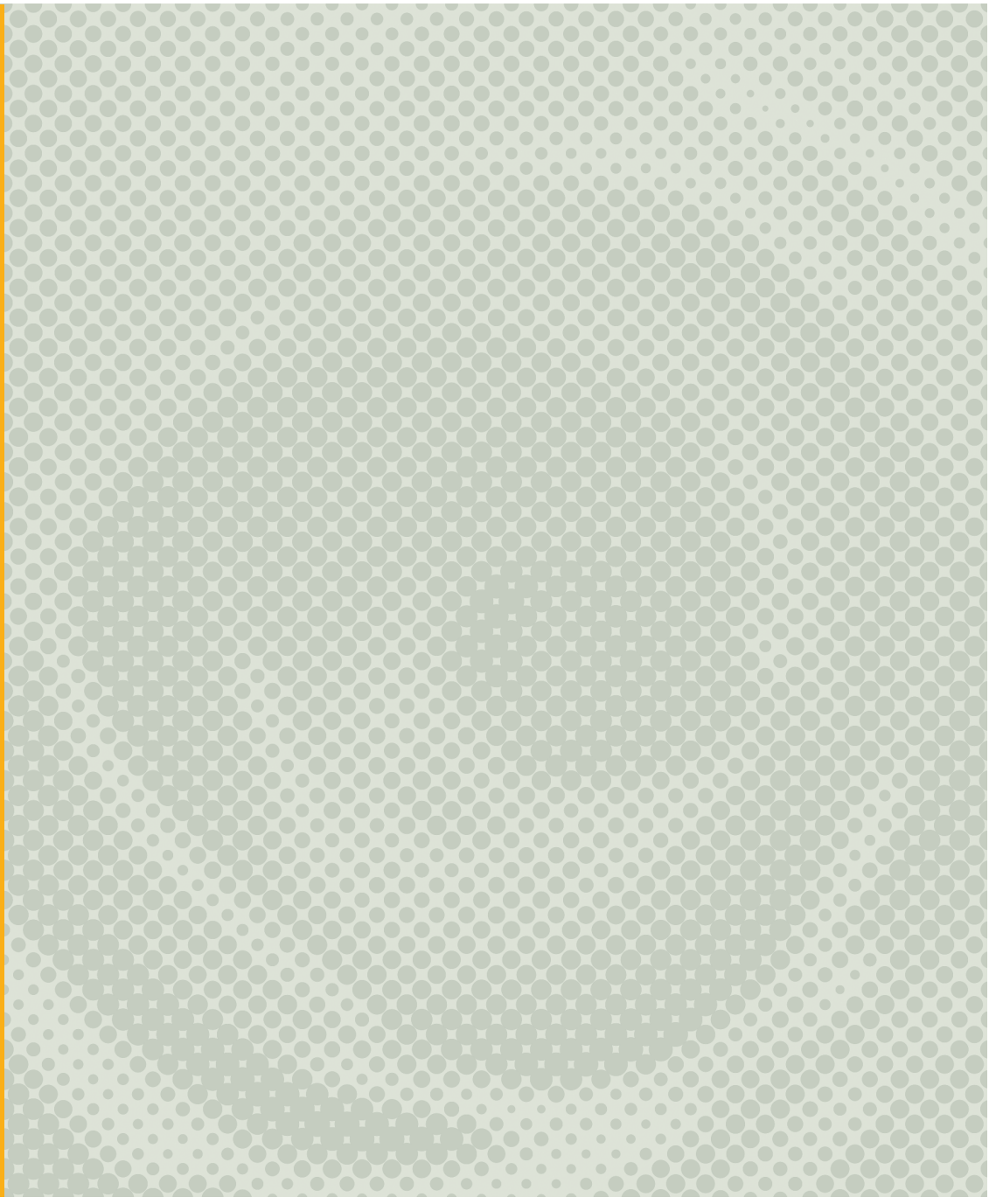

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Declaration

I, MOHSIN IRFAN, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature……..

Date…….....

DEDICATION

"To my beloved family & especially to my uncle who has been a constant source of encouragement and inspiration for me throughout the course of my life"

ACKNOWLEDGMENT

In the name of Allah, the most Merciful and the Beneficent Who blessed me with the potential to complete this work. And blessings are for His Prophet (PBUH) who is the torch of knowledge for all the Muslims.

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ABBREVIATIONS AND ACRONYMS

AEDB	Alternative Energy Development Board
GOP	Government Of Pakistan
AKRSP	Agha Khan Rural Support Program
UNDP-GEF	United Nation Development Program - Global Environmental Facility
PURE	Productive Use Of Renewable Energy
ARE	Alternative Renewable Energy
PCRET	Pakistan Council Of Renewable Energy Technologies
PCSIR	Pakistan Council Of Scientific and Industrial Research
NUST	National University Of Science and Technology
GTZ	German Agency For Technical Corporation
ADP	Annual Development Program
SHYDO	Sarah Hydel Development Organization
KG	Kilo Gram
NGOs	Non Government Organization
MDGs	Millennium Development Goals
GHGs	Green House Gases
T.B	Tuber Culosis
ENERCON	Environment and National Energy Conservation Center
AEDB	Alternative Energy Development Board
WEHAB	Water, Energy, Health, Agriculture and Biodiversity
ECA	Economic Commission for Africa
SRO-SA	Southern Africa Office
KP	Khyber Pukhtunkhwa
U/C	Union Council
ERRA	Earthquake Rehabilitation and Reconstruction Authority
FW	Fuel wood
DC	Dung Cake
CR	Crop Residues
D	Dilli
K	Kerosene
C	Candles
EL	Emergency Lights

ABBREVIATIONS AND ACRONYMS

LPG	Liquified Purifying Gas
EC	Electricity
IAP	Indoor Air Pollution
WWF	World Wide Fund
NRM	Natural Resource Management
FES	Fuel Efficient Stoves
WHO	World Health Organization
UNDP	United Nation Development Program
CO	Carbon monoxide
ADB	Asian Development Bank
GOP	Government Of Pakistan
AEDB	Alternative Energy Development Board
UNDP - GEF	United Nation Development Board Program - Global Environmental Facility
PURE	Productive Use Of Renewable Energy

LIST OF TABLES

Table # **Page #**

5.1: Agricultural Land Use Pattern of Abbottabad District.....18

5.2: Average Production and Yield of Major Crops in Abbottabad District.....18

5.3: Forest Land Use Pattern of Abbottabad District.....19

5.4: Livestock Population Abbottabad District.....19

5.5: Health Centres in Abbottabad District.....20

5.6: Educational Institutions in Abbottabad District.....21

5.7: The information about population, area, number and structure of the houses in the study villages.....21

6.1: Household Energy Types in the Village Balolia, Abbottabad.....28

6.2: Main type of energy used for cooking by house hold in Balolia, Abbottabad 2011.....30

6.3 Pros and Cons of Traditional & Imroved Iron soves.....32

6.4 : Field Testing of FES and Traditional Stove in District Abbottabad.....33

6.5: Most Common Species Used as a Fuelwood Energy in Abbottabad Region.....35

6.6 : Per Household Requirements of Fuelwood, In Study Village Balolia, Abbottabad.....36

6.7 : Per Household Requirements of Fuelwood for Traditional & FES Stoves.....37

6.8 : Yearly Fuelwood Requirements of Study Village Balolia, Abbottabad.....37

6.9: Distance traveled, time taken and weight of head loads.....41

6.10 : Impacts of fuelwood collection In Village Balolia, Abbottabad.....44

6.11: Health Experiences Of Using Fuelwood For Cooking In Village Balolia, Abbottabad.....45

6.11 Indoor air pollutants and their potential health effects.....55

6.12: Energy Expenditures In Rupees (Rs/month).....59

7.1: Brief Summary Of the Available Renewable Energy Potential In Pakistan.....67

LIST OF FIGURES

Figure# **Page #**

4.1: Examples of the Critical Role of Energy in WEHAB Priority Areas.....11

4.2. Relationship between Energy and the Achievement of MDGs.....12

4.3: Rural Energy Assessment.....13

5.1: Map of the study area.....22

5.2: Household Wealth Ranking of the rural people of Balolia Village.....24

6.1: Rural women preferences for existing energy resources.....29

6.2: Familial Responsibilities In Fuelwood Collection.....37

6.3: Opportunit Cost Of Fuelwood Collection.....39

6.4: Time spend for fuelwood collection.....40

6.5 : Fuelwood Collection Frequency Per Week.....41

TABLE OF CONTENTS

DECLARATION....I
DEDICATION....II
ACKNOWLEDGMENT....III
LIST OF ACRONYMS....IV
LIST OF TABLES....VI
LIST OF FIGURES....VII
TABLE OF CONTENTS....VIII
ABSTRACT....XII
1. INTRODUCTION AND BACKGROUND....1
2. STATEMENT OF THE PROBLEM....3
3. OBJECTIVES AND RESEARCH QUESTIONS....3
4. REVIEW OF LITERATURE AND THEORETICAL FRAMEWORK....6
4.1 Review of Literature....6
4.1.1 National Forest Policy 2002....7
4.1.2 Khyber Pukhtunkhwa Forest Policy, 1999....8
4.2 Pakistan Energy Policy....9
4.2.1 Energy Conservation Policy in Pakistan....9
4.2.2 Alternative and Renewable Energy policy in Pakistan....10
4.3 A Framework for Action on Energy....10
4.4 Energy and Millennium Development Goals....12
5. METHODOLOGICAL CONSIDERATIONS 16
5.1 Research Approach....16
5.2 Universe of Study....16
5.2.1 General Socio-Economic and Cultural Trends in Study Village....17

5.2.2 Agriculture....18

5.2.3 Forestry....19

5.2.4 Livestock....19

5.2.5 Health & Educational facilities in District Abbottabad....20

5.2.6 Energy Situation in the Study Villages, Abbottabad....23

5.2.7 Political System (Decision Making/Conflict Resolution)....23

5.3 CHOOSING STUDY POPULATION....23

5.3.1 Accessibility....23

5.3.2 Energy and Economic Situation of the Study Villages....24

5.4 SAMPLE UNIT....24

5.5 SAMPLING AND SAMPLE SIZE....24

5.6 DATA COLLECTION....25

5.6.1 Transact Walks and Personal Observations....25

5.6.2 Interview Schedule for Male and Female Respondents....25

5.6.3 Focus Group Discussion....26

5.7 PROBLEM FACED....27

6. RESULTS & DISCUSSIONS 28

6.1 Household Energy Types and Usage....28

6.1.1 Preference Of Use Of Energy Types By Rural Men & Women....28

6.2 Types of Energy Used For Cooking In Balolia Village....30

6.3 Types of Energy Used For Lighting & Heating In Village Balolia....31

6.4 Cooking Units In Households....31

6.5 Type Of Stoves Used At Household Level....32

6.6 Fuelwood Collection Source....34

6.7 Most Utilized Species For Fuelwood....35

6.8 Fuelwood Requirements For Domestic Consumption.....36

6.9 Familial Responsibilities & Children Interest In Fuelwood Collection.....37

6.10 Cost Of Fuelwood Collection To Households.....38

6.10.1 Opportunity Cost Of Fuelwood Collection.....38

6.10.2 Time Cost Of Fuelwood Collection.....40

6.10.2.1 Time Serve To Collect Fuelwood from Collection Area.....40

6.10.2.2 Frequency Of fuelwood Collection Per Week.....41

6.10.2.3 Wood Use Per Collection.....42

6.11 Gender Experiences of Fuelwood Collection In Balolia, Abbottabad.....43

6.12 Health Experiences Of Using Fuelwood For Cooking.....45

6.13 Perceptions and Responses to Fuelwood & Dung Cake Use In Balolia, Abbottabad.....51

6.14 Adverse Health Effects due to IAP (Indoor Air Pollution).....54

6.15 Women & Children at Special Risk due to IAP.....56

6.16 Social Implications Of Fuelwood Usage.....57

6.17 Economic Implications Of Fuelwood Use.....57

6.18 Fuelwood Usage Cause Deforestation.....61

6.19 ENERGY SITUATION COMPARISON BETWEEN KAKUL AND VILLAGE BALOLIA 64

7. ALTERNATIVE ENERGY RESOURCES & TECHNOLOGY.....67

7.1 Alternative Energy Resources In Pakistan.....67

7.2 Energy Technology Promoted By NGOs & Government Of Pakistan.....68

7.3 Potential Alternative/Renewable Energy Resources In District Abbottabad.....70

7.4 Expected Potential Economic, Social and Environmental Improvements.....73

7.4.1 Economic Improvements will be.....73

7.4.1.1 Money Saving.....73

7.4.1.2 Time Saving....73

7.4.1.3 Income Generation....74

7.4.2 Social & Health Improvements....74

7.4.3 Environmental Improvements will be....75

7.4.3.1 Firewood Saving and will Reduce Deforestation....75

7.4.3.2 Soil Improvement and Water Control....75

8. ENERGY AND CLIMATE CHANGE....76

9. CONCLUSION....78

REFERENCES....82

APPENDICES....87

PICTURES....97

ABSTRACT

This report provides an in-depth review and critical analysis of the various rural energy resources and their socio-economic, health and indoor environmental impacts on rural people and their livelihoods in Abbottabad, Pakistan. It also explores the potential alternative energy resources and affordable technologies for rural people and as well as their potential socio-economic, health and indoor environmental impacts on rural people and their livelihoods. The review of the consumption aspect has found that traditional fuel (fuelwood, crop residues and dung cake) still dominates domestic energy use in rural areas of Abbottabad and accounts for about 80% of the total. These resources of energy burn innefficiently, thereby giving rise to energy loss. The surrounding environment is also degraded through the depletion of forest resources and that in many areas there is an increasing shortage in firewood supply, which ultimately increases work burden for women whose responsibility, is to collect it. Energy is one of the most important inputs for sustaining people´s livelihoods. Due to lack of modern energy services in Balolia village, rural people have less opportunities for income generation. Their low income levels makes the provision of modern energy services unaffordable for rural people. The resulting, heavily dependance on traditional fuels means less energy efficiency, over exploitation of forest resources, loss of biodiversity, greater health hazards due to indoor air pollution and reduce capacity to mitigate climate change. The analysis of the study show that the impacts on health of domestic fuel use go beyond indoor air pollution and affect the household economy, women´s time and activities, gender roles and relations, safety and hygiene and as well as local and global environment. The energy situation in Balolia village is far worse than in the kakul village. They use traditional fuel in traditional stoves for cooking. Cooking is largely done by women inside the rooms. More than 50% of the domestic fuelwood collection is done by female members.The prefer cooking inside the room especially during winter because it performs dual function like cooking and as well as heating and also thinking that this practice reduces their household energy expenditures. Health situation is also worse in Balolia village. As compare to Balolia village, people of the Kakul village has clean, efficient and cheap energy resources for cooking and heating purposes. Moreover, socio-economic, health and hygienic conditions are also better than Balolia village. By exploring alternative energy resources and by introducing affordable, innovative energy technologies and technical assistance could bring socio-economic, health, hygienic and indoor environmental improvements for rural communities in Abbottabad, Pakistan.

1. INTRODUCTION & BACKGROUND

It has been estimated that 2.4 billion people rely on charcoal, wood, agricultural residues and dung for cooking and space heating. The International Energy Agency (IAE) reported that these figures will remain unchanged in 2015 unless new strategies are adopted to expand access to modern energy services. "*Most people in least developed countries, especially in rural areas, have to rely heavily on traditional fuels for cooking, which are injurious to health and the environment. Indoor air pollution is directly responsible for more deaths than malaria, and almost as many as tuberculosis and HIV/AIDS, killing 1.3 million people per year, mostly women and children. Cutting in half the number of households using traditional fuels by 2015 will require 1.3 billion people switching from traditional fuels to modern fuels such as LPG gas (Millennium Project, UNDP, World Bank, 2005)".* More than 1.6 million women and children die every year because of respiratory diseases caused by indoor air pollution from cooking fuels. In developing countries, poor people spend a higher share of their income on energy services than people in developed parts of the world. Costs per energy unit are also higher. Candles and batteries prove to be the most expensive forms of energy per unit. Four out of five people without access to electricity live in rural areas. Several developing countries like Pakistan, have abundant natural resources including energy, but still that are not effectively utilized. Pakistan has abundant hydro power generation potential and also abundant coal resources.

In Pakistan, almost 70 % of the population belong to rural areas. According to an estimate 94% of households in rural areas and 58 % in urban areas rely on biomass fuels (fuelwood, dung and agricultural waste). Almost 28,000 deaths and 40 million cases of acute respiratory illness are caused by indoor air pollution each year. This puts a significant economic burden on Pakistan with an annual cost of 1 % of GDP (Colbeck, I., et al., 2010).

Energy access is given as a target indicator for achieving the seventh objective of the MDGs, which is to ensure environmental sustainability. Northern areas of Pakistan in particular highly rely on inefficient traditional biomass, use mainly for cooking and heating purposes. More than 80 % of the households fulfill their primary energy demands with traditional biomass like firewood and dung cake. These resources of energy burn inefficiently, thereby giving rise to energy loss. The surrounding environment is also degraded through the depletion of forest resources and that in many areas there is an increasing shortage in firewood supply, which ultimately increases work burden for women whose responsibility, is to collect it. Health damaging pollutants like carbon monoxide, benzene, nitrogen oxides, etc are emitted when these forms of energy resources are used

indoors. Moreover, deaths from indoor air pollution, arising from the burning of biomass fuels (Proceedings of a Workshop held by OFID in Abuja, Nigeria June 8-10, 2008).

Energy is one of the most important inputs for sustaining people´s livelihood (Clancy, J.S., and Skutsch, M., 2002). Due to lack of modern energy services in rural areas, rural people have less opportunities for income and employment generation. Therefore, particularly low income levels in rural areas makes the provision of modern energy services unaffordable to most communities. The resulting heavily dependance on traditional energy sources means less energy efficiency; over exploitation of forest resources and a loss of biodiversity; greater health hazards due to indoor air pollution; and reduce capacity to mitigate climate change (Proceedings of a Workshop held by OFID in Abuja, Nigeria June 8-10,2008).

“ Poverty can be conceptualized in a number of ways, for example, in economic terms (an income of less than $ 1 a day) or in social terms (lack of access to adequate levels of food, water, clothing, shelter, sanitation, health care and education). It is also possible to identify an energy dimension to poverty: energy poverty. Energy poverty has been defined as the absence of sufficient choice in accessing adequate, affordable reliable, high quality, save and environmental beings energy services to support economic and human development (Reddy, 2000).”

Pakistan is an energy poor country, where a large portion of the population at rest does not have access to contemporary day energy services like electricity. Major portion of the total population lives in remote areas. According to an estimate rural population contributes up to 70 per cent of the total in Pakistan and has only biomass and kerosene oil as major energy resources. Out of that 70%, only 16% of rural population has grid-connected electricity for domestic and commercial use. Rural communities living in mountainous areas especially in Khyber pukhtunkhwa province face deficiency of firewood to meet their household energy demands (Ghaffar, M.A., 1994). Most of the rural villages have relatively small population and distant from the main diffusion lines of the national grid, so it is usually considered as not economically feasible to connect these villages to the main transmission lines of the grid. (Abro, R., 2003). Renewable energies has vast potential to supply energy for various applications and has capacity to raise the socio-economic, health and indoor-environmental standards for rural people of Pakistan (Ghaffar, M.A., 1994).

The predominance of firewood as the prime source of energy for cooking, despite of its ineptitude and detrimental impact on human health and environmental degradation, could be attributed to its availability as a free source of energy. Traditional biomass energy sources such as animal dung, firewood and crop residues, play important roles in local household energy consumption. This

conventional energy structure is not only a threat to eco-environment but also to rural women and children as well.

2. STATEMENT OF THE PROBLEM

In this study, I look at socio-economic, health and indoor environmental impacts of the use of various energy resources (like biomass etc) on rural people and their livelihoods. I had divided my thesis into two parts. The first part focuses on the major existing energy resources and their socio-economic, health and indoor environmental impacts on rural people. In this I am interested to get a deeper understanding of major existing energy resources in study areas, people´s demand for energy and for what purpose, energy needs of the rural people, cost and time factors in traditional energy resources etc. The second part explores the potential alternative energy resources and affordable technologies and as well as their potential socio-economic, health and indoor environmental impacts on rural people and their livelihoods. In this part, I also mentions some alternative energy resources and affordable innovative technologies for the rural people that could contribute in sustainable rural development. I also discuss Government and NGOs energy policy for rural areas at the end.

3. OBJECTIVES AND RESEARCH QUESTIONS

The study has the following four main objectives, each with a detailed set of research questions to guide the study.

1. To assess the existing energy resources, energy needs and demands of the rural people in selected villages.

- ✦ What are the major existing energy resources in each village?
- ✦ Which energy resource (electricity, coal, gas, biomass etc) prefer most for domestic consumption (like lighting, cooking, heating etc) by rural men and women?
- ✦ What are the major energy needs (domestic or commercial) of the rural men & women and for what purposes (like lighting, cooking, heating etc)?
- ✦ What are the perceptions of rural men and women about the use of biomass for domestic energy purposes?
- ✦ Which energy resource (electricity, gas, biomass etc) contribute more to fulfill basic rural

household energy demands?

- ✦ How does the use of energy resources (electricity, gas, biomass etc) vary with rural household income levels?

2. To study the impacts of existing energy resources on rural people and their livelihood.

- ✦ What could be the negative impacts of existing energy resources (biomass etc) on rural people and their livelihood?
- ✦ How existing energy resources effect on rural social, economic, health and indoor-environmental conditions for men and women in the villages?
- ✦ How the impacts of existing energy resources varies by gender?
- ✦ Which rural household member (women, girls, children, men etc) are more affected by use of existing energy resources for cooking and lighting? Is it correct that existing energy resources has more threat to rural women and children?
- ✦ What could be the major health consequences of use of biomass energy for rural women and children?
- ✦ Can existing energy resources play role for sustainable rural development?
- ✦ Is there any positive role played by traditional biomass energy in rural household development?
- ✦ Why the traditional stoves have more energy loses and less energy efficiency?
- ✦ How existing energy resources effect on income rate of the rural people?

3. What might be potential alternative energy resources in Pakistan.

- ✦ What are the alternative energy resources in Pakistan?
- ✦ Which energy technology is promoted more by Government of Pakistan and NGOs?
- ✦ Who are the actors in energy research and provision, in Pakistan?
- ✦ Which technologies (hydro, renewable, biogas etc) has potential to fulfill the basic rural household energy demands like cooking heating and lighting etc, and at what level? Does this differ by gender?
- ✦ What is the Government and NGOs energy policy for decentralized areas, how do they differ

with each other and how do they match with local energy needs, access and energy resources?

- ✦ How Govt. and NGOs assess the energy needs of the rural people and what methodology they used?
- ✦ Which energy resource will be clean, efficient, affordable and reliable for rural household energy needs (cooking, lighting and heating etc)?

4. To exploring the potential impacts of alternative energy resources on rural people health and their livelihood in the study areas.

- ✦ What could be the potential alternative energy resources for cooking, lighting and heating in the study area of pakistan?
- ✦ Can the potential energy resources improve or worsen the rural socio-economic, health and indoor-environmental conditions for rural people, if can improve then in what ways?
- ✦ What might be the positive effects of potential energy resources on rural women and children health and development?
- ✦ Do the alternative energy resources can reduce the time and transport burden on rural women and young girls?
- ✦ In what ways, might potential alternative energy resources play a role in reduction of forest and environmental degradation, can replacement of traditional energy resources with potential alternative energy resources and technology in rural areas can reduce burden on forest?
- ✦ What could be unintended consequences of improved energy resources on rural people?

4. REVIEW OF LITERATURE AND THEORETICAL FRAMEWORK

4.1 REVIEW OF LITERATURE

Energy is at the heart of most critical economic, environmental and developmental issues facing the world today. Clean, efficient, affordable and reliable energy services are indispensable for global prosperity. Energy deficient countries particularly developing countries need to expand access to reliable and modern energy services if they want to reduce poverty and health problems of their people. Current energy systems are inadequate to meet the energy needs of the world´s rural people and achieving the Millennium Development Goals (MDGs). Moreover, without affordable and reliable energy services, neither health clinics nor schools can function properly. Access to clean water and sanitation is constrained without effective pumping capacity. Access to modern forms of energy would strengthen the opportunities for the poorest few billion people on the planet to escape the worst impact of poverty. Economic growth also dependent on energy and goes hand in hand with increased access to modern energy services. Low income countries need to expand access to modern energy services substantially in order to meet the needs of the several billion people who has inadequate and unreliable access to energy services and reliance on traditional biomass to meet the household energy needs. Energy services should be economically viable, sustainable, affordable, efficient and that release the least amount of GHGs (AGECC, 28 April 2010).

More than two billion of the world´s poorest people still rely on biomass like wood, charcoal, animal dung, crop wastes and coal-burning for household energy needs. Use of these fuels create indoor air pollution which particularly harm poor women and children. This exposure increases the risk of several diseases. Evidence is also emerging that indoor air pollution may increase the risk of a number of other important conditions, including TB, low birth weight, and direct exposure cause burns to children and injuries to women from carrying wood. Furthermore, economic and environmental consequences of rural household energy use impact on health through such factors as the time women spend collecting firewood and restrictions on educational and economic activities. A wide range of interventions like improved stoves, use of cleaner fuel, better ventilation system and keeping children away from smoke during peak cooking times can reduce the rural health impacts of indoor air pollution. This target can be achieved through policies operating at national level by supply and distribution of improved stoves / cleaner fuel and at local level through community development. Past experience shows that successful implementation requires participation by local rural people especially women and collaboration among different sectors like health, energy, environment, housing and planning etc. It should be noted that the impacts of

traditional fuel use also affect the household economy, women´s time and activities, gender role and relations, safety and hygiene, as well as the local and global environment. It has been estimated that approximately half of the world wide wood harvest is used as fuel. Furthermore,rural families expend more than 20 % of household income to purchase biofuels, or devote more than 25 % of total household labour to wood collection (Schirnding Y.V., et al., 2002).

4.1.1 NATIONAL FOREST POLICY, 2002

According to National Forest Policy 2002, Northern forests have significant importance for Pakistan. They provide a carbon sink to mitigate global warming, are repositories of invaluable biodiversity, control water flows, minimize loss of soil and water from watersheds which ultimately reducing the siltation of dams and canals. Therefore, Government formulate and implement the following policies to significantly improve the conservation and sustainable management of renewable natural resources in forests to enable them to play their functions more effectively. The aim of the National Forest Policy is to promote the sustainable development of forests, grazing lands and biodiversity of Pakistan, for the conservation of environment and the enhancement of the sustainable livelihoods of its rural people especially women and children.Provincial Governments may resume sustainable commercial timber harvesting in the Reserved, Protected, Guzara and Private Forests with the following conditions (National Forest Policy 2002).

I. Commercial timber harvesting shall only be resumed in those areas whose right-holders and owners take fully participation in the management and regeneration of their forests in association with the Forest Department, with due regard to meeting the minimum sustainable needs of the non-right holders to the extent of the productive capacity of each forest.

II. The basic criteria for classifying forests into commercial and non-commercial categories shall not only be stocking but terrain and need for regeneration also; and a creditable guarantee from the owners, right-holders and users that they will ensure the regeneration of the forests by affording them protection from grazing, fires and other sources of injury.

III. The principal objective of commercial timber harvesting in the above forests shall be poverty alleviation through providing income to the owners and right holders and to prime economic activity through generating local employment. To further the attainment of the latter objective it shall be the policy of Provincial Government to train the local people in all timber harvesting operations and encourage and enable them to take on small timber harvesting contracts on the pattern successfully demonstrated in the Kalam and the Kaghan projects.

IV. Since effective regeneration and not the protection of old trees is the sine qua non of sustainable commercial forestry, the utmost emphasis shall be on the establishment of adequate regeneration. Devising and implementing an appropriate system of incentives and disincentives for the owners, right-holders, and users of forests, and the Forest Department functionaries shall ensure this (National Forest Policy 2002).

V. Provincial Governments and forest owners shall provide the necessary resources to rehabilitate the degraded sites in these forests (National Forest Policy 2002).

4.1.2 KHYBER PUKHTUNKHWA (KPK) FOREST POLICY, 1999

The Policy statement is *"Government of Khyber Pukhtunkhwa by sustainably managing and developing the forests of the Province is to foster the economic, social and ecological well-being of the people residing around the forests, N.W.F.P, Pakistan and International Community."* The Policy is based on the following principles:

- ☒ Integrated Resource Management Participation of People
- ☒ Devolution of Authority & Responsibility
- ☒ Promotion of Private Sector
- ☒ Equity, Public Awareness
- ☒ Incentives
- ☒ Cross-Sectoral Linkage

The Provincial Government of Khyber-Pakhtunkhwa (K-P) has decided to broaden the role and scope of Pakistan Forest Institute (PFI) by giving it the status of a separate department in order to promote forestry, range management, bio-diversity wildlife education and training facilities to students. It was decided at the meeting which was by K-P Environment Minister, Environment Additional Secretary and Implementation Committee on 18 Amendment Member that the status of PFI be developed as a separate department, under the administration of the Environment Department (Promoting environment: Pakistan Forest Institute to be made a separate department Published in The Express Tribune, September 12th, 2011.). The federal Government of Pakistan initiated a number of policy reforms but now under the 18 Th. Amendment, Ministry of Environment is going to be devolved in June, 2011, and provinces will get more power in policy development and implementation (Economic Survey 2010-11).

4.2 PAKISTAN ENERGY POLICY

In Pakistan, power generation is mainly in the public sector with two vertically integrated utilities. Due to the electricity demand patterns and lack of funds in the public sector, the Government of Pakistan took step to mobilize private sector resources by introducing it into power generation. In November 1985, the Government of Pakistan encouraged private sector participation in the power generation sector. These initiatives were followed by the Power Policy in Pakistan firstly turned up in 1994. The current power policy in Pakistan, is the ¨ Policy for Power Generation 2002 ¨. This policy covers private, public-private, and public sector projects. The main objectives under this policy are:

- To provide sufficient capacity for power generation at the least cost, and to avoid capacity shortfall.
- To encourage and promote exploitation of indigenous resources, such as human resources, potential renewable resources, participation of local engineering and manufacturing capabilities.
- To ensure that all stakeholders are looked after in the process, i.e. a win-win situation for all.
- To be attuned to safeguarding the environment

In 2005, the Energy Security Action Plan (2005-2030) was officially accepted to meet the requirements of Pakistan´s Vision 2030 for reliable, affordable and quality energy supplies. The main focus of this plan is to enhance energy supply through an optimal combination of all resources including hydropower, gas, coal, oil, nuclear and renewable energy such as solar and wind. It is decided to optimize the utilization of country´s indigenous energy resources to reduce reliant on imported fossil fuels.

4.2.1 ENERGY CONSERVATION POLICY

In 2005, the Ministry of Environment and National Energy Conservation Centre (ENERCON), collectively published a report called ¨National Energy Conservation Policy 2005 ¨. Energy Conservation Policy includes guidelines and possible actions that can enhance end-use efficiency for different energy-consuming sectors. The main objectives of National Energy Conservation Policy are as follows:

- To promote energy conservation through stimulation of resources and regularizing overall energy management programs in all sectors.
- To develop energy conservation market and facilitate commercialization by increasing awareness and launching demonstration projects at national level.
- To maximize the utilization of indigenous resources to fulfill the national energy demand.

- To reduce energy intensity of various energy consuming sectors through appropriate technological and policy measures, so as to promote sustainable growth.

4.2.2 ALTERNATIVE AND RENEWABLE ENERGY POLICY

In 2006, the Alternative Energy Development Board (AEDB) established by Government of Pakistan published ¨Policy for Development of Renewable Energy for Power Generation (small Hydro, Wind and Solar Technologies). The objectives of this policy are:

- promote the deployment of renewable energy technologies in Pakistan
- Introduce investment-friendly incentives, and facilitate renewable energy market to build private sector interest in renewable projects.
- Develop a mechanism to support the private sector in mobilising, financing and enebling public sector investment in renewable

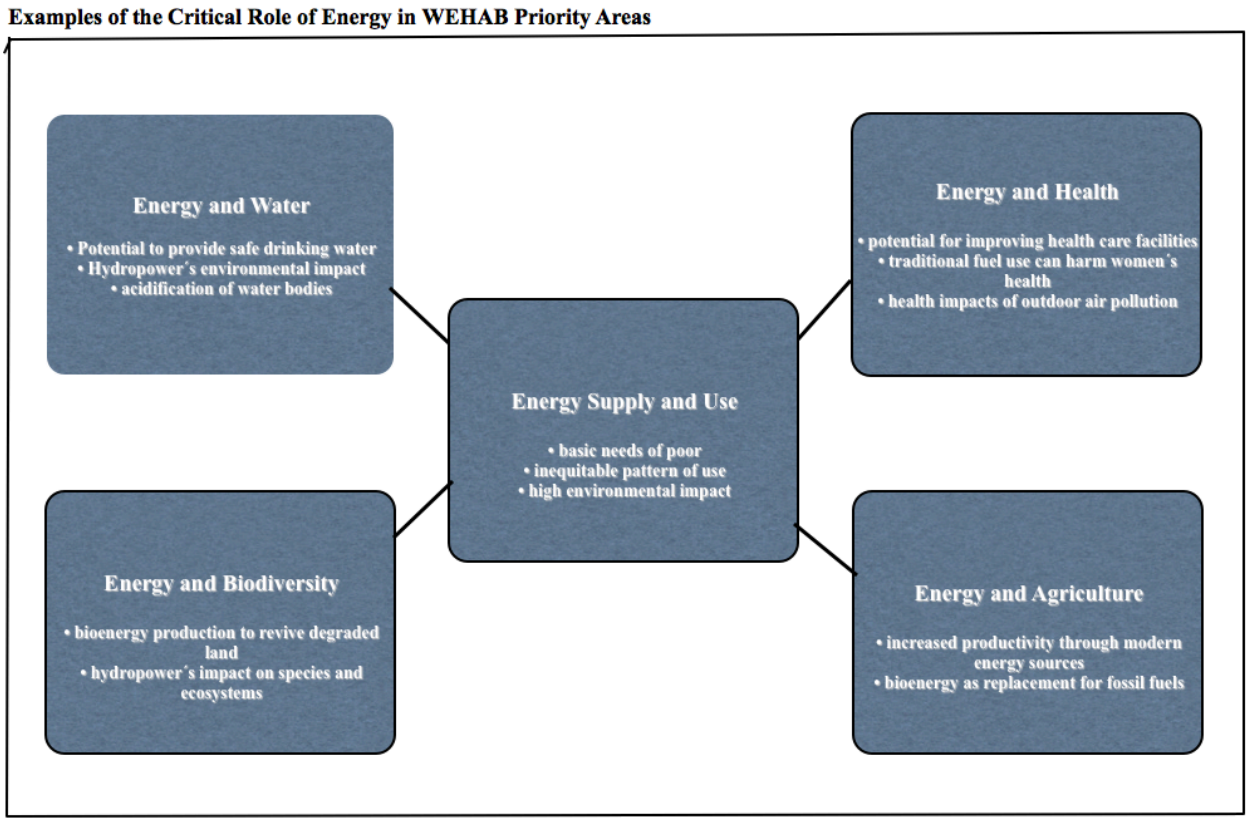
(Environmental Protection Department, Ref. SA 07-003 Review of the International Energy Policies and Actions and the Latest Practice in their Environmental Evaluation and Strategic Environmental Assessment Final Report November 2007).
http://www.epd.gov.hk/epd/SEA/eng/file/energy_index/pakistan.pdf

4.3 A FRAMEWORK FOR ACTION ON ENERGY

The WEHAB (Water, Energy, Health, Agriculture and Biodiversity) framework was proposed by UN Secretary General Kofi Annan as a contribution to the preparation for the World Summit on Sustainable Development (WSSD). It has mainly focused in the five key thematic areas of Water, Energy, Health, Agriculture and biodiversity that are integral for implementation of sustainable development. The WEHAB energy framework described the linkages between energy and goals related to health, water, agriculture and biodiversity, emphasizing the interdependence among sustainable development issues. Energy services are essential for sustainable development issues. Production, distribution and used of energy services affects the social, economic and environmental dimensions of any development achieved. Although, energy itself is not a basic human need, it is critical for the fulfillment of all human needs. Energy services include things such as lighting, heating and cooling, cooking, water pumping, refrigeration, transportation and communication. without access to energy services, people must spend a lot of time and physical energy on basic subsistence activities rather than on earning money. In addition, lack of energy has several indicators of poverty such as poor education, bad health facilities and hardships imposed on women and children. Within the context of the priorities identified by Secretary General Kofi Annan, there are direct links among the five key areas where concrete results can and must be obtained: water and sanitation, energy, health and the environment, agriculture, biodiversity and ecosystem management (WEHAB), (See Figure 4.1). For sustainable development, it is essential to concentrate on delivering energy services that could meet the needs of people, using a variety of

technologies and fuels fitted to local conditions, rather than simply working towards increasing fuel and electricity supplies (WEHAB working group 2002).

I can say that in the light of my research study, any particular energy resource or particular energy technology can never bring sustainable development for rural people. To bring sustainable development, we should move towards integrated energy approaches. The exploration of local energy resources and promotion of variety of simple technologies (that should be affordable and fitted to the local condition) in the light of perceptions of local communities could bring significant improvement in rural people´s livelihoods. By using local knowledge, we could bring innovations in their household using technologies like, we could bring improvement in their traditional stoves, could also heat the water by attaching en helical metal quail with stove or in smoke removing chimney and could also bring improvement in heating system by simple modifications in their housing structure and so many other simple innovative technologies could be possible that will be discussed in the second part of the thesis.

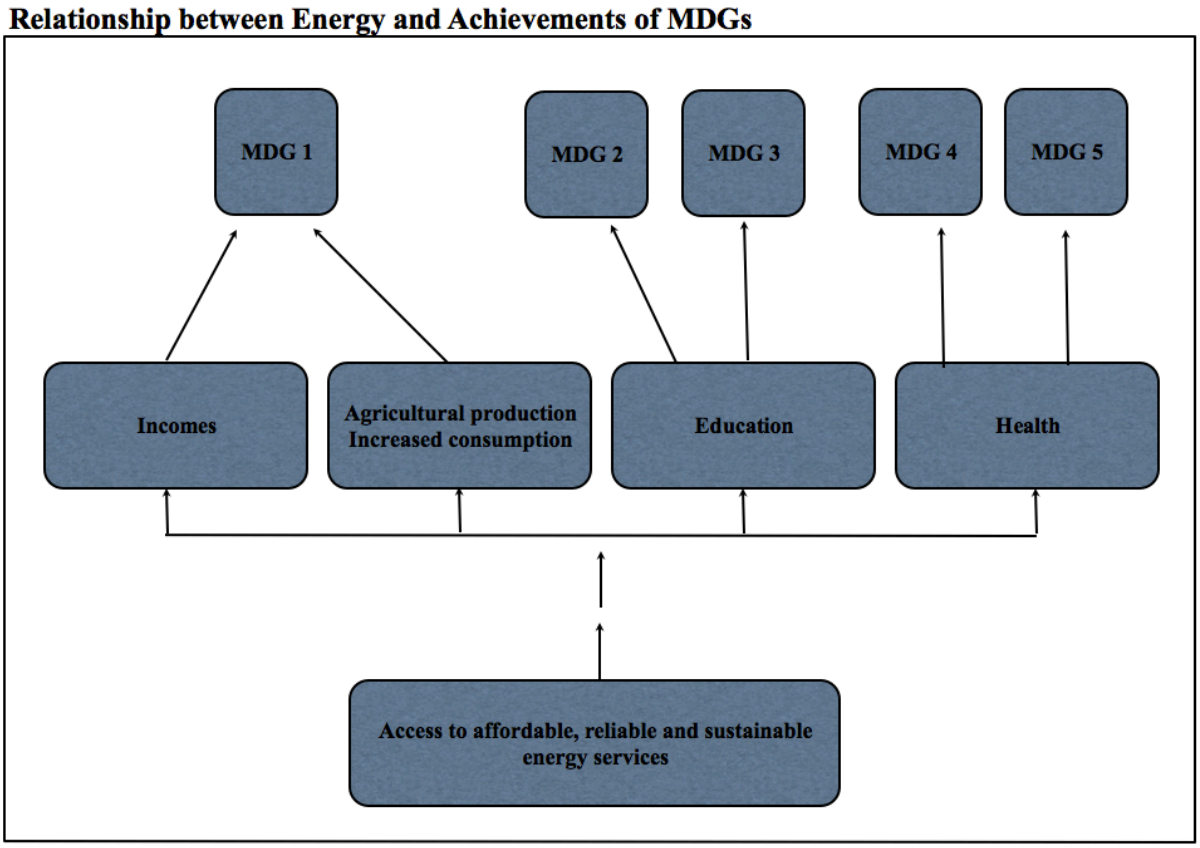


Source: A framework for Action on Energy, WEHAB working group, 2002.World Summit on Sustainable Development

Fig. 4.1: Examples of the Critical Role of Energy in WEHAB Priority Areas

4.4 ENERGY AND MILLENNIUM DEVELOPMENT GOALS

The Millennium Development Goals developed in September 2000 UN Millennium Summit, provide key targets to address the most pressing development needs. Therefore, energy is not explicitly part of the Millennium Development Goals set by the United Nation. Most notably, the importance of energy in meeting the goal of halving poverty by 2015 was reflected in a key decision at the Ninth Session of the Commission on Sustainable Development. ¨ To implement the goal accepted by the international community to halve the proportion of people living on less than one dollar per day by 2015, access to affordable energy services is a prerequisite¨. Beyond this broad goal, the wide range of energy services, including cooking, lighting, heating, water pumping, and communication made possible by renewable energy. Energy efficiency and clean conventional fuels can have a major impact in facilitating sustainable livelihoods and improving health and education (WEHAB working group 2002).



Source: Sustainable Energy: A framework for New and Renewable Energy in Southern Africa. ECA/SA/TPUB/2005/2006.

Fig 4.2. Relationship between Energy and the Achievement of MDGs.

Access to affordable, reliable and sustainable energy assists in achieving MDGs. Analysts agree that none of the eight MDGs can be met without major improvement in the quality and quantity of energy services supplied to the rural poor in developing countries (Economic Commission for Africa (ECA) and Southern Africa Office (SRO-SA), 2005/2006). Access to affordable, reliable and sustainable energy services could play a variety of direct and indirect roles in helping to achieve several MDGs. The above figure 4.2 clearly shows that access to energy services facilitates economic development, reduce hunger and improve access to safe drinking water, play role in education and to promote gender equality and empowerment of women and also improves indoor environmental conditions that ultimately reduces health diseases.

Rural Energy Assessment

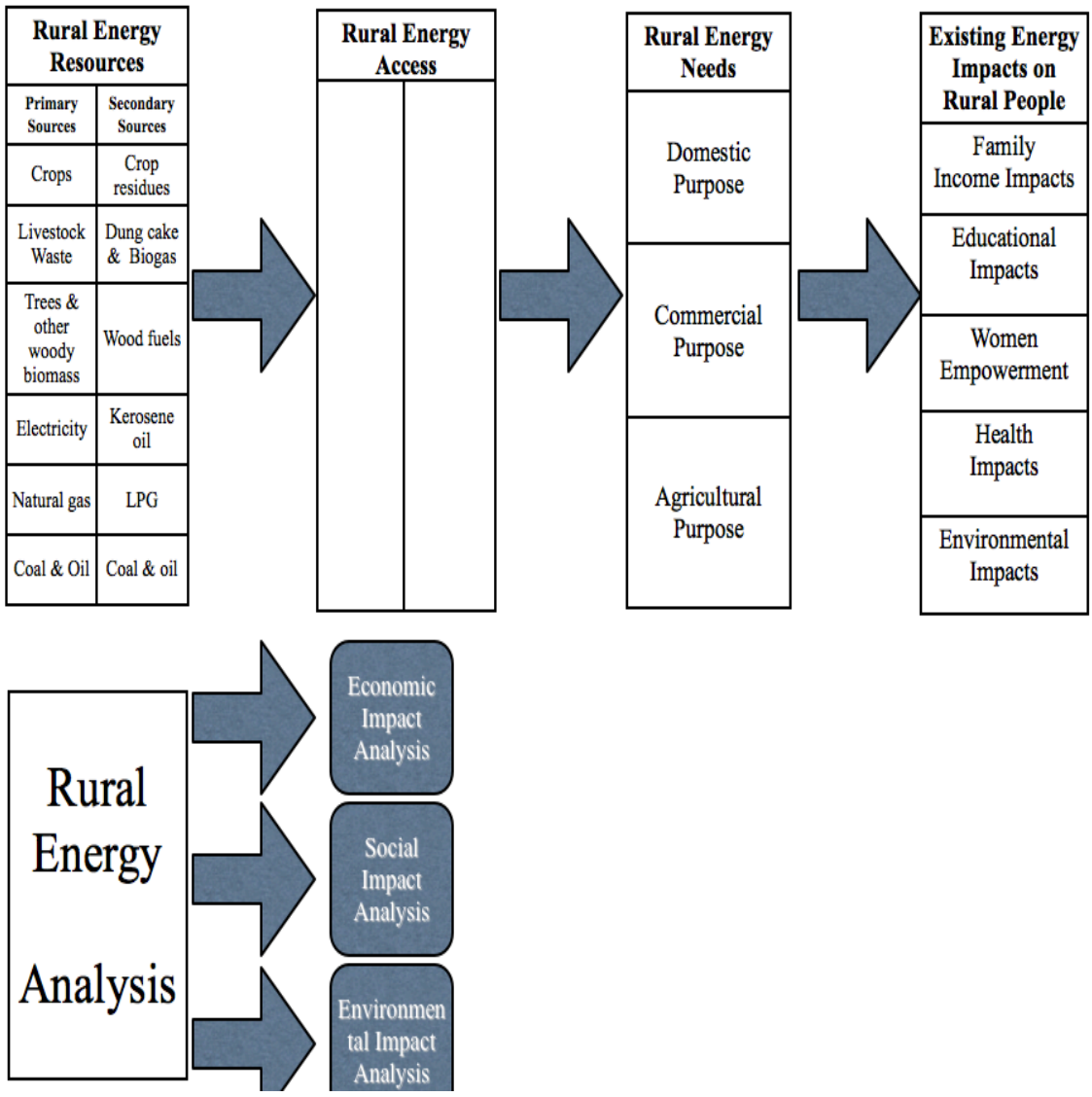


Fig 4.3: Rural Energy Assessment

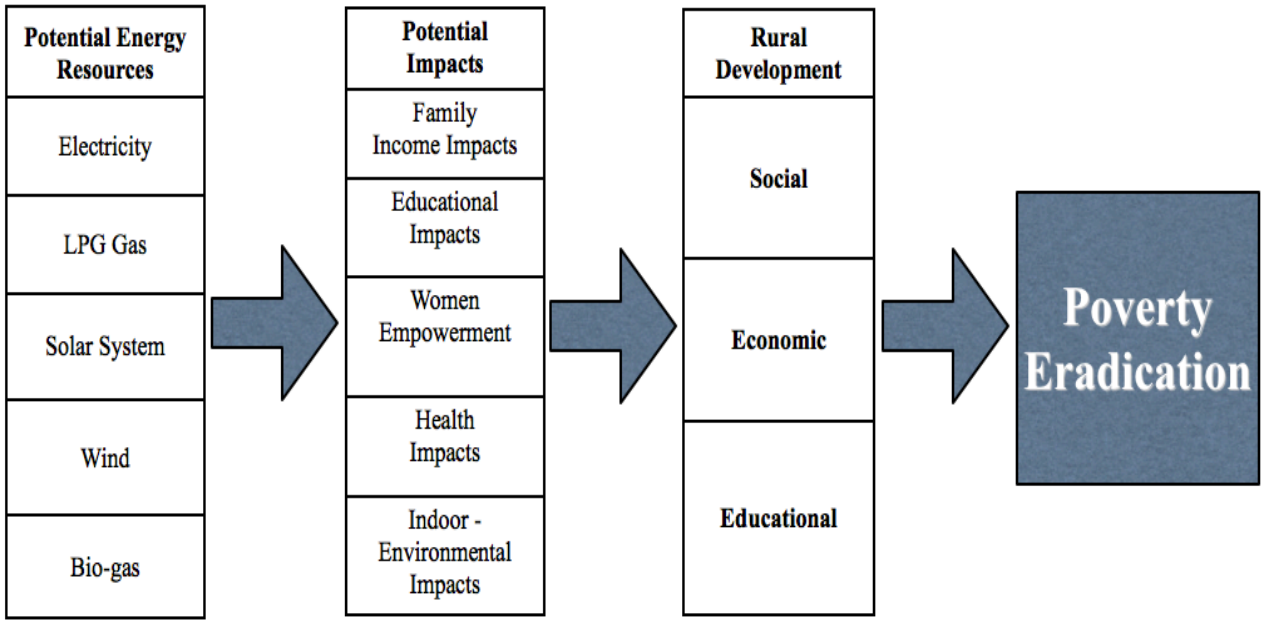


Fig 4.4: Potential Energy Resources and their Potential Impacts

By using the upper frameworks showing in figure 4.3 and 4.4, I try to assess the existing energy resources and access to these energy resources by rural men and women in Village Balolia and Kakul. I investigate the rural people energy needs in this area and also try to find that which energy resource play a major contribution to fulfill the basic rural household energy needs especially for cooking, heating and lighting. So, by using this approach, I also assess the negative impacts of various using energy resources on rural family income, education, women and children health and indoor environmental conditions. AT broader level, I can say that assessment of socio-economic, health and indoor environmental impacts of various using energy resources on rural people in study areas. I also try to link how alternative potential energy resources and affordable energy technologies could play a role in rural development by reducing poverty and through livelihood improvement. These frameworks are explained in detail In results and discussion part of the thesis.

You will get point by studying result and discussion part that energy resources, access to energy resources, energy needs and socio.economic, health and indoor environmental impacts vary from village to village. The research study shows that alternative energy resources and innovative energy technologies could significantly reduce household energy expenditure, play role in education, women empowerments, health improvements and indoor environmental conditions. These possible potential improvements are discussed in detail in results and discussions part.

5. METHODOLOGICAL CONSIDERATIONS

This chapter is devoted to discuss various aspects of methodological framework of this research. Research approach used for the research work is discussed in the first portion of the chapter. The important features of the study area and its selection along with the sample population are also described in the text. This chapter also deals with the data collection and tools used for data collection. Finally the problems faced in the research work are discussed in the end of the chapter.

5.1 Research Approach

The research is both the descriptive and co-relation in nature. A descriptive research demonstrates a situation, problem, services provided to people, preferences of people, living condition of a community and attitudes of a community towards an issue (Kumar, 2008). Descriptive studies answer questions like, ´what, ´when, ´where, and ´how,. A co-relation research is focused to find a relationship among different aspects of a situation. To answer the objectives and research questions for this research work demanded both qualitative and as well as quantitative data collection with dominating contribution of the qualitative research approach. To know the people´s perceptions and preferences about the usage of existing energy resources and about their impacts on health and livelihood, qualitative research paradigm was followed, but to assess the some features like economic status of the respondents, quantitative evaluation were made.

Qualitative research approach suitability is largely depend on the nature of the social phenomena to be explored (Morgan and Smircich, 1980). It is believed that human behaviours are the products of the historical events and cultural values, so it is easy to understand them in light of the meanings attached to them by the humans themselves (Guba and Lincoln, 1985). Qualitative research is a process in which the reality (finding) is created (not discovered) through an interaction between researcher and the respondents (Guba and Lincoln, 1989). Qualitative research aims to develop a deep understanding of a phenomena (Johnson, 1995) and constructivism is the facilitator of qualitative research approach in this regard (Golafshani, 2003). Qualitative research cannot be tested through conventional testing measures, but quality of this research can be tested, as a good quality research will help to understand a situation that would otherwise be confusing (Eisner, 1991). Another important criteria to test the reliability and validity of qualitative research is closely related with the ability of its results to be generalized (Golafshani, 2003).

5.2 Universe Of Study

Abbottabad District of KP (Khyber Pukhtunkhwa) consists of two Tehsils, Abbottabad and Havelian. There are 51 Union Councils in the District Abbottabad. The District is located from

33°49' and 34° 22' North latitudes and 72°55' and 73° 31' East longitudes, with an area of 760.2 sq. ml (1,969 km^2). Its population of about 881,000 people with about 440,718 males and 439,948 females (ERRA, 2007 and District census report of Abbottabad, 2011). The average household size is 6.5 persons both of rural and urban areas. Its annual growth rate is 2.4 % an literacy rate is 56.6% (ERRA, 2007 and District census report of Abbottabad, 2011). Hindko, Pastho, Urdu and Gojree are major languages used for communication. Major economic activities including, Agriculture, poultry, mining, tourism and some small earning activities like labor on daily wages, shop keeping and livestock rearing. In Abbottabad District, Housing units having electricity about 74.98% and only 17.88% housing units having gas for cooking (District census report of Abbottabad, 2011). Abbottabad has a humid subtropical climate with mild to warm temperatures during the spring and autumn months, humid temperatures during June and July and cool to mild temperatures during the winter. The temperature can rise as high as 35°C (95 °F) during the mid-summer months and drop below 0 °C (32 °F) during the winter months. Snowfall usually start in december and January, and last at of the mid of the March. The months of December, January and February are extremely cold. Monsoon season (rainy season) stretching from July to September and frequently causes flooding as we experienced in the last two years.

5.2.1 General Socio-Economic and Cultural Trends in Study Villages

Hinko is the 1st language of the study villages followed by Urdu and people also had a good knowledge of Pashto language. Awan, Syed, Mughal, Juddon, Gujar and Malik are the major castes of the area. Religious institutions are strong and greatly influence the decision making process both at HH and community level. Traditional dress of the study area is Shalwar (loose trousers), Kameez (Long Shirt) and elders of the area keep turban on the head. Women use shawl and dopatta in addition to shalwar and kameez. Males are responsible to do job for earning in order to sustain the livelihoods and females are busy inside their houses in activities like cooking, cleanliness, child rearing, wood and water collection, animal rearing and also in agricultural activities. People mostly depend on farming and labour to earn their livelihood, some are also working overseas and very few are government employers. There are a few health and education facilities available to local people. The health conditions in the research area were really worse. There is only one Basic Health Unit (BHU) in the whole Union Council Kakul but unfortunately that is also remain closed because there is no single doctor available to run that Unit. Flu, cold fever and diarrhea are some of the common diseases of the area. Education facilities in the study area are also very poor, children have to walk several kilometers to attend the school. For this reason people do not send their daughter to

attend the school but they showed consent to allow their daughters and sisters to attend school if the facilities are available in their own village.

5.2.2 Agriculture

Agriculture land is very small and scattered, per land holding is also very small in Abbottabad District. But overall land is fertile and enriched by natural major/minor nutrient elements. Land use pattern of Abbottabad District is as under in Table 5.1

Table 5.1: Agricultural Land Use Pattern of Abbottabad District

Sr. No.	Land Utilization Status	Area in Acres
1	Total area	178,401
2	Cultivated area	63,372
	i Net sown area	52,472
	ii Current fallow	10,900
3	Cropped area	61,369
4	Area sown more than once	8,924
5	Un-cultivated area	115,029
	i Waste area	12,586
	ii Forest area	83,201
	iii Not available for cultivation	19,242

Source: ERRA District Abbottabad profile, 2007.

Two major crops, maize and wheat are cultivated everywhere in the district and also in the Village of Kakul and Balolia. The cultivated lands and as well as agricultural production are more in Kakul village as comapared to the Balolia Village. Balolia Village has more hilly area instead of cultivated lands. Some other crops like rice, maize, bajra and barley also sown to some extent. Detail of area, production and yield of some major crops grown in the district is as under in Table 5.2

Table 5.2: Average Production and Yield of Major Crops in Abbottabad District

Sr. No.	Name of Crop	Area (Hectare)	Production in (M/ Ton)	Per Acre Yield in (Kg)
1	Wheat	15,638	19,591	1,253
2	Maize	35,278	39,372	1,116
3	Rice	23	28.7	1,248
4	Jawar	39	34	872
5	Bajra	6	3	500
6	Barley	679	605	891

Source: ERRA District Abbottabad profile, 2007.

5.2.3 Forestry

The Abbottabad land is mostly steep, rocky, rugged and partly covered with various type of vegetation. These forests consist of conifer and broad leaved trees. The most common conifer species are pine, kail, deodar and fir. Spruce and broad leaved species includes horse chest nuts, walnut, maple, oak, acacia and dodonea, viscoss (santha) etc. Area under forest in Abbottabad District is given in the Table 5.3

Table 5.3: Forest Land Use Pattern of Abbottabad District

Sr. No.	Particulars of Forest	Area (Acres)
1	Reserve forests	38,444
2	Guzara forest	89,853
3	Miscellaneous	7,277

Source: ERRA District Abbottabad profile, 2007.

Pepole can use guzara land, free of charge, for their own domestic and agricultural requirements, any trees and forest produce found in these guzara forests and wastelands, but they shall have no right no power to sell any tree, timber, brushwood or any other forest produce growing on such lands, except with the permission of the Conservator of forest (The North West Frontier Province Forest Ordinance, 2002). The forest department has allowed to all the residents to collect dry fallen wood from the protected forest which should not be greater than 15 cm at thicker end for domestic use as concession. Therefore, in the guise of this concession, the local people not only collect the dry fallen wood but also destroy the natural forest by cutting green branches and felling of green trees to meet their domestic winter fuelwood requirement.

5.2.4 Livestock

Livestock population of Abbottabad District is as under in Table 5.4

Table 5.4: Livestock Population Abbottabad District

Sr. No.	Livestock	Number
1	Cattle	115,805
2	Buffalo	133,463
3	Sheep	32,217
4	Goat	222,472
5	Camel	24
6	Horse	8,661
7	Mule	11,991
8	Ass	37,378
9	Domestic poultry	622,649

Source: ERRA District Abbottabad profile, 2007.

Farmers have small land holdings especially in village Balolia as compare to Kakul. Each family rare livestock to meet its daily needs in milk and occasionally meat. The livestock owned are mainly cows, buffaloes, goat and horses. They also use these animals for agricultural purposes. Animal dung also use as a fertilizer. Some people in Village Kakul rears buffaloes and use them as a source of income by selling their milk and milk products. The average number of livestock per household is very low in village Balolia. It was noted that almost all the families have one or more livestock species in both villages.

5.2.5 Health & Educational facilities in District Abbottabad

Health & Educational facilities in District Abbottabad is as under in table 5.5

Table 5.5: Health Centres in Abbottabad District

Sr. No.	Health Centre	Number
1	Civil Hospital, Male and Female	6
2	Rural Health Centres	4
3	Basic Health Centres	49
4	Civil Dispensaries	32
5	Maternity Care Health Centre	1
6	Sub Health Centre	1
7	District Headquarter Hospital	1
8	Women and Children Hospital	1
9	Ayub Medical Complex	1
10	Cantonment Hospital	1
11	T.B. Hospital	1
12	Nawaz Sharif Dispensaries	10

Source: ERRA District Abbottabad profile, 2007.

There is no a single health unit in Balolia village. People usually travel toward Abbottabad city for their medical treatment. They do not have easy access to all health centres those are mentioned in table 5.5. The Kakul village has a basic health centre but the people said that there is no doctor in this health centre. They said that, usually security guard of this health centre gives medicine to the people.

Table 5.6: Educational Institutions in Abbottabad District

Table 5.6: Educational Institutions in Abbottabad District

Sr. No.	Educational Institution	Boys	Girls	Co-Education
1	Ayub Medical College	-		1
2	Govt Post Graduate College	1	-	-
3	Colleges	5	1	-
4	Higher Secondary Community infrastructure s	7	3	-
5	High Community infrastructure	62	24	-
6	Middle Community infrastructure	68	40	-
7	Primary Community infrastructure	523	455	-
8	Mosque Community infrastructure	405	-	-
9	Maktab Community infrastructure	14	-	-
10	JICA Model Community infrastructure	1	1	-
11	Community Model Community infrastructure	-	4	-

Source: ERRA District Abbottabad profile, 2007.

There is only one primary school in Balolia village. Children travel 3 to 4 km for their Primary education. They do not have any high school or college in this area. Boys and girls go in Abbottabad city for their secondary and higher secondary education. There is a primary and high school in the village of Kakul. There is also a private school in the village of Kakul.

This study was conducted in two villages, Kakul and Balolia of Union Council (UC) Kakul in District Abbottabad. Kakul is situated in the Kakul valley, 5 km northeast of Abbottabad city, in KP Province of Pakistan. It is a UC extending at about 10061 Acre with population of about 17,411.

The information about population, area, number and structure of the houses in the study villages is given in Table 5.7

Table 5.7: The information about population, area, number and structure of the houses in the study villages

Village	Population			Household Structure			
	male	female	Total	Cemented	Semi-cemented	Kacha/ mud	Total
Kakul	2831	2768	5599	433	213	235	881
Balolia	1313	1241	2554	179	42	182	403

Source: National Reconstruction Information Management System, 2006

Total number of houses in the village of Kakul and Balolia are 881 and 403 respectively. The population of Kakul village is almost double as compared to the Balolia village.

MAP OF THE STUDY AREA

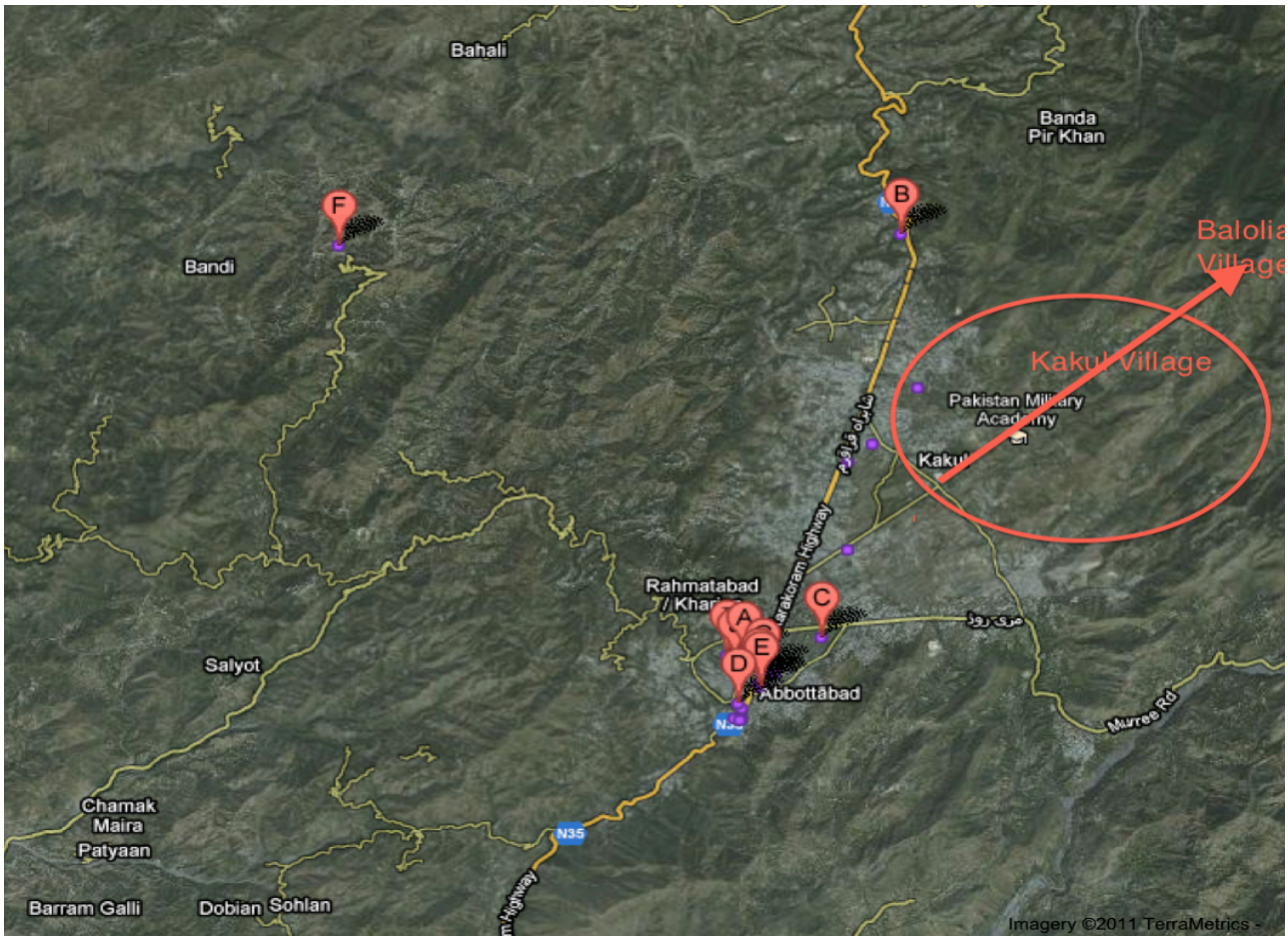


Fig 5.1: Map of the study area

5.2.6 Energy Situation in the Study Villages, Abbottabad

Energy situation in the village Balolia is more worse than Kakul village. In Balolia, people used firewood and dung cake for cooking, heating and boiling. They collect firewood from Govt. forest which is very far away from their homes. Mostly, they spend a whole day for firewood collection. Women, children, boys, girls and men are collected firewood, but especially women and boys are engaged in firewood collection. Balolia village is not facilitated by gas supply and there is no possibility of facilitation by gas in the near future. Electricity supply is also limited, not provided in the whole Balolia village. Load shedding is also a big problem (almost 16 hours a day in summer) in this village Balolia due to energy shortfall in Pakistan. The Kakul village (second study village) is facilitated by gas. Almost, 80% Kakul village has gas facilities for cooking. Energy situation is

better in Kakul village than Balolia. They use gas for heating and cooking purpose. Livelihood conditions are better in Kakul village than Balolia due to better energy situation.

5.2.7 Political System (Decision Making/Conflict Resolution)

In the local government system of Pakistan (from 2001-2009), the Union Council was administrated by the Union Council Nazim (administrative head) and assisted by Naib Nazim (Deputy administrative head). The administrative head monitored all the activities taking place at Union Council level like development and rehabilitation. Conflict resolution was also settled by the intervention of Nazim through a re conciliating body of elders (Masaliati Jirga). Masaliati Jirga consisting of the elected members of the Union Council and local elders. The current government of Pakistan has resolved this local government system. Meanwhile, the Masaliati Jirga controlled by the local elders, is a strong source of decision making.

5.3 CHOOSING STUDY POPULATION

We have selected two main villages, Kakul and Balolia. Both of these villages also contain several sub-villages. These villages had similarities in their socio-cultural conditions. These villages were selected on the basis of following characteristics.

5.3.1 Accessibility

The villages were selected for study on the basis of accessibility. So, as to avoid wastage of time to approach there as there was no possibility to stay there or anywhere near to carry out the research work.

5.3.2 Energy and Economic Situation of the Study Villages

While selecting study villages, the energy situation of the villages was taking into consideration. These two study villages were selected on the basis of gas availability. The Kakul village was facilitated by gas supply while Balolia village was deprived from this Gas facility. The main purpose behind this selection criteria was to made a better comparison of socio-economic, health and indoor environmental conditions of two villages. While selecting study villages, economic conditions of the people were also considered. The Kakul village represents relatively more economically stable as compared to Balolia village. Small scale business like shop keeping, overseas employment, small scale agricultural activities, government employment and labor on daily wages are major sources to earn livelihood in Kakul. While, Balolia village represents the most economically vulnerable area because majority of the people are labors depending upon daily

wages to sustain their livelihoods. It was tried to ensure that sample population must represent the large population by selecting villages with comparatively large population size, inhabitants belonging to different castes representing all castes of the area, people belonging to different occupations and education level.

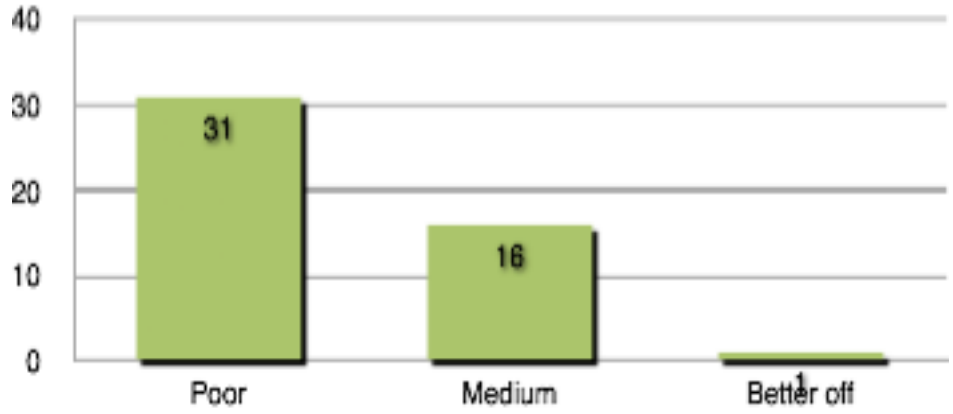


Fig 5.2: Household Wealth Ranking of the rural people of Balolia Village

The above figure shows the household wealth ranking of study population. It clearly shows that most of the people are very poor whose monthly incom is less than 8000 Rs and they live in Kacha house (not cementd). People whose income rage is 8000 to 20000 Rs comes under medium and those whose incom is more than 20,000 Rs per month comes under better off.

5.4 SAMPLE UNIT

Households (HH) of the villages were selected as unit of analysis and household heads (HHH) as well as family members men, women, young girls and boys as respondents. The maximum interviews were conducted to women (who are responsible for cooking) and household heads (HHH). Household heads (HHH) play significant role in decision making towards adoption or rejection of certain interventions at household level.

5.5 SAMPLING AND SAMLPE SIZE

In two study village 150 HH were the main focus of our research, 75 HH selected from each of the village to collect representative information. Purposive sampling techniques was used to select these HH as the study population. The household list that obtained from Union Council Kakul Office was used as the sampling frame. Random sampling technique was employed for the selection of respondent HH. The HH interviews were conducted to women, men, young girls & boys. We had also collected some information from young children their views and perceptions about biomass

usage as a energy purpose. The approach to women and girls for HH interviews was the first priority of our research but due to social and cultural constraints, we faced several problems in data collection. But, after having achieved a saturation level of similar responses from respondents and some social and cultural constraints to personally approach the females respondents, a total of 55 male respondents were interviewed including key informants (Imam masjid, Nazim, elders of the community etc) and 65 females were interviewed. Along with the HH interviews, there focus group discussions were also conducted in the study villages.

Several structured and semi-structured interviews were also conducted from the different departments, Agencies and NGOs who are working in the area and some of them are also working on energy issues, which are listed below

• Forest Department District Abbottabad
•WAPDA (Water and Power Development Authority)
• Sui Northern Gas Department Abbottabad
•Nazim and Naib Nazim U/C Kakul
•WWF (NGOs)
•Sungi Foundation Abbottabad
•Environmental Protection Agency Abbottabad

5.6 DATA COLLECTION

Primary data was gathered directly from the respondents in the field. Several techniques as mentioned below were used to collect the required data.

5.6.1 Transact Walks and Personal Observations

Transact walks of the study villages with the individuals of the community and in alone enabled me to observe personally the living conditions of the people, education and awareness level, energy practices practiced for cooking, heating and lighting, main source of income of local people, available facilities like health centers and schools. A systemic walk with the local of the area observed, asked, listened and discussed the resources is very helpful in observing the problems faced by the people, solution sought for them, and opportunities available (chambers, 1997). Daily activities of the study population were also observed, so as to know the time at which respondents can be approached for data collection without disturbing their routine activities.

5.6.2 Interview Schedule for Male and Female Respondents

To gather primary data from key respondents, separate interview schedule were designed for government officials, NGOs and for the community key respondents according to the study objectives. HH interview schedule designed for community aimed to address seven major aspects; demographic character (household head, gender, age, profession, caste) of respondent, socio-economic condition of the people, existing energy resources, indoor household conditions, ventilation system, willingness for replacement of existing energy resources with alternative energy resources and health issues faced by community. Local language like Urdu and Hindko were used to ask the question for the ease of community. Local people speak Hindko, so, I faced some problem but not too much in interacting with the respondents. This language problem was tackled by the assistance of COMSAT University. Research Associate in COMSAT University Iftikhar Zaib was helped me in data collection.

The interview schedule comprised of both open ended as well as closed ended questions, and the interview schedule questions were continuously redesigned throughout the research work so as to incorporate the deficiencies. The interviews from female respondents were conducted by the female MS (Master of Science) student of COMSAT University Abbottabad because the local culture did not allow me to direct interact with female respondents.

5.6.3 Focus Group Discussion

Two focus group discussions with the male members of the community and one focus group discussion with female members of the community were also arranged so as to know their perceptions and preferences about existing energy resources (biomass/firewood), and their knowledge about socio-economic, health and indoor environmental impacts of firewood usage on rural people and their livelihood and what could be the best alternative energy resources of this area. Almost, 15-20 people attended these focus group discussions depending on the availability of the people. Two focus group discussions were held in Kakul village and one in Balolia. Generally the agenda of FGD in Kakul village was to share the fuelwood usage problems faced by men, women,girls, boys and children before the provision of gas supply in the village by government of Pakistan and what differences the gas supply has made at the household & village level.

Secondary data especially about the total population of the study villages, total numbers of HH, major castes of the area, occupations, major crops cultivated, basic health units, primary and

secondary schools, total forest area, future plan of the WAPDA and Sui Northern Gas Department was taken from the concerned offices and governments Census report.

5.7 PROBLEM FACED

The most important problem faced during the study was approaching the community. The road was very dangerous and population scattered. Approaching to respondents in the study area was very time consuming. In village Balolia, people did work on daily wages, so they moved away from their houses early morning and came back to their homes at evening.

Writing field notes was also appearing as a problem. Most of the respondents felt heasitation in sharing information with me, when they saw that I am writing their views. This problem was more significant in women as comppared to men. Women did not allow us to take their photographs. Some of the respondents thought that we (I and COMSAT students) came from the Government Department like Banzir Income Support Program.

6. RESULTS AND DISCUSSIONS

6.1 HOUSEHOLD ENERGY TYPES AND USAGE IN BALOLIA VILLAGE

A Table 6.1 .shows that fuelwood (FW), dung cake (DC), crop residues (CR), dilli (D), kerosene (K), candle (C), emergency lights (EL), LPG gas (LPG), and electricity (EC) were identified as the main household energy sources used in the Balolia village.

Table 6.1: Household Energy Types in the Village Balolia, Abbottabad

Energy Types	Acronyms	Uses	Sources
Fuelwood	FW	Cooking & Heating	Forest trees
Dung Cake	DC	Cooking & Heating	Animal
Crop Residues	CR	Cooking	Agriculture
Dilli	D	Lighting	Forest trees
Kerosene	K	Lighting	Fossil fuel
Candle	C	Lighting	Market
Emergency Lights	EL	Lighting	Markets
LPG Gas	LPG	Cooking, Boiling & Lighting	Fossil fuel
Electricity	EC	Lighting, Running electrical appliances	Centralized power station

Source: Own Study Survey, 2011

6.1.1 PREFERENCE OF USE OF ENERGY TYPES BY RURAL MEN & WOMEN

Generally, preferences of use of existing energy sources for cooking and heating, observed that fuelwood as the most preferred and frequently used energy source for cooking and heating in Balolia village. Dung Cake was also used to supplement firewood, and used mostly for boiling of water (for washing & bathing) and for preparing food for animals. Therefore, estimated that almost

(68.3%) of the women respondents showed their preference for fuelwood and only (31.7%) study population showed their preference for fuelwood and dung cake combined usage for cooking and heating. They showed more preference for fuelwood over dung cake because they said dung cake produce bad smells and heavy smoke and also considered to be a fuel for the poor. Female respondents also showed their preference for fuelwood usage for cooking and heating and had less preference for dung cake. When I asked to female respondents why you do not prefer dung cake for cooking, they said it was because making dung cake is a hard and tough job for women and secondly, the usage of dung cake not only produces the big smoke but also increases the work load for women in the form of house and utensils cleaning. Electricity play also a major contribution to fulfill their basic household energy demands. Generally, they used electricity for lighting but they also used kerosene and candles for domestic lighting during the load shedding period, load shedding is a big problem now a days in Pakistan due to energy shortfall in the country.

The more frequent and preferable use of fuelwood as a energy resource describes the reasons for gradual and steady degradation of the mountain forest resources in and around the research area. The increase in population of the study area and its characteristic, energy poverty and the severe cold winter that needs substantial domestic heating, force its population to create a heavy pressure on the natural forest resources of the area. Cutting of fuelwood for energy purpose from the surrounding forest is a major source of forest degradation and this degradation is ultimately contributing to high lost of biodiversity and their habitats.

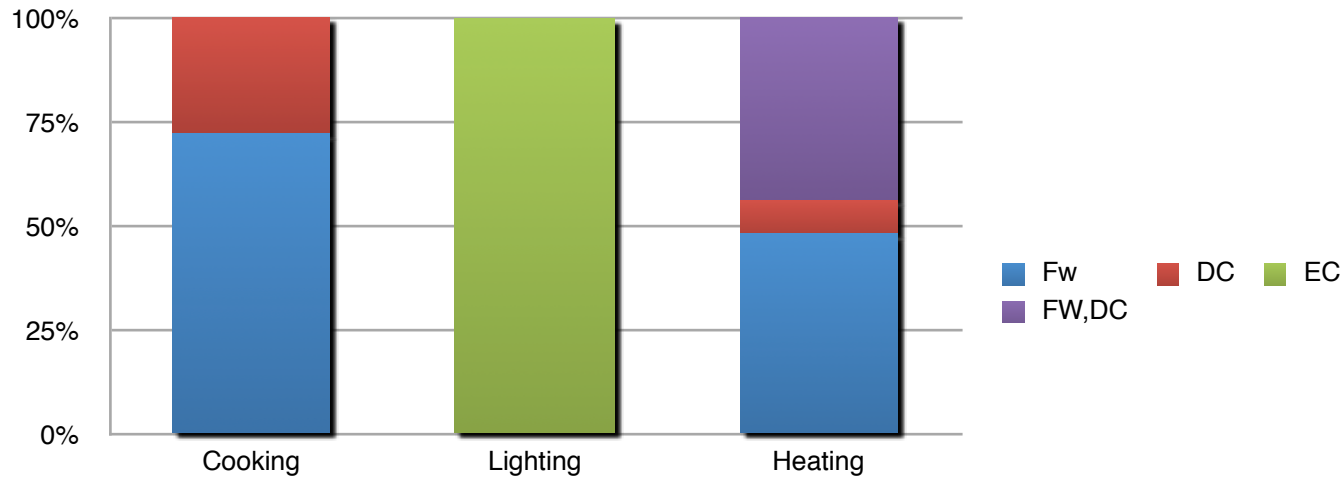


Figure 6.1: Rural women preferences for existing energy resources Balolia village

6.2 TYPE OF ENERGY USED FOR COOKING IN VILLAGE BALOLIA

At the time of this study, from December 2010 to March 2011, there was no gas facility in Balolia village and fuelwood was the main energy source for cooking . Fuelwood and dung cake ranked the highest for Balolia village as the main source of cooking energy. Gas (LPG) cylinder was also used to supplement firewood, and LPG only used mostly for quick cooking tasks like making tea for guests, making breakfast for children and also used during the Holy month Ramzan. Therefore, Kerosene was not used for cooking purpose because of the high prices of the petroleum products. People are very poor and they cannot afford the use of the kerosene oil for cooking purpose. When I asked why people did not use kerosene or electricity for cooking , they answered it was because electricity and kerosene prices are very high and they do not have enough capacity to use these energy resources for cooking. Another reason, more risk involve in kerosene and electricity usage for cooking was also mentioned by some respondents. When I asked to study population why people prefer to use firewood and dung cake for cooking, they answered it was because of the two main reasons, first they had no alternative option and second reason was that they had easy access to forests and dung cake. Therefore, they considered firewood and dung cake as a cheaper source of energy for cooking because they get firewood and dung cake with low cost or even free of cost. Majority of the study population involved in Agricultural as well as animal rearing activities at household level. So, they used animal dung for making dung cake for cooking energy. Dung cake was also sold by some people and especially women were involved in such type of activity at local level. The respondents showed more preference for firewood over dung cake usage because dung cake produce bad smells and heavy smoke inside the kitchen. The more commonly used energy sources for cooking in the study area are fuelwood (Pinus wallichiana & Quercus), dung cake, crop residues, cobs (after removing seeds) and LPG gas cylinder.

Table 6.2: Main type of energy used for cooking by house hold in Balolia, Abbottabad 2011.

Fuel Used	Household respondents N=60	Percentage %
Firewood and dung cake	40	66.7
Firewood and dung cake &LPG	8	13.3
Firewood only	10	16.7
Firewood and LPG gas	2	3.3
Dung cake only	0	0
Gas LPG only	0	0

Source: Own study survey, 2011

6.3 TYPE OF ENERGY USED FOR LIGHTING AND HEATING IN VILLAGE BALOLIA,

Electricity is the primary source of energy used for lighting in the study area and fuelwood is the main energy type used for HH substantial heating during the winter season. The stored the fuelwood before the winter start used it for heating purpose during the peak winter season. They did not use dung cake for heating purpose because they said dung cake produce heavy smoke and bad smell inside the room durning process, so they preferred fuelwood for heating purpose. Electric heater was also not used for heating purpose because of high cost of electricity which is not affordable for the rural people. The main energy source for domestic lighting in the study village is electricity followed by kerosene, candle, emergency lights and dilli (small piece of wood). Dilli is a small piece of wood, making by cutting the small branches or tree bark of tree Pinus wallichiana. We observed that rural people of the study area used this piece of wood (dilli) for lighting purpose. Therefore, where dilli gives good light to perform HH functions but also emit big smoke.

6.4 COOKING UNITS IN HOUSEHOLDS

Cooking is done largely by women inside the rooms, corridors of rooming apartment, outside in open air and in kitchen detached from the main house. Cooking inside the room is a major practice in the study village of Balolia. Therefor, most of the households (81.7 %) cooked inside the room/ house and only (18.3%) households used separate kitchen for cooking. Out of total study population, 53.3 % households did not have separate kitchen and only 36.7% enjoyed with separate kitchen in their houses. It was very strange that household had separate kitchen but they did not use it for cooking and especially in winter. When I asked to the respondents why you do not use your separate kitchen for cooking purpose as you have this separate kitchen facility, they said it was because we could not afford the separate heating system, so we preferred cooking inside the room (especially in winter) which perform dual function like cooking as well as heating. They also told that this practice also reduce the HH expenditure for energy especially in winter by reducing the demand of fuelwood for domestic heating purpose. I also observed that most of the women had very good knowledge about the health implications of IAP (indoor air pollution) but their poverty insisted them to cook inside the house to control their HH energy expenses.

Children around the stove with their mother

6.5 TYPE OF STOVES USED AT HOUSEHOLD LEVEL

During the field work, it has been observed that most popular stove used for cooking is still traditional stove (called Chulhas in local language). Traditional stove has an efficiency 5 to 10% and also very hazardous to health because of its much smoke emissions and low thermal efficiency (Singh S., & Bajpai U., 2010). It has been found that 83.3% of respondents used traditional stove (mud stove) and only 16.7% of HH used Iron stove (Improved stove) for cooking purpose. Traditional stove is easy to made because no special material or skill is required to make this mud stove. Local women were self-sufficient in making this mud stove at HH level. They mostly made these stoves in a kitchen or in a common sitting room for cooking. Generally, two types of traditional stoves (fixed & moveable) were found in the study area. Improved Iron stoves were also used by some people. It has good chimney system to remove smoke from the room or kitchen. I had investigated from the respondents, the pros and cons of traditional and Impoved stoves which are listed below.

Table 6.3 Pros and Cons of Traditional & Imroved Iron stoves

Traditional stove	Improved Iron stove
✦easy to make but required large quantity of wood	✦fuel efficient stove and also reduce cooking time
✦In the access to every one but require long time for wood collection	✦reduce burden of work on women
✦ required long time for cooking	✦saved much time for fuel collection
✦suitable for winter season but smoke damage our health & home and we have to clean house several times in a month	✦saving forest and jungle
✦ more smoke	✦ less smoke in room & kitchen

Source: Own made

Some NGOs like WWF and SUNGI Foundation had done few small projects on fuel efficient stoves in District Abbottabad and Muree. WWF had distributed fuel efficient stoves in Nathia Galli (Muree). During my field work, personally, I had visited Nathia Galli. We had made a contact with WWF local office in Nathia Galli and visited in some houses with WWF field officer in Nathia Galli where WWF had delivered fuel efficient stoves. I found that benefited people were very satisfied with fuel efficient stoves provided by WWF. These stoves are accessible to poor people because their cost is not to much as the local people assumed.

UN-HABITAT with the collaboration of SUNGI Foundation had also launched a 2 days training programme in June 2010, for making efficient mud stove for fuel efficiency and smoke reduction by using local materials with new techniques in District Abbottabad. Training have been imparted in ten villages, total 98 participants had participated in which 86 were women and 12 were men. UN-HABITAT & SUNGI Foundation has made a comparison showed in table 6.4, between fuel efficient and traditional stoves in terms of time and timber requirement for cooking activities.

Table 6.4 : Field Testing of FES and Traditional Stove in District Abbottabad

Timber Consumption in Traditional Stove (per day)	Timber Consumption in FES (per day)	Cooking Time with Traditional Stove	Cooking Time with FES Stove	Remarks
B.Fast : 6 kg	B.Fast : 3 kg	B.Fast: 1:30 hrs	B.Fast: 45 mins	Reduced Smoke and Reduced Carbon/ In case of wind, smoke comes inside
Lunch: 7 kg	Lunch: 4 kg	Lunch: 2:30 hrs	Lunch: 1:30 hrs	
Dinner : 9 kg	Dinner : 4 kg	Dinner:3:15 hrs	Dinner:2:00 hrs	
Total: 22 kg	Total: 11 kg	Total Hrs: 7:15	Total Hrs: 4:15	

Source: UN-HABITAT & SUNGI Foundation Training programe for making mud stove in Abbottabad, 2010

Fuel Efficient Stove

Traditional stove

6.6 FUELWOOD COLLECTION SOURCE

The study revealed that fuelwood collection source is mainly from protected forest (state owened) followed by own land, Guzara, waste land and from wood market. “Government may declare any forest land or wasteland which is not included in the reserved forest, but which is the property of government or even which government has property rights, or to the whole or any part of the forest produce of which government is entitled, a protected forest” (The North West Frontier Province Forest Ordinance, 2002).

Guzara is a area, set aside at the time of settlement to meet the local people requirements but now, this area is not sufficient as compared to meet the fuel requirements as compared to the population which increased manifold. In 1918, the forest were opened for grazing, grass cutting and collection of dry fallen wood for sale and domestic requirements. In 1921, the concession of dry fallen wood for sale was removed in order to stop the illegal felling of green trees for fuel (Project Procurement International, 2011) Pepole can use guzara land, free of charge, for their own domestic and agricultural requirements, any trees and forest produce found in these guzara forests and wastelands, but they shall have no right no power to sell any tree, timber, brushwood or any other forest produce growing on such lands, except with the permission of the Conservator of forest (The North West Frontier Province Forest Ordinance, 2002).

It has been recorded that 91.7% of the respondent households collected fuelwood from the state owened forest to fulfill their domestic energy needs. They collect mostly dead wood, either on the ground or from the trees because government not allowed to carry fresh wood. The forest department has allowed to all the residents to collect dry fallen wood which should not be greater than 15 cm at thicker end for domestic use as concession. Therefore, in the guise of this concession, the local people not only collect the dry fallen wood but also destroy the natural forest by cutting green branches and felling of green trees to meet their domestic winter fuelwood requirement. The fuelwood demands of the people are very large and always on the increase. Therefore, Guzaras and waste lands in the villages are not enough to meet these domestic fuelwood requirements. So, pressre of growing demands of an increasing population has exerted to the reserved forests, which is also a major cause of deforestation in the study area Abbottabad. Forests in Abbottabad cover almost 20 % of the total area of the District (Wiederaufbau, K.F., 2000) and account for 5.4% of the province´s forest resources. It has also found that some people collect fuelwood from their own small Agricultural lands near their houses. Mostly, they used trees grown on the bank of their farm lands for fodder and fuelwood purposes. Wood market is also a source of fuelwood, some people purchased fuelwood to meet their commercial as well as domestic energy needs. Local People

purchased the wood from wood seller or from wood market, they paid very high cost for fuelwood, almost 200 Rs per 40 kg of wood. The cost depends on the dryness or wetness of the fuelwood, dry wood is more expensive than the wet wood.

6.7 MOST UTILISED SPECIES FOR FUELWOOD

Undoubtly, the most utilised fuelwood specie was Pinus wallichians, accounting for 93% of the responses followed by Quercus, Acacia, Dalbergio sisso, Salix, White & Black Mulberry and Abies Pindrow etc. Women and men mostly collect Pinus wallichiana and Quercus for number of reasons. They collect mostly dead wood, either on the ground or from the trees because fresh wood is heavier and difficult to carry over long distances. Pinus wallichiana and Quercus produce more dead wood. To some extent, they also used shrubs (local species) and grasses as a fuel energy. Local people preference for fuelwood also varies from specie to specie. W had observed that the local people used different criteria for choosing the best fuelwood specie, They used following criteria for the best fuelwood selection like less smokey, high heat value, free and easy availability, burn even in fresh condition, gets dry soon, prolong and continuous flame and should be light in weight.

District Abbottabad has various kinds of herbs, shrubs, weeds, flowers and trees. Most common of them are, Dhaman Persian lilac, hiltoon, holly, spindle wood, jujube, maple, Indian horse chestnut, sumach, pistachio, Shisham, Siris, Peach, apricot, bird cherry, wild pear, way faring tree, rhododeudron, European date palm, ash, wild olive, box, tallo tree, jarga leaved elm, Nethla tree, mulberry, fig, chinar, walnut, oak,hazal, willow, poplar, yew, pine, deodar, Himalayan spruce, Himalayan silver and fir are found in the district Abbottabad (Project Procurement International, 2011).

Table 6.5: Most Common Species Used as a Fuelwood Energy in Abbottabad Region

Botanical Name	Family	Habit	Local Use
Viburnum cotinifolium D.Don	Caprifoliaceae	Shrub	Fruit, fuel wood
Diospyros lotus L.	Ebenaceae	Tree	Fuel wood, fruit, fodder
Elaegnus parviflora Wall. ex Royle	Elagnaceae	Shrub	Fuel wood, fruit
Acacia modesta Wall	Mimosaceae	Tree	Fuel wood, Fodder, medicine
Dalbergia sissoo Roxb.	Papilionaceae	Tree	Fuel wood, fodder
Desmodium elegans D.C.	Papilionaceae	Shrub	Fodder, fuel wood.
Abies pindrow Royle	Pinaceae	Tree	Timber, Fuel wood
Pinus wallichiana A.B.Jackson	Pinaceae	Tree	Timber, fuel wood, torch wood

Botanical Name	Family	Habit	Local Use
Picea smithiana (Wall) Boiss.	Pinaceae	Tree	Timber, firewood
Prunus domestica L	Rosaceae	Tree	Fruit, fodder, fuel wood
Populas ciliata Wall	Salicaceae	Tree	Fuel wood, fodder, shelters for tobaco drying
Salix tetrasperma Roxb.	Salicaceae	Tree	Fuel wood, medicine, smoke pipes
Quercus baloot Griffith	Fagaceae	Tree	Tools, fuel wood, seed

Source: Project Procurement International, (2011)

6.8 FUELWOOD REQUIREMENTS FOR DOMESTIC CONSUMPTION

It has been recorded that the average weight of fuelwood stored between mid june and mid septemberis 2,385 kg per household (Environment and NRM assessment report, World Vision Pakistan, 2011). Fuelwood requirements for households varie from season to season. During the summer, each household uses an average of 19.8 kg of wood per day. In winter, the average is of 42.2 kg per day (Environment and NRM assessment report, World Vision Pakistan, 2011). Baesd on these results and on the basis of 150 winter days and 215 summer days per year, we have calculated the fuelwood requirements per household for a day, month and for the whole year. We have also calculated the yearly fuelwood requirements of study village Balolia.

Table 6.6 : Per Household Requirements of Fuelwood, In Study Village Balolia, Abbottabad

Season	Fuelwood Req. Per Day (kg)	Fuelwood Req. Per Month (kg)	Fuelwood Req. Per Year (kg)
Summer	19.6	588	4214
Winter	42.2	1266	6330

Source: Own made

The above table shows that In winter season HH requirements of fuelwood are more as compaered to the summer season. The HH fuelwood demand for domestic energy purpose becomes doubles during winter season because of more consumption for heating purpo**se.**

Table 6.7 : Per Household Requirements of Fuelwood for Traditional & FES Stoves

Stove	Fuelwood Req. Per Day (kg)	Fuelwood Req. Per Month (kg)	Fuelwood Req. Per Year (kg)
Traditional Stove	22	660	4730
Fuel-efficient Stove	11	330	1650

Source: Own made

The above table clearly shows that the fuelwood requirement of traditional stoves for cooking activities are double as compared to fuel efficient stoves. Traditional stove consumes more wood and gives less efficiency and takes more time for cooking. On the contrast fuel efficient stove takes less time and as well as consumes less wood and gives more heat that also reduces cooking time.

Table 6.8 : Yearly Fuelwood Requirements of Study Village Balolia, Abbottabad

Village	Number of HH	Winter Consumption (150 days)		Summer Consumption (215 days)		Total Consumption (365 days)	
		Kg	Tonnes	Kg	Tonnes	Kg	Tonnes
Balolia	403	2,550,990	2550.99	1698242	1698.24	4249232	4249.2

Source: Own made

6.9 FAMILIAL RESPONSIBLITIES IN FUELWOOD COLLECTION

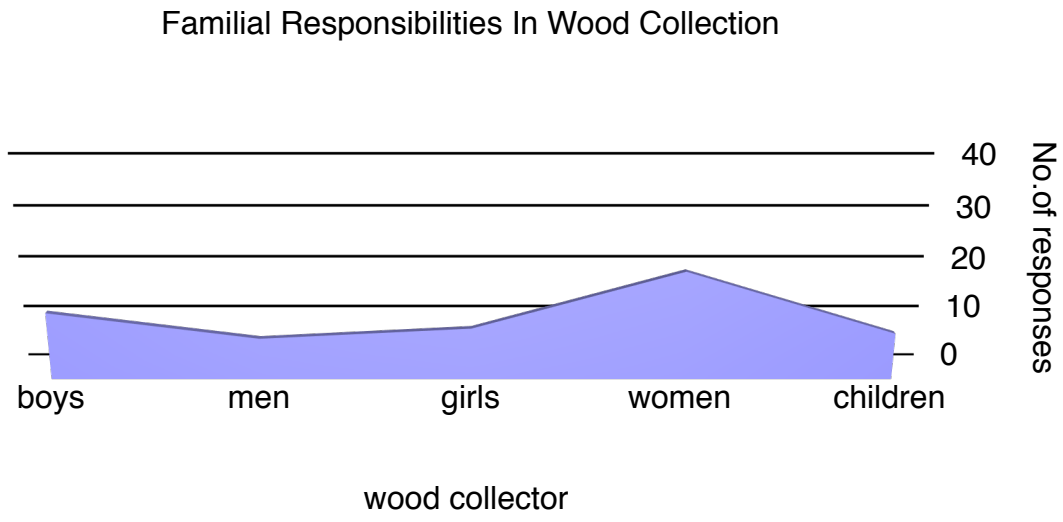


Figure 6.2: Familial Responsibilities In Fuelwood Collection

Fig 6.2 shows that women are main responsible for fuelwood collection followed by boys, girls, children and men.

They start collecting from their childhood age and continue well into their 60s and ocassionaly 70s. Therefore, women and boys whose age range from 15-30 years carry 25 to 30 kg of firewood on their heads. They also used donkey to carry fuelwood. It has been recorded that, almost 56 % of the fuelwood collection was done by women and boys. Therefore, overall women are main responsible and contributed 35% in fuelwood collection followed by young boys 21% and girls 17%. Children and men are also participated and their contribution in fuelwood collection was about 15% and 13% respectively. It was very strange for me, when I asked to female respondents, who is the main responsible for fuelwood collection, they said women are the main responsible for fuelwood collection because our male family members are engaged in economic activities. While, on the other hand, when I asked the same question to male respondents, most of them answered that men are responsible for fuelwood collection because our social culture does not allow our women to go outside for fuelwood collection.

Almost, 50% of the domestic fuelwood collection was conducted by female members while, over 36% of collection responsibility was done by male members of the households. Moreover, I also saw a number of cases in which over 60 years old women and men coming from fuelwood collection trip. The children in the village of Balolia start collecting fuelwood at their age of 10 to 12 years. The for away and difficult route of forests are considered not to be safe for the children undre the age 10. It has observed that 90% of fuelwood was collected and transported by women (Farrukh Hussain et al, 2006). Siddique et al (1990) stated that both male and female are responsible for fuelwood collection in Hazara Division Pakistan. Rural women in Asia including Pakistan play a significant role in the development of their family. The collection of fuelwood , fodder and transport of water are the major duties performed by the women in many parts of the Pakistan (Farrukh Hussain et al, 2006).

6.10 COST OF FUELWOOD COLLECTION TO HOUSEHOLDS

6.10.1 Opportunit Cost Of Fuelwood Collection

Loss of opportunity for other (economic, social & household) activities is a main cost of fuelwood collection that faced by the rural people. Almost, all respondents mentioned that fuelwood collection detracted from other activities. Therefore, some respondents did not consider wood collection as preventing engagement in other activities. The respondents described lot of activities that are affected by the wood collection. We have divided these activities into 5 general activity groups.

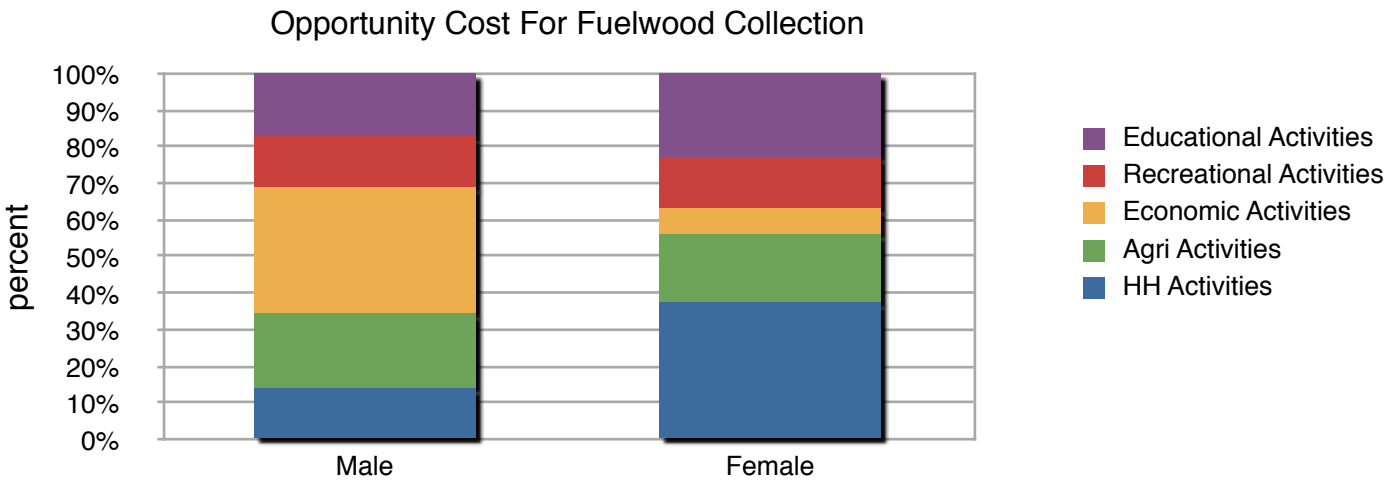


Figure 6.3: Opportunit Cost Of Fuelwood Collection

- ✦ Household activities (cooking, cleaning, washing and water collection)
- ✦ Agricultural activities
- ✦ Economic activities (labour, business, marketing)
- ✦ Rest & recreation activities (sports & social interaction)
- ✦ Educational activities

The main activities affected by fuelwood collection was presented in the ratio graph in Figure 6.3, to demonstrate an overview of activities affected. The graph clearly shows that the following two activities like household and economic, were the most affected activities by fuelwood collection. Therefore, 40% household activities and 22% educational activities of the female respondents affected by wood collection. Female Agricultural activities featured as the third most affectd activity while recreational activities comes fourth followed by economic activities for female. The female respondents stated that their household work burden become doubled due to fuelwood collection. Their cooking, house cleaning, washing and water collection household activities were really detracted and most of the times they do not able to manage all the activities. Due to more work burden female had less time for recreational as well as educational activities. Moreover, their less interest in income generation activities may be due to more work burden and less time availability. On the contrast, almost 34% economic activities and 20 % agricultural activities of the male affected by fuelwood collection activity. Male members are less engaged in household activities, so their HH activities affaected only 12 % and their educational activities noted as the third most affected activitiy followed by HH and recreational activities. So, overall, male responses emphasised economic activities while female responses emphasised household activities.

6.11.2 Time Cost Of Fuelwood Collection

Time cost of fuelwood collection was deived by getting the answer of following three questions

1. time served to collect wood from forest
2. how often do you collect wood / frequency of collection
3. how long one load of wood lasted

6.10.2.1 Time Served to Collect Fuelwood from Collection Area

Fuelwood collection times depends on the distance to the wood collection source and also on wood avalibiltiy.

Figure 6.4: Time spend for fuelwood collection

The above figure 6.4 demonstrated the time spend for fuelwood collection. It was very strange for me when I got answered from most of the respondents that they spent whole day for fuelwood collection. According to the figure 6.4 almost 60% of the respondent households served whole day for fuelwood collection from the surrounding forests. Therefore, 33% of the respondents mentioned that they spent 3 to 6 hours for wood collection and 10 responses also responded that they wasted 6 to 8 hours for fuelwood collection. So, majority of the respondents spent whole day for collection. They collect wood from the government owned forest which is approximatelly 4 to 7 km from the village centre. The route that goes to forest is very difficult and slopy, big stones in the way also creates problems in transportation of wood. Some of the respondents also mentioned that the scarcity of wood they travelled more distance in search of fuelwood. They preferred to collect wood from the dense forest because it takes less time in collection but on the other hand it also increases the fuelwood transportation time. The most significant reasons of wood scarcity mentioned by the respondents are forest degradation by timber mafia and increase in wood demand due to increased population and lack of planting trees.

Table 6.9: Distance traveled, time taken and weight of head loads

Distance travelled (km)	Time taken to & back (hours)	Weight of head load (kg)	Respondents %
1- 4	3 - 6	20 - 30	33%
4 - 6	6 - 8	20 - 25	7%
6 +	Whole day	15 - 20	60%

Source: own made

According to an estimation a daily average time of approximately 6 hours that is needed for the collection of biomass in Taktse. This is a time loss of rural community for recreation and education like reading and learning. The time cannot be used for education after the collection of biomass because people are too tired (Gang et al., 2008).

6.10.2.2 Fuelwood Collection Frequency Per Week

Frequencies of fuelwood collection were derived from the answers of following question " how often do you collect fuelwood per week"?.

The fuelwood collection frequency of 2 times per week was generally found among the respondents. It was recorded that 52% of the respondentss collected wood 2 times per week and 34% of the respondents experienced wood collection 3 times a week. Howeever, over 10% of the respondents collected fuelwood only once a week and less than 10% of the respondents colected more than 3 times per week.

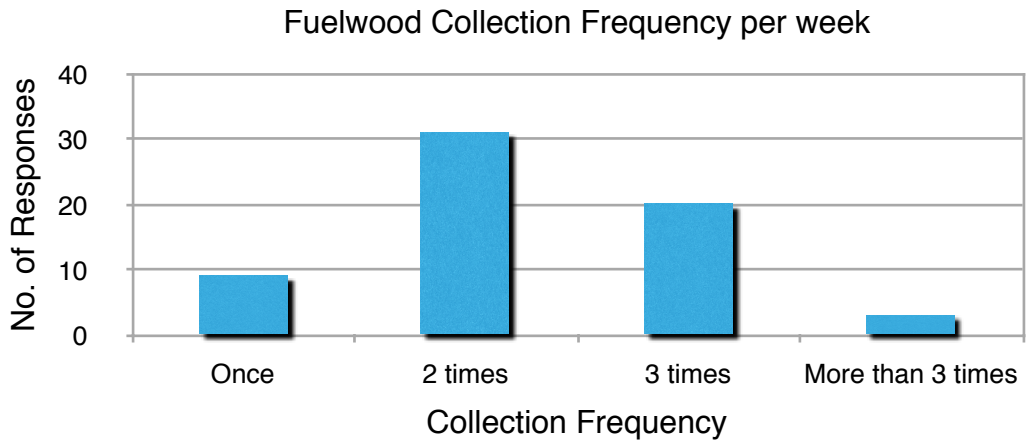


Figure 6.5 : Fuelwood Collection Frequency Per Week

The fuelwood collection frequency depends on the family size and also on distance from wood collection source. I had observed that the households whose family members are four or more than four, they collected wood 2 to 3 times per week. Whereas, those families which contains less than 4

members, they usually collected wood 1 to 2 times per week. Therefore, we can also say that the fuelwood collection frequency increases with the increase in family size and vice versa. The large household families required more fuelwood to fulfill their domestic energy needs, so they collected more than one time per week. It was also observed that the distance from the source (forest) also effects on fuelwood collection frequency. It was found that the household near the forest collected wood almost 2 to 3 times per week and those HH who are very far away from the forest, they collected only 1 to 2 times per week. In this section, I consider only those respondents who collected wood from the forest and not taking into account those who collected wood just a few meters away from the kitchen.

6.10.2.3 Wood Use Per Collection

Head loads come in various sizes depending on male and female loads of wood and also on distance of collection site from the home. There was a significant difference between male and female loads of wood. It was observed that overall men and boys bring more head loads of wood than women and girls. When I asked to the respondents ` how long a load of wood lasted , they shared with me that it depends on the type and number of meals cooked by each collected bundle and also depends on the season. In winter season, due to increase in demand of energy needs for cooking and especially for heating, a load of collected wood lasted early. Therefore, in summer season a load of wood goes for more days due to fall in energy demands. Almost, all respondents said that their fuelwood energy demands become double during winter season. Moreover, a load wood lasted also depends on type and number of meals cooked by each collected bundle. Majority of the households in study area cooked 2 to 3 meals per day, consisting of a breakfast, lunch and a big meal in the evening. Therefore, more than 80% of the respondents stated that one bundle of collected wood lasted two to three days with the normal cooking and heating activities less than 20% of the respondents also indicated that a load of wood lasted upto a week. So, I had found that these 20% respondents were those whose family contains less than four family members and some of them are those who used donkey for wood collection. The average wood load carried by donkey is approximately 40-60 kg. Gender responses also indicated that a load of collected wood lasted 2 to 3 days. Therefore, in study village Balolia most households collected wood 2 to 3 times per week, spending 3 to 6 hours or whole day for each wood collection journey, and collected wood load lasted 2 to 3 days, which also confirmed the fuelwood collection frequency of 2 to 3 times per week .

Most of the respondent households, from the study village of the Kakul has facilitated by gas supply. So they used gas for cooking and heating purpose. They did not have experience about

fuelwood collection, but some of the HH in Kakul village still had not facilitated by gas supply. These HH still used fuelwood and dung cake for their enegy needs. These HH respondents also stated that collected load of wood lasted 2 - 3 days. Therefore, they also used dung cake as a supplement of fuelwood because most of them had animals (buffaloes) and had easy access to dung. These HH are very far away from the forest, so due to a long distance they carry less load of wood on their heads. That´s why their collected load of wood also lasts within 2 - 3 days same like as in Balolia village.

6.11 GENDER EXPERIENCE OF FUELWOOD COLLECTION

Women & men use axes to cut off branches if they cannot get wood from the forest floor. They also used it to break off dead branches. Commonly, they collected fuelwood from the state owned forest. The forest department does not allow to fell trees and even not allowed to cut off fresh branches from the forest trees. But most of the respondents from the study area (Balolia) ststed that they useaxes to cut off the fresh branches and also to fell small trees from the state owned forest. They cut off fresh branches and fell trees in the absence of forest guard. Majority of the respondents stated that if the forest guard see them to cut off the trees, then they fined by the forest guard. Some of the respondents said that he also give physical punishment to local people (wood collectors). When I asked to the respondents “why you cut the fresh branches and fell trees from the forest” then two main reasons were mentioned by all of the respondents. The first reason that was mentioned by them is `they do not have alternative option`and the secomd reason is `scarcity of wood due to gradual increase in population and continuous decrease in forest cover area. They cut fuelwood into suitable pieces by using an axe or by breaking it against the knee.

Generally back pain was a common problem (in case of fuelwood collection) faced by both men and women. They also faced several injuries during transporting of wood and also from accidents with axes while cutting wood. Dut to the hilly area, the way to the forest is very steep and difficult. Most of the respondents mentioned that they fell several times when they were coming back from the wood collection trip. Sometimes they got severe injuries and fractured from these accidents.

As the fuelwood collectors, collect adequate amount of wood, they tie it up with rope in small boundles and put these bundles on their heads to carry them home. Some people also used donkey to carry the fuelwood to their home.

Therefore, In Balolia village, health problems (like muscular pain, tiredness and injuries) and falls were the main problems faced by the people during collecting and transporting fuelwood. They also had an additional issue of fear of government fine and punishment by forest guard.

Table 6.9 shows the impacts demonstrated by respondents. Therefore, from the table we can divide the reported impacts into two categories such as health impacts and social & economic impacts. There are various health impacts of fuelwood collection wer mentioned b the respondents which you can see from the given table 6.9.

Table 6.10 : Impacts of fuelwood collection In Village Balolia, Abbottabad

Reported Impacts	Total number of respondents Reporting n=60
Back pain	35
Whole body pain	22
Muscular pain	19
Neck pain	32
Accidents	18
Broken bone	3
Falls	24
Tiredness	37
Time consuming	50
Fear of fine & Punishment	30
Social and Economic life disturbed	40

Source = own made

The most significant reported health impacts of fuelwood collection were body fatigue followed by back pain and neck pain. Majority, of the respondents demonstrated, they become tired due to fuelwood collection and feel severe back pain & neck pain due to transporting collected wood.

From the table 6.9, you can see that in general impacts time consuming is the main impact of fuelwood collection followed by social & economic life disturbed reported by the respondents. More time served for fuelwood collection and less time availability for economic as well as social activities have adverse impacts on rural people economy and on their livelihoods.

Generally, women collect fuelwood in groups and they do not go alone in forest for fuelwood collection due to some social restrictions and security reasons. However, women do not climb on trees because pine trees are very tall but on the other hand mail fuelwood collectors usually climb on trees to cut the fresh as well as dead branches which increases the chances of falling from a tree breaking bones and other serious health injuries that require hospitalization.

Personally, I have decided to visit the wood collection area (state owned forest) in Balolia, Abbottabad. Iftikhar Zaib Research Associate COMSAT University has joined me for this task. Due to the mountainous area the way to the forest was very hard, stony and steep slopy path. It was really very hard to cover such a long and hard distance of the forest. We were totally exausted, when we have covered more than half distance of the forest. Unfortunately, we did not bring water to satisfied our thirst, that´s why we did not able to complete this task. I can say, we did not able to cover such a difficult and long forest way even without any load. The most important thing that really wondered me that how the local people travel such a long distance with head-loads of the wood.

It was observed that muscular pain, back pain and injuries are a critical experience for women who collect wood. Since, despite the described impacts of wood collection, men and women are compelled to continue collecting fuelwood, understanding how they perceive and respond to their experience is critical and this is discussed in the next section.

6.12 HEALTH EXPERIENCES OF USING FUELWOOD FOR COOKING

The given table 10, below shows that health related problems faced by women, men girls and children (less than 10 years) by using firewood for cooking in Balolia village, Abbottabad. I have reported these impacts from women, men and girls. Here I want to mention that I did not collect any health related information directly from children, however I have asked to their parents and they shared with me the common health problems experienced by children with fuelwood usage.

Table 6.11: Health Experiences Of Using Fuelwood For Cooking In Village Balolia, Abbottabad.

Impact Reported	Respondents			
	Women	Men	Girls	Children
Eye Irritating problems	34	11	19	29
Headache	31	3	4	X
Flu	29	19	24	27
Makes me cough	26	17	21	19
Makes me breathlessness	21	4	15	14
Minor burns	15	7	17	27
Tediousness of burning damp wood	19	X	14	X
Work burden increase	27	3	21	X
Hard work for making D.C	7	X	4	X
Hand, face and house dirt	20	13	25	11
Bad smell from clothes & houses	5	9	18	7
Affects child´s chest	X	X	X	10
Make my T.B worse	2	X	X	X

Impact Reported	Respondents			
	Women	Men	Girls	Children
Asthma	4	2	X	1
No problem	4	5	X	X

Source: own made

The table 6.10, describes that the most reported impact in women was eye irritating problem follwed by headache. As can be seen from the table the female respondents had reported that eye irritating problem is a main health problem faced by using fuelwood for cooking. Headache was also a main health problem after eye disease experienced by women in Balolia village. Majority of the female respondents had reported that they severely got headache when they cooked inside the room or kitchen due to heavy fuelwood & dung cake smokes. Personally, I had observed that majority of the respondent households cooked inside the room or in a separate kitchen. Almost whole village instead of few middle class households, they did not have any proper system to remove smoke from their rooms or kitchen. Females were main responsible for cooking activities in the study village, so, females and small children spend most of their times at cooking places like in rooms or kitchen with heavy smokes that could be a cause of headache in women. Commonly, they used iron pipe for blowing. The female respondents demonstrated that the dampwood/freshwood creates tediousness in burninig and also needs heavy blowing for burning. Freshwood also produce more smoke durning burning process. Therefore, freshwood burning needs more blowing for cooking purpose which ultimately exert more pressure on females head that could be a one of the reasons that creates headache problem in women.

The above table 6.10, clearly shows that eye irritating problems and headache were less common in men than women in Balolia village. It was also observed that children suffered more in eye irritaing problems than men and girls but less than wome. The above table also shows an expresson that eye irritating problems and headache were more common in those respondents who spend more times at cooking places like in kitchen. The young girls also has more eye irritating problems and headache than men. The female respondents did not say anything about the headaches in children, they just said that children were not able to share their probloems. They did not go to the doctor for eye irritating and headache. Generally, they used self-medication and takes pain killer like disprene or paracetamol to cure headache. They purchased eye drops from medical store without doctor advice and used them for eye diseases.

As can be seen from the table 6.10, that flu, cough and breathlessness were also common in women followd by children. Generally, women experienced more flu followed by cough and breathlessness.

The respondents also stated that flu and cough also become severe in winter season. Some female respondents said that as the winter start they captured in flu and it remains the whole winter season. When we asked to the female respondents " what you think which could be the main reason behind your flu"?. They blamed on fuelwood smoke and said it could be a main cause of their flu. The female respondents demonstrated that their flu become more severe with fuelwood & dung cake smoke. Some of them had stated that they suffered in smoke Alergi . Flu and cough was also less reported in men than women and children.

It was observed that some of the respondent households used improved iron stoves with chimney system to escape smoke from their cooking places. We had also conducted interviews from the females of these houses. It was found that flu, cough and headache were less common in these women.

The female respondents also experienced minor burns during cooking with fuelwood. It was observed that young girls and children suffered more in minor burns. Minor burns cases were more in children because they spend most of their times in kitchen with their mothers. In winter season, minor burn cases were also become more in children because they sat around the stoves to get warmth due to severe cold that brings burns accidents for children. It was also found that minor burn cases were more in those respondent households who used iron made stove for cooking. They told us that iron stove become warm during burning process and when children (who sit very close to the stove to get heat) touch these warm stoves , it cause burns for children. So, that´s why minor burn cases were more in children. Moreover, burn cases were also significant in youg girls, because they had less experience and did not know how to deal with fuelwood burning. Young girls helps to their mother´s in household activities especially in cooking. However, men were not involved in cooking activities, so they had less burn cases from wood burning.

The household cooking activities were conducted by women & young girls. Men and boys were not involved in cooking activities in Balolia village. Therefore, tediousness of burning dampwood were also reported by wome and girls in the study village of Balolia. They reported that dampwood/ greenwood took more time in burning and gives less heat which ultimately increased the time of cooking. Especially, in rainy season tediousness of burning dampwood became a crucial problem for women & girls in study area.

The given table 6.10, also shows an increase in work burden for women & girls with the use of fuelwood for cooking activities. This impact was less reported in men and boys because they were not involved in cooking activities. Increase in work burden for men and boys were also observed in the form of wood collection. It was found that increase in work load on women & girls with the use

of fuelwood was due to two main reasons. First reason was more time wasting for cooking activities. Female respondents stated that fuelwood burning gives less heat and it takes more time for cooking food which ultimately reduces the time for other household activities like cleaning, washing and caring child etc. It was observed that majority of the respondent households used traditional stoves which were less fuel efficient and took more time for cooking. On the contrast, those respondent households who used improved stoves for cooking, spend lesser time and wood for preparing their foods. Second reason which increases in female work load was utensils and house cleanig. Fuelwood consumpton for cooking activities brings heavy dirt for their utensils and houses. The female respondents stated that utensil cleaning needs extra work and much time because fuelwood smoke and ash accomulate on utensils. Their houses especially walls and roofs become very dirt due to fuelwood smoke. Generally, after 2 to 3 years, they painted their houses because they cannot afford painting each year due to their poverty. Personally, I had observed that hygienic conditions were very poor in the study village Balolia. Cooking places and cooking & eating utensils become very dirt. Here, I also want to mention that water scarcity is also a major problem in Balolia village. People do not have enough water to clean the utensils properly, so they used utensils more than once for cooking before cleaning. Unfortunately, they do not have enough water oppertunity to clean their utensils and houses.

Making dung cake for fuel energy was also the responsibility of women. Men and boys never helped to their women in dung cake making. Women demonstrated that making dung cake is very hard job. It is not easy to prepare dung for making dung cake, it takes much time and also needs more hard work.

Dung cake produces more smoke than wood and also brings more dirt for utensils and houses. It also produces very bad smell during burning process. Bad smells from clothes due to wood and dung cake usage was aslo reported by the respondents. The female respondents demonstrated that fuelwood usage for cooking makes their hands and face black. This impact was reported by women and youg girls. They also said that their hands and face skin were also become dry.

As can be seen from the table 6.10, we had met with two female respondents who suffered in T.B disease. They had clearly said that fuelwood smoke makes their T.B more worse. Both were almost over 50 years old. I did not find any male patient who suffered in T.B disease. May be some of the male patients who suffered in T.B could be there, but I did not find any one. I had decided to conduct indepth interview from one of these two women. But due to social restrictions, it was not possible for me to make direct contact with women for conducting interview. However, this indepth interview was also conducted by the two female students of COMSAT University. In both villages,

all female interviews were conducted by these two female students. This indepth interview was just like a case study. To see the questions of this indepth interview, please follow the appendix.

The patient who suffered in T.B was almost 50 to 60 years old. She was married. She suffered in T.B disease after marriage. Before her marriage, she did not has any sign of T.B disease. She told to the interviees that I checked to the doctor, he gave me medicine but did not told me the actual cause of disease. When interviees asked to her "what in your opinion, what could be the cause of your disease" She quickly blamed on fuelwood usage. She also used fuelwood for household energy activities like cooking & heating before her marriage and aslo after the marriage. She was alone in her family who suffered in T.B disease. She said that fuelwood smoke makes my T.B more worse. Few respondents also shared that they do not have any problem with the fuelwood usage.

Asthma disease was also reported by some respondents in Balolia village. As can be seen from the table 6.10, Asthma disease was also more common in females than males. We had found four females, two males and one children who suffered in Asthma disease in Balolia village. Children who suffered in Asthma was less than 10 years old.

During my data collection, I heared a very surprising story from a school teacher. He lived in Gaddi, which is the sub-village of Balolia. This sub-village located at the top position of the mountain. Personally, I had conducted interview from this school teacher. He discussed with us, the overall energy situation of Balolia village and as well as the energy sources that he used in his house. He also shared fuelwood usage impacts on human health with us. When I asked to him "what is the major health disease in your village". He mentioned several diseases but asthma was major and more devastating disease in his village. I was shocked, when he said that almost 10 to 15 people died due to asthma disease during his entire life in his village. He (respondent) was 32 years old. We can say that almost two people died each year in his small village due to asthma disease. He also stated that female dath rate due to asthma disease was also more than males in his village. He did not know the main cause of this asthma in his village. He demonstrated that patients usually faced problem in respiration process and sudden stop of respiration process become the cause of their deaths. The government hospital is very far away from his village. There was no road and transportation facility in his village which creates inconvenience in carrying patients to the district hospital. I had also met with seven years old boy who also suffered in Asthma. His father was also suffered in the same disease asthma. They also did not know the cause of their disease asthma.

Therefore, in concluding remarks, in the light of above description, I can say that eye irritating problems, flu and headache are the common health problems faced by women by using fuelwood for energy purpose in Balolia village. Men are less victimized by these health problems because

they are less exposed to fuelwood smoke. Minor burns and eye diseases are also very common health problems experienced with the fuelwood usage among young girls and children. Indoor air pollution is also a major consequence of fuelwood usage which puts adverse impacts on human health especially on women and children.

We had also conducted a health survey in Kakul village. The health situation was totally different in the village of Kakul from the village of Balolia. As, I have already described in the methodology chapter that in Kakul village, people used gas for cooking activities as well as for heating purpose. Whereas in study Balolia village, people totally dependent on fuelwood & dung cake to meet their energy needs. We had conducted several household interviews from men and women in the Kakul village. We had also conducted some interviews from key informants like from Nazim, Naib Nazim, school teacher and from Amam Masjid. We had discussed with them about the general health diseases in their village. They shared with us that diarrhea is a common health disease in children. Men are mostly suffered in fever. They had also demonstrated that most of the women suffered in joint problems and fever is also common among females. It was very interesting that they did not stated flu, eye diseases, headache, asthma and respiratory diseases. Minor burns was also not a problem in Kakul village. But they had stated that natural gas gives irritating smell burning. They also said that risk involved in gas usage like in the case of gas leakage. They viewed that gas leakage also create suffocation. They did not mentioned any gas leakage case which cause the death of a person in their village.

After conducting the interviews from key informants, we moved forward towards community. We had selected number of respondent households in the entire community to conduct household interviews to get appropriate information about health disease. The general female health problems found in the study Kakul village were fever, joint problem and diabetes. Flu and asthma were also reported but these are not much significant as in the case of Balolia village. The female respondents did not reported eye diseases and headaches but they reported diabetes and joint problems more frequently. There was no a single women in Kakul village who suffered in T.B disease. They said that in past (almost 25 years before) T.B disease had been very common and considered more devastating disease. But now, it is not much common disease. The female interviewers asked to the female interviees “what you think, what could be the cause of your joint problem”. Most of the female respondents demonstrated that lack of physical activities may be the cause of their joint problems. One of them also shared that gas supply interventions has reduced their household work and physical exercise that may be a of their joint problem. Few of them blamed on gas heater. They

said that during winter, sitting very close to the gas heater to take heat may be a cause of our joint problems.

However, Diabetes, heart attack and blood pressure were reported more as a male health diseases. There was also a very old patient in Kakul village who suffered in T.B disease. But unfortunately, he did not available at home at that time to conduct interview. Common health diseases in children that were reported by the respondents are Diarrhea, Pneumonia, fever and to some extent cough and flu was also reported by the respondents. Therefore at last, I can conclude that overall diabetes, joint problems, diarrhea and phenomena are the most common diseases mentioned by respondents in the study village Kakul.

The use of open stoves without chimney especially inside the house very often, in order to burn biomass for domestic use like for cooking and boiling water. A high concentrations of CO, NO2, SO2 and TSP (Trisodium Phosphate) are emitted from burning of biomass, which can cause chronic diseases like pneumonia and lung cancer, allergies and diseases associated especially with skin and eyes. Rural women and children are suffered more from these diseases because they spend their much time around the stoves and fire locations (Gang et al., 2008).

There is consistent evidence that exposure to biomass smoke increase the risk of a range of common and serious diseases of both children and adults. Chief amongst these are acute lower respiratory infections in childhood, particularly pneumonia (Schirnding et al., 2002).

6.13 PERCEPTIONS AND RESPONSES TO FUELWOOD & DUNG CAKE USE IN BALOLIA & KAKUL VILLAGE

In this section, I will try to analyse the responses of fuelwood and dung cake users in the study villages. This section will also show the different forms of behaviours and actions in which respondents were engaged to minimise the effects of fuelwood use. During data collection process, I had observed that majority of the respondent households did not have any proper ventilation system to escape fuelwood smoke from their houses. In winter season they cooked inside the rooms and did not use separate kitchen for cooking because they could not afford the expenses of cooking and heating separately. Indoor cooking also served as a heating purpose in cold season.

In Balolia village, some of the respondent households used chimney system to remove fuelwood smoke. These respondents came under middle and better off class in wealth ranking. These chimnese are usually made up of Iron. It consists of long iron pipe that starts from the stove´s head corner and goes out from the walls or roofs of the houses. These chimnese could efficiently removed fuelwood smokes from cooking place. These chimney systems were found only in few house. According to the respondents views, it was observed that there were two main reasons that

generally preventing the people to use these iron stoves with chimney. The first reason is high cost of these stoves that poor people cannot afford it. The second reason was reported by the respondents is less fuel efficiency of these stoves. They said that it burns more wood because air enters from the top opening of the chimney pipe that accelerate burning process. Personally, I had observed that both above mentioned reasons were totally based on misperceptions. I had found that cost of these iron stoves were not much high. Its cost was almost 500 to 1000 Rs (65 Kr according to the current currency rate). It was also a misperception about iron stoves with chimney among community that these stoves are less fuel efficient. Basically, these are fuel efficient stoves that approved by WWF and Sungi Foundation. WWF and Sungi Foundation had distributed these iron stoves with chimney as a fuel efficient stove.

Therefore, lot of respondents reported that generally they opened their house windows to remove fuelwood smoke and to minimize the effects of fuelwood use. But practically, I did not see such type of practice among the community. Generally, they closed their house/kitchen windows to stop "cold air" from getting in. However, they opened their doors during day time to remove fuelwood smoke and maximum smoke go out from these doors. The household members especially women and children did not go out to avoid smoke. They remained in their rooms or kitchens even with heavy smoke. I had found that respondents are well awared that opening windows could reduce the effects of fuelwood smoke on their health. Some of the respondents replied "that we are used to it".

Apart from firewood, dung cake was also used for cooking purpose in the study villages. Generally, they used it in combination with fuelwood. The respondent households used it both indoors and outdoors. Some respondents did not preffered to use dung cake indoors because it produced big quantity of smoke and a strong smell. The respondents who used dung indoors reported that its smoke is worse than that of firewood. The female dung cake users were worried that dung use makes their houses dirty and brings bad smells that never goes away. They said that "we do not have alternative option except dung cake use to control the fuelwood expenses.

Few female respondents also reported that making and handling of dung cake causes hand infections (irritations) which ultimately leads to skin damage. The skin damage is usually because of its high alkalinity characteristics. Handling of dung cake could also transfer faecal-philic pathogenes to food and water (Matinga, M.N., 2010).

In conclusion, I could say that maximum respondents are well awared about the health implications of fuelwood smoke. They showed interest to improve indoor household conditions. But due to limited economic resources, they are not able to bring the indoor improvements. Therefore, I had

also observed that low cost interventions and innovations like fuel efficient stove with chimney can efficiently reduce the fuelwood smoke and could improve indoor household conditions.

Therefore, in the study Kakul village, people who still used fuelwood had almost the same type of cooking stoves and also showed the same type of behaviours and actions to minimize the effects of fuelwood smoke as described above in the case of Balolia village. Moreover, the households who were facilitated by gas supply in Kakul village, had less smoke problems and better indoor household conditions. Almost all respondent households in Kakul village had separate kitchens in their houses. They did all their cooking activities in their kitchens. They used gas heater for heating purpose and gas lamp for lighting purpose during electricity load shedding. Their kitchens and houses were clean and had less health impacts of smoke. The female and young girls had also less work load due to less time spending for cooking activities on gas. They used exaust fans to remove smoke and smell from from their kitchens. They had less smoke problem due to clean energy use (gas) for cooking and heating purpose. However, they also designed reasonable size windows in their kitchens for ventilation purpose.

6.14 ADVERSE HEALTH EFFECTS DUE TO INDOOR AIR POLLUTION (IAP)

Air pollution is an atmospheric condition which includes gasses, particulate matter, radioactive materials etc that can produce unfavourable impacts on human health and their environments. In developing countries the use of biomass fuel for energy purpose is the major source of indoor air pollution (IAP). Fuelwood smoke contains a variety of health-damaging pollutants like carbon monoxide and particulate matters etc. The concentration level of these pollutants vary greatly depending on the time of day, season and place of measurement.

The World Health Organization report 2002, stated that 2.7 % of the global burden of disease is due to indoor air pollution. Health implications of IAP are greater in heigh mountaneous rural areas because in these areas people construct very small and closed type of houses to cope with sever winter. In developing countries, women and children are at greatest risk because they are main responsible for household activities and spending a lot of time indoors that cause a high exposure to IAP.

More than 2 billion people in the world still reply on biomass for energy purpose. Therefore, two and half million people expire each year from air pollution in which indoor air pollution contributes almost 65 %. The air polution emitting from biomass fuels had less harmful effects on environment (than fossil fuels used in industry) and had more devastating impacts on human health because human exposure to IAP is much higher. It has been recorded that more than two million children die

each year in developing countriws from respiratory diseases. Fuelwood smoke and inadequate ventilation systems are significant risk factors for acute respiratory diseases (WHO, 2005)

Biomass use for cooking and heating purpose has significant health and environment impacts at the household, local, regional and global levels. It is also considered a cause of sickness and premature deaths (© UNDP, 2004). In low income countries, women and children inhale in amounts of fuelwood smoke equivalent to consuming two packs of cigarettes per day (WHO, 2006). Several harmful pollutants are released from the combustion of biomass fuels. These pollutants include suspended particulate matters, CO, farmaldehyde, nitrogen dioxide, ozone and polycyclic aromatic hydrocarbons. The given table below shows indoor air pollutants and their potential human health effects.

Table: 6.11 Indoor air pollutants and their potential health effects

Indoor air pollutants and their potential health effects		
Pollutants	**Mechanism**	**Potential health effects**
Particulate matters (PM-10/2.5)	✦ Bronchial irritation ✦ Reduced mucocilliary clearance	✦Respiratory infections ✦COPD and exacerbation ✦Wheezing asthma ✦Excess mortality including CVD
Carbon monoxide (CO)	✦ Binding with Hb (reduced oxygen delivery)	✦ Low birth weight ✦Increased perinatal deaths
Benzopyrene	✦ Carcinogenic	✦Lung cancer ✦Cancer of mouth, pharynx, larynx
Formaldehyde	✦ Nasopharyngeal and airway irritation	✦ Increased infections? ✦May lead to asthma ?
Nitrogen oxides (NOx)	✦Acute: bronchial reactivity ✦ Chronic: infections	✦ Wheezing ✦Respiratory infections and reduced functions
Sulphur oxides (SOx)	✦ Acute: bronchial reactivity ✦ Chronic: particulate effects	✦ Wheezing, asthma ✦COPD, CVD
Smoke	✦Absorption of toxin into lens, leading to oxidative changes	✦ Cataract

Indoor air pollutants and their potential health effects
Source: WHO 2002. The health effects of indoor air pollution exposure in developing countries

Small particles (diameter up to 10 microns) are the most widely used indicator of the health hazard of IAP. Fine particles (diameter up to 2.5 microns) can enter deep into the lungs and appear to have significant health damaging potential. It has been recorded that these particles can cause inflammation of the air ways and lungs impair the immune response (WHO, 2006).

Therefore, some studies have associated exposure to indoor smoke to asthama, Cataracts, tuberculosis, low birth weight, adverse pregnancy outcomes, heart disease, lung disease, and nasopharyngeal and loryngeal cancers. In year 2002, WHO has stated that indoor air pollution from burning solid fuels as one of the top ten global health risks (WHO, 2006). It has been recorded by WHO in 2002 that globally, 1.5 million people died from diseases caused by indoor air pollution (WHO, 2006). In 2002, South-East Asia experienced 483000 deaths due to indoor smoke (WHO, 2006).

6.15 WOMEN AND CHILDREN AT SPECIAL RISK DUE TO IAP IN DEVELOPING COUNTRIES

Fuelwood collection and cooking are the main responsibilities of women in the rural areas of low income countries. This is also the main responsibility of women in the study villages Kakul and Balolia. Women are at special risk, because they cook meals for the whole family and this activity exposes them to high level of IAP produced during the biomass fuel burning process for cooking activities. Women do not have alternative option to escape from this indoor air pollution problem. They said that “we are used to it”.

Newborns and Infants are more vulnerable to IAP, because they spend most of their time with their mother´s while she is cooking. She carried them on her back or kept close to the warm hearth while she is engaged in cooking. Consequently, children inhale polluted air at very early stage of their life when their metabolic pathways and immune systems are in developing phase, make them particularly vulnerable (WHO, 2006). It has been recorded that indoor smoke becomes the cause of approximately 800,000 children deaths annually worldwide. In which, 358,000 deaths recorded on the African Continent and 288,000 child deaths occurs in South-East Asia (WHO, 2005 & 2006).

In developing countries, women are usually responsible for household cooking activities. They spend most of their time in the vicinity of the fire or stove. Poor household energy practices has significance health impacts on pregnant women. Fuelwood collection and carrying collected wood

on head may bring about prolapse during pregnancy. Indoor air pollutants also effect on developing embryo which may lead to low birth weight as well as still birth (WHO, 2005 & 2006).

The World Health Organization (WHO, 2006), stated that 1.5 million people faced premature deaths each year due to indoor air pollution from the use of solid fuels.In these premature deaths, more than half of them are children below below 5 years of age. It has been argued that more than 85 % of these deaths are because of biomass use, the rest due to coal (Babalola, F.D., 2010).

The WHO (1984) also demonstrated that female can inhale a sufficient amount of benzopyrene during food cooking which is equivalent to 20 packets of cigarette a day. The deaths associated with biomass use are more than malaria, tuberculosis and almost half as many as HIV/AIDS (Aina and Odebiyi, 1998).

The use of open stoves without chimney especially inside the house very often, in order to burn biomass for domestic use like for cooking and boiling water. A high concentrations of CO, NO2, SO2 and TSP (Trisodium Phosphate) are emitted from burning of biomass, which can cause chronic diseases like pneumonia and lung cancer, allergies and diseases associated especially with skin and eyes. Rural women and children are suffered more from these diseases because they spend their much time around the stoves and fire locations (Gang et al., 2008).

6.16 SOCIAL IMPLICATIONS OF FUELWOOD USE

Where fuelwood use for energy purposes has economic, health and environmental impacts, where also has some social impacts on rural people. Loss of opportunity for social activities is one of the main cost of fuelwood collection that faced by the rural people. The respondents stated lot of activities that are affected by the wood collection like household, educational, agricultural and recreational activities. Due to extra work burden of fuelwood collection, female had less time for recreational as well as educational´s activities. The respondents has stated that “we have less time for our children because most of our time is wasted in wood and water collection activities. The male respondents said that interaction with relatives as well as with community is also affected by fuelwood collection due to less time availability. They did not have much time for sport´s activities as well as for their friends. The female respondents stated that mentally they were very stressed due to over burden of work. Social life of women´s and young girls were affected more due to fuelwood use. Their work burden increased by two times as compared to men. They had less time for productive activities and social interactions. According to an estimation a daily average time of approximately 6 hours that is needed for the collection of biomass in Taktse. This is a time loss of rural community for recreation and education like reading and learning. The time cannot be used for education after the collection of biomass because people are too tired (Gang et al., 2008).

6.17 ECONOMIC IMPLICATIONS OF FUELWOOD USE

Generally, women and children were engaged in collection and transportation of fuelwood. They spend lot of time for gathering and transporting the fuel each year. Therefore, if they utilized this time for some productive work, it could improve the economic conditions of these poor´s women. We know that not all of this time could serve into income generating activities, due to many reasons such as child labour, low efficiency, low skill and less opportunities for employment. It has been considered that, if even 25% of the time could serve for productive work, it could be able to bring improvement in rural economy and could also improve rural people livelihood conditions (Laxmi, V., et al. 2003).

Therefore, most of the respondents collected fuelwood from the state owned forest without any costs. They did not consider the time cost that they usually wasted in search of wood collection and transportation. Fuelwood collectors spend more and more time in search of wood. It has been considered that the time spend on wood collection could impact on the time that could be spent in income earning activities like agriculture or small scale business (Sepp, 2002 and Murphy, M.E.G., 2009). Women´s time spend on wood collection could also affect on the time that could be spent on education, child nurturing and family health (Sepp, 2002).

As, I have already mentioned that their household fuelwood requirement becomes almost double during winter season as compared to summer season. So, to fulfill this increase in fuelwood demand, they purchased wood from the wood market or from the local wood sellers. At that time, rate of the fuelwood was 200 Rs/mound (40 kg) at local wood market. The fuelwood prices vary in winter and summer seasons. The increase in wood prices in winter season and fall in summer season were observed.

A school teacher has demonstrated that " I purchased wood in both seasons because I do not have much time to collect wood from the forest. His children were very small and he did not allow his wife to go for wood collection by leaving his small children alone at home. Almost all respondents mentioned that they purchased wood especially during winter season.

In order to gather information about household energy expenses from rural respondents, we had made a section in our questionnaire related to energy cost. This section provided us per month household energy expenditures and as well as how these energy expenditures vary with energy types. Following types like fuelwood, electricity, LPG, candles, kerosene and natural gas are commonly used to fulfill household´s energy requirements in both study villages.

As you can see from the table 6.12, we had made 5 ranges (0-500 Rs, 1000 - 2000 Rs, 2000 - 3000 Rs, and above 3000 Rs) of per month household energy expenditures. It has been observed that

energy expenditure vary significantly with energy types. We had calculated energy´s expenditure of each energy type separately. Our main focus was fuelwood expenditure that how many rupees (Rs) spend for fuelwood energy at household level in a month. We had also collected information about per month household gas expenditure in village Kakul to make a comparison with fuelwood expenditures.

Table 6.12: Energy Expenditures In Rupees (Rs/month)

Energy Expenditures in Rupees (Rs/month)						
Energy Type	**0 - 500 Rs**	**500-1000 Rs**	**1000-2000 Rs**	**2000-3000 Rs**	**above 3000 Rs**	
Fuelwood	11 Not paid	7	11	22	8	**Number Of Responses**
Electricity	32	20	3	1	X	
LPG	1	3	5	X	X	
Candles	12	X	X	X	X	
Kerosene	7	3	1	X	X	
Natural Gas	19	28	10	3	X	

Source: own made (1 USD = 85.89 Rs)

As you can see from the table 6.12, 37% of the total respondents have 2000-3000 Rs/month fuelwood expenditure. Therefore, 19% of the respondents had 1000-2000 Rs/month fuelwood expenditure and only 11% respondents showed 500-1000 Rs/month expenditure. Moreover, 18% of the respondents stated that they do not pay for fuelwood. These were very poor respondents and did not have fuelwood purchasing power. It was also observed that more than 10 % of the respondents have above 3000 Rs/month fuelwood energy expenditure. In Balolia village, all of the respondents described that fuelwood energy is more expensive than electricity for them. Their fuelwood expenditure was significantly high than electricity expenditure. The rural respondents demonstrated that they could control the electricity expenses by reducing its use but they are not able to control fuelwood expenditure. Because, they require fuelwood to fulfill their basic household energy needs like cooking and heating.

However, per unit electricity cost is very high in Pakistan. Because maximum electricity generation dependent on imported fossil fuels. It was very interesting that rural respondents said that “electricity is very expensive but our electricity expenditure are fair, because we use electricity only for lighting during night. I had found that generally, they used electricity for lighting and watching T.V. They did not have modern electric appliances like refrigerator, washing machine, computer, oven and electric stove etc. However, sometime they used iron for pressing when they go for a

function like marriage etc. They also used electricity for mobile charging and emergency torch. So, we could say that poverty has reduced their electricity demand.

As we can see from the table 6.12, that 53 % of the respondents have 0 - 500 Rs/month electricity bill. Their electricity bills usually fluctuate between 200 - 500 Rs/month. Therefore, 33 % of the respondents had 500 - 1000 Rs/month electricity bill. There were only one respondent who had 2000 - 3000 Rs/month electricity bill and there were no a single respondent in both villages who has more than 3000 Rs/month electricity bill. I had also observed that per month electricity expenditure were more in village Kakul than village Balolia. Because, In village Kakul people have better living conditions and good life´s standard than the people of the village Balolia. People of the village Balolia commonly used refrigerator, washing machine, forage cutting machine and iron in their homes. That´s why their electricity expenditure were more than the people of the village Balolia.

Moreover, few respondent households also used LPG for cooking and as well as for lighting purpose. They used it for lighting purpose during electricity load shedding. They did not use it for normal routine cooking, but oftenly used for making tea for a guest or few respondent household used it only during the Holy month (Ramzan). Those households who used LPG for cooking and lighting purpose, they normally spend 1000 - 2000 Rs/month for it. But those households who used it only for lighting purpose during electricity load shedding, they have 500 - 1000 Rs/month LPG expenditure.

Generally, kerosene was not used for cooking purpose in both study villages because of its high prices. But in village Balolia, few respondent households used kerosene for lighting purpose during electricity load shedding. These respondents stated that they had almost 0 - 500 Rs/month kerosene expenditure. Their kerosene expenses fluctuated between 400 - 600 Rs/month. They also used candles for lighting purpose during electricity load shedding. They used candles only for indoor lighting because candles are not workable in open air. So, they used kerosene for lighting purpose in open air because candles are switched off in open air. Therefore, they also spent almost 0 - 500 Rs/ month on candles.

As early described, the village Kakul is facilitated by natural gas supply. The people of the village Kakul used gas for cooking and heating purpose and as well as for lighting during electricity load shedding. The given table 6.12, shows that 47 % of the respondents in study village Kakul has 500 - 1000 Rs/month gas bill expenditure. Therefore, 32 % of the respondents has less than 500 Rs/month gas bill expenditure. There were 16 % of the respondents showed 1000 - 2000 Rs/month gas bill expenses. There were only 3 respondents who stated that their gas bill expenditure are 2000 - 3000 Rs/ month. However, there was no a single respondent who stated gas bill expenditure above 3000

Rs/month. Here, I also want to mention that change in season brings significant fluctuation in gas bill expenditure. It was observed that gas bill increased by two times in winter season as compared to summer. The gas demand for household energy purpose during winter also becomes double. They need substantial heating due to severe cold winter. It was observed that the use of gas heaters and geysers in winter season, significantly increased their gas expenses. They had stated that their gas bills fluctuate between 200 - 600 Rs/month during summer but during winter season it normally falls under 700 - 1500 Rs/month.

There was a significant difference between per month fuelwood expenses and gas bill expenditure. On average basis, the people of the village Balolia spend almost 3000 Rs/month for fuelwood and on the contrast, people of the village Kakul spend only approximately 1500 Rs/month for gas. Therefore, I could say that the people of the Balolia village have poor, inefficient and expensive energy resource (fuelwood) for cooking and heating. Therefore, on the other hand the people of the Kakul village have clean, efficient and cheap energy resource for cooking and heating as compared to Balolia village.

Therefore, by drawing conclusion from the table 6.12, we could say that rural people of the Balolia village have approximately 3000 - 4500 Rs/month total energy expenditures, while the people of the Kakul village has approximately 1500 - 3000 Rs/month total energy expenses. Here, I also want to mention that the average household income in Balolia village is approximately 6000 - 8000 Rs/ month. Generally, households of the Balolia village, share their energy expenditures between electricity and fuelwood while households of the Kakul village spend on electricity and natural gas. At last, I conclude that the use of fuelwood for cooking and heating purpose could severally worsen the livelihoods of the rural people.

6.18 FUELWOOD USAGE CAUSE DEFORESTATION

Forests in Abbottabad cover almost 20 % of the total area of the district (Wiederaufbau, K.F., 2000) and account for 5.4 % of the province´s forest resources. These forests are demarcated according to ownership, jurisdiction and entitlement management. There are several factors that continuously degrading district´s forests including illicit felling, regeneration failure, institutional failure, progressive depletion and the lack of participatory management (IUCN Pakistan, 2004).

It has been reported that deforestation rate in Pakistan is the second highest in the world (IUCN, 2002). The World Conservation Union (IUCN 2002) has estimated that if the current rate of deforestation continuous, Pakistan´s forests may deplete within the coming 10 - 15 years.

Across the district, population is highly dependent on wood as a source of fuel. Due to the lack of affordable alternative fuels, 80 % of the district´s urban households and greater than 90 % of rural

population use wood-burning stoves and rely on fuelwood. It has been observed that with the increase in population, annual fuelwood demand is growing at an alarming rate and also creating degradation for local forests. The heavy dependence on fuelwood compels poorer households towards illegal felling and collection which ultimately accelerates the process of forest degradation (IUCN Pakistan, 2004).

The environmental implications of over exploitation of forests for fuelwood use includes degradation of forests, watershed areas, users conflicts and desertification. The fuelwood collectors go various supply areas to meet their needs, continuous collection from a sight over a period of time is subjected to environmental degradation (Pandey, 2000). As an example, evidence of intensive collection in northern Kenya (Mc Peak, 2002), in Yuksam-Dzongri trekking corridor in Nepal (Chettri and Sharma, 2007), Northwest Bengal in India (Pandey, 2000), in Nicaragua (Pandey 2000) and lot of others research studies showed loss of biodiversity, deforestation and degradation and a shift from forest to grasslands. It has been stated by Pandey that " deforestation through fuelwood use may not be explicitly linked, but when the fuelwood collection pressure increases from the capacity of the forests then degradation is sure to follow".

Comparison between fuelwood demand and annual growth in biomass from existing forest resources were made in various regions of the developing world, and reported that in those regions where fuelwood demand exceeded growth it was assumed that this gap can be covered by over-cutting and depletion of forests (Terrence, B., 2008). Moreover, various research studies predicting a growing "gap" between declining wood-fuel supply and rising demand. It was observed that fuelwood demand and population grow side by side (Arnold, *et al. 2*003 and 2006).

It has been found that fuelwood scarcity has negative social and environmental outcomes, including increase in women and children fuelwood collection times and more use of agricultural residues for fuel with subsequent loss of soil fertility (Terrence, B., 2008). Terrence 2008, stated that " fuelwood use were a primary cause of deforestation".

Forestry policy paper 1995 published by Asian Development Bank claimed that " there is increasing evidence that the biggest threat to tropical forests of the region is uncontrolled fuelwood collection and unsustainable agriculture" (ADB, 1995). The ADB proposed a policy interventions - subsidies for alternative cooking fuels to minimize fuelwood demand and the establishment of large - scale fuelwood plantations to increase supply - that achieved little success (ADB, 1995).

Communities are living very close to natural forests and as population and agriculture activities are incrasing creating a pressure on forests. The natural forests are under pressure as the local community use it for fuelwood. Forest degradation ultimately brings destruction for natural habitat

for biodiversity such as leopards. Most of the forest degradation is done directly or indirectly by people living inside or in the vicinity of forests, who depend on them for their fuelwood, timber and grazing needs. For example, the mountain climate is cold and the dwellers are forced to keep their houses warm round the winter. The poor cook, eat and sleep around the fire places. Heating consumes large quantities of fire wood, which is cut and collected from the adjecent forests. Collection of fuelwood from the forests is their only alternative due to the harsh climate, their poor purchasing power and the absence of alternative energy sources for cooking and heating. The wood demands for construction and repair of houses is another factor contributing to the damage of forests.

Dependance on biomass fuels for energy purpose in developing countries have focused global attentions over both environmental implications such as deforestation and soil erosion and the adverse health consequences of IAP emitted by burning of fuelwood, dung cake or crop residues (Bruce et al., 2000). The impact of fuelwood collection on deforestation and its connection with rural livelihood has getting varying attention with the passage of time (Arnold et al., 2003; 2006). Global debate over poverty and environment, has also believed that forest degradation is also a source of further impoverishment for poor people who relay on forest resources (Cavendish, 2000; Duraiappah, 1996; 1998). Rural household firewood consumption is a major factor behind the deforestation and also led to soil erosion and desertification in Taktse (Gang et al., 2008).

Rural household energy utilization causes significant damage to eco-environment and socio-economic conditions of rural´s people in many developing countries. Traditional biomass energy sources such as animal dung, firewood and crop residues play important roles in local household energy consumption. This conventional energy structure is not only threat to ecoenvironment but also to rural women and children as well. A case study in June 2006 in Taktse, has conducted, the study analyzed the rural household energy supply and consumption structure, and its harmful impacts on socio-economic, health and environmental conditions. It has been observed that biomass use counts upto 70%, which leading towards several environmental problems such as deforestation, land degradaton, soil erosion, desertification and an other important harm such as human being diseases (Gang et al., 2008).

6.19 ENERGY SITUATION COMPARISON BETWEEN KAKUL AND VILLAGE BALOLIA

Energy situation in the Balolia village was far worse than Kakul village. In Balolia, people used firewood and dung cake for cooking, heating and boiling. They collect firewood from Govt. forest which is very far away from their homes. Mostly, they spend a whole day for firewood collection. Women, children, boys, girls and men are collected firewood, but especially women and boys are engaged in firewood collection. Village Balolia is not facilitated by gas supply and there is no possibility of facilitation by gas in the near future. Electricity supply is also limited, not provided in the whole Village Balolia. Load shedding is also a big problem (almost 16 hours a day in summer) in this village Balolia due to energy shortfall in Pakistan. The village Kakul (second study village) is facilitated by gas. Almost, 80% of the Kakul village has gas facilities for cooking. Energy situation is better in Kakul village than Balolia. They use gas for heating and cooking purpose. Livelihood conditions are better in Kakul village than Balolia due to better energy situation.

The village Kakul represents relatively more economically stable as compared to village Balolia. Small scale business like shop keeping, overseas employment, small scale agricultural activities, government employment and labor on daily wages are major sources to earn livelihood in Kakul. While, village Balolia represents the most economically vulnerable area because majority of the people are labors depending upon daily wages to sustain their livelihoods.

Therefore, in study village Balolia most households collected wood 2 to 3 times per week, spending 3 to 6 hours or whole day for each wood collection journey, and collected wood load lasted 2 to 3 days, which also confirmed the fuelwood collection frequency of 2 to 3 times per week .

Most of the respondent households, from the study village Kakul has facilitated by gas supply. So they used gas for cooking and heating purpose. They did not have experience about fuelwood collection, but some of the HH in Village Kakul still had not facilitated by gas supply. These HH still used fuelwood and dung cake for their enegy needs. These HH respondents also stated that collected load of wood lasted 2 - 3 days. Therefore, they also used dung cake as a supplement of fuelwood because most of them had animals (buffaloes) and had easy access to dung. These HH were very far away from the forest, so due to a long distance they carried less load of wood on their heads. That´s why their collected load of wood also lasts within 2 - 3 days same like Village Balolia.

Therefore, most of the respondents collected fuelwood from the state owned forest without any costs. They did not consider the time cost that they usually wasted in search of wood collection and

transportation. Fuelwood collectors spend more and more time in search of wood. It has been considered that the time spend on wood collection could impact on the time that could be spent in income earning activities like agriculture or small scale business (Sepp, 2002 and Murphy, M.E.G., 2009). Women´s time spend on wood collection could also effect on the time that could be spent on education, child nurturing and family health (Sepp, 2002).

In village Balolia, some of the respondent households used chimney system to remove fuelwood smoke. These respondents comes under middle and better off class in wealth ranking. Therefore, lot of respondents reported that generally they opened their house windows to remove fuelwood smoke and to minimize the effects of fuelwood use. In conclusion, I can say that maximum respondents are well awared about the health implications of fuelwood smoke. They showed interest to improve indoor household conditions. But due to limited economic resources, they are not able to bring the indoor improvements. Therefore, I had also observed that low cost interventions and innovations like fuel efficient stove with chimney can efficiently reduce the fuelwood smoke and could improve indoor household conditions.

Therefore, in the study village Kakul, people who still used fuelwood had almost the same type of cooking stoves and also showed the same type of behaviours and actions to minimize the effects of fuelwood smoke as described above in the case of village Balolia. Moreover, the households who were facilitated by gas supply in the village of Kakul, had less smoke problems and better indoor household conditions. Almost all respondent households in village Kakul had separate kitchens in their houses. They did all their cooking activities in kitchen. They used gas heater for heating purpose and gas lamp for lighting purpose during electricity load shedding. Their kitchens and houses were clean and had less health impacts of smoke. The female and young girls had also less work load due to less time spending for cooking activities on gas. They used exaust fans to remove smoke and smell from from their kitchens. They had less smoke problem due to clean energy use (gas) for cooking and heating purpose. However, they also designed reasonable size windows in their kitchens for ventilation purpose.

Therefore, In the study Village Balolia, eye irritating problems, flu and headache were the common health problems faced by women by using fuelwood for energy purpose. Men were less victimized by these health problems because they were less exposed to fuelwood smoke. Minor burns and eye diseases were also very common health problems experienced with the fuelwood usage among young girls and children. Indoor air pollution was also a major consequence of fuelwood usage which puts adverse impacts on human health especially on women and children.

The health situation was totally different in village Kakul from the village Balolia.Common children health diseases that were reported by the respondents are Diarrhea, Phenomena, fever and to some extent cough and flu was also reported by the respondents. However, diabetes, heart attack and blood pressure were reported more as a male health diseases. The general female health problems found in the study Kakul village were fever, joint problem and diabetes. Flu and asthma were also reported but these were not much significant as in the case of Balolia village. Therefore at the last, I can conclude that overall sugar, joint problems, diarrhea and phenomena were most common diseases mentioned by respondents in the study village of Kakul.

There is a significant difference between per month fuelwood expenses and gas bill expenditure. On average basis, the people of the village Balolia spend almost 3000 Rs/month for fuelwood and on the contrast, people of the village Kakul spend only approximately 1500 Rs/month for gas. Therefore, I could say that the people of the village Balolia had poor, inefficient and expensive energy resource (fuelwood) for cooking and heating. Therefore, on the other hand the people of the Kakul village have clean, efficient and cheap energy resources for cooking and heating as compared to Balolia village. Therefore, by drawing conclusion, I can say that rural people of the Balolia village has approximately 3000 - 4500 Rs/month total energy expenditures, while the people of the Kakul village has approximately 1500 - 3000 Rs/month total energy expenses. Here, I also want to mention that the average household income in village Balolia was approximately 6000 - 8000 Rs/ month. Generally, households of the village Balolia, shared their energy expenditures between electricity and fuelwood while households of the village Kakul spend on electricity and natural gas. At last, I could say that use of fuelwood for cooking and heating purpose severally worsen the livelihoods of the rural people.

7. ALTERNATIVE ENERGY RESOURCES & TECHNOLOGIES IN PAKISTAN

7.1 ALTERNATIVE ENERGY RESOURCES POTENTIAL IN PAKISTAN

Pakistan is blessed with an abundance of renewable energy potential, but so far this remains unharnessed except for a few large hydroelectric projects. Pakistan has recently showed its to renewable energy sources, but realizing these in practice could still be a long way off. Many now believe that Pakistan needs to initiate a transition towards greater use of renewable energy as an indigenous, clean and abundant resource. The Government of Pakistan intends to pursue this objective of harnessing power from renewable resources with the full participation and collaboration of the private sector. The Government makes policies and strategies to exploit such resources and attract investments in electricity generation projects utilizing hydro , wind and solar power. Additional policy guidelines shall be issued in the future concerning biomass conversion and other Renewable Energy technologies, as well as for non-power renewable energy applications, as the sector grows and technology advances take place (Development of Renewable Energy for Power Generation, Employing Small Hydro, Wind, and Solar Technologies. Government of Pakistan 2006).

The table 7.1 given below shows a brief summary of the available renewable energy potential in Pakistan.

Table 7.1: Brief Summary Of the Available Renewable Energy Potential In Pakistan

Resource	Potential
Hydro	The total Hydro Power potential in the country, not fully investigated but conservatively calculated to be 45,000 MW.
Wind	It has been estimated that Pakistan has 346,000 MW wind power potential, out of which around 60,000 - 70,000 MW is technically exploitable. According to the wind map of Pakistan, major wind corridors are, in Southern parts of sindh, Central parts of Khyber Pakhtunkhwa and AJK, Western parts of Balochistan, with several isolated wind corridors in central and Western punjab, Central and Southern Balochistan and Gilgit Baltistan areas.
Solar: Photovoltaic (PV) and thermal	Pakistan is blessing with solar potential of more than 5-6 kWH/m^2/day of irradiation in many areas. The potential is feasible for both Solar PV and Solar Thermal application. The area with highest solar potential is the province of Balochistan followed by Eastern Sindh and Southern Punjab promising technical and financially viable solar energy projects.

Resource	Potential
Biomass: Bagasse, rice husk, straw, dung, municipal solid waste, etc.	Pakistan's agricultural and livestock sector produces large amounts of biomass in the form of crop residues and animal waste, such as bagasse, rice husk, and dung, much of which is currently collected and used outside the commercial economy as unprocessed fuel for cooking and household heating. In addition, municipal solid waste produced by a large urban population is presently openly dumped, which could instead be disposed of in proper landfills or incinerated to produce useable methane gas or electricity. This sector has estimated potential of generating 4,000 MW of power.
Geothermal	There are several sites identified in different parts of the country having exploitable geothermal potential. Sites with different ranges of temperature and the pressure underneath the earth surface. The geothermal heat available at these sites can be used for power generation as well as internal heating/cooling purposes. However, exact potential for geothermal heat and power is still to be exploited. This sector has estimated potential of generating 2,000 MW of power.
Ocean	Pakistan is blessed with 1,046 km long coastal belt. There are several sites within this belt which can be exploited for power generation. However, exact potential of generating power from ocean is still to be exploited.
Biofuels	Pakistan being the agricultural country is having huge prospects for energy plantation. Around 34 million hectares of marginal land is available in different parts of the country that is best suited for this purpose. This has estimated potential to produce 50 million tones of bio-fuels per annum.

Source**:** Alternative and Renewable Energy Policy 0f Government Of Pakistan, 2011.

7.2 ENERGY TECHNOLOGY PROMOTED BY NGOs & GOVERNMENT OF PAKISTAN

Government of Pakistan (GOP) and NGOs are working on renewable energy resources like hydro power, wind power, solar (PV), biogas etc. Alternative Energy Development Board (AEBD) is actively engaged with Agha Khan Rural Support Program (AKRSP) to install 103 Micro Hydro power plants at various places like Chitral and other parts of Gilgit Baltistan. Moreover, UNDP-GEF (United Nation Development Program- Global Environmental Facility) have committed US $ 1.00 Million for Productive Use of Renewable Energy (PURE). It has been recorded by USA in collaboration with USAID that wind power potential in Pakistan is around 346,000 MW. The Government of Pakistan has made a target that power generation from ARE (Alternative Renewable Energy) sources by the year 2030, should be contributed at least 5 %. AEDB is also engaged in facilitating private sector organizations for building and promoting waste to energy projects in Pakistan. Therefore, AEDB is formulating national strategy and policies for the utilization of waste to energy resources to achieve targets sets by federal Government.

In Pakistan, Public sector organizations are actively engaged in research, development, promotion and dissemination work in the field of renewable energy. Pakistan Council Of Renewable Energy Technologies (PCRET) and Alternate Energy Development Board (AEDB) are playing a major role in promoting the renewable energy technologies in the country. Therefore, some other departments such as Pakistan Council of Scientific and Industrial Research (PCSIR), Agha Khan Rural Support Program (AKRSP), National University of Science & Technology (NUST), COMSAT Institute of information technology and National Center for Physics and some universities are participated in research and development of renewable energies in Pakistan (Pakistan Renewable Energy Report, 2009).

Moreover, several International donor agencies such as Asian Development Bank (ADB), United Development Program (UNDP), European Union (EU-Asia), German Agency for Technical Corporation (GTZ), and World Bank have started various mega projects for the promotion and development of RET in Pakistan (Pakistan Renewable Energy Report, 2009).

China and Pakistan has signed an agreement on February 2009. According to this agreement China will provide technical assistance to Pakistan for hydropower projects on the model of the Three Gorges Dam, which is one of the largest hydropower complexes in the world (Dr. Zaidi, Z.I., 2009).

During the last two decades, Pakistan has not made significant developments in Renewable Technologies. Photovoltaic technology commonly used for rural electrification, telephone exchanges, highways emergency telephone, refrigeration of vaccines etc in Pakistan. Solar Panels in different powers and sizes are imported from America, Europe, china and also being constructed in the country. PCRET has manufactured solar water-heaters, solar dehydrator, solar cookers and solar desalination plants. Solar dehydrator are commonly used in Northern areas of Pakistan for drying of fruits and vegetables. Solar water heaters are very populated in northern areas, manufacturing locally in the country and also imported from America, Australia, Europe and China. PCRET is mainly engaged in the installation of biogas plants in Pakistan, which are locally constructed. PCRET and Agha Khan Rural Support Program are also engaged for making micro hydel plants in the Northern area of Khyber Pukhtunkhwa. Micro hydel turbines are fabricated through local manufactures and wind turbines are imported from abroad. Now, the micro wind turbine manufacture facilities are available in Pakistan (Pakistan Renewable Energy Report, 2009).

7.3 POTENTIAL AITERNATIVE ENERGY RESOURCES AND TECHNOLOGIES IN ABBOTTABAD

Abbottabad is a district of Province Khyber Pukhtunkhwa Pakistan. It comes under Northern areas of the Pakistan. The Northern part of the country has great hydro power potential. There is a large number of sites in Khyder Pukhtunkhwa Province where natural and manageable water-falls are abundant and available. There are large number of micro.hydro power plants could be installed in these hilly areas. The population in these areas is scattered and is located far from physical infrastructure. Such rural population could be benefited from such energy sources.

The provincial government of Khyder Pukhtunkhwa had been decided to spend most of foreign aid on energy projects by freeing its Provincial Annual Development Program (ADP) funds during last fiscal year 2010-12. The Sarhad Hydel Development Organization (SHYDO), Khyder Pukhtunkhwa has initiated to restart construction work on the project in current fiscal year 2011-12 to fulfill growing energy needs of the province (Shah, A.A., 2011). Shydo, had constructed a three year feasibility study for several renewable energy projects to generate 48MW power in the Province, including Kyoto HPP (Dir Lower) with capacity of 31MW, Karoro New HPP (Manshera) 7MW. The energy and power department had prepared a hydel development action plan for 2011-2025. The action plan include seven different power projects of total capacity of 524MW in the Province (Shah, A.A., 2011).

Biogas is environment friendly technology and could be used for lighting, cooking, water heating and space heating especially in rural areas. Almost, 70% population in Pakistan lives in rural areas. So, dung from animals is available in all the four provinces of Pakistan. There are two common types of biogas plants. The chinese design could not succeed because it is more technical and required skill for the construction of leak proof biogas plants. Therefore, the Indian design of moveable dome with few modification was getting success in Pakistan (Dr. Zaidi, Z.I., 2009).

Biomass includes trees, grasses, crops residues, aquatics plants, animal manure, etc. Biomass is a renewable energy resource and could be available as long as the Sun shines. Biogas is a most significant type of biomass energy which makes optimal utilization of the valuable natural resource of dung. It is the source of clean gas for cooking and household energy needs. It could also provides enriched bio-fertilizer for improvement of soil productivity. Promotion and development of biogas technology could not only offset the fossil fuel from wood consumption but could also enhance the process of recycling of nutrients from agro-animal residues. Moreover, biogas could also contribute towards environmental protection, sustainability of ecosystem and conservation of biodiversity.

According to the per livestock census 2002-03, there are 48 million of animals in Pakistan and there average daily dung dropping is almost 690 million Kg. " It has been assumed that only 50 % collect ability, could produce 17.25 million cubic meter of biogas daily by anaerobic fermentation of dung through installation of about 5.0 million family size biogas plants, which could meet the cooking needs of 50 million people. Doing this we could meet about 50 % cooking requirements of the rural masses from biogas alone. Besides this, it could also provide 35.04 million tons of biofertilizer per year, which could play significant role for sustaining the fertility of agricultural lands." (Dr. Khalil, M.S., 2009).

Biogas production could also be introduced as a pilot project in this area. It needs to check the feasibility of such intervention by experts.Site selection is an important criterion for biogas plants. In different villages different biogas models could be installed. Biogas plants could be feasible in the study villages but their capacity will be reduced in winter season due to cold temperaure. This biogas could be used for lighting and heating purposes.

The use of fuelwood for energy especially for cooking and heating is causing significant pressure on the forest resources. To minimize this pressure, alternative fuel sources should be considered for conservation of forest and biodiversity. Therefore, LPG cylinder, solar panels, solar heaters and solar cookers could be introduced at the local level. It was also observed that LPG cylinder may not be affordable by the rural communities, because these people are economically very poor. So, in these rural areas fuel efficient stoves could also be a best option. Whereas solar panels are also expensive and cannot be affordable for the rural people individually, so these panels could be distributed at community level like in mosques, schools, colleges, Government dept. Hospitals etc. During the field work, it has been observed that most popular stove used for cooking in study areas was still traditional stove. Some NGOs like WWF and Sungi Foundation had already done few small projects on fuel efficient stoves in District Abbottabad and Muree. WWF has distributed fuel efficient stoves in Nathia Galli (Muree). During my field work, personally I had visited Nathia Galli, I had found that benefited people were very satisfied with fuel efficient stoves. By introducing these fuel efficient stoves in village Balolia, we could reduce pressure on forest resources and could also improve indoor environmental conditions. It could also reduce diseases caused by fuelwood smoke.

Solar water heaters and cookers and even water purification plants could be introduced in the study area. But before introducing such kind of technology, it is better to have a detail feasibility study. In Summer Sun duration is more, so it could be utilized for more time. However in Winter as the Sun duration is for less time Solar cookers panels could be utilized for less time. But it could contribute

in decreasing the pressure on forest in these areas where people totally rely on fuelwood for energy. It has been calculated that, number of clear Sunny days varies from 250 in northern region to above 300 days in all other parts of the country (Dr. Zaidi, Z.I., 2009).

PCRET has designed Solar Cells, PV modules, PV systems which could be used in Solar torch, Home light systems, street lights, Park lights, Solar Fountain and solar mobile charger etc (Dr. Zaidi, Z.I., 2009). Different Solar thermal appliances including, Solar water heater, Solar fruit and vegetable dryers, Solar water distillation plants, Solar room heating system and Solar cookers have been designed by PCRET for domestic as well as commercial purposes. These appliances could be used for household energy purposes. Different NGOs like WWF and Sungi Foundation etc had distributed Solar water heaters in District Abbottabad. They had distributed these heaters to Government dept., Community Centers, mosques, hospitals etc. These Solar water heaters works very well even in peek winter season (when sun light is less). The benefited people were fully satisfied with solar water heaters. Therefore, power generation from Solar energy could also be used for heating, cooling and cooking purpose. Solar cooker in Northern hilly areas could significantly play role in forest conversation (Dr. Zaidi, Z.I., 2009).

Pakistan Energy Council and Renewable Energy Technology has started work on the gas, electricity supply and alternate fuels, micro-hydro projects, Solar systems and biogas. Principal Research Officer of Pakistan Energy Council and renewable energy technology at Abbottabad has demonstrated that wind power generation potential is also available in some areas of Abbottabad.

7.4 EXPECTED POTENTIAL ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPROVEMENTS

Expected potential economic, social and environmental improvements could be achieved by introducing fuel-efficient technologies or appliances in the rural communities.

7.4.1 Economic Improvements could be

It has been observed that economic improvements could be achieved in study area through money saving by introducing an improved and fuel-efficient stove. By introducing fuel-efficient stoves, people could spend less time for fuelwood collection and could have more time for income generating activities like agriculture, small scale business etc and earning from these activities could be used for other purposes.

7.4.1.1 Money Saving

Money could be saved by using fuel-efficient stoves. It has been observed that fuel-efficient stove requires less firewood as compared to the traditional stove. So, by using efficient stoves, people could spend less money on fuelwood and their fuelwood collection time could also reduce. As, I have discussed in discussion part, traditional stoves require almost double fuelwood as compared to the fuel-efficient stoves. Therefore, people could cut their half fuelwood expenses by using fuel-efficient stoves for cooking purpose.

This money could be used for other purposes like household means or food. It could also be used on school and books for children. This money could also bring improvements to rural family´s life.

7.4.1.2 Time Saving

Different NGOs like WWF, UN-HABITAT and Sungi Foundation has estimated that time can be saved by using fuel-efficient stoves for cooking purpose. Traditional stoves take more time for cooking and give less efficiency. Whereas fuel-efficient stoves are more energy efficient and take less time for cooking activities.

Secondly, time could be saved during fuelwood collection. However, this time saving can be showed in two ways. People could go less often to the fuelwood collection (instead of two or three times once a week) and could also carry less head load. Firewood collection could take a couple of hours, depending on the distance to the forest and if the family members will go less often for collection then this could be a relief for them. This spare time could be used for other income generating activities. If, they will go less often for collection and will also collect less wood then it could save time and further more it could be a relief for their backs.

Moreover, women could also experience time saving during the cooking process. The fuel-efficient stove cook faster than the traditional stove. Generally, fuel-efficient stoves have two or three fireplaces and therefore more than one things can be cooked at once. However, traditional stoves have only one fireplace.

People could have more time to spend on homework, farming, agriculture, gardening, labour, on small scale business, cottage industry and on social interactions. So, if they have more time for other income generating activities then it could improve their livelihoods.

7.4.1.3 Income Generation

Manufacturing of fuel-efficient stoves at local level could also be a source of income generation for local producers. They could sell these stoves for money, for goods like maize, chicken, beans or

7.4.2 Social & Health Improvements

Social and health improvements could also be achieved by fuel-efficient stoves. They could appreciate the fast cooking, time saving, heat retaining, money saving and less work load. They could also experience the stability and modernity of stoves, the clean kitchen and the smoke reduction and safety. Social life of the rural people could also improve. Women could improve their social position and role in the families and villages. The women have traditional responsibility to organize foodS, cooking and moreover to fuelwood collection. So, the fuel-efficient stove usage could reduce their household work burden.

Fuel-efficient stove could also reduce the amount of smoke around the fire place because these stoves have efficient smoke removing chimney. Whether, the cooking place will outside or inside the house, the relief due to smoke reduction could be significant. Indoor air pollution could also reduce and indoor household conditions could be improved. Therefore, several smoke related diseases like respiratory diseases, headaches, eye burning, cough, flu etc could also decrease. The whole cooking place could be cleaner and more hygienic, as there will be less smoke and less ashes. This could provide better kitchen climate, attracting less flies and bacteria to breed. When there will be less ashes and smoke around the pot, then the food could be cleaner and healthier.

The fuel-efficient stove could be more safer and less accidental than traditional stoves. The fire is smaller and kept within the stove. Therefore, fire cannot spread easily and could not cause accidents with children or burn down whole houses. This could bring an improvement for many families who often face injuries and kitchen´s damages.

Modern energy services could play a major role in improving the status of women in households and societies. Cooking activities are conducted by women in most of the developing countries, so they and their children are highly vulnerable to IAP generated by fuelwood burning. It was also

observed in some cases that when wood become scarcer, girls are withdrawn from education because more time is required for wood collection and transportation. " This could have lifelong effects on literacy, family size, well being and economic opportunities for women. Energy use patterns could also influence population growth by affecting social and economic conditions that could have an impact on family size. The development of energy for industries that generate employment and income for women can help delay the age of marriage, which is an improved determinant of fertility (WEHAB working group, 2002)

7.4.3 ENVIRONMENTAL IMPACTS

7.4.3.1 Fuelwood Saving and Reduced Deforestation

Fuelwood saving is considered the most significant aspect of fuel efficient stove. Fuelwood saving could not only provide economic benefits in terms of saved money or time, it could also have significant environmental impacts. It has been observed that fuelwood use with traditional stove is about twice as compared to the fuel-efficient stoves. Therefore, a lot of wood could be conserved by replacing traditional stoves with fuel-efficient stoves. If the fuelwood collection pressure on forest is reduced and the number of trees felled for fuelwood is minimized then this habit could significantly reduce deforestation rate. The awareness campaign in rural communities about forest protection could also play significant role in forest conservation.

The forests, bushes and hedges around the villages could also increase. The scarcity of wood could also be over come by using fuel-efficient stove because it could save wood.

7.4.3.2 Soil Improvements and Water Control

Deforestation is considered the main cause of soil degradation and erosion in hilly areas of Abbottabad. Gradual decline in forests, there are no roots to absorb water and hold the soil firm after heavy rainfalls. Therefore, floods also carrying away the top fertile soils. Therefore, timber cutting for fuelwood is also considered one of the major cause of deforestation. So, by reducing deforestation rate, we could improve soil fertility and as well as could also control floods. Instead of using dung cake as a energy purposes, dung could be used as a source of fertilizer for soil improvements.

8 ENERGY AND CLIMATE CHANGE

Almost, 2.5 billion people strongly dependent on biomass fuels to boil water and for cooking food. Therefore, 2 million tonnes of biomass are burned for cooking purpose every day. It has been observed that where fuelwood is scarce and the human population is dense, fuelwood collection significantly damage the forests. Carbon dioxide is building up in the atmosphere and it is a main cause of our climate change, leading to increased temperatures, changes in precipitation patterns, floods, droughts and more frequent extreme weather events. It has been estimated that use of biomass fuels and coal for cooking and heating contributes about 10 % and 15 % of global energy use. It is totally misperception that fuel woods are always harvested and used in a sustainable way (WHO, 2006).

The use of biomass for cooking and heating purpose in poor homes in the developing countries does not convert all fuel carbon into CO2 and water. Open fires and traditional stoves have low efficiency and lose a large quantity of the potent greenhouse gas methane (CH4), which remains in the atmosphere for decades (WHO, 2006).

By introducing household energy practices that reduce IAP, save wood and minimize GHG emissions, can play major contribution to achieving Millennium Development Goals 7 (WHO, 2006).

Anthropogenic activities increase the rate of GHG into the atmosphere. This is a major source of atmospheric pollution and this pollution has been the major cause of climate change (Hart, 2005). Biomass fuel is still the primary source of energy for most of Sub- Sahara Africa (Anderson, 1986). Rural population in South Africa still also use wood for energy purpose. It has been recorded that approximately 11 million metric tons of fuel wood is burned annually in South Africa (Gander, 1994). More than 4 million ha/yr of forest in Africa are cutted annually since 2000 (FAO 2005). Carbon emissions due to this annual loss in forests and other vegetation are recorded to range from 440 to over 1200 Mt CO2/yr in sub-Saharan Africa (IPCC, 2007). According to an estimate, deforestation and forest degradation in the tropics currently account for about 20 % of global green house gase emissions and majority of these emissions from developing countries (IPCC, 2007, Gullisonet, et al 2007).

Climate change can be tackled by mitigation (reducing sources or enhancing the sinks of green house gases) and adaptation (reducing the impacts of climate change). Forest ecosystem play a vital role in both climate change adaptation and mitigatio. Forest ecosystems act as a sinks of green house gases (Locatelli, B., et al., 2011). Efforts to reduce emissions from deforestation and forest degradation (REDD) will only succeed with the meaningful participation of indigenous people,

local communities and other relevent stakeholders that rely directly on forest for their livelihoods (The UN-REDD programe strategy, 2011-2015). International climate change negotiations and policy makers giving more attention on natural forests as a terrestrial carbon sink. The REDD climate approaches show an important international attempt to place a value on forests and their services in storing and sequestring carbon (Poffenberger, et al., 2010).

A new mechanism REDD + has been approved by the UN Framework Convention on climate change to stop deforestation, forest degradation and to reduce emissions of carbon into atmosphere. Pakistan has vast potential of controlling deforestation under REDD programe by providing due compensation to forest communities with the international financial assistance (Economic Survey of Pakistan, 2010-2011). Fedral Minister for Environment in Pakistan reported that the Ministry of Environment was implementing mega forestry project in all provinces of Pakistan for preservation and expansion of forest wealth in the country. In order to get optimum potential of REDD, it is needed to work collectively, as there are many political, social and scientific challenges should be addressd at the initial stage (Environmental Ministry Implementing Mega Forestry Projects in Pakistan, January 02, 2011. Daily Times)

CONCLUSION

It could be noted that the impacts on health of domestic fuel use go beyond indoor air pollution and affect the household economy, women´s time and activities, gender roles and relations, safety and hygiene and as well as local and global environment.

The energy situation in Balolia Village was far worse than in the Kakul village. The Balolia Village was not facilitated with gas supply and there is no possibility to facilitate this village with gas in the near future. Electricity supply was also limited, not provided in the whole Balolia Village. Load shedding was also a big problem (almost 10 to 15 hours in a day during summer season) in this village due to energy shortfall in Pakistan.

In Balolia Village, people used fuelwood and dung cake to meet their household energy needs like for cooking, heating and boiling. They also used crop residues for cooking purposes and Dilli, kerosene, candles and emergency lights for lighting purposes. Some of them also used LPG gas for cooking, boiling and lighting purpose to supplement fuelwood. Electricity was mainly used for lighting and running electrical appliances. Gender preferences of both males and females for the use of existing energy resources for cooking and heating, is identified fuelwood as the most preferred and frequently used energy resource for cooking and heating in village Balolia. Dung Cake was also used to supplement firewood, and used mostly for boiling of water (for washing & bathing) and for preparing food for animals. Female showed more preference for fuelwood usage for cooking and heating over dung cake.

Moreover, they considered firewood and dung cake as a cheaper source of energy for cooking because they get firewood and dung cake with low cost or even free of cost. A majority of the study population involved Agricultural as well as animal rearing activities at household level. So, they used animal dung for making dung cake for cooking energy.

The more frequent and preferable use of fuelwood describes the reasons for gradual and steady degradation of the mountain forest resources in and around the research area. The increase in population of the study area and its characteristic, energy poverty and the severe cold winter that needs substantial domestic heating, force its population to create a heavy pressure on the natural forest resources of the area. Cutting of fuelwood for energy purpose from the surrounding forest is a major source of forest degradation and this degradation is ultimately contributing to high loss of biodiversity and its habitats.

The study revealed that fuelwood collection source is mainly from protected forest (state owned) followed by own land (Guzara), waste land and from wood market. They collect wood 2 to 3 times in a week and mostly spend a whole day. The fuelwood collection frequency depends on the family size and also on distance from the source. Large families require more wood to fulfill their domestic energy needs, so they collect 2 to 3 times in a week. Their fuelwood demand doubles in winter season as compared to the summer season because they require more fuelwood for heating purposes. It has been recorded that, almost 56 % of the fuelwood collection was done by women and boys. Undoubtly, the most utilised fuelwood specie was Pinus wallichians, accounting for 93% of the responses followed by Quercus, Acacia, Dalbergio sisso, Salix, White & Black Mulberry and Abies Pindrow etc. They collect mostly dead wood, either on the ground or from the trees because fresh wood is heavier and difficult to carry over long distances. Their main activities affected by fuelwood collection are households and economic activities. Almost, 50% of the domestic fuelwood collection is conducted by female members while, over 36% of collection responsibility is done by male members of the households They waste much time in fuelwood collection and have less available time for the economic as well as social activities which adversely affect on rural people´s economy and their livelihoods.

Generally, they used a traditional stove for cooking. A traditional stove has an efficiency 5 to 10% and is also very hazardous to health because of its big smoke emissions and low thermal efficiency. Improved iron stove (fuel efficient stove) was also used by some people. It has a good chimney system to remove smoke from the rooms or kitchen. Fuelwood consumption rate of traditional stove was almost double as compared to the fuel efficient stove. Traditional stoves consume more wood, give less efficiency and take more time for cooking. On contrast, fuel efficient stoves take less time , consume less wood and give more heat that ultimately also reduces cooking time.

Cooking was done largely by women in inside the rooms. Cooking inside the room was a major practice in Balolia Village. Some households have a separate kitchen in their homes but they do not use it for cooking especially during winter season. They prefere cooking inside the room especially during winter season because it performes dual function like cooking and as well as heating. According to their views, cooking inside the room not only reduces their fuelwood demand for domestic heating but also reduces their HH energy expenditures.

Generally back pain, muscular pain, tiredness and injuries were the common problems faced by the people during collecting and transporting fuelwood.

Eye irritating problems, flu and headache were the common health problems faced by women using fuelwood for energy purpose in Balolia Village. Men were less victimized by these health problems because they were less exposed to fuelwood smoke. Minor burns and eye diseases were also very common health problems experienced with the fuelwood usage among young girls and children. Indoor air pollution was also a major consequence of fuelwood usage which put adverse impacts on human health especially on women and children.

The health situation was totally different in village of Kakul from the village of Balolia. Therefore, Diabetes, heart attack and blood pressure were reported more as a male health diseases. The general female health diseases found in the study village of Kakul were fever, joint problem and sugar. Flu and asthma were also reported but these were not much significant as in the case of Balolia Village. Eye disesases and headache were not reported by females. Common health diseases in children were Diarrhea, pneumonia, fever and to some extent cough and flu was also observed.

In order to overcome the increasing levels of indoor air pollution, health hazards in pakistan need an initial meeting of the energy stakeholders to make a policy and an action agenda. Simultaneously, governamental, non-governmental and academic institutions gathering evidence of impacts of interventions through available technologies like (improved stoves) could have favourable impacts especially on women and children´s health. A countrywide public awareness campaign on the association of indoor air pollution with ill health, followed by practical interventions would be a significant approach.

There are several factors that are continuously degrading district´s forests including illicit felling, regeneration failure, institutional failure, progressive depletion and the lack of participatory management. Due to the lack of affordable alternative fuels, 80 % of the district´s urban households and greater than 90 % of rural population use wood-burning stoves and rely on fuelwood. It has been observed that with the increase in population, annual fuelwood demand is growing at an alarming rate and also creating degradation for local forests. To minimize this pressure on the forest resources, alternative fuel sources should be considered. Therefore, LPG cylinder, solar panels, solar heaters and solar cookers could be introduced at the local level. During data collection, it was observed that LPG cylinder could not be affordable by the rural community, because these people are economically very poor. So, in these rural areas fuel efficient stoves could also be the best option. The most common stove used for cooking in study areas is still the traditional stove. Some NGOs like WWF and Sungi Foundation has already done few small projects on fuel efficient stoves in District Abbottabad and Muree. WWF has distributed fuel efficient stoves in some areas of

District Abbottabad. I had found that benefited people were very satisfied with fuel efficient stoves. By introducing these fuel efficient stoves in the village of Balolia, we could reduce pressure on forest resources and could also improve indoor environmental conditions. It could also reduce diseases caused by fuelwood smoke. Forests play major role in carbon sequestration and act as carbon sink. They store carbon and ultimately reduce concentration of carbon dioxide in atmosphere.

Whereas solar panels are also expensive and could not be affordable by the rural people , so these panels could be distributed at community levels like in mosques, schools, colleges, Government dept. Hospitals etc. Solar water heaters and cookers and even water purification plants could be introduced in the study area. But before introducing such kind of technology, it is better to have a detail feasibility study. In summer sun duration is longer, so it could be utilized for more time. However in winter as the sun duration is lesser time, so solar cookers panels could be utilized for less time. But it could contribute in decreasing the pressure on forest in these areas where people totally rely on fuelwood for energy.

Abbottabad is a district of Province Khyber Pukhtunkhwa Pakistan. It lies on the Northern areas of Pakistan. The Northern part of the country has a great hydro power potential. There are large number of sites in the Khyder Pukhtunkhwa Province where natural and manageable water falls are abundant and available. There are large number of micro.hydro power plants could be installed in these hilly areas. The population in these areas is scattered and is located far from physical infrastructure. Such rural population could be benefited from such energy resources.

Biogas is environment friendly technology and could be used for lighting, cooking, water heating and space heating especially in rural areas. It is the source of clean gas for cooking and household energy needs. It also provides enriched bio-fertilizer for improvement of soil productivity. There are two common types of biogas plants: the chinese design could not succeed because it is more technical and requires skills for the construction of leak-proof biogas plants. Therefore, the Indian design of moveable dome with few modification was getting success in Pakistan. But due to severe winter in District Abbottabad, production capacity of biogas plants could be reduced because temperature plays a significant role in the biological decomposition processes.

By introducing several types of affordable innovative energy technologies as mentioned in above text, could bring economic, social, health and environmental improvements for rural communities in Abbottabad.

RECOMMENDATIONS

- In order to overcome the increasing levels of indoor air pollution, health hazards in pakistan need an initial meeting of the energy stakeholders to make a policy and an action agenda. Simultaneously, governamental, non-governmental and academic institutions gathering evidence of impacts of interventions through available technologies like (improved stoves) could have favourable impacts especially on women and children´s health. A countrywide public awareness campaign on the association of indoor air pollution with ill health, followed by practical interventions would be a significant approach.
- The efficient use of domestic fuels (fuelwood, crop residues and dung cake) could offer the ideal option for sustainable household energy in rural areas of Abbottabad.
- A suitable rural energy policy should be formulated to ensure a sustainable supply of traditional fuels without having negative consequences on forest resources and the environment. The policy should also give first priority on the development of renewable energy resources
- By exploring alternative energy resources and by introducing affordable, innovative energy technologies and technical assistance could bring socio-economic, health, hygienic and indoor environmental improvements for rural communities in Abbottabad, Pakistan.

REFERENCES

Abro, R., (2003).Introducing solar power: Pakistan. Examples of successful uses of Renewable Energy Source in the south.

Aina, O.I., and Odebiyi, A.I., 1998. Domestic Energy Crisis in Nigeria: Impact on Women and Family Welfare African Economic History, No. 26, pp. 1-14

Anderson, (1986): In Von Maltitz, G.P and R.J. Scholes (1995). The Burning of Fuel wood in South Africa: when is it sustainable?. Environmental Monitoring & Assessment , 38. Kluwer Academic Publishers . Netherlands.

Arnold M, Kohlin G, Persson R, Shepherd G. 2003. Fuelwood Revisited: What Has Changed in the Last Decade? Center for International Forestry Research: Jakarta, Indonesia; CIFOR Occasional Paper No. 39.

Arnold M, Kohlin G, Persson R. 2006. Wood fuels, livelihoods, and policy interventions: changing perspectives. World Development 34: 596–611.

Arnold, M., Köhlin, G., & Persson, R. (2006). Woodfuels, Livelihoods, and Policy Interventions: Changing Perspectives. World Development, 34(3), 596-611.

Arnold, M., Köhlin, G., Persson, R., & Sheperd, G. (2003). Fuelwood Revisited: What Has Changed in the Last Decade? Center for International Forestry Research Occasional Paper No. 39, Jakarta.

Asian Development Bank (ADB). 1995. The Bank's Policy on Forestry. ADB: Manila, Philippines; Publication R232-94.

Babalola, F.D., (2010). Harnessing Energy Crisis and Gender Empowerment: Impacts of household energy consumption pattern on women´s welfare and education.

Bensel, T., (2008). Fuelwood, Deforestation and Land Degradation: 10 years of evidence from Cebu Province, the Philippines. Land Degrade. Develop. 19: 587-605 (2008).

Bruce, N., Perez-Padilla, R., & Albalak, R. (2000). Indoor Air Pollution in Developing Countries: a

Bryman, A. (2008). Social Research Methods. Oxford University Press, New York.

Cavendish, W. (2000). Empirical Regularities in the Poverty-Environment Relationship of African

Chambers, R. (1997). Who's Reality Counts? Putting the First Last. London: Southampton Row.

Chettri, N., and Sharma, E., (2007). " Firewood Value Assessment: A comparison on local preference and wood constituent properties of species from a Trekking Corridor, West Sikkim, India." Current Science 92(2), Pg 1744-1747.

District census report of Abbottabad, 2011. Pakistan Census Organisation

http://www.census.gov.pk/NWFP/ABBOTTABAD.htm

Dr. Khalil, M.S., (2011). Renewable Energy in Pakistan, Status and Trends. Pakistan Alternative Energy Development Board.

Dr. Zaidi, Z.I., (2009). Pakistan Renewable Energy Report. Asian and Pacific Center for Transfer of Technology of the United Nations - Economic and Social Commission for Asia and the Pacific.

Duraiappah, A. K. (1996). Poverty and Environmental Degradation: A Literature Review and Analysis. CREED Working Paper Series No.8, International Institute for Environment and Development, London.

Duraiappah, A. K. (1998). Poverty and Environmental Degradation: A Review and Analysis of the Nexus. World Development, 26(12), 2169-2179.

Economic Commission for Africa (ECA), Southern Africa office (SRO-SA), TPUB. (2005-2006). Sustainable Energy. A framework for New and Renewable Energy in Southern Africa.

Eisner, E.W. (1991). The Enlightened Eye: Qualitative Inquiry and the Enhancement of Educational Practice. New York. NY: McMillan Publishing Company.

Environmental Protection Department, Ref. SA 07-003 Review of the International Energy Policies and Actions and the Latest Practice in their Environmental Evaluation and Strategic Environmental Assessment Final Report, November 2007

http://www.epd.gov.hk/epd/SEA/eng/file/energy_index/pakistan.pdf

(Environmental Ministry Implementing Mega Forestry Projects in Pakistan, January 02, 2011. Daily Times)

ERRA. (2007). Abbottabad District Profile. Earthquake Reconstruction and Rehabilitation Authority, Government of Pakistan.

Gander, (1994): In Von Maltitz, G. & R.J. Scholes(1995). The Burning of Fuelwood in South Africa: EMA 38.Kluwer Acad. Pub.

Ghaffar, M.A., (1994).The energy supply situation in the rural sector of Pakistan and the potential of Renewable Energy Technologies. Renewable Energy,6(8), 941-976.

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. The qualitative report, 8 (4), 597-607.

Government of Pakistan, (1992). Forestry Sector Master Plan 1992. Volume 1. Islamabad, Pakistan: Ministry of Food, Agriculture and Co-operatives, Government of Pakistan.

Gullison, R., E. et al., 2007. Tropical forests and climate policy Science 316 985-6

Hart, J. (2005): “Global Warming”. Microsoft Enact 2006;(CD) Redmond, W.A: Microsoft Corporation 2005.

Hussain, F., Badshah, L., Dastagir, G., Burni, T., (2006). Ethnobotany of fuelwood plants of LADHA South Waziristan, Pakistan. Department of Botany, University of Peshawar, Pakistan. Pg 195-203.

IPCC (Intergovernmental Panel on Climate Change) 2007: The Physical Science Basis: Summary for Policymakers.

IUCN [The World Conservation Union]. 2002. Environmental Issues. Land. Fuel- wood. http:// www.edu.sdnpk.org/edu/land.htm; accessed on 15 March 2003.

IUCN Pakistan (2004). Abbottabad- An integrated Development Vision (Abbottabad Strategy for Sustainable Development). IUCN Pakistan and NWFP, Karachi, Pakistan.

Johnson, S.D. (1995). Will our Research Hold Up Under Scrutiny? Industrial Teacher Education, 32 (3), 3-6.

Clancy, J., & Skutsch, M., (2002). The Gender Energy Poverty Nexus Finding the Energy to adverse gender concerns in development. DFID Project CNTR 998521.

Kreditanstalt für Wiederaufbau (KfW). 2000. Provincial Forest Resource Inventory. Peshawar. Draft final report.

Kumar, R., (2008). Research Methodology: A Step-By-Step Guide for Beginners, 2nd Ed., Pearson education.

Laxmi, V., Parikh, J., Karmakar, S., Dabrase, P., (2003). Household Energy, Women´s hardship and health impacts in Rural Rajasthan, India: Need for sustainable energy solutions. Energy for Sustainable Development. Volume VII No.1.

Lincoln, Y.S., & Guba, E. G. (1985). Naturalistic inquiry. Beverly Hills, CA: Sage.

Major Environmental and Public Health Challenge. Bulletin of the World Health Organization, 78 (9), 1078-92.

Liu, G., Lucas, M., Leishen, (2008). Rural household energy consumption and its impacts on eco-environment in Tibet: Taking Taktse county as an example. Renewable and sustainable energy review 12 (2008) 1890-1908.

Matinga, M.N., (2010). “WE GROW UP WITH IT” An ethnographic study of the experiences, perceptions and responses to the health impacts of energy acquisition and use in rural South Africa.

Mc Peak, J., (2002). Fuelwood Gathering and Use in Northern Kenya. New York, Department of Public Administration, Syracuse University.

Morgan, G., and Smircich, L. (1980). The Case for Qualitative Research, Published by: Academy of Management, 5, 491-500.

Murphy, M.F.G., (2009). " What is free about fuelwood?" A critique of the value of fuelwood in the rural and squatter settlement households in the Eastern Highlands of Papua New Guinea, PhD thesis, Southern Cross University, Lissome, NSW.

North West Frontier Province Forest Ordinance, (2002). Published by Government of the NWFP, law department.

Pandey, D., (2000). Fuelwood studies in India- Myth and Reality. Jakarta, Center for International Forestry Research (CIFOR).

(Poffenberger, Mark, Hanssen, S., Kathryn, 2010. Forest Communities and REDD Climate Innitiatives)

Project Procurement International, (2011). Environment and Natural Resource Management Assessment Report for Area Integrated Program in Nathia Gali, Abbottabad. www.projectpi.com.pk . Conducted by World Vision Pakistan.

Proceeding of a workshop held by OFID in Abuja, Nigeria June 8-10-2008. Energy poverty in Africa.

Rural Households. World Development, 28 (11), 1979-2003.

Reddy, AKN and BS Reddy (1994). Substitution of energy carriers for cooking in Bangalore. Energy; 19 (5): 561-71.

Schirnding, Y.V., Bruce, N., Smith, K., Ballard-Tremeer, G., Ezzati, M., Lvovsky, K. (2002). Adressing the Impact of Household Energy and Indoor Air Pollution on the Health of the Poor-Implications for Policy Action and Intervention Measures.

Sepp, C., (2000). Household Energy and Forestry. Germany, Eco Consulting Group: 7 pp

Shah, A.A., (2011). Khyber Pukhtunkhwa Floods Hindered Development Of Renewable Energy Projects. Article Published in Business Recorder Newspaper.

Siddiqui, K. M., M. Ayaz, and A. Jah. 1990. Fuel collection in coniferous forests of Hazara Civil Division, N.W.F.P. Pak. J. Forestry, 40: 71-81.

Stern, R.D., Coe, R., Allan, E.F., Dale, I.C. (2004) Good statistical practice for natural resources research. CABI Publishing, Oxfordshire.

The Secretary-General´s Advisory Group On Energy And Climate Change (AGECC) (2010). Energy for Sustainable Future, summary report and recommendations.

WEHAB working group, (August 2002). A Framework for Action on Energy. World Summit on Sustainable Development.

WHO, (2005). Situation Analysis of Household Energy Use and Indoor Air Pollution in Pakistan.

WHO, (2006). Fuel for life, Household Energy and Health

World Health Organization (WHO) 1984. Biomass fuel consumption and health. World Health Organization (WHO), Geneva.

World Health Organization (WHO), 2007. Indoor Air Pollution: National Burden of Disease Estimates. WHO, Geneva

APPENDICES

APPENDIX I

HOUSEHOLD QUESTIONNAIRE

General Household Information

Household head	☐ Male
	☐ Female
Sex of respondent	☐ Male
	☐ Female
Name of respondent	
Age of respondent	Age_____ years
Education level of respondent	☐ Never attended school
	☐ Attended primary school
	☐ Attended middle school
	☐ Attended high school
	☐ College level or above
Household Category	☐ Poor
	☐ Medium
	☐ Better off
Name of village	
Number of family members	Male = female= children=
Type of house construction	Kacha
	Pakka
	Shelter
Major cast	
Agricultural Land holdings (kanals)	☐ 0-5 ☐ 6-10 ☐ 10+
Forest land	☐ 0-5 ☐ 6-10 ☐ 10+
Agriculture crops	Wheat, Area in kanal= Prod=
	Maize, Area in kanal= Prod=
Livestock	**# of Buffalo=**
	# of cow=
	# of bull=
	# of goat=
	# of sheep=

Q.1 What is your major source of household income?

- ☐ Agriculture
- ☐ Non-Agriculture
- ☐ Business
- ☐ Services
- ☐ Other (specify).....

Q.2 What are the major existing energy resources, uses and purposes served ?

Energy Resource Usage

1._____ 1._____
2._____ 2._____
3._____ 3._____
4._____ 4._____
5._____ 5._____

Q.3 Which energy resource prefer most by men?

1. For cooking ..... why.....
2. For lighting ..... why.....
3. For heating ..... why.....

Q.4 Which energy resource prefer most by women?

1. For cooking ..... why.....
2. For lighting ..... why.....
3. For heating ..... why.....

Q.5 What do you use for lighting, currently? (Give Ranking)

- ☐ Electricity
- ☐ Kerosene
- ☐ Candle
- ☐ Other (specify).....

If answer candle/ kerosene, why use these more.....?

Q.6 How many hours you use candle or kerosene for lighting in a day?

- ☐ One hour
- ☐ Two to three hours
- ☐ Four hours
- ☐ If More (specify.....)

Q.7 What type of fuels do you use for cooking? (Give Ranking)

- ☐ Fire wood / fuel wood
- ☐ Straw or agricultural residues
- ☐ Animal manure wastes
- ☐ Electricity
- ☐ Gas
- ☐ Fossils fuels
- ☐ Other (specify).....

First priority which & why,.....?

Q.8 If you use more than one fuel, what is the second fuel you use for cooking?

- ☐ Wood
- ☐ Residues
- ☐ LPG Stove
- ☐ Kerosene stove
- ☐ Others

Q.9 How do you heat the house?

- ☐ No heating system
- ☐ Electric heating
- ☐ Electric heating stove
- ☐ Use coal, charcoal or fuelwood
- ☐ Gas heater
- ☐ Other (specify).....

First priority which & why,.....?

Q.10 What are the major energy needs of men?

1._____
2._____
3._____
4._____

Q.11 What are the major energy needs of women?

1._____

2._____
3._____
4._____

Q.12 Who is the main firewood collector?

- ☐ Women
- ☐ Girls
- ☐ Women & girls
- ☐ Boys
- ☐ Men
- ☐ Boys & men

Who is the main & why.....?

Q.13 Children interest in collection of wood?

- ☐ Like
- ☐ Dislike

If dislike then why.....?
Q.14 How much time spend for collecting firewood.....?
Q.15 How much travel across the villages in search of wood, animal waste and crop residues?
.....

Q.16 How many times you collect firewood per week?

- ☐ Once per week
- ☐ Twice per week
- ☐ Three times per week
- ☐ More than three times

Q.17 Collected firewood comes from

- ☐ Own farm
- ☐ Open land
- ☐ Public forest/ bush
- ☐ Other sources (specify.....)

Q.18 How do you get firewood?

- ☐ Collect it
- ☐ Buy it
- ☐ Buy and collect it

What constraints do you face during firewood collection?

1. .....
2. .....
3. .....
4. .....

Q.19 How many meals do you cook per day?

- ☐ One meal per day
- ☐ Two meals per day
- ☐ Three meals per day
- ☐ More

Q.20 Do you cook inside the house?

- ☐ yes
- ☐ No

If yes then why,.....?
Q.21 Do you have separate kitchen?

- ☐ Yes
- ☐ No

If no then why,.....?
Q.22 What is the main stove type you used for cooking?

- ☐ Three stone fire

☐ LPG stove
☐ Kerosene stove
☐ Others (specify.....?

If three stone stove then why.....?

Q.23 What type of problems experience by women with use of biomass and animal manure for energy?

1._____
2._____
3._____ _____
4._____ _____
5._____ _____

Q.24 What type of problems experience by men with use of biomass and animal manure for energy?

1._____
2._____
3._____ _____
4._____ _____

Q.25 What type of problems experience by girls and children with use of biomass and animal manure for energy?

☐ Girls .....
☐ Children .....

Q.26 What could be the possible solutions to overcome these problems?

1._____
2._____
3._____ _____
4._____ _____
5._____ _____

Q.27 Do you have an air ventilation system in house?

☐ Yes
☐ No

If yes, then what type of system .....?

Do you have an air ventilation system in kitchen?

☐ Yes
☐ No

If yes, then what type of system .....?

And why this .....?

Do you need improvement ?

☐ Yes
☐ No

Q.28 In what ways indoor household conditions could be improved?

1._____
2._____
3._____ _____
4._____ _____
5._____ _____

Why you did not still have it.....
.....

Q.29 Would you recommend this source of energy to other users?

☐ Yes
☐ No

If no then why.....?

If yes then why.....?

Q.30 Why you use firewood as a domestic use?

☐ Easy access
☐ Cheap source
☐ Traditional cause

☐ No other source available
☐ Other (specify.....)

Why you use dung cake as a domestic use?

☐ Easy access
☐ Cheap source
☐ Traditional cause
☐ No other source available
☐ Other (specify.....)

Q.31 What is your source of electricity?

☐ Grid electricity (centralized)
☐ Decentralized

If decentralized, then do you have any possibilities of being connected to the grid in the near future

☐ Yes
☐ No

Q.32 which energy resource is more expensive?

1.....why.....
.....

And which energy resource is more cheaper?

2.....why.....
.....

Q.33 How you think about your firewood expenses for HH energy?

☐ Very expensive
☐ Expensive
☐ Fair
☐ Cheap
☐ I do not pay for firewood

Q.34 How you think about your electricity expenses for HH energy?

☐ Very expensive
☐ Expensive
☐ Fair
☐ Cheap
☐ I do not pay for electricity

Q.35 If your energy expense is high, what are the reasons?

☐ Over consumption of energy
☐ High fuel cost
☐ High electricity cost
☐ High firewood cost
☐ Other reason (specify.....)

When energy expenses go up and down and why .....
.....?

Q.35 Have you ever adopted energy saving measures?

☐ Yes
☐ No
☐ If yes, then what.....?

And why .....?

Q.36 Do you want to replace the existing energy resources with alternative energy resources?

☐ Yes
☐ No

If yes, what you prefer .....?
And why .....?

Q.37 What are the most common diseases among rural people?

1._____
2._____ 3.----------

Q.38 Which health problems experience most by women ?

1._____
2._____
3._____

Q.39 Which health problems experience most by men?

1._____
2._____
3._____

Q.40 Which health problems experience most by children (less than 10 years old)?

1._____
2._____
3._____

Q.41 Which health problems experience most by girls & boys?

1._____
2._____
3._____

Q.42 How many rupees (Rs.) you spend?

For kerosene oil in a week.....?
For firewood fuel in a week.....?
For electricity in a month.....?
For LPG gas in a month.....?

Q.43 Which energy technology is promoted more by Government of Pakistan and NGOs?

1. _____

2._____

What you think about it _____

_____

Its according to your needs _____

_____

If not, why_____

_____

Who is coming with it? _____

_____

They understand your energy needs _____

_____

Will give you cheap energy _____

APPENDIX II

Focus Group Discussion

Q.1 What are the major existing energy resources for household cooking, heating and lighting?

Q.2 Which energy resource prefer most by men & women?

1. For cooking .....
2. For lighting .....
3. For heating .....

Q.3 What are the major energy needs of men and women and for what purpose?

Q.4 What are the perceptions of rural men and women about the use of biomass for domestic energy purposes?

Q.5 Which energy resource contribute more ?

For cooking?

For lighting?

For heating?

Q.6 How does the use of energy resources vary with rural household income levels (poor, medium & better off)?

Q.7 What are the negative impacts of existing energy resources on rural people and their livelihood?

Q.8 How the impacts of existing energy resources varies by gender?

Q.9 Is there any positive role played by traditional biomass energy in rural household development?

Q.10 What are the major health consequences of use of biomass energy on rural women and children?

Q.11 Do the people want to replace the existing energy resources with clean and affordable energy resources?

Q.12 In what ways indoor conditions could be improved?

Q.13 Why you use firewood as a domestic use?

Q.14 Who is the main firewood collector?

Q.15 What are the major energy needs of men and women?

Q.16 Do you cook inside the house?

Q.17 What is the main stove type you used for cooking?

Q.18 Have you ever adopted energy saving measures?

Q.19 What are the most common diseases among rural people?

Q.20 Which energy technology is promoted more by Government of Pakistan and NGOs?

Q.21 What are the potential and constraints of resources.

APPENDIX III

CASE STUDY

Name _____ Age _____ Sex_____
Village _____ Education _____ Caste _____

Marital status_____ When got married ?_____

When you come to know bout your disease? (Before or after marriage?)

_____
_____

What in your opinion could be the cause of your disease?

_____
_____

Did you go to the doctor?

_____

What was his opinion?

_____
_____

Did he take any tests?

_____
_____

What was diagnosed?

_____
_____

What was your daily routine before the diagnosis of disease?

_____
_____

Is there any change in the daily activities now?

_____
_____

Are there any specific times when your condition becomes severe? (like cooking, dusting, washing etc.)

_____
_____

What fuel you used for cooking and other activities like heating water for washing or bathing before marriage?

_____
_____

What are the current fuels?

_____

_____

Are there any issues related with the firewood smoke?

_____
_____

Are there any issues related with the natural GAS used as a domestic fuel?

_____
_____

What in your opinion is the better fuel among firewood, natural gas, and dung cake?

_____
_____

Are there any specific diseases in your family?

_____
_____

Is there a person in your family suffering from same disease as you are suffering?

_____
_____

In what age group is this disease in your family mostly prevailing?

_____
_____

Has any one in your family died of this disease?

_____
_____

Can you suggest any cause of this disease?

_____
_____

Is there any traditional way of treating this disease?

_____
_____

APPENDIX III

Semi structured Interview for Forest Department

1. Total Forest Area.....?
2. Forest Type .....?
3. Common Forest Area .....?
4. Legislation about cutting, (especially for local people)...?
5. Wood cutting allowed or not .....?
6. If allowed, then what type of cutting is allowed.....?
7. What type of cutting is not allowed.....?
8. What are the major tree species .....?
9. Which tree species mostly used for firewood .....?
10. Current deforestation rate.....?
11. What you think, deforestation rate is increasing or decreasing.....?
12. Measures to control deforestation rate.....?
13. Is allowed wood cutting for commercial purpose or not.....?
14. If yes, then for what purpose.....?

FOCUS GROUP DISCUSSION IN VILLAGE KAKUL

INTERACTION WITH COMMUNITY IN BALOLIA VILLAGE

THREE IN ONE (KITCHEN, BEDROOM AND TV ROOM)