Purposeful Emergence and Knowledge Networking in the Large Cardamom (*Amomum subulatum*) Agroecosystems of Sikkim and Beyond

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ABSTRACT

In human activity systems, systemic resilience arises as a result of the causal relationships between its intrinsic structure (organizational boundary) and the functional interconnectivity among actors within it (communication) through a process of collective inquiry over time. In traditional agricultural communities farmers often find themselves ill equipped when it comes to finding effective innovations on their own to deal with extrinsic pressures on a crop or practice. Conversely, scientific results yielded through controlled experiments may make broad claims and fail to account for the intricate socio-ecological and economic context the farmer is facing. Rather, inquiring into complex, systemic issues in agroecosystems requires a more comprehensive, holistic approach. A trans-disciplinary convergence of knowledge, perspectives and resources from actors at each stage in the value chain could help build innovation capacity and bring socioeconomic and ecological resilience to the system.

Large cardamom (*Amomum subulatum*) is a rare and endemic spice crop which has played an important role in the shaping of rural livelihoods and land use practices in the middle hills of Sikkim, India. In the past 10 years, the crop has experienced a decrease in production and productivity due to a chain of factors; many plants have become compromised due to continuous vegetative propagation and increased age; irregular seasonal rainfall and the effects of climate change have increased the spread of diseases and pests. The loss of large cardamom cultivation practices brings with it a host of interconnected issues, including a change in land use patterns, a loss of genetic biodiversity, family members seeking income from external sources, rural to urban youth migration, and ultimately the loss of traditional knowledge systems in Sikkim. Fortunately, society has responded through the ongoing efforts of different government and non-governmental agents whose objectives across the board seem genuinely concerned with improving the situation for rural livelihoods. A great deal of knowledge has been developed through traditional practices of large cardamom cultivation as well as through scientific research and developments. However, convergences among and between the various stakeholders within the large cardamom knowledge network are limited, and where interaction does take place it takes the linear form of training rather than a process of mutual understanding between farmers, scientists, and policymakers.

In my experiential learning process, I took on the roles of an action researcher seeking to facilitate convergences within the large cardamom system, and of a reflective practitioner seeking to improve the way I go about facilitating convergences within the system. As an action researcher, I involved a group of active stakeholders in a series of three successive workshops, through which we collectively identified root issues, drivers, and key actors in the large cardamom system, visualized gaps in the current structure for knowledge generation and sharing, envisioned a desired future for the large cardamom system, and developed a strategic action plan based on a real convergence of knowledge and resources of different stakeholder constituencies. Additionally, the specific case study on the complex issues surrounding large cardamom served as a window through which the larger opportunities and challenges towards a "sustainable Sikkim" could be collectively interpreted. As a reflective practitioner I was required to bring my own knowledge and experience into perspective, combining workshop results with the tools and techniques I have acquired in order to develop models for systemic improvement and identify limitations or assumptions I have about the world which affect and are affected by my practice as an action researcher.

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LIST OF ABBREVIATIONS

AFS	Agroforestry Systems
AR	Action Research
BMC	Biodiversity Management Committee
CARS	Community-Based Agroforestry Replantaion Scheme
CAU	Central Agricultural University
CM	Chief Minister
DST	Department of Science & Technology
FEWMD	Forest Environment & Wildlife Management Dept.
FRO	Foreigners Registration Office
FS&AD	Food Security and Agriculture Dept.
GBPIHED	GB Pant Institute for Himalayan Environment and Development
GIAHS	Globally Important Agricultural Heritage Site
H&CCD	Horticulture and Cash Crops Development Dept.
ICIMOD	International Center for Integrated Mountain Development
ICRI	Indian Cardamom Research Institute
KBA	Kangchendzonga Biosphere Reserve
KVK	Krishi Vigyan Kendra (Farmer Knowledge Extension)
LC	Large Cardamom
LNU	Norwegian Children and Youth Fund
MAT	Mutually Agreed Terms
MGNREGA	Mahatma Ghandhi Rural Employment Guarantee Scheme
NBA	National Biodiversity Authority of India
NERAMAC	North Eastern Regional Agricultural Marketing Corporation Ltd.
NTFP	Non-Timber Forest Products
PAR	Participatory Action research
RAAKS	Rapid Appraisal of Agricultural Knowledge Systems
RMDD	Rural Management Development Dept.
SAP	Strategic Action Plan
SB	Spices Board
SBCFP	Sikkim Biodiversity Conservation and Forest Management Project
SICB	State Institute of Capacity Building
SSC	Sikkim Sustainability Coalition
SSM	Soft Systems Methodology
ST	Systems Thinking
TGA	Total Geographic Area
TIPI	Trans-Interpersonal Inquiry
TKS	Traditional Knowledge Systems
TMI	The Mountain Institute-India

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1. Introduction

Whoever coined the phrase “knowledge is power” was only partially right. What they did not specify is the type of knowledge which is serving to empower the individual. According to Leeuwis and van den ban (2004) knowledge represents power in two ways; the first is insofar as it serves to strengthen the dominant paradigm or worldview of a particular society, and the second is through its ability to unite people and transform societies. The degree of influence which a specific type of knowledge holder has in society is called their *agency.* In the case of rural agricultural development, farmers have traditionally held less agency than the scientists, extensions workers, or policy makers who would seek to improve their very lives. This sometimes becomes apparent when words like *transfer* of technology and knowledge *dissemination* are the goals and objectives of funded programs. These schemes are often short lived and rarely have the desired adoption rate beyond a few years. In contrast, a multiple perspective stakeholder constituency is more situated to address complex and changing conditions, and future actions are based on the continuous dynamic interaction between diverse knowledge holders.

Increasing pressures such as climate change and cultural influences are permeating and changing the unique socio-ecological and agricultural traditions in Sikkim, India. My research took me to Sikkim and through a process of participatory inquiry, where we addressed the emerging environmental, socioeconomic, and political issues affecting large cardamom, and the capacity for farmers to innovate. While farmers have found agricultural innovations and adaptations to the climate and land over time, these issues are affecting rural society at a faster rate than they are able to find accommodations to. The symptoms of climate change are manifested through the rapid spread of diseases at higher altitudes, irregularity of seasonal rainfall, and the drying up of high altitude springs, while the symptoms of socioeconomic pressures are seen as a change in family values and a rural to urban migration of youth seeking alternative income to support their families.

Currently, scientists are conducting both ex-situ and in-situ studies on improving large cardamom productivity and disease resistance through tissue culture trials. The studies are yielding promising results, but these kinds of studies take time and repetition to be certain. Researchers at The Mountain Institute – India among others have published extensive reports on the multi-functional benefits of traditional *Alnus*-cardamom agroforestry systems in Sikkim. What does not

exist, however, is a focus of the policymakers on developing long-term sustainable accommodations to these issues.

Traditional cash crop agroforestry ecosystems have emerged as a way to stabilize the soil and maintain irrigation on marginal land while maximizing returns per hectare. Perhaps the most socio-ecologically adapted agroforestry system in Sikkim incorporates the endemic spice crop large cardamom (*Amomum subulatum* Roxb.) beneath the shade of its natural associate the Himalayan alder (*Alnus nepalensis* D. Don). Large cardamom is a perennial, herbaceous rhizome which grows well on marginal land under forest canopy and can live up to half a century or more, but reaches its peak productivity around 20-30 years then becomes much less productive (Zomer and Menke, 1993). The *A. nepalensis* is a high altitude N-fixing tree, which cycles nutrients to large cardamom through litterfall for up to 20 years, after which it decreases the N-fixing capacity and increases lignin in leaves (Sharma et al., 2008).

Farmers who originally established the plantations were attracted to the low-input, high-return potential of this system, and prospered economically over decades of production. As these plantations aged beyond their productivity range, signs of weakness and susceptibility in the system began to emerge. Most have put the blame on the compromised age of large cardamom plants and the irregularity in climate and seasonal precipitation for creating the conditions in which the diseases have spread so quickly. However, before addressing the complex root issues in the system, it is important to explore the knowledge network regarding large cardamom and the capacity of farmers to innovate and adapt to the changing conditions that are affecting their livelihoods in the present.

A lack of roads and infrastructure in the rural areas of Sikkim presents a problem for remote farmers who are not able to keep up on scientific findings regarding disease and pest management. Likewise, a plant scientist conducting breeding trials may have little understanding of the cultural or socioeconomic context of the large cardamom farmer and his or her practices. The gaps between scientific knowledge holders and farmers are filled by extension agents and NGO workers, but their reach and effectiveness are limited by issues of funding, time and commitment. Government policies in agriculture and horticulture are, however, focused on improving rural livelihood and maximizing productivity through a state organized “Green Initiative”.

Indeed there are a host of official programs coming from different departments in the Government of Sikkim that are trying to achieve these same objectives through different means. In most cases these schemes use a linear approach of training farmers on new techniques and

disseminating scientific findings for best management practices. Unfortunately, there is a lack of interdepartmental convergence when it comes to the implementation of "improvement" schemes. The beneficiaries of these schemes are always the farmers, but there is no effort to include farmers in the process of designing them. The capacity for farmers to innovate and adopt new technology and practices would greatly improve if they are encouraged to take an active role and share their knowledge and practical experience. Once a sense of 'ownership' is felt by farmers regarding the policies that affect their lives, confidence and commitment to goals could increase.

With this understanding of issues and actors in the system, I defined my research objective **"to facilitate the transition towards a more efficient knowledge and information network within the large cardamom value chain in Sikkim in order to strengthen the innovation process and empower farmers to generate sufficient livelihoods while simultaneously preserving regional biodiversity"**. Through a participatory action research methodology, and using the tools and methods of Soft Systems Methodology (SSM) (Checkland and Poulter, 2006) and Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) (Engel, 1997), I wanted to answer the following research questions:

What are the various causes for the need to innovate in large cardamom systems of Sikkim (main problems observed)?

What or who is driving innovation in the large cardamom knowledge system?

How could the existing knowledge network be strengthened to maximize innovation?

Is there a shared vision for the future of large cardamom in Sikkim?

Is there a need for new roles or initiatives in order to achieve a proposed 'shared vision'?

What would constitute an improvement in the current social order of innovation?

What would constitute a technical innovation in the current system?

Analysis of the research results in 3 levels of discussion: concrete case study level (D1), epistemological level (D2), and at the global level (D3). I answer the research questions at the concrete case study level using the results of field surveys and a three stage participatory workshop series, combined with a literature search and reflective modeling. At the epistemological level I reflect on my own epistemology, and discuss the causal implications of the methods and tools I chose to use in the process. The third level includes a reflection on evolution, holism, purposeful emergence of "social organisms", and the importance of banishing

the illusion of “ego” in communication while seeking to achieve desirable and feasible accommodations in agroecosystems.

1.1. Why I Chose Sikkim

I first visited this beautiful land of Sikkim in 2009, during which I spent 9 months as a self-financed volunteer, building a terraced farm at Taktse International School for the hostel, and constructing 2 steel-framed greenhouses at different monasteries in North Sikkim. I fell in love with this place both for its natural beauty and unique biodiversity, and its diverse cultural and spiritual heritage. During this period, I became aware of the important role that large cardamom plays in the livelihoods of rural inhabitants and the increasing occurrence of viruses, but never went further into it until I started brainstorming ideas for my thesis work during the first semester at UMB. In my second semester at UMB, I was enrolled in a course on characterizing and managing tropical soils. For the required research paper, I decided it would be a good idea to explore the different types of soils in Sikkim, so that I could get a better understanding of the geological history and agroecology of Sikkim before I finalized my decision to conduct my thesis research there.

One of the most interesting papers I found was co-authored by Dr. Ghanashyam Sharma of The Mountain Institute-India (TMI) entitled Opportunities and Challenges of the Globally Important Traditional Agricultural Heritage Systems of the Sikkim Himalaya (Sharma and Dhakal, 2010). As soon as I discovered the mission of TMI directly reflected the agroecological objectives which I was focused on learning, specifically preserving mountain cultures, enhancing rural livelihood opportunities, and protecting mountain biodiversity of Sikkim, I got in contact with Dr. Sharma about the possibility of working as a Research Intern at TMI for the duration of my field work.

In summer of 2012, I worked with a good friend of mine from the International Students Union of Norway, HiØA in Oslo, and together we wrote a proposal and received a grant of 25,000 NOK for a global North/South project funded through the Norwegian Children and Youth Fund (LNU). We proposed to work in partnership with the Uttaranchal Youth and Rural Development Council (UYRDC) in Uttarakhand, India inquiring into the complex issues surrounding rural-urban youth migration in the Pindar River Valley. As my airfare to India was already bought and paid for through the grant, I decided to extend my stay and travel to Sikkim to speak directly with Dr. Sharma. In the following six months I worked through a rough proposal for my thesis research, through email correspondence with Dr. Sharma at TMI-India and Tor Arvid Breland at UMB, and in person with Alexander Wezel at ISARA.

From the beginning I was aware that a lot of the methods and material details would be up in the air until I became actively engaged in the system; however I decided that the research would have a focal point around the large cardamom value chain and strengthening the existing knowledge network for farmer innovation. While the methodological approach was flexible, my focus on studying the current decline in large cardamom production systems stayed the same. The loss of large cardamom seems to be a pressing issue in Sikkim at present, and I wanted to understand if it could be part of a much larger, systemic issue which could be addressed through structured dialogue from multiple-perspective.

It was during the initial months of my research while I was amassing literature and interviewing key informants that I came to learn of the unique socio-ecological and political situations surrounding agriculture in Sikkim. Some of these factors helped, while others hindered the process. One thing was certain; after interviewing key actors in the government and research and development, I found many people remarked on the need for more directed collaboration between institutions, policymakers, and civil society to address the complex issues of climate change, and globalization in Sikkim. As large cardamom is the most important cash crop, and a keystone crop of Sikkim, I decided to use the issues currently surrounding it as a 'case study', or window if you will. Through this window I wanted to explore the larger context regarding 'Opportunities & Challenges for Sustainability in Sikkim'. Sikkim has many natural advantages when it comes to sustainability: rare and endemic biodiversity, a range in ecozones from subtropical to glaciated, extensive forest cover, strong and intact cultural heritage, a rich spiritual tradition of Buddhist Dharma, and a rugged topography which does not permit extensive physical development.

Below is a short analysis of the bio-physical, socioeconomic, and political situations of Sikkim, followed by a section contextualizing large cardamom and the increasing threats to its continued production.

1.2. Sikkim in Context

Sikkim is a small landlocked state in the Northeast of India, sandwiched between Tibet to the North and East, Nepal to the West, and Bhutan to the Southeast. It is situated due north of the Darjeeling district of West Bengal. Below is a map illustrating the geographical location of Sikkim in relation the rest of India. In the following section, I will paint a picture of the climate, geography, biodiversity, agri-horticultural, socio-economic, and political contexts of Sikkim as a framework for understanding my case study. Following that is a section on large cardamom, the

importance it has played in the identity of Sikkim, and some of the issues that have arisen as a result of complex external factors.

Figure 1 Geographic location of Sikkim

1.2.1. Climate and Geography

Having only 7,096 km² of total geographical area (TGA), the state of Sikkim represents a mere .22% of the total landmass of India (Subba, 2006). On the basis of administration, the state is divided into 4 districts; North, South, East, and West. With such a small TGA, a surprisingly high diversity of physical features can be found in Sikkim, ranging in elevation from 300 - 8598 m over a distance of 114km from North to South (Avasthe et al., 2005). The state is primarily composed of rugged and inaccessible mountain terrains on three sides, which are categorized into 6 different physiographic classifications: summits and ridges, side slopes of hills, narrow valley, cliff and precipitous slope, glacial moraine, and perpetual snow cover (Subba, 2006). On the Western border lies Mt. Kangchendzonga, the third highest peak in the world at 8598m, which is surrounded by the Kangchendzonga Biosphere Reserve (KBR), and revered by the indigenous peoples of Sikkim as the local guardian deity (Bhasin, 2011).

The soils of Sikkim are less developed geologically speaking, reflecting the relatively young age of the Himalaya region in general. They generally consist of fine to coarse loam, excessively drained in some cases, and severely eroded in others. Base saturation and organic content of the soils are relatively high at 2-5% (Subba, 2006), owing in large part to percentage of forest cover,

the long growing season, and the traditional use of organic manures on agricultural soil. The Soils are Precambrian and classified into 3 broad suborders, namely Inceptisols and Entisols at 42.84% and 42.52% respectively, followed by Mollisols which constitute only 14.64% of the soils (Subba, 2006). The entire state is regarded as a watershed for the two main rivers the *Teesta* and the *Rangit*, which flow to the south into West Bengal, bringing with them increasing amounts of nitrogen, phosphorous, and organic carbon rich sediments as land under cultivation increases (Rai and Sharma, 1998).

5 different climatic zones are found in Sikkim: tropical (300-900m), sub-tropical (900-1800m), temperate (1800-2700m), sub-alpine (2700-3500m), and alpine (above 3500m) (Patiram et al., 2003). The climate varies accordingly with altitudinal increase. Sikkim is located in the Indian monsoon region, and there are three distinguished seasons, chiefly *pre-kharif* or Spring (Feb-May), *kharif* or rainy (May-Sept.), and *rabi* or Winter (Sept/Oct-Feb). The seasons coincide with both seasonal temperature and precipitation patterns, and with the types of crops and timing for planting during the year (Rahman and Karuppaiyan, 2011). Annual rainfall varies according to altitude from 5 mm at the alpine, to 4000 mm at the tropical elevation (Government of Sikkim, 2012). A recent volume was published by the Government of Sikkim (2012) showcasing articles written by several scientists who are researching the effects of climate change on water security, agriculture and livestock rearing, and the status of glaciers in Sikkim. While the temperature and rainfall data presented by the different scientists varied in some instances, a general consensus was had regarding the crucial importance of the seasonal rainfall on the livelihoods of the rural populations.

Watershed dynamics correspond to the fingering ridges and valleys converging into the river basin from higher altitudes. The main rivers are the Teesta and the Rangit Rivers, both originating from glacial sources in the North. High altitude aquifers depend on the continuous flow of the rivers in order to recharge pressure. In 1984 the State Land Use Board was formed to minimize the impact of development projects on watersheds (Patiram et al., 2003). Due to its extreme topography, the rainy season in Sikkim brings sometimes catastrophic landslide events, often leaving roads and other infrastructure in a constant state of disrepair, permanently altering the topography, and removing the fertile topsoil layers leaving land barren.

One study was conducted which compared several types of land use in a watershed of South Sikkim and the associated runoff characteristics of each (Rai and Sharma, 1998). Not surprisingly, what they discovered was that a change in land use patterns from dense forested area into agricultural land or human settlements resulted in a much higher level of sedimentation

in the river. In the most extreme example, one particular village known to have increased its land under agriculture showed a marked rise in organic carbon between the years of 1994-1995 and 1995-1996.

1.2.2. Biodiversity Context

Despite having such a small TGA, Sikkim is host to 26% of the total biodiversity in India. The most important factor influencing the vast biodiversity in Sikkim is the range of altitudes and climatic zones in such a small area. Around 81% of the TGA is under the jurisdiction of the Forest, Environment and Wildlife Management Department (FEWMD); 46% of which is classified as under forest cover and "protected". As such the felling of trees or other activities including grazing, collecting food or animal fodder, land use are strictly regulated (Government of Sikkim, 2012). According to a white paper published by the National Biodiversity Authority of India (Anonymous, 2007), Sikkim is listed under the UNESCO World Heritage Sites for being a "Gene Sanctuary for orchids and rhododendrons" (p.3).

Within this small mountainous state one National Park (KBR), and 7 wildlife sanctuaries can be found containing 4,500 species of flowering plants at different elevations: 515 orchid species, 36 species of rhododendron (many of which are endemic), 362 species of ferns and other allies, and 424 medicinal plant varieties, among others (Manmohan, 2008). The diversity of fauna in Sikkim is equally impressive, boasting 550 bird species, 150 mammals including a variety of rare and endangered species, 48 species of fish, and perhaps most impressive is the 627 (to date) species of butterflies, beetles and other insects (Government of Sikkim, 2012). In 2001, the Government of India in collaboration with an NGO began undertaking a strategic initiative to promote and conserve biological diversity in India through interactions with stakeholders and capacity building. Sikkim is a major hotspot for biodiversity both cultivated and wild, so naturally it became a focus area of the initiative, which resulted in a Biodiversity Action Plan by 2003. The action plan was further updated though stakeholder interaction and a continuous process of revision (Government of Sikkim, 2012).

There are many complex and interacting threats to the conservation of biodiversity in Sikkim, including hydroelectric super projects, road construction, deforestation, landslides, and climate change. While traditional communities continue to inhabit the rugged mountainsides and depend on timber and non-timber forest products (NTFP) from their surrounding forest, land use practices, particularly agriculture, have changed a great deal. In the following section I will elaborate on the unique agricultural context of Sikkim.

1.2.3. Agricultural and Horticulture

While areas under dense forest cover account for the most dominant land use in Sikkim at around 42% TGA, or 2980.32 km², cultivable land only accounts for just over 12% TGA, or 872 km² (Sharma et al., 2000). The limited areas for cultivation are fragmented at various altitudes and often separated by valleys and mountains. One can see this isolation and variation reflected in the rich agrobiodiversity of Sikkim. *Zhum*, or shifting agriculture for rice and other cereals was the common practice in the hills, until deforestation and silt deposition became serious issues (Subba, 2009). Farmers developed their own intercropping techniques, with different crops according to their relative altitude. In terms of agronomic crops, 55 unique cultivars of rice (*O. sativa*), 8 of maize (*Z. Mays*), 8 finger millets (*E. coracana*) and 23 different pulses (*Phaseolus spp.*) exist along with various wheat, buckwheat, and barley at increasing altitudes; for vegetables, 15 different yams (*Dioscorea spp.*), 8 pumpkin (*Cucurbitae spp*), 8 chili (*Capsicum spp.*), 6 taro (*Colocasia spp*) and 6 different mustards (*Brassica spp.*) are commonly found in home garden type plots (Sharma and Singh, Forthcoming). Additionally, cash crops are diversified and widespread such as 13 different citrus landraces, 5 landraces of ginger, and around 11 landraces of large cardamom (*Amomum subulatum*) (Rahman and Karuppaiyan, 2011).

1.2.4. Agrobiodiversity and Endemism

The sharp increase in altitude and distance between valleys in Sikkim produces a wide diversity of locally adapted agricultural and horticultural landraces, many of which are endemic to this part of the Eastern Himalaya. The vast diversity and localization of subsistence crops points to the long-term adaptive cultivation of certain landraces by groups of people at various altitudes. In addition, microclimates of precipitation in sub-tropical and temperate broad leaf forests exist mere kilometers apart. The range of altitude and climate variance over such a short distance produces a heterogeneous spectrum of plant life. In Sikkim one could travel from subtropical humid climate to peri-glacial in less than 100 km. Dense forest mosaics house a variety of tree, shrub, and herb species in diverse ecosystems according to altitude and climate. Within these dense forest ecosystems is a rich genetic bank containing locally adapted, wild progenitors of domesticated fruits and vegetables. Some of these domesticated species served the biological needs of human beings more than others, and one needs only to look at the sum cultivars in each crop in order to determine its relative importance through history. Rice, millet, maize, wheat, and pulses, being staple crops have been grown on terraces and replanted in the same valleys or regions by generations of farmers. This illustrates the subsistence lifestyle that communities have used in Sikkim for centuries. Upland rice has started becoming popular in Sikkim, freeing up paddy land (*khet*) and making room for cash crop production, as staples like rice started to be

imported at cheaper rates from the plains. This could explain the higher variation in landrace development among the cash crops.

Due to the limited availability of flat growing space, traditional agroforestry systems (AFS) are commonly found on otherwise unsuitable land, particularly in conjunction with cash crops such as mandarin-*Albizia chinensis* based systems, and large cardamom-*Alnus nepalensis* based systems (Sharma et al., 1997). In the case of the latter, the two species are an associated pair known to coexist in the natural ecosystems and are endemic to the Kangchendzonga region of the Eastern Himalaya. From an agrobiodiversity perspective, a rich traditional knowledge base on integrated mountain farming systems still exists in Sikkim and should be valued as an important bioresource for future conservation.

This brings up an interesting point when we also consider the variety of cash crops as well. Along with the incorporation into India, Sikkim saw increasing market opportunities and a focus on cash crop production, such as mandarin and large cardamom resulted (Saha et al., 2010). This sometimes meant transforming paddy terraces into large cardamom or mandarin plantations, bringing with it a shift in values from subsistence to profit.

In natural forest type areas, wild plants are collected for many subsistence purposes. In terms of wild edible plants, from the lower to mid-upper elevations up to 2000m where the weather is sub-tropical to temperate there is much more widespread use of different fruits, seeds and flowers of plants, whereas in the upper hills above 2000m more roots and rhizomes are utilized (Sundriyal and Sundriyal, 2001). The use of leaves shoots and stems from wild plants is widespread across elevations. Another study was done by Sundriyal and Sundriyal (2005) in which they selected 6 different wild edible species, including wild avocado (*Machilus edulis*), Autumn olive (*Eleagnus latifolia*), and Nepali butter tree (*Diploknema butyracea*), and measured their growth rates for incorporation into agricultural practices. Their recommendation was for farmers to utilize the potential of these wild species in agroforestry systems to increase species diversity within the ecosystem.

1.2.5. Sikkim: A Globally Important Agricultural Heritage Site

Sharma and Dhakal (2010) report that through a partnership between the Government of Sikkim, the International Center for Integrated Mountain Development (ICIMOD), and The United Nations University, Tokyo, the state is considered under the Globally Important Agricultural Heritage Sites (GIAHS), an initiative started by FAO in an attempt to empower farming communities with unique and traditional knowledge through conservation efforts. In each

ascending agroclimatic zone farmers have developed unique practices best suited to their environment. At the lower elevations rice and maize intercropping practices are particularly well suited. In the foothills of South Sikkim tea plantations can be found sprawled out. Vegetables are grown in homestead gardens, and forests utilized for a variety of resources from fuel, timber, and fodder, to food and medicine. Large cardamom-mixed forest cultivation systems continue to prevail as the dominant agricultural practice, and are considered to be the most ecologically suited and economically profitable in the mid hills of Sikkim, up to 2500m (Sharma and Sharma, 1997). At the trans-Himalayan agroclimatic zone farmers are semi-nomadic yak herders, shifting elevations as the season warms. The natural resource management related to grazing patterns and tree felling in North Sikkim is regulated under a local community-based organization called *Dzumsa*, which promotes a socio-ecological contract through a democratic process in the regions around Lachen and Lachung (Basnet, 2002). Due to the limited cultivable space, locally adapted agricultural practices are still insufficient to meet the food needs of the population, and so communities at all elevations have historically foraged or hunted in the forest to supplement dietary needs (Subba, 2009). Through generations of foraging and relying on the wild for sustenance, a strong traditional knowledge base has developed regarding what to eat, when and where it can be found, and how to manage the wild resources.

1.2.6. Socioeconomic Context

Many factors in Sikkim have helped shape the socioeconomic situation into what it is today. The 2011 Census of India states that the population of Sikkim was at .6m, where just over 75% of the population was still classified as “rural”, however in 2001 the rural population was markedly higher at 89% of the population (Tambe et al., 2012). Ethnically, the state is constituted of several different groups- “Nepali” (Rai, Chettri, Bahun, Subba, Tamang) constitute 80% of the population, whereas Limboo, Bhutia, and Lepcha peoples, who were the original inhabitants of Sikkim, constitute a smaller percentage. In rural areas, over 80% the population is still reliant on agriculture as a means for livelihood and subsistence (Sharma et al., 2000). The terraced farming system introduced by the Nepali settlers was a good solution for maximizing production per hectare. However, the rugged terrain and the inaccessibility to central market hubs make it difficult to go beyond the subsistence level. Arable land in Sikkim, at 11% and is insufficient for meeting the dietary needs, the cultivation of high-value cash crops (i.e. large cardamom, ginger, turmeric, and mandarin orange) presents an attractive and economically viable production model for rural households practicing subsistence agriculture. One market survey shows that during 2008-2009, the total area under large cardamom production decreased by 3000 ha compared to the previous year, and likewise production decreased by 300 MT as a result

(Maheskumar S., 2010). Plant productivity per hectare has diminished during the past 10 to 15 years, and the situation has gotten worse as plants age and become susceptible to diseases, and the traditional cultivation practices are abandoned in search of alternative income sources.

So it seems a trend of rural-urban migration is becoming a serious factor for farm succession, the causes of which could be a mix of a desire to "modernize" and emulate the Western development, a change in family values, a desire for quick income without labor, and job security- things which agricultural work does not necessarily provide. While increasing education rates among youths anywhere is definitely a good progress, the paradox is that the educated youths are unlikely to return to the village life to pursue agricultural ventures when the urban life is more instantly rewarding. Along with the increase in urban population is a rapid growth of housing construction and consumption which is putting an enormous amount of pressure on the small urban centers. These issues have manifested as bumper-to-bumper traffic, unsightly rubbish, clogged drains, and increasing underemployment of the youth seeking urban jobs, not to mention the rise rates of diabetes and heart conditions among urban populations.

Still most of the population remains in rural areas depending on one or more family members employed by the Government of Sikkim, or retired and receiving a pension. The income generated from large cardamom and other cash-crops represents the second most important source of income to rural households. Traditionally, villagers would band together to work in each other's fields when a neighbor was in need. In a typical small household all family members will contribute work to the farm. In the case of large landholdings, labor is often hired in for seasonal work. The laborers often come from Nepal, Bihar, and West Bengal for farm, road, construction and hydroelectric project work through private or governmental contractors.

1.2.7. Spiritual Traditions

The 8th century saint Padmasambhava (Guru Rinpoche) is known to have blessed the region of Sikkim on his sacred journey to introduce the Buddhist Dharma into Nepal, Bhutan, and Tibet. There are many monasteries that date back centuries which continue to teach the sacred dharma cosmology, philosophy, ritual, and language to schools of monks. The most common religion at present however is Hindu, followed by Buddhist, Christian, and then others such as Muslim and Baha'i. Households generally contain a *puja* or shrine room honoring their deities with flowers, incense and water. The original inhabitants of Sikkim, the Lepcha people, had developed an earth-based shamanistic religion which worshipped local deities and the guardian deity of Kangchendzonga. There is a high religious and spiritual tolerance in society, and people are respectful of each other's beliefs wherever you are.

1.2.8. Political Context

The 20th century has undoubtedly been a time of great turmoil in India. The British Raj, or colonial rule in India ended in 1947. India has been an independent nation for the past 66 years, yet it continues to reflect the rigid political hierarchy of the British system. Ever striving to Such is not a unique situation in the world writes Lal, "indeed, the developed world lives the future of the developing world" (1997, p.3). In other words, through cultural imperialism the Western modalities and values are accepted as the standard future for which Indian society is striving to become. Nowhere is this seen more clearly than in the persistently rigid hierarchy of the Indian political sphere and top-down policy making which influences all facets of Indian society. Indeed, the remnants of British colonial rule continue to pervade all disciplines in India, setting the stage for a course of development which is unquestionably alien to the rich cultural heritage of traditional Indian communities. Any form of dissent against this political hierarchy in favor of a uniquely "Indian" form of governance risks the nation to be regarded even farther behind in the accepted model of "Western development" (Lal, 1997).

Between 1642 and 1975, Sikkim was united under the rule of 12 different Chogyals, or kings during the Namgyel Dyanasty (Lachungpa, 2011). Society under the monarch was feudalistic, the rural inhabitants practicing shifting agriculture and subsistence living. Trade routes through India and Tibet established during the British Empire brought exotic goods from distant lands for the wealthy elite. The political infrastructure since 1975 has increased its breadth through the development of many new departments, and the focus on improving rural livelihood and biodiversity conservation through green initiatives in the Government of Sikkim has also increased.

Governmental departments, including Food Security & Agriculture Department (FS&AD), Horticulture & Cash Crop Development Department (H&CCD), Rural Management and Development Department (RMDD), and the State Institute of Capacity Building (SICB) have a strong focus on promoting livelihood generation among the rural poor. The Department of Forests, Wildlife, & Environment (FEWMD) has taken the lead on forest and habitat conservation in the state, creating a Sikkim Biodiversity Conservation and Forest Management Project (SBCFP). The SBCFP has released an impressive document regarding the Sikkim Biodiversity Action Plan 2012. The action plan lays out impending threats, conservation efforts, and ways forward to preserving biodiversity and associated knowledge in Sikkim, with a particular focus on climate change and its current and future impacts (Government of Sikkim, 2012).

The hierarchy of governmental agencies continues, however, to rely on traditional top-down policymaking, with the Chief Minister at the top and directly connected to the central Government of India. Below the CM is a cabinet of Departmental Secretaries which constitute the Sikkim Assembly. In terms of agricultural policies, data and information from field workers is collected and reported to the Director and Additional Directors for policy planning. The State Government of Sikkim is responsible for channeling the funds received from the central Government of India into development projects related to roads and infrastructure, conservation and tourism, forestry, agriculture, horticulture, and more recently floriculture. Hydroelectric superprojects are being constructed all along the rivers in Sikkim, as a partnered venture between the Central Government of India, the State Government of Sikkim, and a third-party contractor.

1.2.8. Panchayati Raj System

In contrast to the largely centralized political infrastructure left over from British rule, another form of local governance has been developed and implemented in India called the Panchayati Raj system. The Panchayati Raj system is a decentralized form of local governance which has heads, or leaders at both the village (Gram Panchayat), and district (Zilla Panchayat) level. In Sikkim there are 4 different districts (North, South, East, and West), and 165 villages under Gram Panchayat (Tambe et al., 2012). This system of decentralized government is an excellent resource for the remote communities as it could be used to bring a voice and empower those who would otherwise perhaps be marginalized in the political process. Unfortunately, while the Panchayati Raj system is ideal for rural empowerment, it is rarely as effective as it could be. The position of power which a Gram or Zilla Panchayat has comes with a great need for commitment and a responsibility to the people which they serve.

A dependency on the income generated from large cardamom and other cash crops has developed in the rural sector of Sikkim. This reliance has been highlighted over the past decade as farmers have increasingly had to seek subsidies from the government. One of the most important programs in Sikkim is the Mahatma Ghandhi National Rural Employment Guarantee Act (MGNREGA), a Central Government scheme providing 100 days per year of paid labor for every rural household in Sikkim (RMDD, 2006). This organized labor usually includes footpath, road, and other infrastructural improvements to the village.

1.3. Large Cardamom- Treasure of Kangchendzonga

Large cardamom (*Amomum subulatum*), also called black cardamom, (Not to be confused with small, or green cardamom (*Elettaria cardamomum*) which is grown primarily in Kerala (Maheskumar S., 2010)) is a spice crop belonging to the *Amomum* Roxb. genus, the second largest genus in the family *Zingiberaceae* (Thomas et al., 2009). *A. subulatum* is a perennial, herbaceous species with clusters of deep red stems emerging from a rhizomatous base, each ending in oblong, lanceolate leaves up to 1-2m long. At the base the plant develops several flower buds up to 6cm (pic. 2).

Picture 1: Thriving A. subulatum plant, in West Sikkim

Picture 2: A. subulatum during flowering period

Picture 3: Inside of cured large cardamom capsule

The yellow flowers open for a day with stigma cups full of nectar, attracting the *Bombus haemorrhoidalis* species, the most important pollinator for large cardamom (Sinu and Shivanna, 2007 ; Kishore et al., 2011). The plant begins fruiting around its 3rd year (Zomer and Menke, 1993) and reaches a maximum productivity around 20-30 years before declining (Sharma et al., 2000). Capsules ranging from dark brown, to purplish red, form in clusters around the base of the plant in October. Inside the capsule (pic. 3) is a white gelatinous membrane surrounding groups of round seeds partitioned into two to four quadrants by membranous walls (Lim, 2013).

1.3.1. Growth Habits

A. subulatum is believed to have originated from wild progenitors particularly well suited to the foothills surrounding Kangchendzonga in Nepal and Sikkim. The spice crop prefers mixed forest setting on marginal to excessively wet land with good drainage between 600 to 2500 m (Sharma

and Dhakal, 2010). The *A. subulatum* plant grows best under shade in mixed forests, particularly in association with *Alnus nepalensis* (Himalayan alder), a high altitude N-fixing species (Sharma et al., 2007). Other tree species most commonly found in association with *A. subulatum* include *Schima wallichii, Maesa chisia, Saurauia napoulensis, Machilus edulis,* and *Melia composite* (Subba, 2009).

Picture 4: A large cardamom-alder mixed agroforest

These diverse *A. subulatum*-mixed forests are valued for their natural ability to cycle nutrients and stabilize the topsoil, while at the same time providing a low-input, high-income crop for rural communities (Saha et al., 2010 ; Sharma et al., 2008). The rhizome sends out lateral 'suckers', which farmers collect for replanting nurseries or filling in gaps in existing plantations.

1.3.2. Historical Significance

Recognized as one of the oldest spices known to man for its ability to remedy many ailments dating back to 6th Century B.C. in India (Lim, 2013), *A. subulatum* was originally collected from the wild by the Lepcha people, the original inhabitants in North Sikkim (Bhasin, 2011). One study found the Lepcha elders had extensive knowledge on 118 different species, from 71 families and 108 genera of wild medicinal plants; among them were 8 species and 5 genera belonging to the *Zingiberaceae* family (Pradhan and Badola, 2008). Later, *A. subulatum* were selectively bred and traditionally managed in mixed agroforests by Lepcha, Bhutia, and Nepali farmers (Sharma et al., 2000).

Picture 5: Various cultivar samples of A. subulatum on display at the Indian Cardamom Research Institute, Gangtok

At present there are reportedly 11 locally adapted cultivars of *A. subulatum* in Sikkim, and a presence of wild relatives are still to be found in the jungle to this day(Rahman and Karuppaiyan, 2011). Such variability between landraces and their wild progenitors lends support to the theory of its endemism to Sikkim. The long-term selective breeding process of large cardamom from these wild varieties brings insight to the importance it has played in the natural and socio-economic history of Sikkim. It is still recommended to keep several wild relatives planted nearby in order to facilitate cross pollination and promote alpha diversity in the large cardamom (Sharma et al., 2000).

1.3.3. A Change in Values

Large cardamom cultivation originally appealed to the farmers for many reasons: the low input required for its cultivation, its regional adaptability, its penchant for marginal, sloping forested land, and the long-term storability of the cured capsules. Stronger trade routes developed after 1975 when Sikkim became a part of India, and this ushered in a widespread transition in practices from paddy and shifting agriculture to the production of high-value cash crops, most notably large cardamom. While large cardamom has started to emerge as an economically viable opportunity in Uttarakhand (Bisht et al., 2010), Northern Vietnam, Laos, and Cambodia (Lamxay and Newman, 2012), it has been cultivated on a larger scale for longer periods in the Eastern Himalaya, specifically in Eastern Nepal, Sikkim, Darjeeling district of West Bengal, and Bhutan (Lim, 2013).

1.3.4. Issues in Large Cardamom Production/Productivity

There are a host of complex interacting factors in the LC value chain which have caused a decline in both productivity of the plants and the overall production in Sikkim in the past decade; An epidemic rise in viral, fungal and bacterial diseases has wiped out entire plantations; climate and seasonal precipitation patterns have become irregular, affecting the plant's reproductive physiology and reducing yields; Adaptive management practices and farmer innovations lag behind the sudden crises; Youth are increasingly choosing to remain in urban areas after education is complete; Labor is hard to come by, and often comes from outside Sikkim;

Extensions agencies have limited reach, and there is a lack of coordination between institutions seeking to improve the situation; and while Government subsidies are readily available, there is no regulated monitoring protocol by said agencies. The complete mind map of these issues is depicted in section 3.1.1. of the Results section in this document.

1.3.5. Institutional Affiliates of Large Cardamom

There are a number of institutions existing that are currently working to improve rural livelihoods through research and development, provision of subsidies and technical expertise, and capacity building in Sikkim. From the Governmental side, H&CCD and FS&AD provide "expert" extensions services and work to improve the large cardamom more specifically through a collaborative effort with the Indian Cardamom Research Institute (ICRI) at Spices Board of India – Sikkim (SB). At ICRI they are also undertaking genetic trials for developing disease resistant strains of large cardamom. SB-ICRI conducts field extensions and trainings regarding irrigation and vermicomposting infrastructure, provides subsidies for replantation and "gap-filling" in existing plantations, and also subsidizes the farmers who wish to start a new nursery for large cardamom, from which the planting material is bought back by the H&CCD. Research institutes such as GB Pant Institute of Himalayan Environment and Development (GBPIHED), and TMI-India have conducted extensive field research on issues affecting biodiversity, socio-ecology, and geohydrology in Sikkim.

1.4. Limiting Factors

The main limiting factor for my research was to be expected when conducting a qualitative case-study in a foreign country: the language barrier. While my cursory understanding of the Nepali language was appreciated by most, going into the field to interview primarily illiterate farmers presented a serious challenge and required me to bring a fellow researcher to act as a translator. The way that I remedied this situation was to structure my farmer surveys with mostly yes/no questions, with the option of expounding upon the question if possible (how?). When facilitating the workshop series, the language barrier became difficult in order to include and engage the farmers who were present in any kind of constructive dialogue. Luckily, the other stakeholders who were present were very willing to translate for me.

A second limiting factor for me was the amount of time it took to go through the process of application for the proper permission to conduct research in Sikkim. Sikkim is a border state with the Tibetan Autonomous Region of China, and as such, extreme measures are taken by India to protect and regulate any and all activity by foreigners within its borders. Being a restricted state of India, foreign individuals who wish to conduct research in Sikkim must go through a

long and tedious process of applications to the Home Department, the Army, the Foreigner's Registration Office (FRO), and in my case, the Forestry Department. Perhaps the most frustrating thing for me in this particular process was the lack of coordination between these different offices. In more than one instance, secretaries and other individuals whom I was applying through (when they weren't on leave) were not even aware of the process themselves, leading me on a wild goose chase from office to office, slowly eating up my time. On top of that, I finally found out that I was to apply to the Home Ministry of Sikkim, located in New Delhi. Unfortunately, such is still the way of Indian bureaucracy, a system which continues to rely on paper rather than computer-based applications, and the mailman rather than email. By the time I finally got the necessary permissions 3 months had passed, and I was certainly itching to get underway with my field work. However, in the meantime I was able to help in the field data collection of a different study initiated by the International Centre for Integrated Mountain Development (ICIMOD), which was exploring the important role of pollination on large cardamom productivity. As a field assistant, I was able to observe and take notes on the elements which pertained directly to my own research without requiring my own research permit.

The time factor was also limiting in the identification of key stakeholders who were open to my ideas and willing to participate in the process. Here, I mostly relied on word-of-mouth recommendations for whom to approach. However, I was very lucky to have found some very interested and influential people who would prove to enhance my research a great deal. This was largely thanks to the help of the Program Director and my supervisor at TMI-India Dr. Ghanashyam Sharma, who himself is very keyed-in to the progressive network of people who are interested in sustainability issues in Sikkim.

The final limiting factor that affected my field work was the inaccessibility of the villages and communities still actively growing large cardamom which I would have liked to visit and observe. The road infrastructure in Sikkim is still largely underdeveloped despite the vast amounts of money allocated to road construction each year, and the frequency of landslides and a focus on building new roads rather than maintaining the existing roads has not significantly improved this situation. Unfortunately, due to my available time and this issue of inaccessibility, I was not able to conduct as much field work as I would have wished.

2. Methodology

2.1. An Agroecological Perspective

Agroecology is an emerging discipline which seeks to find an alternative to the conventional, reductionist research methodologies traditionally associated with scientific inquiry. As an agroecologist, I must necessarily keep a 'whole systems' focus- one that takes into account the embeddedness of economics in societies, and societies in their environments. Exploring all three elements and their inherent inseparability is essential when inquiring into complex agricultural systems. In other words, an equitable society will only emerge if the natural environment is in balance; likewise a prosperous economy will only emerge if its society is equitable (fig 2). Growing food is the most important human activity system because it represents our continuous interface with the natural world from which we came. In this way, nature is but an extension of our own being, and the extent to which we value this interdependency is reflected in the degree of ecological, social, and economic integration within agricultural practices.

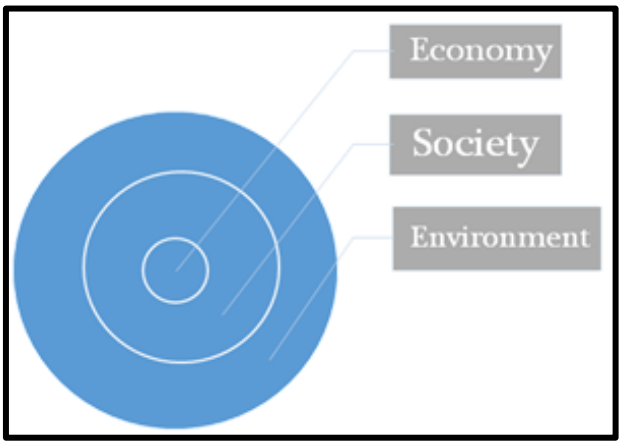


Figure 2: Fundamentals of an agroecological perspective

The *structure* of my methodology was informed through the principles of systemic thinking(ST) (Ison, 2008) and action research (AR) (Reason and Bradbury, 2001); its *function* was to take the specific case of large cardamom as a window through which to analyze the larger opportunities and challenges for sustainability in Sikkim. Throughout a participatory *process* based on Checkland's Soft Systems Methodology (SSM) (1985), I actively engaged a diverse stakeholder group in *purpose*ful inquiry into the large cardamom system adapting the "windows" and "tools" from the Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) resource box (Engel and Salomon, 1997a). I referred to a study by Sol et al. (2012) during the abstract conceptualization of system models (steps 3 and 4, fig 2.). Whereas during the first 7 steps in the methodology were informed through established theory, the final step of my methodology corresponds to the second learning cycle of action research (Bawden, 1991): a reflection on the entire case study as the concrete experience, or launching off point which allows me to explore the broader implications of multiple perspective participatory decision making.

Participatory action research (PAR) is a dynamic process which is fully reliant on the actors involved, the local context, and not least, the mindset of the practitioner. As such, it is not possible to establish a clear-cut methodological framework prior to entering the situation. At any point small factors could change and the methodology will need to accommodate. I found myself actively reflecting on the process in order to adapt my actions within it, particularly with the time and permit making process. Nevertheless, the structure of my research did not change, as it was based on a fundamental belief that, as Entmen puts it,

"By bringing ideas together in one location, communication can aspire to become a master discipline that synthesizes related theories and concepts and exposes them to the most rigorous, comprehensive statement and exploration". (1993, p.51)

Additionally if the action researcher as a "catalyst" remains flexible but determined in his methodological approach utilizing and adapting the tools and methods in a systematic process, the stages of PAR will most certainly yield results indicative of systemic issues. Throughout my experience within the case study, I took on three complimentary roles; researcher, participant, and reflective practitioner. As a researcher, I used ST to structure both the research methodology, and the methods and tools I used to inquire into the large cardamom value chain (Ackoff, 1974 ; Wilson and Morren, 1990 ; Bawden, 1991 ; Laszlo and Laszlo, 1997 ; Ison, 2008 ; Flood, 2010). I used adaptive communication and facilitation tools during the process as a participant and facilitator (Entman, 1993 ; Reason, 1994 ; Wildman and Inayatullah, 1996 ; Engel, 1997 ; Leeuwis and van den Ban, 2004 ; Pohl C et al., 2010). As a self aware human I always play the role of an autonomous learner, relying on the recursion of my actions and self-reflection as it shapes my worldview. This third "inner" state of reflective practitioner is inextricably linked to my conscious and unconscious ontology as I seek to facilitate purposeful accommodations within the system. It is less of a "role" and more of a state of "being" which permeates every step/stage, and which serves to help construct the "window" through which I view the world and then determine the "bag of tricks" to use.

2.2. Soft Systems Methodology (SSM)

The Soft Systems Methodology of Peter Checkland (1985 ; 2000) emerged as a response to the tradition of "hard" systems thinking, which sought to present systems as mechanistic, and mathematically-based. "Soft" systems thinking recognized the inherent conflict between this rational worldview and the dynamic reality of human systems. Checkland believed strongly that long-term and sustainable accommodations for the "wicked" and "messy" problems (Churchman, 1967) inherent to complex systems within a changing environment could and should only come about as the result of the reconciliation of the different epistemological

traditions working towards a shared vision of an ideal future state. SSM is essentially a 7 step process of collective problem identification, abstracting the information and designing visual representations of the system in which the problem exists, comparing the models with the initial problem identified, developing concrete and realistic action steps, and then acting. The process of SSM never yields conclusive results, rather it is an iterative process which should periodically be carried out, and which requires the input from all stakeholders involved in the system in order to gain a truer representation of the system in question. In SSM, the traditional "researcher" role is internalized within the system itself to include all participants as "co-researchers", and the researcher then becomes a facilitator of this participative process, consciously directing the process using the tools of Systemic Thinking and Practice to achieve the Praxis of Systemic Action Research (SAR)(Bawden and Packham, 1993).

2.3. Rapid Appraisal of Agricultural Knowledge Systems (RAAKS)

The RAAKS methodology was designed expressly for the facilitation of an alternative approach to the traditional agricultural extensions model. The objective of RAAKS places the utmost importance on the belief that effective innovation does not come about as a result of one person's actions, but rather through the continued, dynamic interactions of diverse stakeholders (Engel, 1997). To be certain, the effects of globalization are rapidly manifesting in increasingly liberalized economies, and more subtly, a sort of "cultural imperialism" is creeping around the world, threatening the value systems of traditional farming communities. Herein lies the paradox of globalization in traditional communities; how is it possible to preserve rich cultural heritage of traditional peoples without actively denying their right to modern education, healthcare, and all the cultural amenities that go along with a "modern" and "Westernized" lifestyle?

This conflict is not localized- it can be found the world over, wherever indigenous, land-based communities continue to persist. Part-and-parcel with the influence of globalization on the social infrastructure of traditional agricultural communities is the "linear" agricultural extensions model, which uses words like "transfer" and "dissemination" of knowledge, technology, and "improved" seed varieties, as if the findings of modern science and technology hold far more potential than locally adapted seeds, context specific practices, and knowledge developed from generations of direct experience with the natural world. However, it becomes easy to fall into the trap of believing the opposite to be true, which is simply counterproductive. The reality is that many different epistemological traditions exist in this world, the difficult task then becomes how to integrate these different ways of knowing for the improvement of agricultural innovation.

RAAKS is an approach which accepts all knowledge within the "complex innovation theatre" (of agricultural systems) as a subjective construct of the respective knowledge holder. RAAKS uses a 3-stage approach to create a condensed (see: rapid) model of SSM in order to bring together and empower knowledge holders to facilitate self-regulating innovation networks. Through the process of collective inquiry laid out by RAAKS, the limitations and gaps in the current knowledge network are addressed and the potential for effective agricultural innovation is increased. The emergent properties of an integrated knowledge network manifest in the form of mutual trust, respect, commitment, and a constant appreciation for improvement of the system.

The RAAKS methodology is built around the *intentions* of helping the actors or stakeholders within a particular system to reflect on the way they are organized for achieving innovation. With the help of structured but flexible *procedural* and *analytical design* approaches, the researcher has the opportunity to adapt the methods for inquiry to the context in which they are working.

2.4. Steps, Stages, and States

The structure for my research is essentially based on a layered methodological approach to action research, described by Bawden (1991) as a "double-loop" learning process embodying Kolb's (1984) 4 stages in the experiential learning cycle (concrete experience, reflective observation, abstract conceptualization, active experimentation) (fig. 3.1).

The first "loop" includes my experiential learning steps during the concrete case study, and in the second "loop" I take the entire case study as the concrete experience step, reflect on its broader implications, and conceptualize models for future participatory research and development.

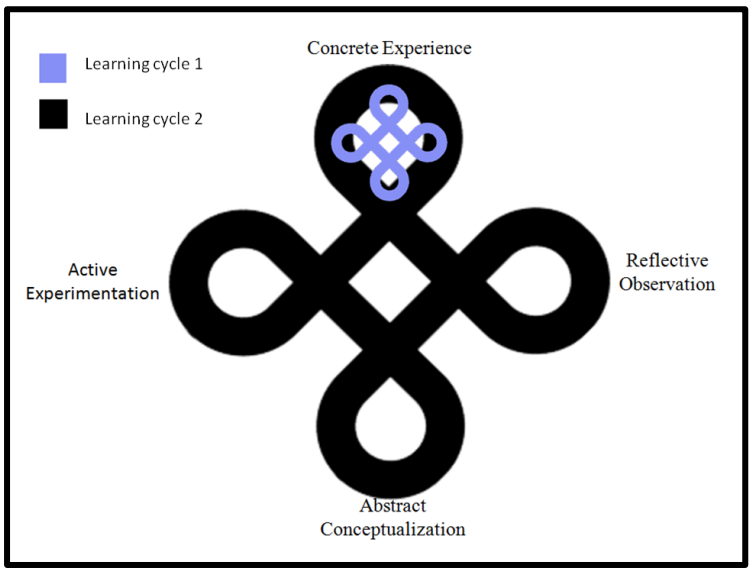


Figure 3.1: The "double loop" learning cycle of action researcher and reflective practitioner, wherein the first learning cycle becomes the "concrete experience" for jumping off in the second learning cycle

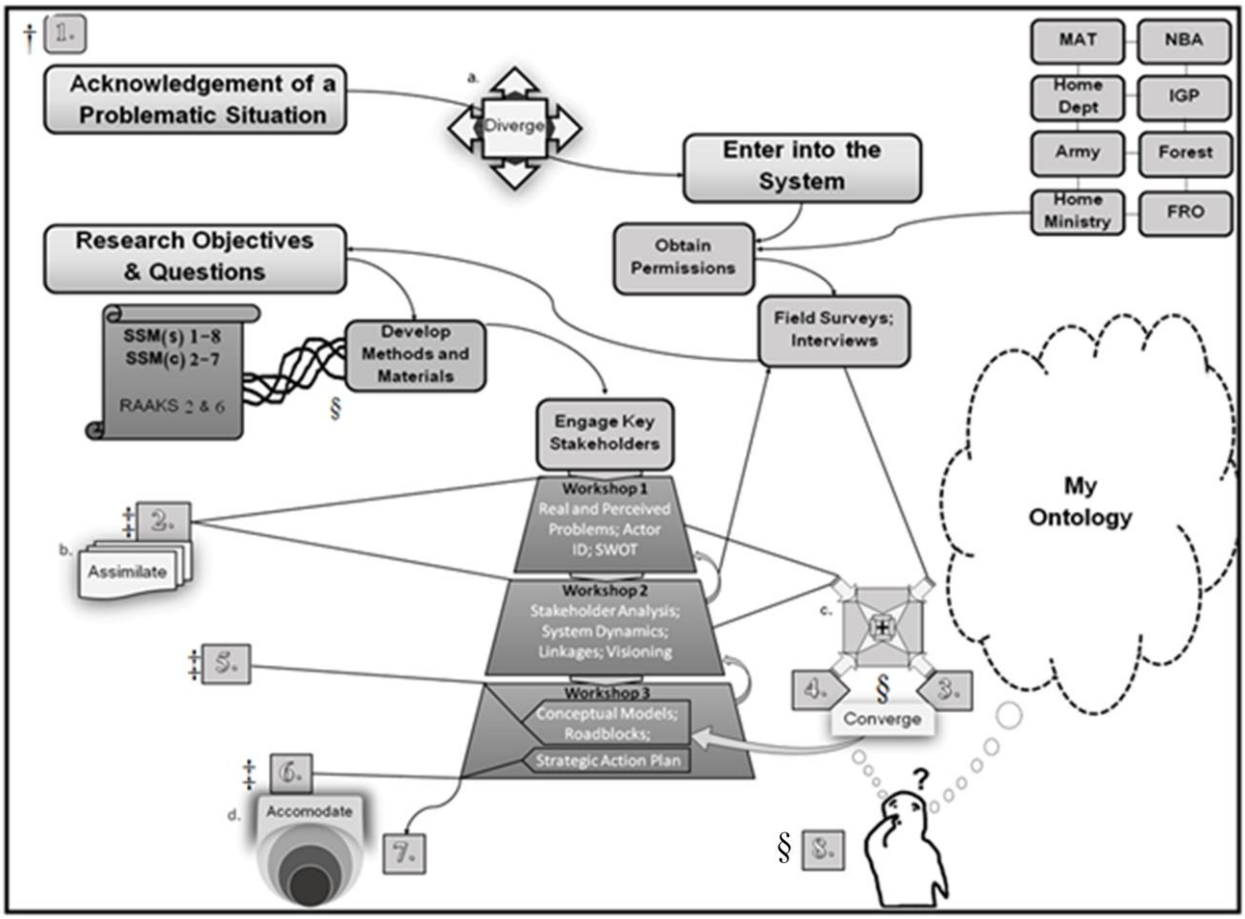


Figure 3.2: Map of my research methodology

My methodology is broken into 8 "nested" steps, 4 stages, and 3 states. I will explain how I choose to differentiate between these elements. A **step** in this case refers to the systematic points during the finite (i.e. temporally fixed) process of the methodology. The 8 steps are numbered, the first 7 of which are adapted from Checkland's soft systems methodology (SSM) (1985), and the final step includes the second learning cycle of action research. SSM(s) in the diagram shows the 'structure' of the research including the 7 steps of the SSM cycle. SSM(c) is the 'content', or the methods, windows and tools I used to accommodate each step.

The **stages** are in reference to the 4 stages of Kolb's experiential learning cycle (1984), which were embodied in the process and expressed at specific points of my action research. It is important to remember that these "stages" did not occur with fixed boundaries- indeed as an action researcher I found myself continuously in a state of either acting, reflecting, making sense, and improving or guiding the process as I went along. However, the 4 stages of both learning cycles on my diagram represent a "macro" view of the process itself, and they correspond to specific periods during the process where those activities were more strongly expressed.

The **states** refer to my state of being, or "roles" in which I had to assume at different steps in the process. The first state is as a researcher external to the situation, and is indicated on the figure 3

as †. The second state is indicated as ‡, and represents my role as a participant/facilitator of the process, including all of my thoughts, emotions, and how I communicated and interacted with others. The third state, or §, is indicative of the reflective-practitioner role, during which I used the tools of systemic inquiry to inform my action in, and thinking on the case study.

2.5. Step-By-Step: a Systematic Presentation on Methods and Methodology

2.5.1. Step 1 External Researcher: Acknowledging a Problematic Situation

The first step of my SSM process involved me as an external researcher collecting information from outside of the system as a student in another country. This step corresponds to Bawden's "finding out" of first-order inquiry (Bawden, 1991). I acknowledged that there are seriously complex issues going on with large cardamom in Sikkim, yet not being immersed in the system, I was clearly unqualified to deal with issues inherent in it. So I used this time to diverge, or the first stage of Kolb's Experiential learning cycle, by conducting a literature search and through regular correspondence with my supervisor Dr. Sharma. I started this process at UMB in the Spring of 2012, where I used the term-paper for a course on Tropical Soils Management as an opportunity to focus on the soils and agro-climatic zones of Sikkim.

As my interest lay primarily in the systemic organization around knowledge for innovation, I spent a great deal of time researching the dynamics of participative action research, with a particular interest in the value of diverse types of knowledge and ways of knowing in the process of purposeful participation. At ISARA in the Fall of 2012, I used the literature review from Module 2 as an opportunity to explore Knowledge Co-Creation as an Emergent Property of Participatory Action Research. It was during this time that I began the application process to the National Biodiversity Authority (NBA) of India for permission to access and document traditional knowledge of large cardamom in Sikkim as a bio-resource.

2.5.1.1. Enter into the System

It took some time to get settled in both physically and mentally once I entered into Sikkim. However, the process was eased greatly with the help of Dr. Sharma and staff of The Mountain Institute (TMI) India, where I was to be a Research intern for the duration of my research. Nevertheless, I knew from the very beginning that I would have to apply for special permission to conduct field research in Sikkim before I could even start collecting data. The application process proved itself to be extremely confusing and time consuming, taking up nearly half of my time here.

During the time leading up to the participatory workshop series and the acquisition of my permit, I was engaged as a research assistant for a project funded by ICIMOD, Nepal that was interviewing farmers on their perceptions of pollination in large cardamom . I participated in two different field visits as a research assistant to interview farmers and collect survey results in East Sikkim and South Sikkim, having 46 and 24 respondents, respectfully. A great deal of the data from the surveys was directly applicable to my own research, especially the questions regarding interactions with Government agencies. In addition, I developed my own farmer survey which I used to interview 19 different large cardamom farmers near Mangan, North Sikkim. I later reviewed the data from the field visit to South Sikkim, during which 14 large cardamom farmers were surveyed. Many of the questions from the ICIMOD survey were recorded in the yes/no format. I reframed some of the questions in designing my own survey, and turned 'yes' into 1 and 'no' into 2 in the recording process. I did this with the intent of comparing my own field data with the ICIMOD survey to evaluate simple trends in their responses.

The preliminary field visits and subsequent interviews with a range of key informants related to large cardamom had immersed me into the system by this point. These key informants included scientists from Spices Board Indian Cardamom Research Institute (ICRI), extensions agents from Spices Board Zonal Development Office (SBDO), a marketing agent from Spices Board Regional Marketing Office (SBMO), scientists and policymakers from Forest and Wildlife Management Department (FEWMD) of Sikkim, policymakers from Horticulture and Cash Crops Development Department (H&CCD) of Sikkim, scientists from G.B. Pant Institute for Himalayan Environment and Development (GBPIHED), the chief marketing agent for Northeast Regional Agricultural Marketing Corporation Ltd (NERAMAC) in Sikkim, a head secretary of the State Institute for Capacity Building (SICB), and two different NGO members.

With all the different and new perspectives I had experienced, I was able to clearly define the objective of my research, and formulate more specific research questions regarding problematic situations within the system of large cardamom production in Sikkim. Having built up a network of key informants and a few progressive farmers, I was ready to begin the workshop series. After receiving confirmation from the Home Ministry of Sikkim in Delhi, I immediately visited Hee Bermiok, West Sikkim once again to draft a Mutually Agreed Terms (MAT) with the established local Biodiversity Management Committee (BMC) in case I needed to conduct research there.

2.5.1.2. Preliminary Models

After assimilating my field observations, interviews and literature findings, I prepared a "mind map" of the perceived causes to the loss of large cardamom, and at the request of Dr. Sharma I

also prepared a visual representation and short analysis of the large cardamom value chain, which I contributed to an article he was writing.

2.5.1.3. Gearing Up

I began preparing the methods and materials for workshop 1. As my research was focused on the Knowledge Systems surrounding cardamom, I decided to use the "windows" and "tools" of the RAAKS Resource Box (Engel and Salomon, 1997b), which I had purchased the previous summer, pre-emptively anticipating this experience. The diagram below (fig. 4) illustrates the objectives and process of the 3 participatory workshops that were carried out

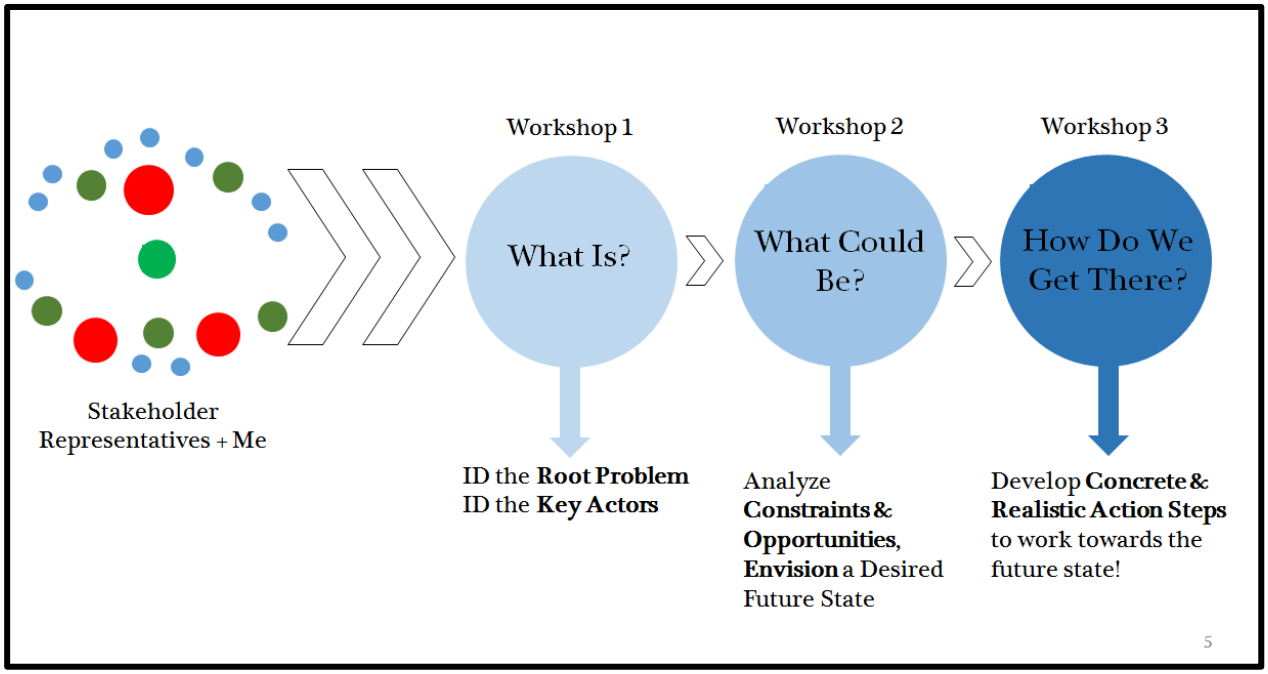


Figure 4: Schematic for participatory workshop series

I proceeded to design a formal invitation to the first workshop for around 20 key stakeholders, and then visit their office or home to deliver it in person and explain it further. This process was nerve wracking but I think it was an important step in gaining the trust and interest of the individual.

2.5.2. Step 2 as Participant: Problematic Situation Expressed

The second step of my SSM process included both the first and second workshops of the RAAKS approach. During this period, I was acting more as a facilitator and less as a reflective practitioner, in order to guide the stakeholder dialogue in a constructive manner. Here, I was primarily in the assimilation stage (b.) of Kolb's learning cycle, collecting the "expert" views and opinions on the system from stakeholders actively involved in working within it and combining them with my own findings.

2.5.2.1. Workshop 1: Exploring "What Is?"

For the first stakeholder workshop, I prepared a packet for each participant including 5 individual/pair exercises, each followed by a group activity to stimulate constructive dialogue. The main objective of this first workshop was in collectively determining the "boundary" which we were exploring, and finding out "what is" in the system at present. In other words, I wanted to stimulate the stakeholders into sharing what they each perceived as the main problems facing large cardamom production in Sikkim, who they perceived to be the main knowledge holding constituencies or actors, and what they perceived as the "prime mover", or driver of the system. The final exercise/activity involved a SWOT analysis of the large cardamom system in Sikkim.

At the beginning of the workshop I gave a short presentation on my own background, the nature of PAR as an effective research methodology, and my research objective in Sikkim. This was followed by a brief introduction of each stakeholder present regarding their respective relationship to large cardamom. The workshop consisted of 14 participants: scientists/researchers from ICRI, GBPIHED, and TMI; extensions agents from SBD, and H&CCD; a progressive cardamom farmer/homestay owner from West Sikkim; a policymaker from FE&WMD; a representative from an NGO in North Sikkim; and a marketing agent from NERAMAC.

Picture 6: Participants during the first workshop

The first exercise draws from Tool A1 of the RAAKS Resource Box entitled "Problem Definition Exercise" (Engel and Salomon, 1997b). I had provided a sheet for each stakeholder with questions in order to develop a general picture of the socioeconomic, biophysical, and political boundaries in which the systems exists before we began our inquiry into it. Questions included "what is the system being

Table 1: Causes and importance survey

Activity: Causes Survey
Name:
I am a: Farmer | Researcher | Extension agent | Marketing agent | Policymaker

Please rate the following factors causing the declining status of large cardamom productivity according to their relative importance:

	1	2	3	4	5
Management					
Socio-economic					
Pests					
Diseases					
Climate/ Environment					
Policy/outreach					
Spiritual					
Other:					

1= Highest importance
5= Lowest importance

explored?"; "what general problems could be identified in this system?"; "who is under the impression that a problem exists, and what characterizes these actors?"; "who is affected by these problems, and what characterizes these constituencies?"; "when do you think these problems first arose?"; and "what do you perceive as the most urgent aspect of the problem/s?". The goal of this exercise was to stimulate the thinking of stakeholders in preparation for the rest of the workshop. The exercise was followed directly by a group activity in which a table was prepared (table 1) consisting of the issues we collectively determined, and pairwise ranking was used to order the issues regarding their respective influence in the system.

The second exercise of the workshop was adapted from Tool A2 of the RAAKS Resource Box, entitled Actor Identification Exercise. For this exercise I provided each person a sheet with a few questions to stimulate the inclusive thinking about all actors/constituencies holding knowledge regarding large cardamom, and who may be involved in or affected by the decline in its production. I had asked them to be as specific as possible when it came to broad groups like farmers (i.e. large/small, young/old, male/female) in order to acknowledge that broad categorization often marginalizes one group in favor of another. The group activity which followed involved a discussion resulting in the development of an "actor identification sheet" (table 2), serving as a "complete" list of actors from which we selected the most important/influential actors as "key actors".

Table 2: Actor identification and relative importance

System Actors	Key actor? Y/N	Why or why not?
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
...		

The objective of the third exercise of this workshop was adapted from adapted from Window A3, "Tracing Diversity in Mission Statements" of the RAAKS Resource Box. The activity however was of my own design. I chose to design a unique activity for different reasons; the first was that I was already accustomed to each of the stakeholder groups, and I had come to know their respective objectives as organizations/individuals through the interview process, and the second was because my findings related to the first showed me that even though the modes of operation among stakeholder constituencies differed, they all sought to remedy the same issues within the system. In light of this, I wanted an activity which facilitated these stakeholder representatives to

come to this realization on their own. Unfortunately, though an interesting discussion was had that produced a list of all the different actor objectives, this activity was cut short due to the lunch arriving. By the time we reconvened I chose to move to the next exercise in the interest of time. I did, however, manage to use this exercise/activity in the second workshop as the "stakeholder analysis" activity, so all was not lost.

The fourth exercise I partially adapted from Window A5/ Tool A5:B6 of the RAAKS Resource Box, "Clarifying the Problem Situation". The objective of this exercise was to identify the "driving forces" behind the desire to cultivate large cardamom in Sikkim, and to think about the implications of such motivational factors on the knowledge and value systems of the farming communities. In the packet I included a short page for individual or pair stakeholder reflection which included three main questions, namely: "what do you perceive as the primary motivating factor that is driving the large cardamom in Sikkim?"; "who or what do you see as having the most influence over the system?"; and "who or what has the power to change the system, and would they be interested in doing so?". Following a 5 minute reflection, the participants were given 5 minutes to fill in a table (table 3) according to who/what they perceived as the driving factor behind large cardamom cultivation in Sikkim, and the relative influence of each one respectively. Afterwards, the group was reconvened to share our different perspectives, and through pairwise ranking on the table, we were able to draw a radar chart of the results.

Table 3: Driving Forces Assessment

Driving Factor ↓ Scoring →	1	2	3	4	5

1= Least Influential, 5= Most Influential

In the final exercise, I wanted to conduct a SWOT analysis, or analyze the Strengths, Weaknesses, Opportunities, and Threats associated with the large cardamom system in Sikkim. Many people present were unfamiliar with the use of a SWOT analysis as a functional tool for organizing the elements of complex systems in order to better understand them. Anticipating this, I had prepared a reflection guide in the packet that included many important elements which should be kept in mind when conducting a SWOT analysis. After a brief explanation, participants were asked to reflect for around 10 minutes on the sheet before we began the exercise. Below you will find the reflection guidelines sheet which I handed out before the exercise (fig. 6).

Geophysical Elements (Climate, soils, terrain, altitude, etc.)
Biological Elements (Crop requirements, surrounding vegetation and animal life)
Economic Elements (subsidies, return, spending, etc.)
Socioeconomic Elements (Ethnic groups, status, caste, age, gender, income, etc.)
Political Elements (Policies, laws, regulations etc.)
Skills & Technological Services Availability (Expert, farmer, extensions, labour,)
External Pressures/Opportunities (Markets, socio-economic, policy, etc.)
External Resources (Institutional funding, central gov't support, markets, etc.)

Figure 5: SWOT analysis reflection guide

Participants were asked to reflect for 5-10 minutes, after which a lively discussion ensued while developing the SWOT table. It was interesting to observe how the different professional roles of each participant may have affected his/her perception on the weaknesses and threats of the system. The workshop wrapped up on a positive note as we discussed all the positive elements that Sikkim has to promote improvements, and all the potential opportunities which could be pursued in the future if the right conditions are met. The minutes for the workshop were recorded by a friend and fellow researcher at TMI, which I transcribed along with the findings of each exercise, and emailed out to all the participants. I also wrote a press release which was published in the newspaper the following day (appendix 5)

2.5.2.2. Workshop 2. Analysis of Constraints and Opportunities; Envisioning the Future

Where the first workshop was focused on exploring the *structural* aspects of the system, the second workshop was used for inquiring into the *functioning* of the system. By incorporating the results garnered from our first workshop regarding the issues and the actors, we were able to analyze the dynamics of and between constituencies who are working to improve the situation of large cardamom in Sikkim. As an action

Picture 7: Inside the second workshop

researcher, I was still in the assimilation stage (b.) of Kolb's experiential learning cycle at this point. In the second workshop there were 4 exercises conducted: system modeling or "rich picture", Stakeholder Analysis, Stakeholder Linkage Matrix, and a Visioning exercise. The first three exercises were intended to help us understand and visualize the flow of knowledge, goods, and money in the system. The last exercise was to explore the similarities and differences in the "ideal" visions for the future between the participants to see if there were commonalities there.

Prior to the second workshop, I had worked on a rough draft of a system model, or "rich picture" of the large cardamom system in Sikkim. I chose not to construct a finished product at that point at the risk of imposing my own worldviews and assumptions on the system dynamics. Instead, I relied on the actors involved in the system itself to provide insight and perspective on the development of a rich picture. In premeditation of the limited workshop time, however, I did prepare a chart paper which included the names of all the key stakeholder constituencies situated around a drawing of a large cardamom plant. I figured that in the workshop we could discuss where to draw arrows signifying the flow of resources and influences.

During the second exercise of this workshop I was able to go deeper into the respective objectives of each stakeholder constituency, something which we were not able to cover in the

Table 4: Stakeholder analysis exercise

Exercise 2: Stakeholder Analysis										
Actors↓ Objectives→	1	2	3	4	5	6	7	8	9	10
Small Farmers										
Large Farmers										
Spices Board										
Horticulture Dept.										
Research Institutions										
NERAMAC										
NGO's										
D.S.T.										
S.I.C.B.										
R.M.D.D.										
I.C.A.R.										

"tracing diversity of mission statements" exercise of the first workshop. The tool which I used for this exercise was self designed (table 4) using the perspective provided through Window B2: "Actor Analysis" of the RAAKS Resource Box. The objective of this exercise was to illustrate that principal interests among the stakeholder constituencies were apparent, even though their respective knowledge or degree of relationship in the system may differ. This exercise was fundamental to the interpretation of the following exercise, which looked at the present convergences of action between the stakeholder knowledge groups who share common interests. The third exercise of this workshop was intended to build upon our understanding of the system dynamics by exploring the type, and frequency of convergences happening between the stakeholder constituencies. This exercise included a matrix table (table 5) which was modeled

after Tool B4a, the “Linkage Matrix” of the RAAKS Resource Box. The matrix table is essentially a lattice, where each group on the left hand side corresponds to their numbers across the top, providing a systematic approach to comparing each stakeholder constituency with every other one. Before beginning to fill in the matrix, we used the results from the Stakeholder Analysis Exercise to “cluster” the specific groups according to their resources and objectives. This helped our understanding by enabling a wider perspective on the trends for interaction around knowledge and resources in the system.

Table 5: Stakeholder linkage matrix

Exercise 3: Linkage Matrix										
Stakeholder Groups?Linkages?	1	2	3	4	5	6	7	8	9	10
1. Research Institutions										
2. "Hard" Scientists										
3. Extensions Agents										
4. Marketing Agents										
5. NGO's										
6. Policy Makers										
7. Small Farmers										
8. Large Farmers										
9. Youth										
10. Women's Groups										

Over time, we tend to get stuck in our respective “roles” and “rules” in society, often judging what is or isn’t possible based on our understanding of the world through our “lens” of discipline. A visioning exercise, if executed properly, can serve as a powerful tool for dissolving our tendencies to rationalize a situation as “impossible”. It allows us to go beyond the barrier of “what is possible under the current circumstances” to dream of an ideal or utopian vision for the future. From the perspective of a facilitator who is guiding a multidisciplinary group of people through a visioning exercise, it is a way to coax the participants through introspection in order to “see the bigger picture”. After all, before any concrete action steps can be developed, there should first be a collective dream of what the desired future looks like.

Before the workshop, I had prepared a short monologue to help guide the participants through the visioning exercise. First, I said, it is important to center yourself and come into the present. So I had the participants close their eyes and take a few deep breaths. Then, I asked them to imagine themselves in their day-to-day activities regarding large cardamom. Where they go, what they see, who they talk to, and what decisions they make. Next, I asked them to imagine they are gently drifting outside their bodies, slowly up, up into the sky, above the city, above the landscape. I asked them to try and view the state from a bird’s eye view. What kinds of land-use patterns do you see? What is happening with large cardamom from your perspective? I asked them to imagine the landscape changing before their eyes, to something which made them very happy. Slowly, I guided them back down, through the clouds and the tree canopies, back into

their bodies. I then asked them to see their new surroundings. What has changed? How are people treating each other? Are they happy? And what about large cardamom plantations? What do they look like?

After returning back to the present and opening our eyes, I requested that they take around 10 minutes to write down their thoughts on paper. We proceeded to share our individual thoughts and dreams for the future of large cardamom in Sikkim. The results of this exercise were inspirational to everyone, and the workshop concluded on a high note, with a sense of unity among the diverse participants.

2.5.3. Step 3 as Reflective Practitioner: Root Definition

Moving from the "real world" to the "abstract world", this step of the process I carried out largely on my own utilizing the information, concerns, and visions assimilated during the first two workshops, farmer surveys, and through my own ongoing literature search. The stage of Kolb's experiential learning cycle during this time involved converging (c.) of information into a condensed sentence which reflects a "key issue" (from workshop 1), a "key element" (from the visioning exercise of workshop 2), and a specific action steps that are acceptable (based on my past experiences and tools as a reflective practitioner of action research).

I used the CATWOE tool of Checkland's SSM (1985) to enrich my root definition, and to ensure it was comprehensive to the context of the large cardamom system. CATWOE, in short, refers to Customers, Actors, Transformations, *Weltanshauungen* (worldviews), Owners, and Environmental constraints within a human activity system. By including the Customers (system beneficiaries), Actors (those who work directly in the system), and Owners (those who have the most control over the system) we can more clearly define the "structure" of the human activity system, and the way it "functions" over time through the "process" of Transforming knowledge and resources, given its contextual Environment (constraints) and the general Worldviews, for the "purpose" of a collectively determined goal. My understanding of all the elements of CATWOE was informed by and with the stakeholders themselves during the workshops.

A root definition attempts to answer "how" the specific roadblocks can be overcome in order to achieve desirable and feasible changes in the system. This "how" action is represented by the "T", or Transformation in the CATWOE assessment. In order to justify the feasibility of the proposed action, Checkland and Poulter (2006) recommend using the "3 E's" of efficacy, efficiency, and effectiveness as an analysis tool.

Sometimes particular stakeholders in a human activity system can be marginalized or taken for granted, and as a reflective practitioner of action research, it was my duty to be as inclusive as possible in this step. It means I was responsible for representing all key actors in the system, tracing the opportunities and limitations underlying all my findings, and reducing them to the essential elements within this particular knowledge and innovation system. A successful root definition is informed by the results provided through participatory workshops, interviews, and personal observations, and complimented by past experiences and ST tools acquired by the researcher.

2.5.4. Step 4 as Reflective Practitioner: Conceptual Models

The development of a root definition leads to a conceptual model for a "purposeful human activity system" (Checkland and Poulter, 2006). Conceptual models in SSM are often carried out by the researcher as a reflective practitioner, who must take a comprehensive perspective of the system based on the root definitions in order to inform the construction of socially and politically acceptable models within the specific environmental context. The construction of conceptual models answers the question of "what" an improvement to the current situation could actually look like. This converging (c.) step in the SSM process is perhaps the most important part of the first-order learning process because this is when the "real world" and the "abstract" world are reconciled with the intention of creating purposeful and realistic models for improving the system. As a reflective practitioner working alone during this step, I was very conscious to limit the influence of my own worldviews as much as possible, using only the tools and methods from my past experiences to inform the process.

I used the Windows/Tools C1, "Knowledge Management Analysis", & C2, "Actor Potential Analaysis", from the RAAKS Resource Box as a guide to help me understand the current knowledge network regarding large cardamom, and decide on an effective strategy for its re-configuration with the purpose of improving the capacity for farmer innovations. In developing these conceptual models I drew from my own past experiences from working with the Southeast Massachusetts Agricultural Partnership (SEMAP); our case-work as an action researching team in Tolga, Norway; and my personal experience as part of an action researching team in Uttarakhand, India. The tools I used to construct conceptual models came from various literatures on knowledge co-creation and social learning (Pohl C et al., 2010 ; Sol et al., 2012), which I adapted to the specific context of this case study.

2.5.5. Step 5 as Facilitator: Comparison of models to real world

Re-entering the "real world", step 5 of my SSM methodological approach took place during the 3rd stakeholder workshop on Networking Knowledge for Innovation in Large Cardamom Production Systems of Sikkim. This workshop was entitled "Towards a Sustainable Sikkim, Through Knowledge Co-Creation". The final workshop was a space for the presentation of my conceptual models, and a dialogue on feasibility of the models between the participating constituencies. In this step, I took on the dual roles of reflective practitioner and participant simultaneously; as a reflective practitioner, I used the responses from the visioning exercise of Workshop 2 to justify "why" the models seek to overcome the roadblocks, while at the same time facilitating a constructive dialogue around the potentials and limiting factors of them. This step of the SSM process corresponds with the accommodating (d.) stage of Kolb's action learning cycle, in that the active comparison of the models with the real world, and subsequent modifications, represents the first step in making desirable and feasible changes in it. The key to this step as an action researcher who is defending their conceptual model is to remain as objective as possible, and to be open minded to criticism and compliment alike. After all, the word "stakeholder" implicitly refers to the "stakes" that the participants (not the researcher) have in the system! In this way, the fundamental objective of this step is not to reach a "consensus" among the stakeholders, but to facilitate "accommodations" which always requires compromises to different worldviews regarding power and control dynamics that are inherently found in the current system (Checkland and Poulter, 2006)

2.5.6. Step 6 as Facilitator: Defining Desirable and Feasible Changes

The 6th step of my SSM methodology involved working up a strategic action plan (SAP) during the 3rd stakeholder workshop. This is the last step that I was actively involved in this process of as a facilitating participant. As it is based around the future coordinated mobilization of different resources, stakeholder constituencies involved in the development of an SAP should involve first ask the questions "what?", "who?", and "when?".

Table 6: Strategic action plan

Step	What	Who	When
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			

During this exercise, I facilitated an extensive dialogue addressing these questions in order to reach more formal agreements on the plan. I was affirmed in my efforts by the noticeable enthusiasm of the participants to engage in a future convergence of efforts between their organizations, and even more so by their systematic thinking process of the concurrent steps to reach a common goal. The "action planning sheet tool" (table 6) which we used to begin to formulate an SAP was adapted from the Tool C3 of the RAAKS Resource Box.

2.5.7. Step 7: Stepping Back From the Situation

The final step in the SSM approach is the actualization of the SAP, and is dependent upon the parties involved to carry it out in a manner that includes. As a research intern at TMI India, I agreed to help out in this process by producing an illustrative guide in participation with the participating constituencies for the distribution to cardamom farming communities across the state. Furthermore, I suggested that the group explore the possibility of the first pilot project to take place at Hee Bermiok, West Sikkim, based on my experiences there, and the fact that I knew they already had an organized BMC which met regularly.

2.5.8. Step 8 as Reflective Practitioner: Discussions on the Learning Cycles

The 8th step of my AR methodology includes a three-part reflection on my learning cycles at the case-study, epistemic, and global levels.

3. Results & Analysis

The following section contains the results in the form of figures, diagrams, and tables in their consecutive order. Included with each result is a short analysis of the findings as they relate to the system of inquiry.

3.1. Step 1: Enter the Problematic Situation

3.1.1. Field Surveys

The field survey results consist of an aggregated database containing the completed survey of 103 large cardamom farmers in all 4 districts of Sikkim. The survey was designed by ICIMOD and contained 27 pages of questions. Dr. Sharma agreed to help ICIMOD with the data collection, and was requested to complete up to 90 surveys on the perceived importance of pollination on large cardamom productivity (Sharma, 2013). The surveys were very comprehensive, and some of the questions piqued my interest as they pertained to my own

research. The first field visit took place at Sang Namgeythang, E. Sikkim, and 46 surveys were completed between Dr. Ghanashyam Sharma, Mr. Dilli Ram Dahal, Mr. Durga Sharma, and myself. The second visit took place at Hee Bermiok, W. Sikkim, where we conducted 24 farmer surveys. At this time I had created my own field survey (appendix 2), in which I reworked seven of the questions from the ICIMOD survey into Y/N choices, with the plan to collate the related data from the first two field visits with my own field visits. I wanted to get a better perspective on farmer's perceptions about the effects of climate change, their ability to meet economic needs through large cardamom cultivation, and their awareness of Government subsidy and training programs pertaining to large cardamom. I visited Mangan, N. Sikkim, where I surveyed 19 large cardamom farmers in different surrounding villages. A fourth field visit for the ICIMOD study took place in S. Sikkim, but I was not able to assist due to my own research occupying my time. The raw data from the 84 total ICIMOD surveys was compiled by two staff researchers at TMI-India, Mr. D.R. Dahal, and Mr. D. Sharma. I input my own data into an Excel spreadsheet, and combined it with the data regarding the seven questions I had adapted from the ICIMOD survey. I reformatted the aggregated data so that Y becomes 1 and N becomes 2 for a quantitative analysis. Below is a series of pie charts that I made combining data from the 3 field visits of the ICIMOD study with my own data set. The raw data can be found in appendix 2.1.

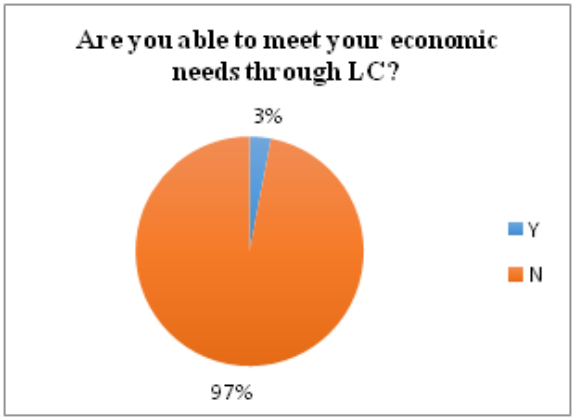


Figure 6.1. Meeting Economic Needs

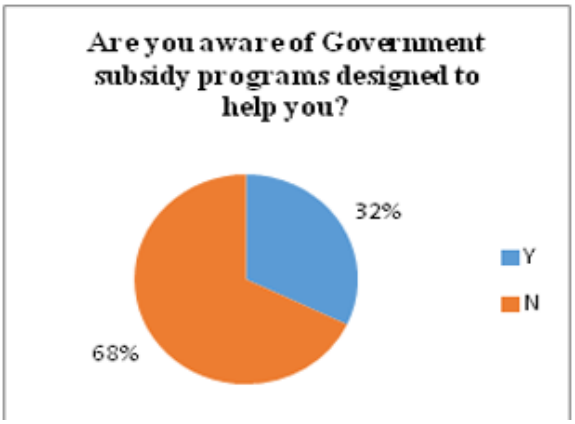


Figure 6.2. Awareness of Subsidies

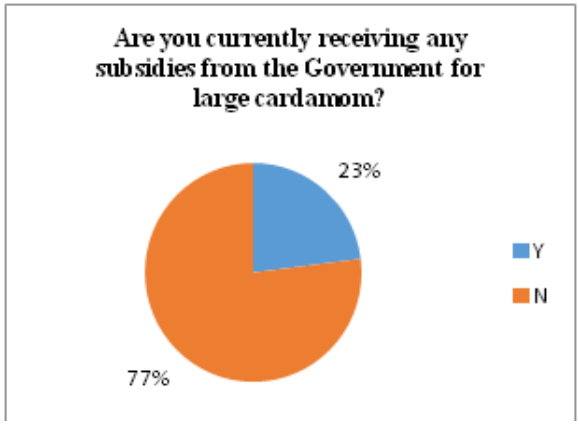


Figure 6.3 Subsidies Received

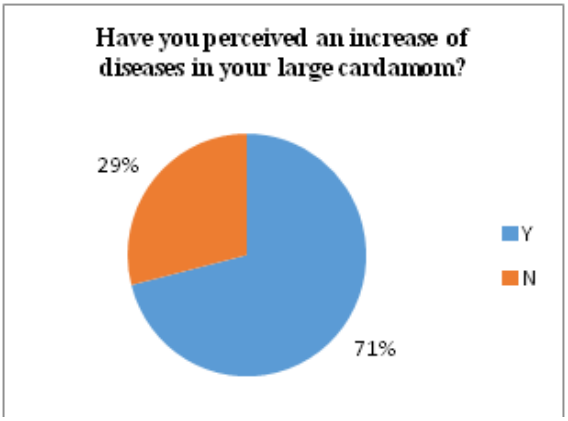


Figure 6.4 Perceived Increase in Diseases(past 10 yrs)

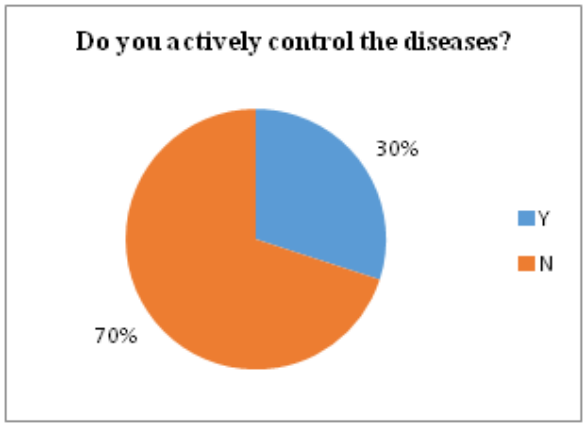


Figure 6.5. Disease Management Practices

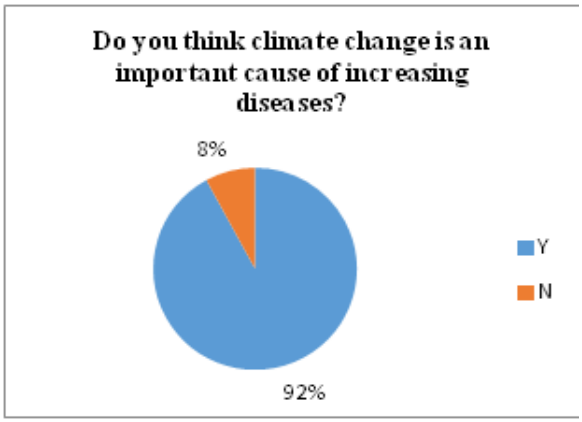


Figure 6.6. Perceptions on climate change and diseases

The pie charts above (figs 6.1-6.6) show that an overwhelming number of respondents are not able to make enough from growing large cardamom to pay for food, education and school items for family members, and proper health care. While there is a good awareness of the subsidy and support programs offered through the Government of Sikkim and Spices Board of India-Gangtok, less than a quarter of respondents admitted to receiving any support. The spread of

diseases has ruined the livelihoods for many families in just a few years, and communities are tight-knit, so the perception that there is an increase in diseases is relatively high at 71% (fig 6.4.). Interestingly, the percentage of respondents who use control measures on the diseases is only 30% (fig 6.5.). This exposes a gap in the knowledge network- farmers know there has been an increase in diseases, but they have not yet developed the skills to manage them. The issues with disease control are compounded by the changing frequency and timing of seasonal precipitation, which the majority of respondents agree is a major cause of diseases and disruption of the natural flowering period (fig. 6.6).

3.1.2. Qualitative Analysis – Preliminary Models

The mind map below (figure 7.) is the result of my own field observations, interviews with key informants, and a thorough an extensive literature search on the topic of large cardamom in Sikkim. In retrospect, it is misleading to isolate the different factors as they are all interconnected. The exercise of creating the diagram, however, served a great purpose in strengthening my foundation for understanding the case within its context. That foundation is exactly what I needed as I began to seek out key people from the government and nongovernmental sector who influence/are influenced by these issues, and invite them to participate in the workshops.

Figure 8 (appendix 4) is a preliminary system model that I created on the value chain of large cardamom in Sikkim. It was also informed through the key informant interviews and literature search. This was a tool I used to write a value chain analysis for a paper Dr. Sharma was working on at the time (Sharma et al., *Forthcoming*). The model shows the flow of goods and services in black, and money in red between the different actors. It was another important step for me in understanding the way the system is organized.

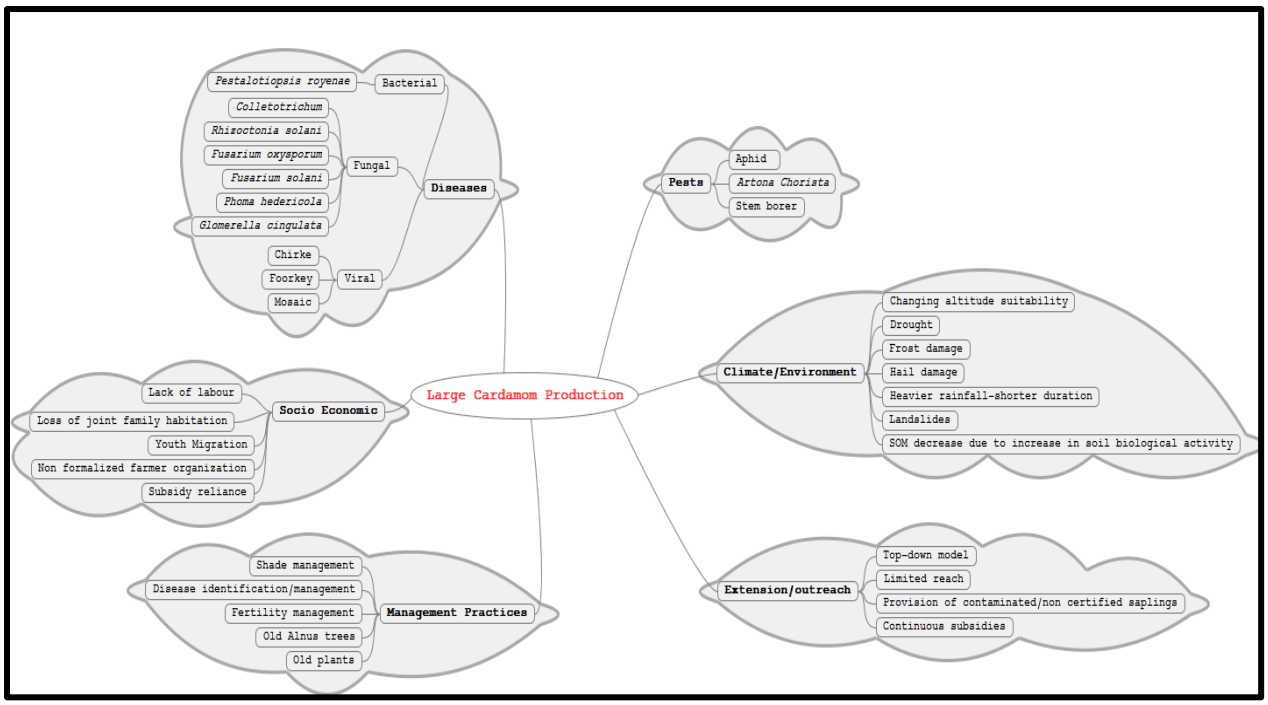


Figure 7: The range of causes in the decline of large cardamom (preliminary model)

The many factors affecting the production and productivity of the plants, and the practice of large cardamom cultivation in Sikkim are interconnected in complex ways. If we take Climate/Environment as the element most outside the system thereby unchangeable in the short term, a lot of the issues could be linked to the weakening of the plants and susceptibility to disease and pest infestations. It seems that large cardamom has begun to increase its altitude suitability, which means old plants at lower, warmer altitudes are subject to conditions ripe for the spread of fungal and rhizome rot diseases. Different pest species injure the plants in various ways. Some attack the vegetative parts of the plant like *Artona chorista* caterpillars and stem borers, and others like aphids act as a vector for the *chirke* and *foorkey* viruses. Insufficient knowledge for identification and proper management practices among farmers has enabled the diseases and pests to spread.

When plantations are wiped out the entire economic structure of the family is changed. Youths are encouraged to attend schools far away in larger settlements, and prefer to seek out government employment, small business or private sector jobs rather than return to the village life and continue to farm. Government extensions programs, though well intentioned have limited reach in and of themselves. In addition, H&CCD acquires the planting material from farmers who are managing large cardamom nurseries and facilitates the distribution of it across the state. However, there is no disease certification process, and thus no way of knowing if diseases are spread in this way.

3.2. Step 2 Expressing the Problematic Situation: Workshops 1 & 2 Results

In this section I present the graphs and tables which resulted from the first two participatory workshops on Networking for Innovation in Large Cardamom Production Systems of Sikkim. During these two workshops there was an emphasis on looking at "what is", or how could we best express the issues in the knowledge system? What roadblocks could be addressed and how? Some of the raw data can be found in appendix 3.

3.2.1. Workshop 1 Results

3.2.1.1. Problem definition Exercise

There was an almost unanimous perception among the participants that diseases of large cardamom were the most influential factor causing the loss in productivity (fig. 9). The most well-known and destructive diseases were the viruses "chirkey", "foorkey", and a macluravirus, also known as cardamom mosaic virus (CdMV). Plant pathologists and other scientists present were aware of the many other fungal and bacterial diseases as having a great impact on the growth and productivity of large cardamom, most notably the *Colletotrichum gloeosporioides* fungus which attacks the rhizome and is difficult to spot before it is too late to take action.

Plants affected by chirke virus

CAUSES	Rating
Diseases	1
Socio-economic	2
Management	3
Climate/Environment	4
Pests	5
Other	6
Policy	7
Spiritual	8

Plants affected by foorkey virus

Figure 9: Importance ranking of perceived causes

The socio-economic factors came in high due to the trend of youth migration out of the village, a shifting of values which manifests as a desire for "quick money" rather than through hard work, and the shortage of sufficient labor to carry out the necessary work throughout the year. Management practices were considered very influential because many participants thought the cardamom fields were being neglected when it comes to maintaining fertility, weeding, effectively identifying diseased plants, and destroying them properly. Climate and environmental factors were a very real concern, owing chiefly to the recent changes in rainfall and temperature

patterns, as well as more severe events like landslides effectively destroying large swaths for cardamom plantation. Pests in this case is referring to both invertebrate and vertebrate animals that attack all parts of the plant respectively; roots, shoots, leaves, and fruits. Many of these pests are insects which cause damage to both the above and belowground vegetative components of the plant, while there also seems to be a problem with rodents, civets, and monkeys eating the sweet stems and fruit capsules before they are harvested.

The category "other" was suggested by some participants who thought that perhaps there were unknown factors that were affecting productivity, and there was a movement to include this in our analysis. Policy as an influence on large cardamom productivity was considered negligible, and in fact most participants agreed that there was a great deal of effort by policymakers to provide planting materials, disseminate knowledge and train farmers on proper disease control, and provide subsidies for irrigation and vermicomposting infrastructure. The final category, spiritual, was suggested by me because I was made aware of the rich cultural tradition of cultivating large cardamom, and that the associated *pujas* or rituals undertaken by local shamans during the flowering and fruiting periods of large cardamom were becoming less and less frequent.

3.2.1.2. Actor Identification

Table 8 is the result of the second exercise during the first workshop. While many of the constituencies were represented in the workshop, there were many others whom I was not aware of or who could not make it. The table shows the compiled list of stakeholder constituencies who are either primarily or secondarily associated with large cardamom. The ones who were judged as being primary or "key" actors in the system are labeled with a Y, and the ones who secondarily contribute are labeled with an N. To the

Table 7: Results of actor identification exercise

System Actors	Key Actor?	Why? Why not?
Sm Farmers	Y	Owners/workers
Lg Farmers	Y	highest production
Spices Board	Y	works on entire value chain
H&CC Dept	Y	provides subsidies and planting material
KVK	N	extension services...not much on cardamom
ICAR	Y	technology dissemination... less on cardamom
ICRI	Y	research directly on improving cardamom productivity
CAU	Y	Improvement of post-harvest technology
IARI	N	KVK extensions in Kalimpong
TERI	N	one experiment on imp. Bhatti
NERAMAC	Y	auctions/ competitive market model
DBT	N	research on biotechnology
NAIP Dzongu	Y	capacity building in cardamom communities
GBP	Y	research/gap filling local landrace, imp. Bhatti
TMI	Y	Cardamom agroforestry research...biodiversity cons.
Merchants	Y	control the local market for remote areas
SIMFED	N	not marketing cardamom
Media	Y	spread knowledge to far places quickly
NABARD	Y	providing loans to small farmers

right is a description of each constituency's main activity in the LC value chain, explaining why it is, or is not considered a key actor.

3.2.1.3. Primary Drivers of the System

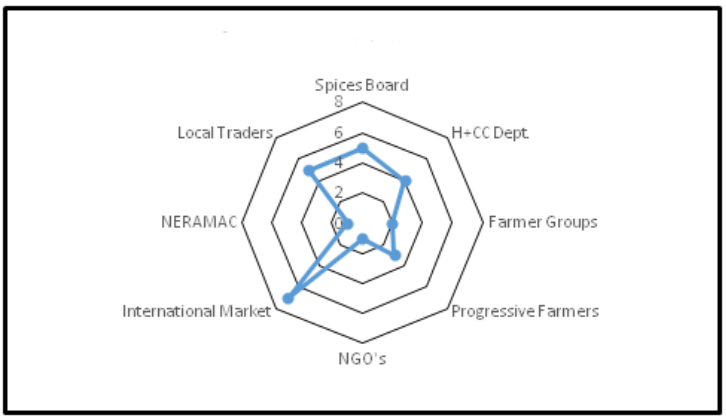


Figure 10: Prime driver radar chart

The relative amount of votes of each driving factor in the radar chart illustrates the perception among participants regarding the influence that it has in motivating farmers to grow large cardamom. Here, it was clearly decided that the international market price was by far the most important factor driving the large cardamom system. Large cardamom is a highly localized cash crop; the production elsewhere in the world is limited. As such, the international demand, particularly from Pakistan, is considerably high. This factor arouses great interest in the rural farmers to capitalize on their unique crop with the greatest returns. Likewise, the desire by farmers to see large cardamom flourish has driven the research and development initiatives by the Government of Sikkim.

Spices Board of India at Gangtok is associated with the Central Government of India, but works closely with the state level in implementation of policies and subsidies. In this way, the Spices Board has three Department Branches in Sikkim; the ICRI is focused on plant breeding and pathology; Development Dept, which is in charge of extensions and field work, and Marketing Dept, which works in collaboration with NERAMAC to facilitate a direct marketing channel for cardamom growers. Naturally, being keyed in at all stages in the value chain the Spices Board are regarded as a significant driving factor for large cardamom production. The local traders are a sort of "middle man" between the domestic and international market and the farmers. In fact, it could be asserted that though the international market prices are dominant, it is inevitably up to the local traders what they are willing to pay for the product. Again, the essence of local traders as a driving factor for the production of large cardamom ultimately comes down to farmers seeking a higher return for their farm products, and so it is an economic incentive.

The H&CCD, Government of Sikkim, ranked in third place according to our discussion. This was explained due to the role of the department in providing subsidies for farmers to undertake seedling nurseries, purchasing them from the farmer, and then actively distributing the planting materials to the rural population. This incentive was seen as important, but not altogether a main

driving factor for the continuation of large cardamom farming. At the progressive farmer level, though they were considered influential at the village scale by providing a physical example of successful large cardamom farming to their neighbors, their sphere of influence most often does not reach beyond the ward level into other regions. Likewise, participants agreed that farmer groups organized around large cardamom production were relatively unfound, but there were comments that the potential for organized large cardamom farmer groups to grow and network were great. However at this time, they have little to no influence over the system.

Lastly, NERAMAC and NGO's were decidedly lacking in any influence over the system. NERAMAC, being newly founded in Sikkim, has yet to exert itself as an important resource to farmers. In fact, my own findings from field surveys in North Sikkim showed farmers completely unaware of this establishment altogether. NGO's have a similar story to progressive farmers; they usually work at the village level, and are regarded as working to improve the rural life through social capacity building rather than working to improve the productivity of large cardamom specifically.

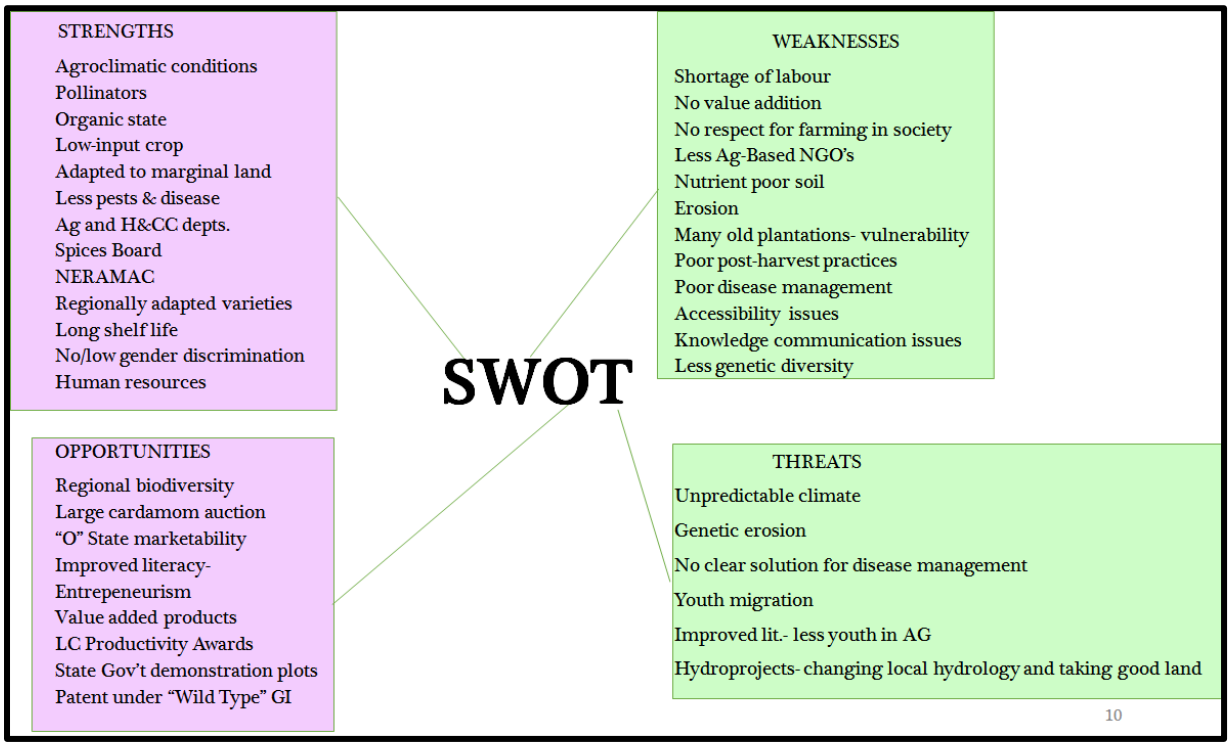


Figure 11: SWOT analysis for large cardamom in Sikkim

3.2.1.4. SWOT Analysis

The SWOT analysis for the large cardamom system in Sikkim that we carried out at the first workshop yielded some very interesting information. In order to categorize and understand all of the strengths, weaknesses, opportunities and threats listed, we can put the elements into the sub-categories of environmental, socioeconomic, and political.

Strengths

Large cardamom is strongly believed to have originated in Dzongu, North Sikkim. The length of time it has existed in this place it seems to have co-evolved with its context, and its suitability to the agroclimatic conditions, associated plants, and human commoditization have essentially preserved its existence. In different parts of the state, a reported 11 locally adapted cultivars can be found. Large cardamom is particularly adapted to thrive on marginal areas. The crop itself is regarded as a low/no input crop, implying that it need not take up valuable paddy land in order to thrive, and continuous labor and maintenance is not necessary. Though the diseases and pests are apparent, there are only a few different kinds of them, so finding treatment for them is easier.

The population of Sikkim represents a sufficient amount of human resources to carry out the inputs and advisory services, production and processing, and marketing of large cardamom. The gender gap between men and women across the state is low to non-existent, expressed at the policy level by the number of women holding official position, and at the farm level by both women and men taking part in the day to day labor duties. The large cardamom capsules, if properly dried using the *bhatti* or local kiln to ~10% mc, have a long shelf life, allowing the farmer to store them in a proper way until he/she is ready to sell and/or if the market price increases. NERAMAC has recently started holding Large Cardamom Auctions in Rangpo, East Sikkim, on border of West Bengal. These auctions seek to provide a direct market link to the farmers, where previously a middleman would collect the product from the villagers and transport it to merchants to make a cut of the profit.

Institutionally, the Government of Sikkim is an enormous asset to large cardamom farmers. There has been a strong initiative the past 15 years by the current Chief Minister, Shri Pawan Chamling, to push the state towards becoming fully organic by 2015. The organic initiative has a strong influence in the FS&AD and H&CCD., who provide subsidies for replantation and rejuvenation of cardamom, irrigation infrastructure, and vermicomposting units.

Weaknesses

The soils of large cardamom plantations have biologically adapted to the cycling of nutrients from N fixation and nutrient rich leaf litter of associated trees and leaf litter. As a result of intensifying production, the soils have become leached of nutrients, and getting them back to fertility requires a lot of organic matter input. In many cases, cultivation is on open terraces, which leads to erosion if not properly maintained. As the focus on large cardamom farming has dwindled, old plantations have been neglected or not properly maintained, sometimes still containing plants that are up to 50 years old. The weakened status of plants is compounded with the increasing disease pressure, and the management practices are not sufficient to deal with this. In addition, for generations the farmers have practiced vegetative propagation, taking 'suckers' off the rhizome for planting material, so genetic erosion is a very real weakness due to human management.

Unfortunately, though the human resources are physically there, the general mindset of members of Sikkimese society regard doing agricultural work as unattractive in favor of pursuing government jobs, which provide job security and a good economic return. As a result, there is a very real shortage of on-farm labor, and migrant workers from Nepal have frequently been hired to do the farm work in villages. Youth and male members of rural households are going in search of employment off the farm in order to meet household economic needs. The generational chain of large cardamom based traditional knowledge is disintegrating, and inaccessibility of remote villages limits both the farmer's access to markets as well as the reach of extensions workers and NGO's.

Opportunities

The sub-temperate to temperate agroclimatic ecosystems which large cardamom is found supports a high plant biodiversity. Many of the associated wile plants have cultural value, including food, medicine, of for ritual purpose. The potential to cultivate these crops for economic purposes is also viable. The floral diversity of the edge habitats are like pollen banks for bees and butterflies.

All of the elements listed seek to enhance the socioeconomic status of large cardamom farmers across the state. The potential opportunities in value addition are enormous; the integrated large cardamom operation could include many other crops including medicinal plants and fruits, which through transformation could bring exceptional returns to the family. The opportunity for entrepreneurial thinking youth is great, and if a business plan for improving the productivity of

large cardamom or strengthening the value chain is developed and presented to the state government, it would be easily be considered to receive a subsidy for start-up. This is a main objective as the state is seeking Organic status. The improved literacy rate among youths is such that they could improve the traditional idea of farm labor being worthless through the validation of progressive, integrated, and diverse agricultural business plans.

Being local in origin, the opportunity for patenting large cardamom under a "wild type" Geographical Indicator could draw market interest at an international level. This is especially true as the state is becoming recognized for its organic status. The state government has the opportunity to develop "best practice" demonstration plots as an example for farmers to adopt. Further, the H&CCD and A&FSD are creating incentives for large cardamom production through the newly founded "Large Cardamom Productivity Awards" which offers a substantial amount of money to male and female farmers for high quality operations.

Threats

The regularity and duration of rainfall patterns has apparently changed in the past decade. The Government of Sikkim has recently published an impressive volume on Climate Change in Sikkim, including 23 different papers ranging from evidence of climate change in Sikkim to its impacts on the forests, agriculture, springs and glaciers, to vulnerability assessments, to initiatives which are focused on addressing climate change. It seems there is much more work to be done in the near future in accommodating climate change.

The long term urbanization of the populace poses clear threats to the traditional ways of living and associated knowledge systems. Youth, while shifting to urban centers to achieve higher education status are reluctant to return to their village and pursue agricultural work. The return on farm products are minimal compared to a government salary and one must have the means and the mind to build something lucrative over time with hard work. Breeding of disease resistant varieties of large cardamom also takes time, and in the meantime there does not seem to be any clear solutions for the spreading diseases.

One extremely important threat in Sikkim currently is the increase in hydroelectric projects across the state. Participants expressed the complex effects which damming the rivers has on the surrounding ecosystem, as well as their influence on the recharge rate of high-altitude aquifers, which has resulted in the drying up of critical springs in the villages. The hydroprojects are funded through a partnership between the Central and State Governments, their impact on local livelihoods and food security are often disputed. Usually the projects assimilate cultivable, flat

land- a rarity in such a mountainous state. To further complicate the matter, developers of what some of India's largest mega hydroprojects are seeking carbon credits through the UN Clean Development Mechanism (CDM), which some would argue is at the expense of the natural ecosystem and livelihoods of local peoples.

3.2.2. Workshop 2 Results

3.2.2.1. Large Cardamom System Diagram

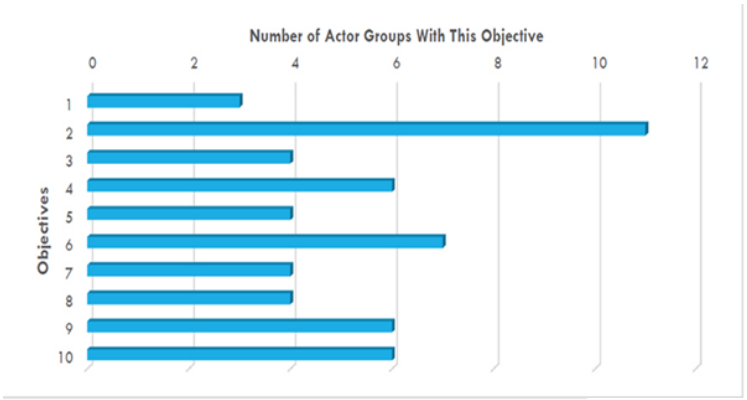
The system diagram was the result of the first activity of the second workshop. The result is less of a "rich picture" and more of a model. I wanted to develop a model of the system including the inputs from all participants. For example, I thought middlemen were still a link in the value chain (you can see it crossed out), but it turns out that farmers are less willing to work with middlemen now that information on market prices is readily available through the internet.

Climate, politics (Central Gov't), and geology all lie outside of the system "boundary" as they are largely beyond the direct control from a local context. The State Government of Sikkim H&CCD regulates the cultivation practices of large cardamom through the development of policies and subsidies, which transfer through researchers and extensions inputs. Subsidies for infrastructure and replantation material, post-harvest technology, information, and training for best management practices are all provided from both governmental organizations and NGO's.

As you can see, large and small farmers, including labor, are the only ones actively working at the production level. Once harvested, the capsules are dried using a traditional kiln, or "bhatti". Large scale cardamom plantation owners will hire labor to do this work. Small scale producers will do the curing themselves. Once the capsules are reduced to a 10% MC, the product is stored in a temperature neutral room until marketing.

When the producer is ready to sell, the traditional route is through the local market, usually situated in the urban capital of each district. However, through the work of H&CCD and NERAMAC, new auction centers have opened up which bring a direct link between farmers with high quality product and merchants. Naturally with less links, the return to farmers is much higher at an auction, and it is further increased by the bidding process between merchants. Farmers are allowed to recall their submission if they are not happy with the auction price. Once the merchants acquire the product, they will sell it in India.

3.2.2.2. Actor Analysis



Objectives Key	
1	Production & Processing
2	Rural Livelihoods
3	Biodiversity Conservation
4	Improving Plant Prod.
5	Policy Implemenation
6	Extensions/Training
7	Market Development
8	Inputs/Subsidies
9	Innovation
10	Plant Pathology & Physiology

Figure 12: Results from the actor analysis exercise

Actor Groups Analayzed	
-Small Scale Producers	-NERAMAC
-Large Scale Producers	-NGO's
-Spices Board	-D.S.T.
-H&CCDD	-S.I.C.B.
-Research Institutions	-R.M.D.D.
-I.C.A.R.	

The second exercise of the Opportunities and Constraints workshop was looking at the primary objectives of 11 different stakeholder groups in order to trace the differences and similarities between them, and notice trends (figure 12). The groups included small and large scale producers, Spices Board, H&CCDD, Research institutions including TMI and GBPIHED, ICAR, NERAMAC, NGO's, Department of Science and Technology (DST), State institute of Capacity Building (SICB), and Rural Management and Development Dept (RMDD).

Each stakeholder group plays a unique role in the large cardamom system, and sometimes the means by which they try to achieve their objectives overlap, providing a space for collaborative partnerships to arise. Here we can see the different objectives correlation of objectives between constituencies. Improving rural livelihood opportunities emerged as a unanimous objective among the groups present, objectively because it has such a broad context. 7 out of the 11 groups declared that extensions and training work constituted a significant objective of theirs. 6 groups identified with improving plant productivity, plant pathology and physiology, and promoting innovation, respectively. Only 4 groups claimed to be interested in biodiversity conservation, policy implementation, improving markets, and providing subsidies and inputs.

3.2.2.3. Linkage Matrix

Stakeholder Groups↓Linkages→	1	2	3	4	5	6	7	8	9	10
1. Research Institutions	-									
2. "Hard" Scientists	√	-								
3. Extensions Agents	√	√	-							
4. Marketing Agents			√	-						
5. NGO's	√	√	√	√	-					
6. Policy Makers	√	√	√		√	-				
7. Small Farmers	√	√	√	√	√	√	-			
8. Large Farmers	√	√	√	√	√	√		-		
9. Youth			√		√		√		-	
10. Women's Groups	√		√	√	√	√	√		√	-

Table 8: Actor linkage matrix

The linkage matrix was a tool to see who interacts with whom through their work within the large cardamom knowledge system. The numbers across the top correspond to the stakeholder constituencies on the left. The green cells are the interactions that do not occur. It should be noted that the tick marks in table 9 do not necessarily represent "formal" relationships, many simply illustrate that communication is happening between the constituencies on a regular basis.

A "network" is just that; ideally it acts like a social "net" to recapture knowledge and resources. The gaps in the network are like holes in a net, and everyone knows it's difficult to catch a fish with a holey net. The gaps could be seen as potential opportunities for further strengthening the resilience of the knowledge system. While the above network for knowledge and resource sharing in the large cardamom value chain appears relatively well defined, if we extract the essential linkages through the lens of Production, Research and Development, Biodiversity Conservation, Capacity Building, and Marketing respectively, the gaps are expressed further.

I call the following diagrams "fingerprint diagrams" because they show the communication network "fingerprint" of the specific objective outlined. They could be interpreted two different ways; the first is to assess the currently existing network linkages. How strong or formalized are they? What kinds of things are exchanged? Who holds more power in the linkage?

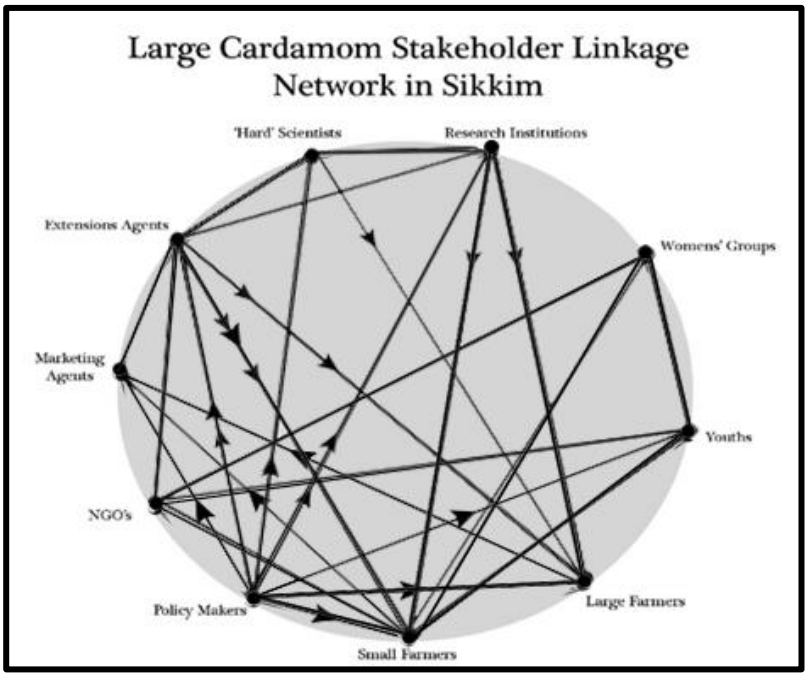


Figure 13: Large cardamom knowledge network "fingerprint"

Such are the questions asked when looking from this angle. The arrows illustrate the direction of influence. The links with no arrows represent a neutral or mutual relationship. From the second angle we could focus on the gaps in the network, which could guide thinking towards opportunities for new roles and tasks that could serve to strengthen them.

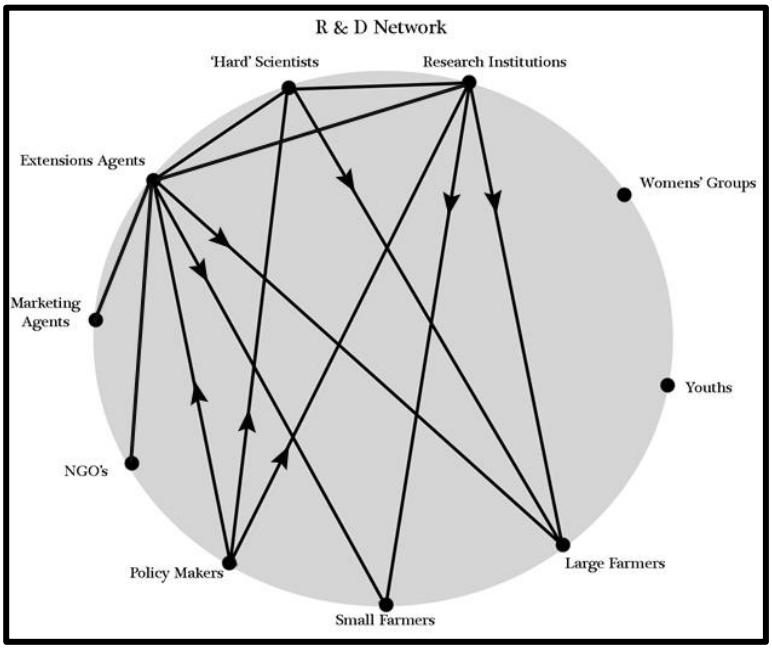


Figure 14: Large cardamom R&D "fingerprint"

The hierarchy of influence in the research and development system (fig. 14) starts with the policymakers, who are responsible for allocating funds for development. The policies handed down through government departments direct the programs and schemes developed by government extensions agencies. The "hard" scientists such as ICAR, ICRI, and DST rely on funding for their research, which is used to guide the extension schemes of their organization. In the case of ICRI, there is a very close link with both extensions agents from H&CCD, SBD, and KVK. The results of scientific knowledge generation are transformed by the extensions workers, who are responsible for applying it in the field. The research institutions in this case are institutions not so directly influenced by government policies, such as GBPIHED, TMI, CAU, and Sikkim University. Nevertheless, the findings of these institutes often apply directly to the situation on the ground, and as such, they do influence the extensions schemes and activities.

Both large and small farmers are at the receiving end of this chain of knowledge dissemination. In the case of large farmers, scientists themselves often visit their fields to take part in the training process or on a specific program. Small scale producers are found to a much greater extent across the state, and the reach of knowledge and training directly from scientists is limited in this case. There is clearly a lack of networking with women's groups and youths in regards to research and development. This could be attributed to the scientific focus strictly on plant productivity, with less regard for the strength of communities that seek to benefit from the improved practices.

The second fingerprint is an assessment of the biodiversity conservation network in the large cardamom system. According to Section 3 and Section 19(1) of the Biological Diversity Act of India, 2002, we assume Traditional Knowledge Systems (TKS) as an integral part of biodiversity (Anonymous, 2007).

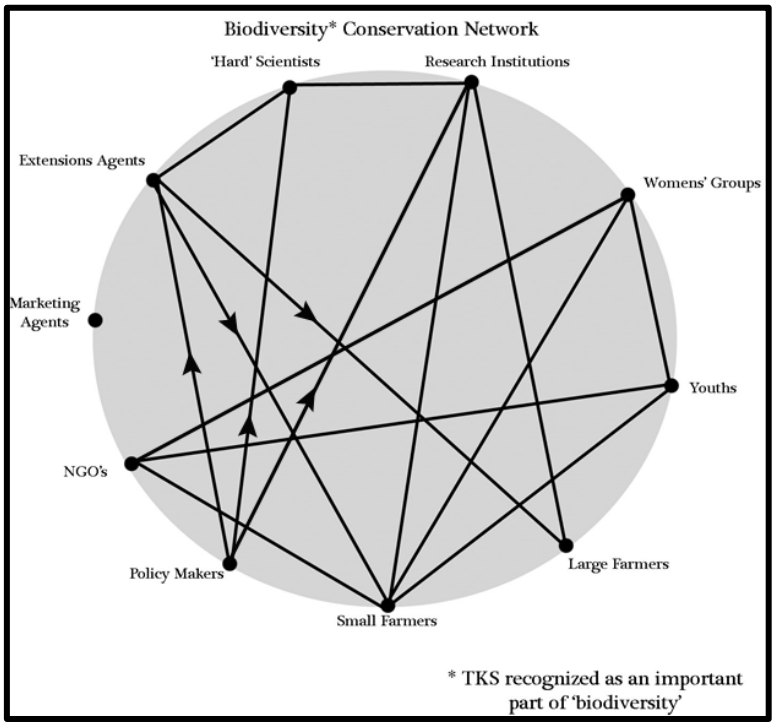


Figure 15: Biodiversity and conservation "fingerprint"

As expected, we can see the influence of policy over the activities of scientists, researchers and extensions agents. The scientists work towards biodiversity conservation through breeding and work with the genes of large cardamom. GBPIHED as a research institute has carried out extensive work on the identification and development of local landraces of large cardamom throughout the state. Researchers at TMI-India, GBPIHED, and ICIMOD-Nepal have written or co-written numerous papers on *Alnus*/cardamom agroforestry systems, large cardamom pollination, and related capacity building work. There is a gap between research institutes and extensions agencies however, but they meet at the production level to improve the biodiversity at a village scale. Perhaps it is an opportunity to incorporate the field research findings in the future action steps of government extensions agencies.

NGO's are constantly in the field working with communities to build social capacity at a village scale in order to preserve local biodiversity. Unfortunately, it was deduced in the SWOT analysis that agriculture-based NGO's are not as common in Sikkim. Where they do exist they seek to promote rural livelihood through empowering the women's groups, youths, and small farmers. However, BMC's at the ward level have emerged with the assistance of TMI-India, to come together around issues threatening their biodiversity, and to form a social contract among the villagers.

The third fingerprint diagram illustrates the objective of capacity building among the stakeholder constituencies. The government extensions agencies provide valuable training and development at the village level, which seems to have some impact on community replantation and rejuvenation of organic farming operations, but less focus is directly on large cardamom.

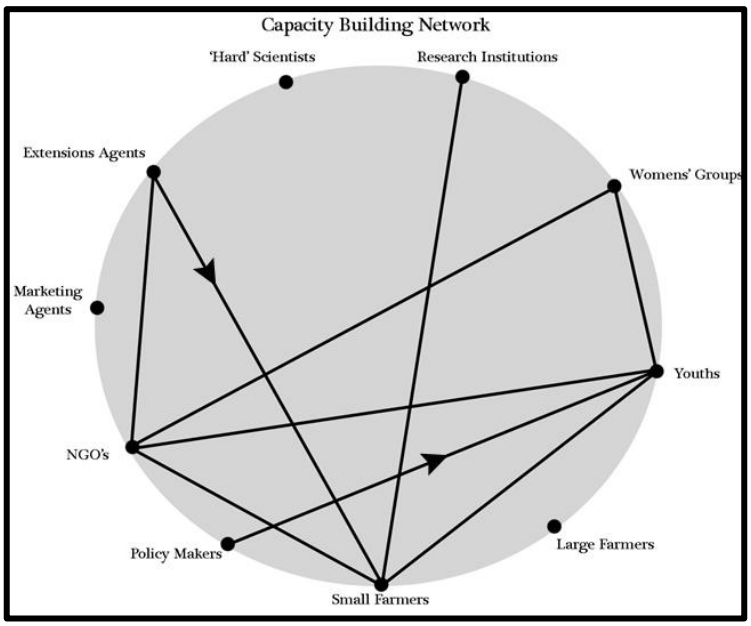


Figure 16: Large cardamom capacity building "fingerprint"

Research institutes have worked with small scale farmers to increase awareness on biodiversity issues, track the spreading of diseases, and capacity building for local spring management. Policymakers in this case is referring to the State Institute for Capacity Building, which has initiated Livelihood Schools, including large cardamom training, for the purpose of bringing localized income and building social resilience. The primary focus of the existing NGO's is to build social capacity among youths, women's groups, and other farmer groups in order to strengthen their collective independence. Large scale cardamom farm owners are most often landlords, government servants or employed off-farm, and so they do not concern themselves as much with capacity building initiatives.

The primary objective of both large and small scale farmers is the production and processing of large cardamom. Often times the entire family will contribute to the labor on a small scale operation, including youths. Because the women's groups are an integral part of small farming communities in Sikkim, applying for bank loans and organizing together, they were considered to contribute to the

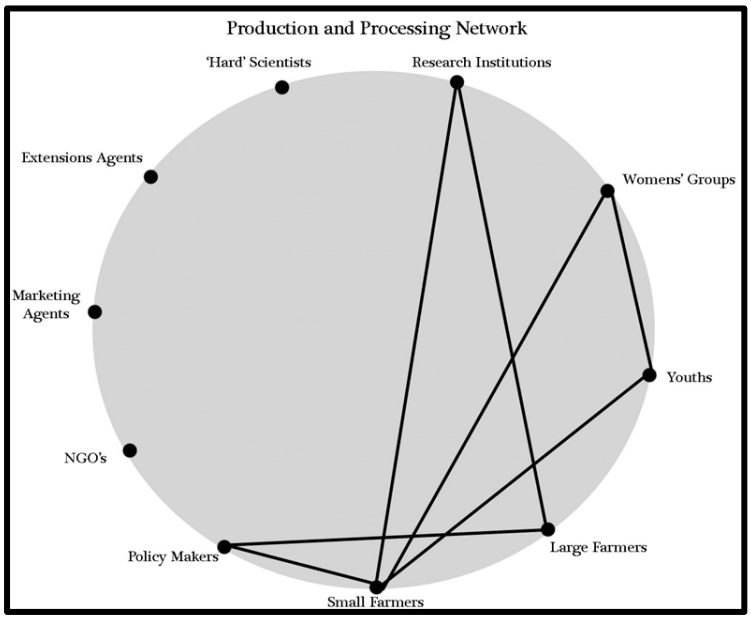


Figure 17: Large cardamom production and processing "fingerprint"

process as well, however in the field surveys I analyzed over 75% of the respondents claimed that women in their home are not engaged in large cardamom cultivation. In support of post-harvest transformation, there have been several attempts to develop an improved “bhatti” or kiln by SB, GBPIHED, H&CCD, and even outside institutes, who are interested in ways to dry the capsules more evenly and divert the smoke that changes the oil content and flavor of the cardamom. However none of the improved models have resulted in wide-scale applicability just yet, and most small farmers continue to rely on traditional earthen bhattis for post-harvest transformation, though very careful to regulate the evenness of heat and time.

Fingerprint diagram number four (fig 18) illustrates the the last link in the network- that of the marketing of the cured and dried capsules. Presently, based on global market demand the H&CCDD policymakers will set the price for large cardamom. To be certain, the market prices are known to fluctuate. In case of a market drought, farmers have taken to storing their processed cardamom until they are ready to sell it. If they choose to store it, there must be caution to ensure the capsules are fully dried, as it is known to rot if stored with a high moisture content. Most commonly the farmers sell to a local merchant or trader (not shown), who may also store the product until a market opens up.

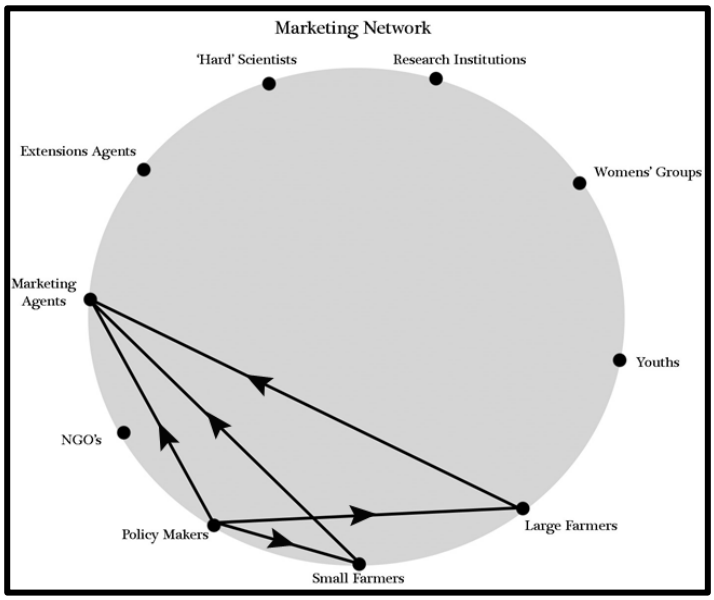


Figure 18: Large cardamom marketing network "fingerprint"

Recently, NERAMAC has opened up a series of auctions bringing traders together in one location to bid on the product of each farmer. This auction process seeks to empower farmers to negotiate prices and bring higher returns in the process. Further, the auctions could be seen as an incentive for farmers to produce higher quality cardamom. There is certainly a great potential for future links in the marketing network


Picture 8: Traders inspect the product at the 7th large cardamom auction in Rangpo

of large cardamom. While the direct marketing infrastructure should be developed further, it makes sense that the focus of research and development is on improving productivity and production of large cardamom as it is much more pertinent to the present case in Sikkim.

3.2.2.4. Visioning Exercise

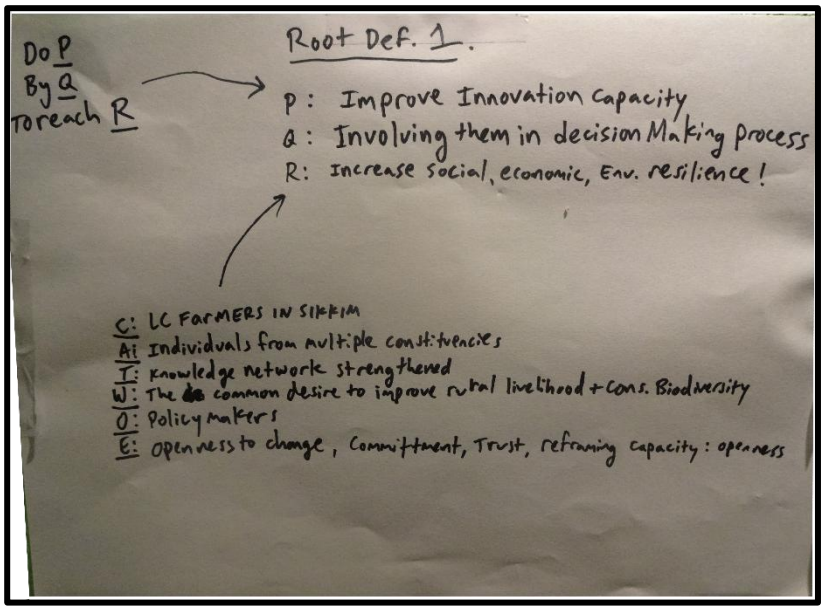
The results from the visioning exercise of the second workshop are a valuable part of this process for two reasons: the first is that it helped to give me as a researcher a perspective on the long-term goals and objectives of the group for my own analysis in the next step, but more importantly the second reason was through the reflection and presentation of their respective visions, diverse stakeholders could begin to see the common objectives among them. Once a vision for the future and common goals are shared in a group, it facilitates a constructive dialogue between the actors, as they begin to recognize the important role of each stakeholder constituency in their vision.

Figure 19: Inspiring feedback from the visioning exercise

Above (fig. 19) are some highlights of the visioning exercise. There were many comments on building linkages between farmers, scientists, extensions, and markets for the improvement of large cardamom production. There also seemed to be a movement to improve the link between the objectives of biodiversity conservation and rural livelihood opportunities. Perhaps the most inspiring comment was the last one which came from a farmer; "Lets unite and really work for reviving our valuable crop- the large cardamom- for all Sikkimese people!" From the outset, it appears the long-term vision among the stakeholders is common, and there is hope for improvement.

3.3. Step 3 Abstract Conceptualization: Developing the Root Definition

In the third step of my SSM methodology, I used the tools provided by Checkland (1985) to reflect on "what is" from the first two workshop combined with my own field observations and literature study, and "what could be" from the visioning exercise, in order to develop a root definition for what an improvement to the system could look like. The first part of developing a root definition involves working out all of the elements of CATWOE in the system. I defined the Customers as large cardamom farmers in Sikkim, being the primary beneficiaries of the production system. Through the results of the visioning exercise and personal discussions I had, I deduced that a multi-disciplinary team of Actors should be involved in the decision making process. I reflected on Transformation as the strengthening of the knowledge network in the large cardamom system. Improving rural livelihood opportunities is the common Worldview across the board. Most resources and planning originate from the policy level and are handed down through the system. Policymakers represent the Owners of the system, having the power to fundamentally change or alter its course altogether. The Environment context in this case applies to the mindset of actors in the system; is there openness to change mental models among both traditional "power holders" and those with historically less power? How can people from different disciplines learn to trust one another in working towards a common goal? How committed are people to the process, as the improvements may take time to be expressed in the real world? And finally, is there a common ground for footing in order to collectively reframe the problems as they emerge over time? The use of PQR as a tool helps to bring all the elements together by outlining the objective of the improvement (P), by means of an action step (Q), in order to reach a shared vision for the future (R).



Picture 9: Developing the root definition using CATWOE

The root definition which I developed is as follows:

"A way of involving farmers, scientists, extensions and marketing agents, research institutions, and policymakers in the development and implementation of policies regarding large cardamom production by means of a formalized, multi-disciplinary coalition, in order to improve the respective capacity for dynamic ecological, economic, and social resilience."

Where P is the objective of a process of participatory decision making, Q is the formalization of a multi-disciplinary stakeholder coalition, and R is the improved resilience at a system scale. The ability to innovate is essentially about building resilience in the system in order to effectively adapt to a changing climate, markets, disease pressures, or any other external pressures on the system. Strengthening the links in a knowledge network should be about bringing resilience to the entire system, including the capacity for livelihood practices to promote cultural, biodiversity, and geological resilience.

3.4. Step 4 Conceptual Models: A Synthesis for the Future

From my root definition, I was able to develop two different but complimentary conceptual models for improvements in the system. The first is a model for the structure, function, and purpose of a multi-actor innovation network called Sikkim Sustainability Coalition (SSC), which I adapted from Sol et al. (2012) and Pohl et al. (2010) on social learning and knowledge co-creation in regional innovation projects. The second model is a proposal to develop a Community Based Agroforestry Replantation Scheme (CARS) through a regional innovation network like an SSC.

3.4.1. Sikkim Sustainability Coalition

The idea I had for a Sikkim Sustainability Coalition came partly from the apparent complexity of problems in the large cardamom system of Sikkim, and partly from my own belief in the power of linking different perspectives through purposeful communication. In an effort not to restrict the model explicitly to the large cardamom system, I wanted to create something which could serve to find accommodations to all current and future issues threatening "sustainability" in Sikkim. The model points to a systemic re-configuration of the traditional hierarchy of influence, and seeks to empower farmers as valuable knowledge holders in the process of developing and implementing policies. That is to say, an SSC would serve to integrate stakeholder groups both horizontally (i.e. between constituencies at the same level sociopolitical hierarchy) and vertically (i.e. between constituencies at different levels of sociopolitical hierarchy).

The model I used was adapted from an exceptional paper on regional innovation projects by Sol et al (2012), where they inquire into complex agricultural systems through a participatory "social learning" process. The emergent properties of a functioning multi actor constituency, they conclude, are that of of "trust, commitment, and reframing" of commonly agreed upon issues (p. 2). I feel that this approach is directly applicable to the case in Sikkim, and being such a small state it could greatly benefit from this type of sustainable organization.

This model for a Sikkim Sustainability Coalition is constituted of a diverse range of stakeholder groups representing critical interests both within the large cardamom value chain, and outside of it as they frame the context of the system. In order for a multiple perspective stakeholder group to be successful, its structure should function as a collective unit through a process of group inquiry. A collective vision for the future of Sikkim serves to further strengthen the mutual trust and enthusiasm for the project between diverse stakeholders. The purpose of such an approach to sustainable development is to increase the system resilience to sudden environmental, social, or economic changes.

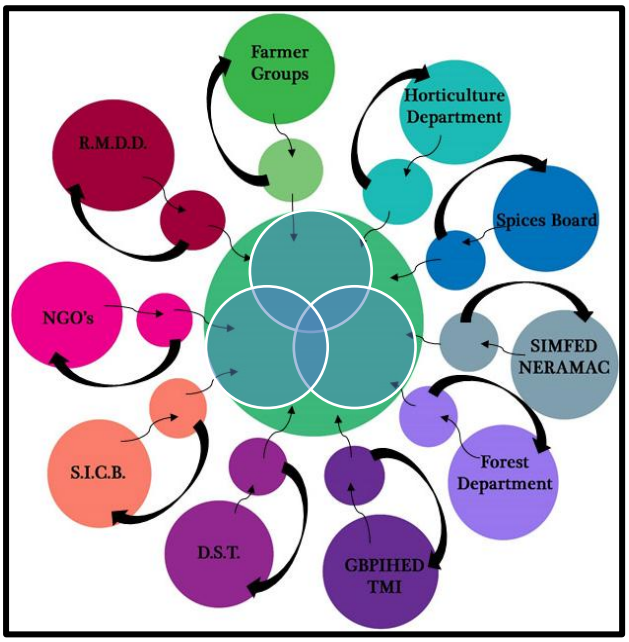


Figure 20: The structure of a Sikkim Sustainability Coalition (adapted from Sol et al. 2012)

3.4.1.1. SSC Structure

Each participating constituency sends a willing representative (or more) to engage as a part of the *outer structure* of the coalition (various colored circles, fig. 20). In the center of the model (fig. 21) are three multi-actor innovation subcommittees, with the triple "lenses" of sustainable livelihoods, sustainable environment, and sustainable economy as the group objectives. The lenses of sustainability emerge at the center of the SSC model to reflect its *inner structure* as an integrated, multi-perspective innovation network. Different stakeholder groups represent different knowledge holders, and ways of knowing about the system. As this is the case, some are more accustomed to seeing the system through one particular lens over another, using more tacit or explicit knowledge (Reber, 1989), and coming to that knowledge through either propositional or practical learning (Reason & Rowan, 1981 in: Sriskandarajah et al., 1991). The diagram depicts my own interpretation in specific stakeholder groups which could contribute different knowledge and experience to the

functioning of three "subcommittees". The overlapping of sustainability lenses brings a much more holistic view of both problematic situations and a more comprehensive approach to finding accommodations to those problems. Pohl et al (2010) refer to this central point of knowledge co-creation as the "AGORA" (bottom of fig. 21), or a permeable space where collective intent of a diverse group overlaps.

3.4.1.2. SSC Function

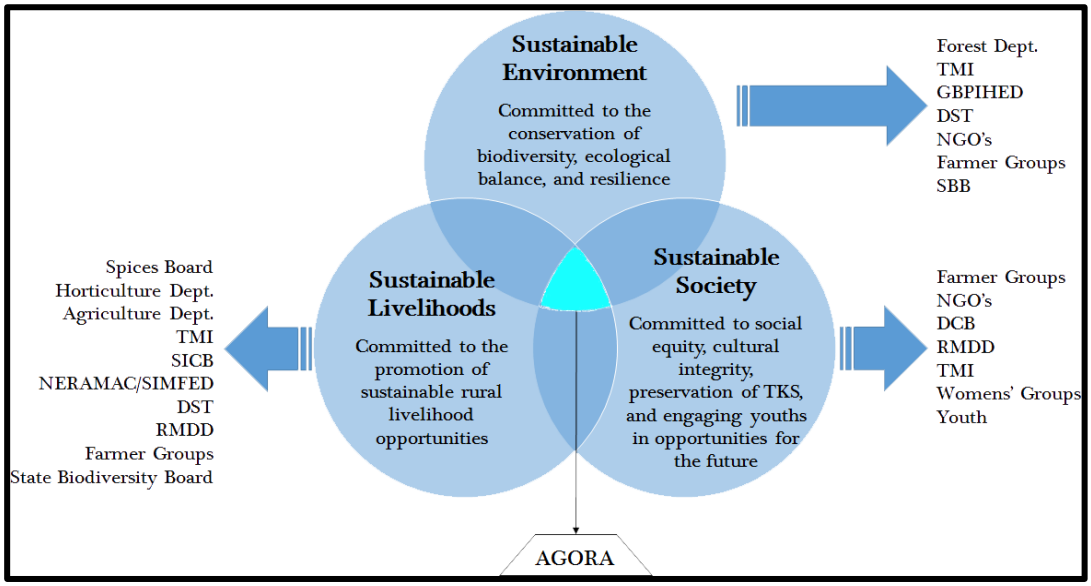


Figure 21: The Function of a Sikkim Sustainability Coalition

At this point there are two functional improvements an SSC can provide; first, the representative can use the ideas and information garnered from the SSC to improve the effectiveness of their respective constituency (thicker arrows, fig 20), and second, the SSC itself has the opportunity to develop more holistic policies and schemes for improving innovation and resilience in the system within the "agora" (figure 19) (Pohl et al.). The different stakeholder constituencies to the outside of the concentric circles in figure 21 represent the different knowledge resources available to bring perspective on the ecological, social, and economic issues within the system of inquiry.

3.4.1.3. SSC Process

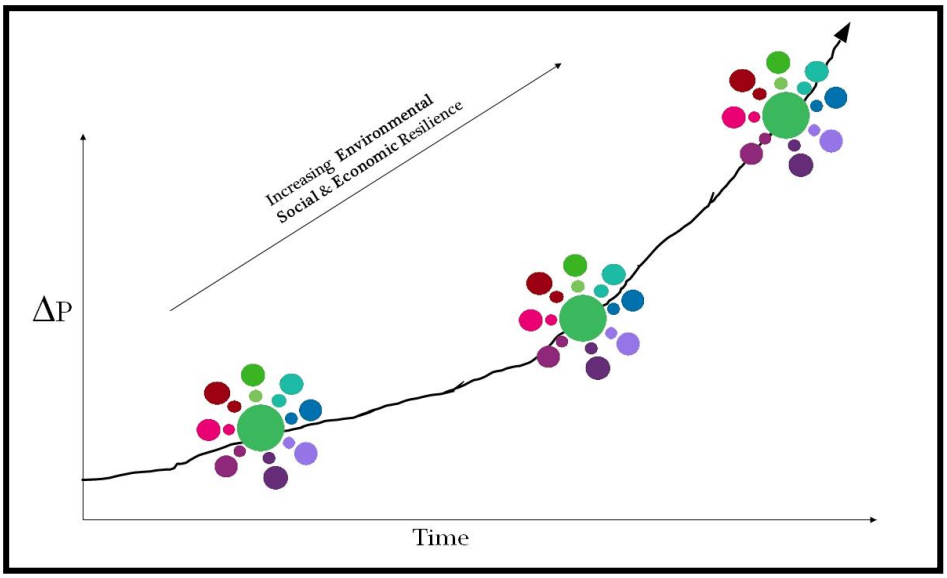


Figure 22: System resilience as an emergent property from the process of participatory inquiry and knowledge co-creation (adapted from Sol et al. 2012)

Figure 22 illustrates the potential opportunities for change (ΔP) over time. With continuous and directed interactions of an SSC, mutual trust, commitment, and the ability to reframe issues become the emergent properties of the process (Sol et al, 2012). There is a positive correlation between increased social cohesion within the system and the potential for systemic resilience over time. That is to say, with a stronger communication and knowledge feedback network, purposeful accommodations to complex issues can be developed through knowledge co-creation (Pohl et al, 2012), implemented, maintained, and monitored from input to marketing. The long term goal, ideally, is to develop a system which facilitates all agricultural innovation naturally through a strong knowledge and resource support network from diverse inputs.

3.4.2. Community-Based Agroforestry Replantation Scheme

The second model that I began developing was a Community-Based Agroforestry Replantation Scheme (CARS) as a partnership project between many of the stakeholder groups represented. My research was primarily focused on the situation of large cardamom as a case study; however, the CARS model could be adapted to other agroforestry replantation schemes in the future. *Alnus*-cardamom agroforestry has developed as a traditional practice for generations in Sikkim and Nepal, and in addition, a great deal of scientific research has emerged regarding the various ecological and economic efficacies of these traditional agroforestry systems (Singh et al., 1989 ; Zomer and Menke, 1993 ; Sundriyal et al., 1994 ; Sharma et al., 1994 ; 1997 ; 2002 ; 2007 ; 2008 ; Saha et al., 2010 ; Sharma et al., 2010 ; Gaira K.S. et al., 2010).

Taking into consideration that this system is already based on traditional knowledge and practices it is considered socially acceptable. Additionally it is backed up by a body of scientific data. The first objective of the model is to propose a way of integrating the context specific TK on bioresources with the scientific data in order to propose a scheme for Government funding and future policymaking. Agroforestry systems provide many ecosystem services, as illustrated in fig 21. Both *A. nepalensis* and cardamom are locally adapted and suited to marginal or abandoned lands which are highly susceptible to erosion.

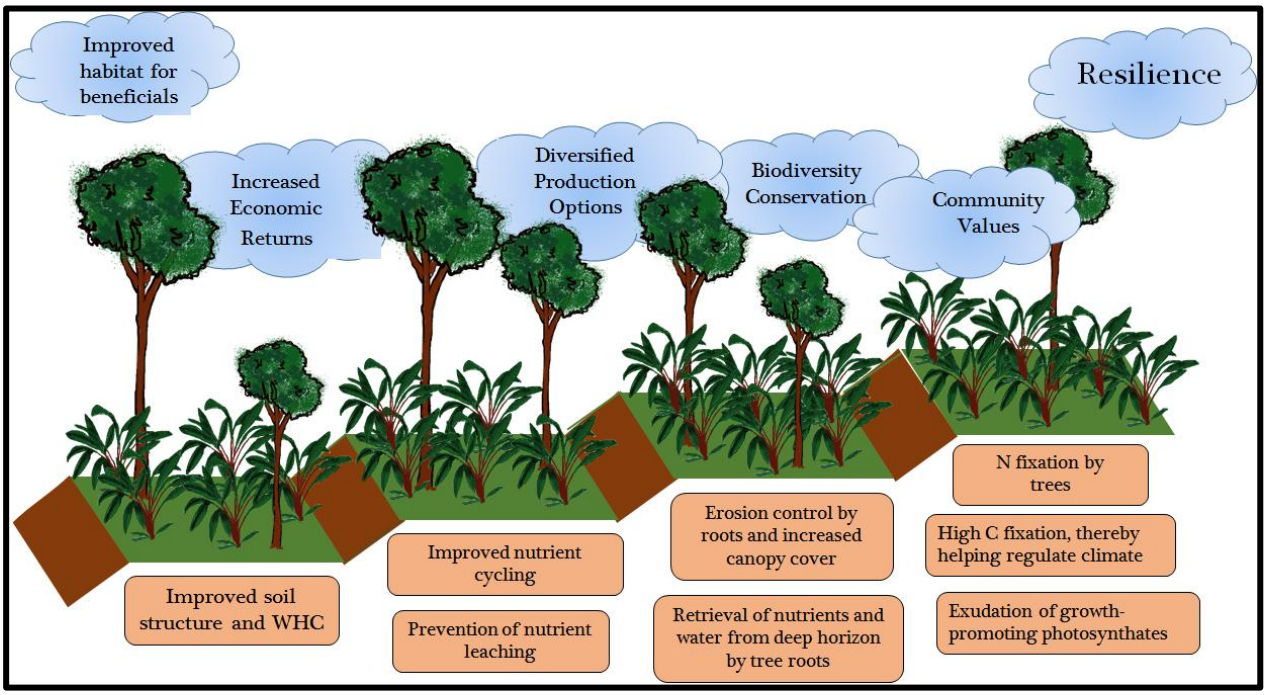


Figure 23: The multi-functionality of Alnus-cardamom agroforestry systems (information adapted from Saha et al., 2010)

Agroforestry systems serve to reduce leaching and runoff rates, regulate high-altitude aquifer recharge, and improve the soil structure and resistance to erosion- all major problems in Sikkim. By pairing naturally occurring plant associates, a well managed *A. nepalensis* and cardamom-based agroforestry system could help conserve biodiversity by recreating the ecosystem services of its natural setting in a long term adaptive management strategy. CARS is a scheme designed to find a common ground between the different stakeholder groups with their respective organizational objectives. It seeks to address the issues of rural livelihood opportunities though diversification of production and the inclusion of high value cash crops, which serves to empower rural cardamom farming families to build something sustainable in the long term.

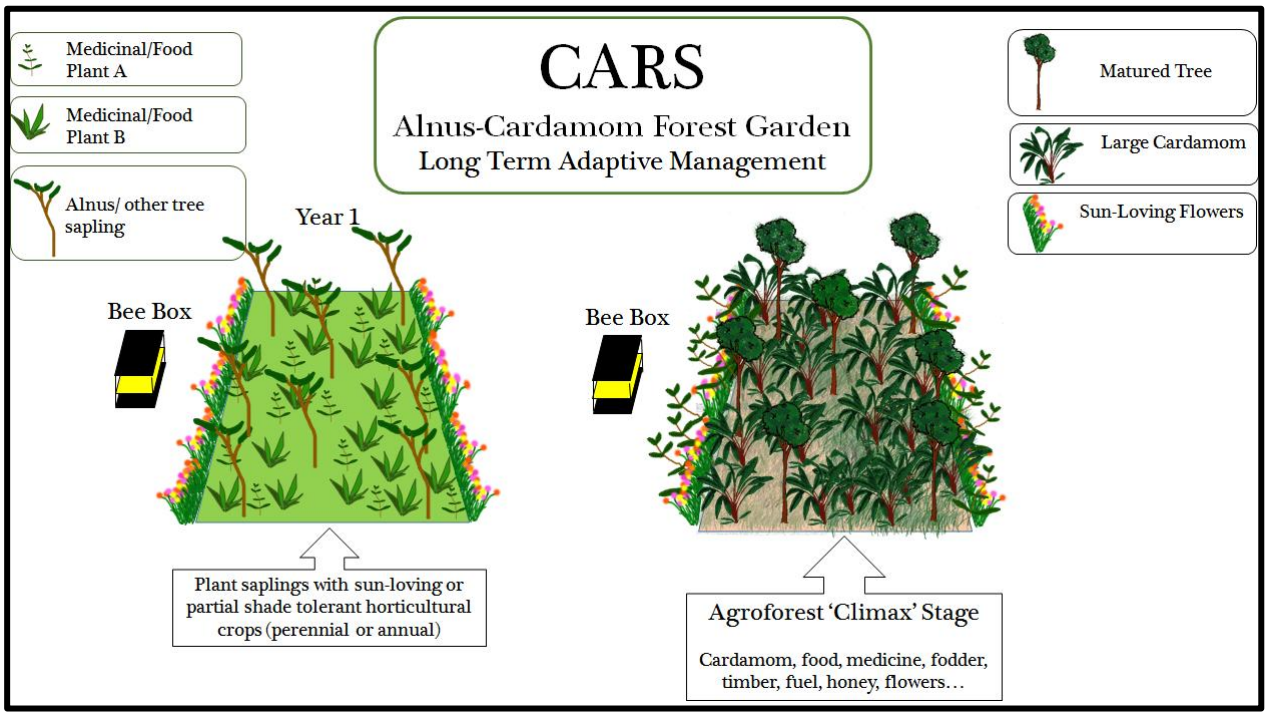


Figure 24: Community based Agroforestry Replantation Scheme- a long term adaptive management model

The CARS model takes into account that both *A. nepalensis* and large cardamom reach their peak performance at around 20 years (Sharma et al., 2008), and so it follows that the model is based on a 20 year rotation cycle. In the first years, *A. nepalensis* and other useful tree saplings are interplanted with sun loving or partial shade tolerant medicinal or food crops (this could also include forage crops). The perimeter is planted in flowers and made attractive for the bees and other pollinators to stay nearby. Large cardamom is interplanted as trees age and begin to provide more shade.

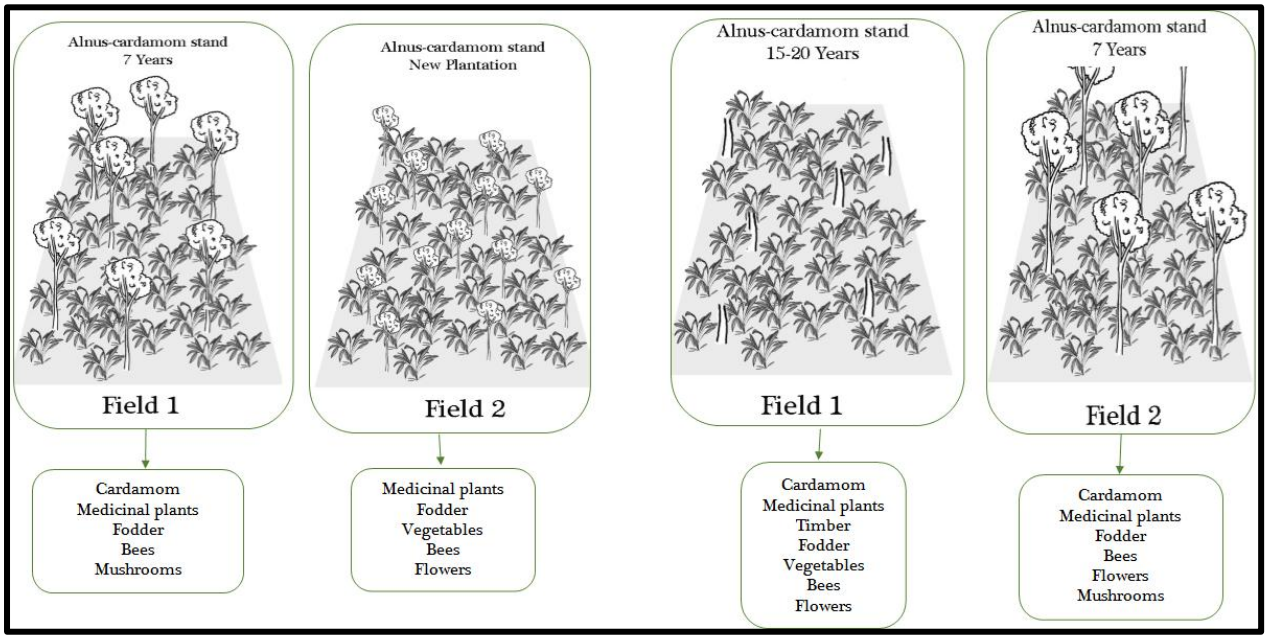


Figure 25: 15-20 year alder-cardamom based agroforestry rotation model

In the case of large land holdings, two different fields could be used in the rotation. After about 7 years (or approximately half of the rotation cycle) in Field 1 (fig 25), Field 2 is planted under the same conditions. When large cardamom and *A. nepalensis* reach their "climax" stage at around 20 years, *A. nepalensis* and other trees are harvested for timber and firewood, and cardamom is dug up and destroyed. At this point the process begins again and Field 1 is replanted under the initial conditions. As Field 1 reaches the halfway mark in its cycle, trees in Field 2 are ready to be harvested and large cardamom destroyed. For the duration of the entire cycle, farmers are diversifying their income and creating work opportunities, while at the same time conserving soil, water and wildlife. An added benefit is the regulation of local microclimates, as well as the reduction in greenhouse gases globally.

The scheme would be a collaborate effort between participating stakeholder constituencies. In this case, RMDD could source and fund the labor through MGNREGA, hiring the villagers who would directly benefit in the long term. H&CCD could source and provide the disease-free large cardamom planting material. FEWMD could oversee the silviculture aspect and the provision of tree saplings from local nurseries, as well as biodiversity considerations. TMI-India and GBPIHED could provide training and expertise on the management and upkeep of the systems. SB could consult farmers on disease control, fertility, and weed management. NGO's could work on capacity building at the Gram Panchayat level, helping to facilitate farmer cooperatives and bring social solidarity. An finally, if marketing agents are involved, they could work with farmers to develop direct channels for marketing the output of the system.

In this way, the CARS scheme seeks to propose a technical strategy for combining different knowledge and resources with the purpose of finding long-term accommodations to the systemic issues affecting large cardamom cultivation, and provides broader agroecosystemic resilience at the same time. A short literature review on the scientific and socioeconomic justifications for an *Alnus*-cardamom based agroforestry scheme is provided in appendix 1.

3.5. Step 5 Comparing the Models to Reality

Entering back into the real world, I was enthusiastic about the models I had created. In preparation, I printed a color brochure of the SSC model which I distributed to higher-level government officials from H&CCD, RMDD, DST, and others, along with a formal invitation for the third and final workshop. The third workshop would serve two purposes; the first was focused on the opportunities, challenges, and shortcomings of the models I presented, and the second part was reserved for the development of a strategic action plan (step 6). Through a group dialogue it was decided that a "formal" contingency could pose several issues if it were

enacted. The first issue was regarding a concern that designated representatives who participate may not be as committed to the long term vision of the group, and interest may diminish after just a few meetings leaving a gap in the network. The second and perhaps more influencing issue was the amount of bureaucratic red tape that would have to be dealt with in order to mobilize a formal institution such as an SSC. There was, however a consensus that more interaction and collaboration between policymakers, researchers, scientists and extensions worker, and farmers should be a critical focus area in the strategic development and implementation of policies leading to sustainable development in Sikkim. During this debate, two specific governmental agencies, RMDD and H&CCD, emerged and assumed the roles of partnering coordinators for the implementation of a large cardamom agroforestry replantation scheme based on the CARS model that I presented. It was decided that between the two agencies, many important resources could be mobilized for the scheme; several Additional Directors of H&CCD present noted they could source and distribute the disease free planting materials; through the Mahatma Gandhi Rural Employment Guarantee Act (MGNREGA) of India, RMDD provides a resource which allots 100 days of guaranteed paid employment to every rural household in Sikkim, thereby providing employment opportunities to the farmers while simultaneously helping them develop a strategy for their own long-term livelihood generation through a diversified production model.

3.6. Step 6 Developing a Strategic Action plan

Step 6 took place during the second half of the third workshop, following a discussion of the proposals and identification of resource holding stakeholder constituencies. While there was considerable energy in the air among the participants, it was decided that a concrete plan for action steps in the near future should be outlined and serve as a guide for the next few months as the plan got underway.

Table 9: Tentative strategic action plan from Workshop 3

Sl	What	Who	When
1	Cardamom Replantation Handbook (Illustrative and people friendly)	TMI,H&CCD, RMDD, GBPHIED, Spices Board	July
2	Replanting Scheme	H&CCD, RMDD, ICAR	October
3	Identify Location	H&CCD, RMDD	August
4	Sensitize and Awareness	H&CCD, RMDD, ICAR	October
5	Ward level cardamom Association (80-100 HH)	H&CCD, RMDD, ICAR	October
6	Training	H&CCD, RMDD, ICAR	Nov
7	Land sanitation / Land development	Grower, CGA	December
8	Inspection of the land	H&CCD, Spices Board	
9	Plantation and shed management	H&CCD, RMDD, Farmers	June
10	M & E of progress	TMI, DST and NGOs, Research Institutes	
11	Soil and pathogens status	ICAR, Gangtok, Spices Board	

The first step of developing an illustrative handbook was suggested as a means to reach the broadest audience of farmers as possible. The truth is that farmers in remote areas are often either

too far away from educational facilities, or heavily reliant on farm- based income and so require the labor input from the younger family members. In many cases these farmers and youths are illiterate and so a guidebook based on pictures and drawings could serve as an excellent resource to convey the step-by-step actions for replantation. I offered to begin working on the guide and below you will see a sample of one of my illustrations depicting a farmer group discussing all the potential products of an agroforestry system, including fruits, cardamom, medicinal plants, fodder, timber and firewood, mushrooms, and honey. The illustrative guide is still in the process of being developed.

Figure 26: Preliminary artwork for a pending Illustrative Guide on large cardamom agroforestry.
(L to R: using steel bar to uproot diseased or old cardamom rhizomes; pulling out plant from the soil by hand; collective dreaming on the potentials of agroforestry; burning plants infected by disease)

The guide is the only step on the strategic action plan which I was a part of. The rest of the steps require the cooperation and input from the participating stakeholder constituencies to be developed and carried out, or step 7 – Actualization.

3.7. Step 7 Actualization

The 6 month window for field research is too short for any long term results. Within such a short period I was unable to see the process of actualization come to fruition, neither an expert in large cardamom production nor a in Sikkim. This being the case, the final step in the SSM process is left in the hands of the stakeholder constituencies to manifest through a natural process. Since I have left Sikkim, it has become known to me that there is indeed a partnership forming between the RMDD and H&CCD departments towards the development of an integrated replantation scheme, wherein RMDD is coordinating the labour at the Gram Panchayat, or ward level through capacity building extensions work, and H&CCD is mobilizing the planting material. What that

actually looks like remains to be seen, however, and I can only hope that I had some sort of influential role in facilitating its development.

4. Discussion

The following discussion section is technically the 8th step of my research methodology. It is divided into 3 parts (D1, D2, D3), based on the double-loop learning cycle of action research. The first part is a reflection on the concrete phenomenon of the case study. The second part is a reflection on myself as an action researcher, and the successes and limitations of the particular methodology, methods, and tools I used. The third part is on the broader implications of participatory inquiry as a means for accommodating complex issues in agricultural systems in other parts of the world.

4.1. D1: Discussion at the Case-Study Level

4.1.1. On the Case Study: Reflecting on Research Questions

4.1.1.1. What are the various causes for the need to innovate in large cardamom systems of Sikkim (main problems observed)?

The factors limiting the production and productivity of large cardamom plants are increasing and presenting some very complex issues at the systemic level. Climate changes affect the physiology of the plants, and influence susceptibility to disease and pest infestation. Identification and proper control of disease outbreaks is lacking. The socioeconomic structures are changing and farmers are forced to find other sources of income off the farm. A great deal of effort is exerted through different government and nongovernmental organizations to ease the household economic pressure, but a dependence on subsidies tends to hinder the innovation process through complacency. A great deal of scientific research is continuously carried out and best management strategies are developed by extensions agents and research and developers. In this case there is an issue of both horizontal and vertical integration to improve the capacity for farmers to innovate. The process of innovation is dynamic and reflexive and should be informed through a more comprehensive understanding of the system. Through an integrated and multi-perspective initiative, complex, systemic issues can be addressed more constructively and for the longer term.

4.1.1.2. What or who is driving innovation in the large cardamom knowledge system?

It is clear that since the large cardamom is a spice commodity with an international market, the prospect of a high economic return to farmers is enough to accept the risk involved in its

cultivation. The factor driving farmers to innovate and gain knowledge towards large cardamom is to improve the quantity and marketability of their product. Innovation and adaptive practices are carried out by farmers at a localized scale, and large cardamom farmers have not yet begun forming cooperatives and building market potential. A lot of money is afforded by the government to conduct research and development programs and through subsidies to help improve the rural livelihood in Sikkim. While the R&D is certainly yielding promising results, continuous subsidies without a proper check in or "leash" creates disincentive for the farmer to innovate and continue to adapt to the environmental pressures on the plants, and the socio-economic pressures affecting management and family welfare.

4.1.1.3. How could the existing knowledge network be strengthened to maximize innovation?

Although a "formalized" Sikkim Sustainability Coalition was met with several valid points of disagreement, the sentiment it proposed was agreed upon with enthusiasm. The future integration and cooperation between governmental agencies, institutes, and farmers is fundamental towards facilitating effective innovations- in agriculture, research and development, and policymaking. An informal alliance of diverse knowledge holders from the different constituencies could share views and experience in a monthly meeting in order to improve their own perspective and future work.

4.1.1.4. Is there a shared vision for the future of large cardamom in Sikkim?

The visioning exercise was extremely important to my research. It gave me a window into the perspectives of diverse knowledge holders and the common lines that run through them. It also brought a sense of camaraderie and enthusiasm among the participants, further inspiring dialogue and perspective sharing. There is a real desire to see stronger future linking of farmers with scientists and policymakers for the socioecological benefit of rural Sikkim. This further reinforced my conviction in the methodology and methods that I had chosen for the case study.

4.1.1.5. Is there a need for new roles or initiatives in order to achieve a proposed 'shared vision'?

In terms of integration, it is important to first identify the contribution of individual stakeholder constituencies to the knowledge and innovation system. Farmers could organize with NGO's and coordinate their management and disease control at the Gram Panchayat level. There could be a post in each village or region regarding this kind of coordination. Government departments having different objectives of conservation, livelihoods, or rural empowerment could mutually benefit from a convergence of knowledge and experience in rural policymaking. Interdepartmental agencies could emerge which integrate the conservation of bio-resources with

rural livelihood opportunities. Scientists from governmental and nongovernmental institutions could also gain a more objective perspective on their own research methods by presenting their findings at small conventions. It was proposed by a large scale farmer that NERAMAC set up a new auction center at Jorethang as it more accessible to inhabitants from West and South Sikkim. They have also planned to start an "e-auction" which could potentially link farmers directly with international traders and cut out the local merchants altogether.

4.1.1.6. What would constitute a socio-ecological innovation to the system?

If the long term objective of a stakeholder group is only to preserve the unique and rich biodiversity, the people who have lived in these remote places and depended on the forest resources for generations are forced to seek alternative income. Conversely, if the objective is strictly to promote rural livelihood opportunities it may compromise the soil, water, and wild biodiversity. Rather, a policy scheme for rural empowerment through community networked agroforestry systems could link the various knowledge and resources to converge towards a concrete action plan (fig. 28). The resulting socio-ecological foundation of an integrated, long-term adaptive agroforestry system could create the conditions for rural communities to prosper in a mutually beneficial relationship with the natural world.

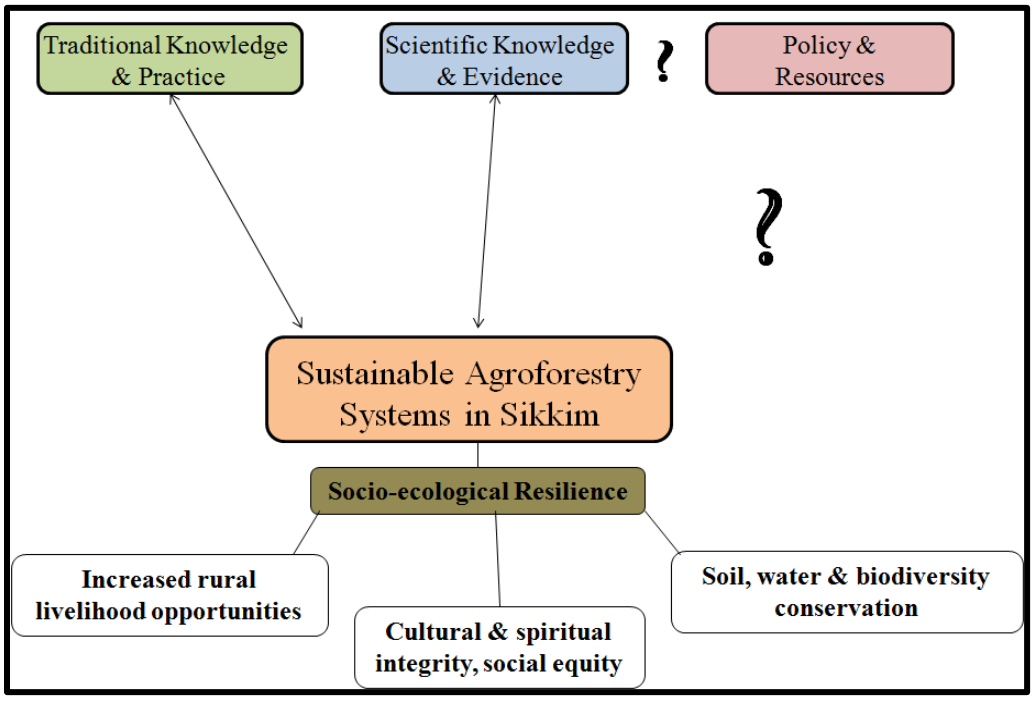


Figure 28: The missing link between policy and agroforestry in Sikkim

4.1.2. Knowledge, Agency, and Human Values in Sikkim

The agency which practical vs. scientific knowledge holders exert in Sikkim requires a look at history and the prevailing sociopolitical worldviews of India through time. Institutions like the

caste system have become ingrained in society over such a time that social hierarchy is the accepted norm. Prior to 1975, Sikkim as a Kingdom under the Chogyal was a feudalistic society, and levels of respect were paid as part of due process. Over time, socioeconomic and political inequality between practical and scientific knowledge has been internalized and the farmers and villagers believe they are inferior to scientists and that their knowledge is insignificant. Such is the dynamic of knowledge and agency in Sikkim, where as von Schomberg (1994) puts it, "in the political arena, scientific data is used as a weapon in the battle for access to information".

Coming from the position of power in the system, the Government of Sikkim has a responsibility to acknowledge that the process of innovation is the result of a continuous process of interaction between diverse stakeholders. As such, the practical knowledge and values of farmers should play an integral role in the design and implementation of subsidy, training, and support programs. Over time through trans-disciplinary inquiry, a diverse group begins to trust and commit through communicative workshops, and the issues of an individual's agency based on their epistemology falls away. What emerges is a group dynamic that expresses a "collective agency" or potential for transformative innovations at the agroecological scale in Sikkim. Future actions of a trans-disciplinary stakeholder group should be collective (inclusive of many different knowledge holders), dynamic (flexible and adaptable to complex issues arising at local and regional scales), systemic (able to account for issues and opportunities between social actors within the system of inquiry), opportunistic (able to exploit the potential inherent to the convergence of different knowledge holders), and sensitive (uninfluenced by the dominant paradigm; accepting of different cultures and epistemologies) (Hirvonen, 2008).

4.1.3. On Limitations

Inquiring into the systemic issues surrounding large cardamom in Sikkim called for a more comprehensive perspective on the system as provided through the participatory workshop series. In facilitating a multi-perspective stakeholder group, the dynamics of social and political hierarchy that are commonly accepted came into question. A systemic reconfiguration of the knowledge network means to challenge the socio-political organization of knowledge and agency in Sikkim, and ultimately India. I often times felt that even though individuals were willing to participate in my short workshops, their degree of commitment to the process was limited. I made a point on the invitations and at the first workshop that the inquiry process is spread out over three workshops and it would help to participate in the entire process as an active stakeholder. There were a very few key stakeholders who were able to attend all three, directly limiting the outcome and integrative potential of the workshop series.

4.2. D2: Discussion at the Epistemological Level

4.2.1. On Myself: Action, Reflection, Reflection-In-Action

As an "accommodator" I tend to learn best through active experimentation and the process of trial and error. At the other end of the spectrum, I usually have a hard time in the reflection and abstraction of my experiences for future improvement. The process of conducting action research on and within a complex agroecosystem has been an enabling force in my own personal development as a life-long experiential learner. Reflection-in-action is the purposeful and deliberate approach to action research which requires the methodology and methods to remain somewhat open and flexible to change as the situation unfolds.

As an agroecologist inquiring into the complex issues and dilemmas facing the large cardamom value chain in Sikkim, I often found myself having to balance between the roles of facilitator, researcher, and reflective practitioner during the process. The cycles of experiential learning within the "first-loop" of the action research would become all too apparent in the days following an exciting workshop, as I found myself getting extremely cerebral and less active. During this time I would reflect on the implications of the case results in the larger picture, and also reflect on my actions and methodology in order to constantly adapt and improve the process.

Pretty (1995) states there are two different objectives for using participatory methods in agricultural research; the first is to increase efficiency within the system, and the second is focused on the empowerment of farmers or other marginalized demographic with the right to take part in the decisions that directly affect their lives. Reason (1998) would agree that the inability and degree of agency an actor has within the system is a *political imperative* for adopting a participatory methodology. The issues being explored are fundamentally complex and cause negative reinforcing feedback loops at the human and ecological scales. A multiple perspective approach is critical as both *epistemological* and *ecological imperatives* for building social and ecological resilience.

Having such a short window of time for research, facilitating a multiple perspective approach served two purposes. The first was in order to broaden my understanding of the case study in order to reflect on it and design models for improvement. The second was to begin to forge a joint-learning process between diverse stakeholders who are active in the system. Fortunately, I had spent almost a year in Sikkim during 2009, and was somewhat accustomed to the environment and the social structure, and knew some key people before I had arrived. This was a

critical advantage for me when it came time to seek out and interact with key stakeholders prior to the workshops.

The RAAKS methodology and tools were a powerful (see "rapid") resource when it came to designing a formal participative inquiry process into the large cardamom system in Sikkim. The RAAKS tools are not meant to be used exactly as they are presented, rather, the windows and tools served as a sort of "guide" for me to use as a reference point in order to more efficiently explore the knowledge network in a systematic workshop series. Engel (1997) uses the metaphor of the system of inquiry as a "complex theatre of agricultural innovation". The many "actors" required in an actual theatre production include everyone from stage construction and set design, to producers, directors, trainers, and actors, to marketing and publishing agents. The production is reliant on many different roles whose cooperation is essential to the success of the show. In the same way, in the complex theatre of agricultural innovation each and every role from inputs (monetary or technical advice), to production, processing, and marketing of the product are essential for the innovation process. In many cases, the worldviews of the different "actors" may be different, and conflicting worldviews may lead to communication issues.

The use of RAAKS tools is meant to provide a venue which is open to all voices and perspectives. Regardless of how "objective" one proclaims to be, the reality is that all knowledge held by an individual are constructed based on his or her epistemology and subjective worldview. Taken in this light, the ultimate goal of participative inquiry into agroecosystems is to unite the different worldviews, knowledge, and epistemologies in order to gain a much more realistically "objective" understanding of the "wicked" and "messy" problems (Churchman, 1967) expressed both intrinsically and extrinsically to the system of inquiry.

4.3. D3: Towards a Theory of Trans-Interpersonal Inquiry

"A revolution without self-knowledge is merely a modified continuation of the present state." (Krishnamurti, 1949)

This is a reflection on the structure, function, process, and purpose of participative inquiry into agricultural systems. PAR methodologies propose a multiple perspective, trans-disciplinary and recursive approach to building ecological, social, and economic resilience. Trans-Interpersonal Inquiry (TIPI) is a theory for participative inquiry which seeks to transcend the ego-driven

communication inherent to interpersonal dialogue between diverse actors in order to collectively understand and find accommodations to issues within the agroecosystem. In this section, I hope to lay a theoretical foundation for the development of a "social organism" which emerges as a purposeful structure involving a "re-integrative" stage in human consciousness.

4.3.1. On the Endosymbiotic Theory of Eukaryote Evolution of Dr. Lynn Margulis

The late Dr. Lynn Margulis first made a splash in the world of microbiology in the 1960's when she acknowledged the striking similarity between the structure and function of organelles within a eukaryotic cell and that of free moving bacterium. In Margulis' Endosymbiotic Theory of Eukaryote Evolution, she states that the chloroplast in plant cells, and the mitochondria in both plant and animal cells originated as single-celled bacteria seeking protection from the elements within the membrane of the host cell. Additionally, as bacteria reproduce asexually through the sharing of DNA, the nucleus served as a constant source of genetic material. In return for providing energy through photosynthesis and oxygen metabolism, the organelles were given protection within the cell membrane. In this way, Dr. Margulis was strongly in support of the emergence of eukaryotic cells out of mutualism or common interest between the "symbiotic consortium", rather than through a conflict over resources (Margulis and Sagan, 1987). Such claims turned the Darwinian theory of evolution on its head by claiming it was symbiosis, or cooperation rather than competition which had driven this evolution.

4.3.2. On Biological Organization

Koestler (1967) first proposed a theory for the organization and interconnectedness of all things in his book The Ghost in the Machine. In it, he first uses the word "holon" to express that all things exist simultaneously as a "whole" and a "part" of a larger whole; it's "wholeness" is expressed intrinsically as a product of the continuous dynamic interaction among the components it is constituted of, and its "partness" is expressed as the extrinsic roles it plays within its contextual environment. The term "holarchy" was introduced by Wilber (1995) to refer to the hierarchy of intrinsic complexity with each level of holon organization. From "an organelle inside an amoeba within the intestinal tract of a mammal in the forest on this planet lives in a world within many worlds" (Margulis and Sagan, 1987, p. 126) each successive level of holarchy exhibits greater intrinsic complexity, and thus both *transcends* and *includes* the levels of lower complexity. The holons at the lowest level of complexity are the most significant, and the holons with the greatest complexity are the least significant. This can be illustrated if we remove all organelles from the universe- all eukaryotic life would cease to exist, whereas if we remove all of

the humans from the universe, organelles would continue to exist (perhaps even better!) (Wilber, 1995).

Autopoiesis is the term introduced by Maturana and Varela (1998) to describe the capabilities of self-regulation and self-replication inherent to all living organisms. Through metabolism and the immune system, organisms are able to self-regulate intrinsically as a closed system. The process by which the organism as a holon adapts and changes in response to its changing environment is what they term "structural coupling". Just as the intrinsic structure of an organism defines its extrinsic context in the environment, so too does the environment shape the intrinsic structure and extrinsic function of an organism in causal reflexivity.

4.3.3. On Human Consciousness

Peter Reason (1994) explains the evolution in human consciousness as taking place in three stages (fig. 28); first being undifferentiated from the natural world in which it is a part (A); then becoming separated from our connection to nature, and thereby drawing a boundary between "self" and "other" (B); and in the third stage, a sort of re-integration occurs (C) with the purpose of developing a richer perspective on a collective objective. Humans at present are still arguably stuck in the second, or separated, stage of human consciousness. It is in this stage where the dualistic mind arises in unison with the ego, where the dichotomy between subject and object gives birth to the highly specialized and seemingly isolated disciplines of modern society. The remedy, writes Wilber (1995), is a harmonious reintegration of the previously isolated elements of the *same holon* (which in this case is the system in which all actors are connected).

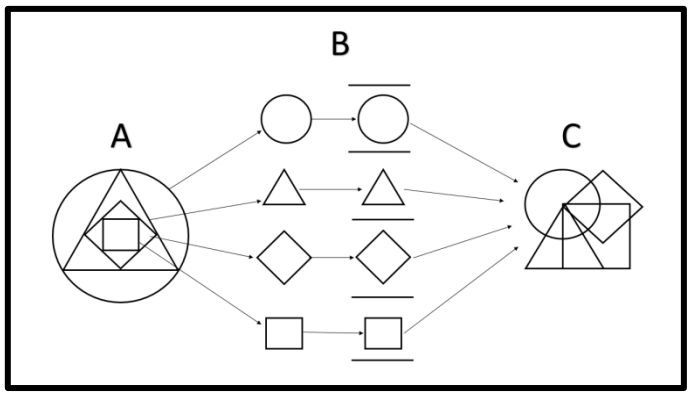


Figure 29 An artistic rendering of the stages of evolution in human consciousness

4.3.4. On Social Organization

Niklas Luhmann was a 20th century German sociologist who believed that over time, human social systems emerge as a product of communication. In the same way as Maturana and Varela's (1998) theory of autopoiesis and structural coupling sought to contextualize the characteristics of a biological organism, Luhmann proposed a theory of "social autopoiesis" in which the "whole" becomes a sort of "social organism" at the next level of holarchy (Seidl, 2004). The biophysical or sociopolitical "boundary" of the system of inquiry is equivalent to the membrane surrounding

a cell. The “organelles” in the cell are the different stakeholders who perform the various functions which enable its continued existence. The “nucleus” is the space where the “DNA” or knowledge, experience and perspectives of the stakeholders are shared in the process of joint inquiry. Just like an organism depends on its immune system to defend against viruses or disease, the stronger the intrinsic solidarity of a social organism the more resilience is built up to deal with increasingly strong external pressures. In Luhmann’s theory, communication drives the intrinsic self-regulatory capacity of the social organism, and through communication the social organism is able to replicate other similar social structures centered around a different shared objective (Seidl, 2004).

4.3.5. On the Ego as a Barrier to Effective Communication

The main roadblocks to effective communication lie in two things: the individualistic belief in a unique “identity”, and the dynamics of power inherent to the dominant ontological paradigm. Our “ego” is responsible for the primary boundary we draw between “self” and “not self” in the construction of our identities. However, as the causal relationships between seemingly unconnected elements are increasingly being recognized, one begins to question the very existence of this boundary. Does not the ego serve to place unnecessary roadblocks to effective communication? Is the individual responsible for the dissolution of his or her ego before the social organism can achieve purpose, or is the dissolution of the ego an emergent property resulting from the continuous process of joint inquiry? In fact, says Wilber (1979), the ego is an illusion that is perpetuated by our radically differentiated societies in order to justify our actions and value schemes, and because it is only an illusion it cannot be destroyed. Rather, he says if you want to find the ego, simply look for it. The very act of searching and never finding it will prove it was never there to begin with.

The great Dharma masters of Mahayana Buddhism have been teaching the essence of non-duality and instructing the meditation and practice of compassion and ego-lessness for thousands of years. Particularly interesting is 1st century philosopher and Buddhist Saint Nagarjuna’s “Stanzas on The Heart of Interdependent Origination”, where in it is written; “The whole world is cause and effect...From factors (which are) only empty, empty factors originate” (Santina, 2002) . It seems that by rigorously training the mind in ever-present, non-dual awareness, the individual will be able to “see through” the illusion of the ego. In this way the consciousness moves away from a paradigm with an emphasis on the individuality of organisms, and shifts towards the spaces “between” them (i.e. communication), and the causal relationships they share. At this point the individual has an existential shift in consciousness wherein the “self as whole”

becomes “self as part” within its ecology of contexts. Just as an experiential learner integrates propositional “knowing” and practical “doing” in the purpose of experiential “being” (Sriskandarajah et al., 1991), successful dharma practitioners employ wisdom in one hand, and skillful means in the other in the attainment of the “three jewels” of clear mind (Buddha), clear speech (Dharma), and clear body/heart (Sangha).

The belief in interpenetration and non-duality is no longer relegated to the “spiritual ether” of the great Dharma masters; Physicists are increasingly puzzled by the non-dualistic characteristics expressed by particles; psychologists continue further down the dark rabbit hole of the human psyche and emerge with more confusion. One recent psychology study concluded that just as our physical muscles can develop through strength training and our intellect can be trained through academic rigor, so too is our “compassion muscle” (i.e. empathy, selflessness) trained through a simple daily meditation practice (Weng et al., 2013). In order to facilitate clear communication and maintain ever-present, constructive awareness, it would be interesting to incorporate (non-religious) introspection exercises into participatory workshops, or even as “take home” exercise during a weekend intensive workshop retreat.

Opportunities for agricultural innovation and system resilience are emergent properties arising from the paradigm for purposeful participation (PPP). In the PPP, the individual practices intrinsic ego transcendence through meditation, and extrinsic ego transcendence through empathy and mindfulness in communication. Throughout the systematic inquiry (process), the “wisdom” (structure) from scientists and the “skillful means” (function) of farmers integrate for the “purpose” of building systemic resilience.

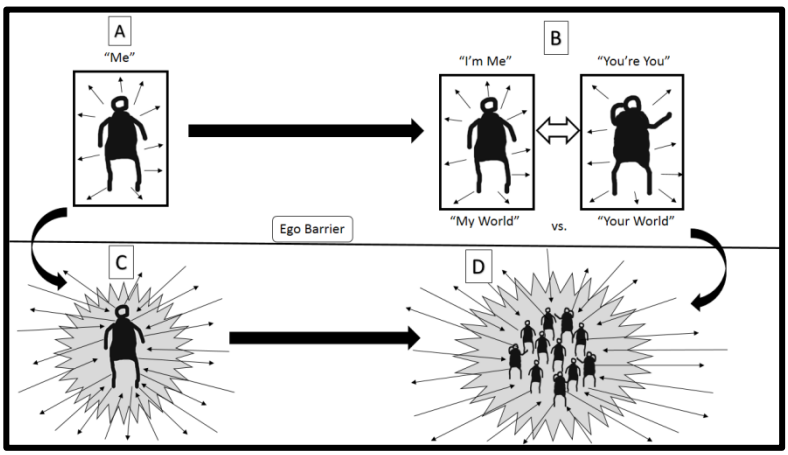


Fig. 29: Top: The journey from ego-driven communication (intra to inter-personal) Bottom: to “no boundary” (trans-personal)(Wilber, 1979), to resilient network of trans-personal actors (trans-interpersonal)

5. Conclusion

There are many factors negatively affecting the production and productivity of large cardamom plants, and the continued practice of its cultivation in Sikkim. Some of these factors are expressed as external influences such as climate change, globalizing markets, or cultural infiltration, and therefore create systemic imbalances at each facet of the agroecosystem. Other factors arise internal to the system of inquiry as a product of conflicting worldviews, socioeconomic inequity, land rights, and natural resource management. The systemic causality of these issues further perpetuates the socio-ecological and socio-economic imbalances and serves to widen the communication chasm between diverse knowledge holders and policymakers in Sikkim. A traditional approach to agricultural policymaking and implementation of extensions is hardly suited to find accommodations which empower the farmer to make informed decisions in the long run. Government funds being haemorrhaged through agricultural subsidies with no leash is like "trying to fix a wheel with a broken spoke by putting grease on its axle". Rather, if the subsidy funds are redirected through a planning collective of diverse stakeholders with an objective of building systemic ecological, social, and economic resilience, the schemes developed could be more integrated with the local and regional context over the long-term.

Sikkim is wealthy beyond economics in several ways; from its range of agroclimatic conditions in such a small area, to its abundance of wild and agro-biodiversity including endemic species such as *A. subulatum*, to the wealth of natural resources including alpine pastures, rich forests, glaciers, rivers and streams, to the traditional knowledge, practice and wisdom of indigenous and naturalized farming communities, and finally to a State Government with a Green Mission focus to promote organic agriculture practices and ecotourism. It seems that a lot of these positive elements would be an advantage to help Sikkim on the pathway to becoming a sustainable society. My research objective was to facilitate the process of participatory inquiry into the large cardamom knowledge system in order to explore gaps and strengthen the network for innovation. I am thankful every day for the opportunity I was given to interact and collectively understand the dynamics of large cardamom in Sikkim, and I can only hope that my words and actions incited a dialogue about the future of this most beautiful corner of the world.

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Appendix

A1. On the Socioecological and Economic Justification for an *Alnus*-cardamom based Agroforestry Replantation Scheme

> *"The need of the hour is to quickly translate the better socio-ecological understanding on biodiversity linked issues that we have today, more than ever before, into sustainable conservation linked developmental initiatives…"* ***(Ramakrishnan, 2010, p. 14)***
>
> *"Conservation of broader biodiversity, ecosystem sustainability and poverty eradication should be linked up with agroforestry systems... The policy makers have challenges to integrate poverty issues linked with the institutionalization of these agroforestry systems for economic gain and improvement of food security in the region."* ***(Sharma et al., Forthcoming)***

Ramakrishnan and Sharma echo a sentiment that is becoming increasingly important as scientists and researchers are discovering the interconnectedness of the environment and human societies. The forthcoming paper is an in-depth study on the socio-ecological potential of four different agroforestry ecosystems traditionally found in Sikkim. Their findings point to the highest ecological and economic suitability of the Himalayan alder (*Alnus nepalensis*) and large cardamom based agroforestry systems. Indeed, a substantial body of research has been done on the multifunctionality of *Alnus*-cardamom agroforestry practices in Sikkim and other parts of the Eastern Himalaya. From improved soil fertility and biodiversity (Saha et al., 2010), recycling of nutrients above and below the ground (Sharma et al., 1994 ; 1997 ; *Forthcoming*), to site index and biomass productivity (Zomer and Menke, 1993), to N fixing energetics (Sharma et al., 2002 ; 2008 ; 2010) to the link between poverty and biodiversity of agroforestry systems (Bawa et al., 2007) and the potential for timber and non-timber forest products (NTFP) to provide livelihood opportunities (Singh et al., 1989), among others. Some of the most intriguing series of research have been done on the potential of agroforestry systems to help mitigate environmental and socioeconomic issues (Sharma et al., 1997). These agroforestry systems have been developed over time through the indigenous knowledge of traditional communities, and as such they are both socially acceptable and ecologically adapted systems. The extensive research findings from the past decades combined with its socially acceptable nature lays a strong foundation to justify the applicability of an *Alnus*-cardamom agroforestry replantation scheme funded through

cooperating government departments, and organized as a multilateral approach to building resilience through improved innovations towards systemic problems in rural Sikkim.

Historical Developments

Sikkim has a strong history of forest management and biodiversity conservation, starting from 1909 when the Forest Department of Sikkim was first set up (Lachungpa, 2011). In the early 1900's the 10th Chogyal, or Crown Prince of Sikkim Sidkeong Tulku laid the initial framework by demarcating "Reserve Forests" in the interest of maintaining forest cover on steep terrains. A focus on forest and biodiversity conservation grew throughout the century, and by the time Sikkim was incorporated as a State of India in 1975, a fully developed Forest Secretariat had emerged to enforce forest protection across the state. By 1980, a Forest Protection Act was drafted, restricting the clearing of forest land for non-forest development. A land survey in all four districts was carried out in 1988, and the forest resources were subsequently mapped. In 1995, a ban on the felling of green trees in the forest was imposed by the Government of Sikkim, followed by a ban on all forest grazing activity by 1998.

The positive results of the new policies are clearly visible, as the land under forest cover in Sikkim has grown from 37% in 1975, to 46% by 2005 (Pathak, 2011), and further to 47.59% by 2009 (Lachungpa, 2011). Under the pioneering guidance of the Honorable Chief Minister, Shri Pawan Chamling, a vision for a "Clean and Green Sikkim" has emerged as the principal tenet of the Government of Sikkim. Many remarkable measures towards improving sustainability have taken place, including a ban on non-biodegradable plastic bags, environmental education programs in schools from nursery to class 8, development of a state medicinal plant board, and most notably the "State Green Mission" was initiated. Under the State Green Mission, Chamling has led the state in reforestation measures through technical know-how, provision of saplings through silviculture schemes, and raising public awareness on the importance of environmental protection. The ultimate goal of the State Green Mission is to cultivate a 'green consciousness" among all citizens, empowering them as environmentally responsible members of society.

There is a strong movement for Sikkim to gain certified "Organic" statehood by 2015, a goal which was informally declared by 2003 (Rahman and Karuppaiyan, 2011). This goal could have many positive implications- especially if sustainable land-use practices are adopted by farmers which maintain productivity, while simultaneously conserving SOM and nutrients, preventing erosion, and promoting habitats/connectivity for biodiversity. According to one Centre for Development Finance (CDF) study on the Environmental Sustainability Index (ESI) of Himalayan States of India, 41 indicators regarding air, water, soil, wildlife, pollution impacts,

and policy responses were used to assess the ESI of Sikkim (Pathak, 2011). The state ranked in the 80-100 percentile in terms of environmental sustainability, receiving national awards for being first in natural resource management and land use performance, and second highest ESI rated state of India.

The strict measures regarding forest conservation, however, potentially undermine the livelihood needs of the rural population. According to the 2011 Census of India, the rural population of Sikkim had decreased from nearly 90% to 75% in the prior 10 years (Tambe et al., 2012), and more than 80% of the population of Sikkim still rely on agriculture as a main source of income (Sharma et al. ; Government of Sikkim, 2012). As it was largely an isolated Kingdom until 1975, Bhutia, Lepcha and Nepali ethnic communities in Sikkim have developed a rich traditional knowledge base on forest bioresources, sourcing food, fodder, fuel, timber, medicine, textiles, and other NTFP's from the forest for generations past(Sharma and Sharma, 2010 ; Bhasin, 2011 ; Sundriyal and Sundriyal, 2005). While the practice of incorporating wild forest resources into household subsistence and livelihood generating opportunities continues to remain in most parts of Sikkim (Goodrich, 2002 ; Avasthe et al., 2005 ; Bhasin, 2011), a total ban on the traditional practice of using the forest for grazing has had an adverse effect on rural livelihoods, particularly as farmers have been forced to scale back their herd size drastically (Pathak, 2011).

The policy measures certainly hold merit however, as traditional farmers are not completely innocent in this case. Saha et al. (2010) report that 42.4% of the TGA suffers from serious land degradation; a consequence of the traditional practice of overgrazing and/or *jhum* (shifting) cultivation over the decades, coupled with the steep terrain and heavy seasonal rainfall in Sikkim. Serious scientific and socioeconomic studies have been funded by the Government of Sikkim on how to integrate forest and biodiversity conservation with rural livelihood issues in the face of growing climate concerns and the influences of globalization (Arrawatia M.L. and Tambe, 2012 ; Government of Sikkim, 2012).

In the case of large cardamom, there seems to have been a historical trend to focus more on quick-return production, rather than long-term ecosystem productivity. As a result, large cardamom traditionally grown in closed nutrient-loop, semi-shade conditions has been moved to open terraces in order to maximize sunlight. In one study, five different multipurpose tree (MPT) species were identified and assessed for their resource conserving abilities. Not suprisingly *Alnus nepalensis*, the N-fixing Himalayan Alder, produced moderate amounts of litter, but with its N rich leaf and twig litter, it had the most rapid decomposition rate among the trees studied (Saha et al., 2010). Sharma et al. (2008) conducted an extensive study on the differing nutrient and

energy release through decomposition of *A. nepalensis* litter at 5, 10, 15, 20, 30, and 40 year-old stands. It was shown that the N-fixing potential and N content of *A.nepalensis* litter reaches a climax at around 15 years, at which point it begins to extract more N from the soil than it fixes. The end result is that trees older than 15 years start to decrease soil pH, causing base leaching as the cation exchange sites are replaced by ferrous oxides. Interestingly, their findings proved what farmers had already tacitly deduced- that older *A. nepalensis* trees have a negative impact on soil nutrient dynamics. A 15 to 20 year long term adaptive agroforestry replantation scheme should be seriously considered by the Government of Sikkim for funding and building resilience through economic security, social integrity, and biological, geophysical, and hydrological conservation. For, as Nair and Jayal (1991) write, "If such a functional design is accepted, the distinction between agricultural and forest lands becomes diffuse. The multiplicity of possible uses necessary for the ecological stability of the land and viability of the species must be accepted." (p. 11)

A2. Key Informant Survey

Date:

Name and Title:

Associated Institution:

Which areas of interest pertaining to large cardamom are you involved in?

Policy/Subsidy	**R&D**	**Production/Processing**	**Marketing**	**Conservation**

In what way?

Please rate the **causes** for the declining status of large cardamom productivity, according to their relative importance by placing an 'X' in the appropriate box:

	Very important	**Important**	**Less important**	**Not important**	**Dont know**
Climate/environment					
Landslide					
Drought					
Temperature Increase					
Disease					
Viral					
Bacterial					
Fungal					
Pests					
Worms					
Insects					
Insufficient Pollination					
Management					
Poor fertility management					
Poor weed control					
Poor disease management					
Lack of knowledge					
Socio-economic					
Lack of labour					
Loss of joint family habitation					
Youth migration					
Policy/outreach					
Lack of Government support					
Limited access of rural areas					
Provision of contaminated saplings					
Spiritual (Contamination)					
Other					

How important do you think large cardamom is for livelihood of rural communities in Sikkim today?

Critical	Important	Less important	Not important	Dont know

Please explain projects past or present, which focus on large cardamom that you or your institution have actively participated in:

A2.1. Farmer Field Survey (spaces removed)

Background Data

Name:

Village:

Number of family members living at residence:

Number of years growing cardamom:

Area (Acres) of land under cultivation:

10 years back-

Presently-

Economic Data

Number of family members actively participating in livelihood generation:

Type of work and percentage of income generated by each:

(Agriculture/cash crop cultivation) (eco-tourism) (outside labor/work)

Type of income generating crop/s:

Are women in your household engaged in cardamom cultivation? **Y/N**

Are you able to meet your economic needs through income from cardamom? **Y/N**

Are you receiving any support in the form of subsidies, training, or information? **Y/N**

From where are you receiving the support?

If no support is provided, what kind of support would you like to receive?

Are you aware of subsidies available through Horticulture & Cash Crops Department?\

How many years has it been since you produced sufficient cardamom for your income needs?

Management Data

How do you maintain soil fertility?

Do you weed your cardamom fields? **Y/N**

Is your cardamom growing in (full shade) (partial shade) (open) ?

Are you growing Uttis trees with your cardamom?

What other tree species are present?

Have you noticed an increase in diseases? Which ones?

How do you deal with diseases on your cardamom?

Environmental Data

Have you noticed a change in weather patterns in the past 10 years? If so, explain:

Have you seen a decline in cardamom productivity?

Future Goals & Aspirations

Do you believe there is a way to save your cardamom plantation? **Y/N**

Are you involved in any farmer self-help groups? **Y/N**

Which ones?

What activities do you do?

If not, would you be interested to participate in an organized farmer partnership in your region?

Y/N

Have you ever had direct help from Spices Board or H & CC. Dept? **Y/N**

Explain:

What is your dream for the future?

Thank you for your time!

A2.2. Causes Survey Data

Climate/Environment	Disease	Pests	Management	Socio-economic	Policy	Spiritual
3	5	1	2	3	2	2
5	5	2	5	1	1	1
5	5	5	1	4	5	4
5	5	5	1	2	1	4
5	5	4	5	4	5	4
5	5	5	4	1	4	2
5	5	5	2	2	1	2
5	5	5	2	2	4	2
3	5	4	2	1	3	2
5	5	5	4	3	4	5
46	50	41	28	23	30	28

A2.2. Field Survey Data

Participant↓ Question→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	1	7.5		1	2	10	1	1			1	1	1		2		1	1	10	1		2	2	36000	B	2	2	1	1	2		1	1	3
2	1	100		1	2	7	1	1			2	2	1		1		1	1	8	1		2	2	35000	B	1	1	1	1	1		1	1	1
3	2	40		2	2	6	1	1			1	2	1		1		1	1	6	1		2	2	25000	B	1	1	1	1	1		1	1	5
4	2	75		1	2	6	2	2			1	1	1		2		2	1	6	1		2	2	25000	B	2	1	1	1	1		2	2	5
5	2	25		1	2	2	1	1			1	1	1		2		3	2	2	1		2	2	12000	B	2	2	1	1	1		1	1	5
6	2	40		1	2		1	2			3	2	1		1		3	1	6	1		2	2	32000	B	1	2	2	2	1		1		3
7	2	100		1	2		1	1			1	1	1		1		1	1	7	1		2	2	25000	B	2	1	1	1	1		1	1	5
8	2	100		1	2	6	1	1			1	2	1		1		1	1	6	2		2	2		B	2	2	1	1	2		1	1	1
9	4	5		2	2	10	1	1			3	1	1		1		3	2	10	2		2	2	25000	B	2	2	1	1	2		1	1	5
10	3	0		2	2	6	1	1			1	2	1		1		1	1	17.5	1		2	1	35000	C	2	2	2	1	1		1	1	5
11	1	0		1	2	7.5	1	2			1	1	1		1		1	1	10	2		2	2	45000	C	2	2	1	1	1		1	2	1
12	1	30		1	2	8	1	2			1	2	1		1		3	1	15	1		2	1	28000	H	1	1	1	1	2		2	2	3
13	1	0		2	2	9	2	2			1	3	1		1		3	1	9	1		2	2	25000	B	1	1	2	2	2		1	1	1
14	1	100		1	2	10	1	1			1	2	1		1		2	1	10	2		2	2	28000	B	1	2	1	1	2		1	1	3
15	2	30		1	2	10	1	1			1	2	1		1		2	2	10	1		2	2	28000	B	1	1	1	1	2		1	1	3
16	4	80		1	2	13	1	2			1	2	1		1		4	1	10	1		2	2		H	2	2	1	2	2		1	2	1
17	3	80		2	2	3	2	2			1	2	1		1		1	1	10	1		2	2	38000	H	2	1	1	1	2		1	2	1
18	1	80		1	1	40	1	1			1	3	2		1		3	1	10	2		2	2	42000	B	1	1	2	1	1		1	2	1
19	2	60		1	2	7	1	1			1	2	1		2		3	1	18	1		2	1	36000	B	1	1	1	1	2		2	1	2

	North	East	South	West		
Meeting Needs w LC?						
Y	1	1	1	0		3%
N	18	45	13	24	0.9708738	97%
	95%N	98%N	93%N	100%N		
Aware of Subsidies?						
Y	16	7	0	N/A	0.3194444	32%
N	3	39	14	N/A		68%
	84%Y	85%N	100%N			
Receiving?						
Y	12	2	0	10	0.2330097	23%
N	7	44	14	14		77%
	63%Y	96%N	100%N	58%N		
Percvd disease incrs?						
Y	15	45	13		0.7087379	71%
N	4	1	1			29%
	79%Y	98%Y	93%Y	N/A		
Control disease?						
Y	11	15	5	19	0.3009709	30%
N	8	31	9	5	0.5145631	70%
	58%Y					
Percvd climate change						
Y	16					
N	3					
	84%Y					
Imp Factor?						
Y	14	43	14	24	0.9223301	92%
N	5	3	0	0		8%
	74%Y	93%Y	100%Y	100%Y		
Interact W NERAMAC?						
Y	0					
N	19					
	100%N					

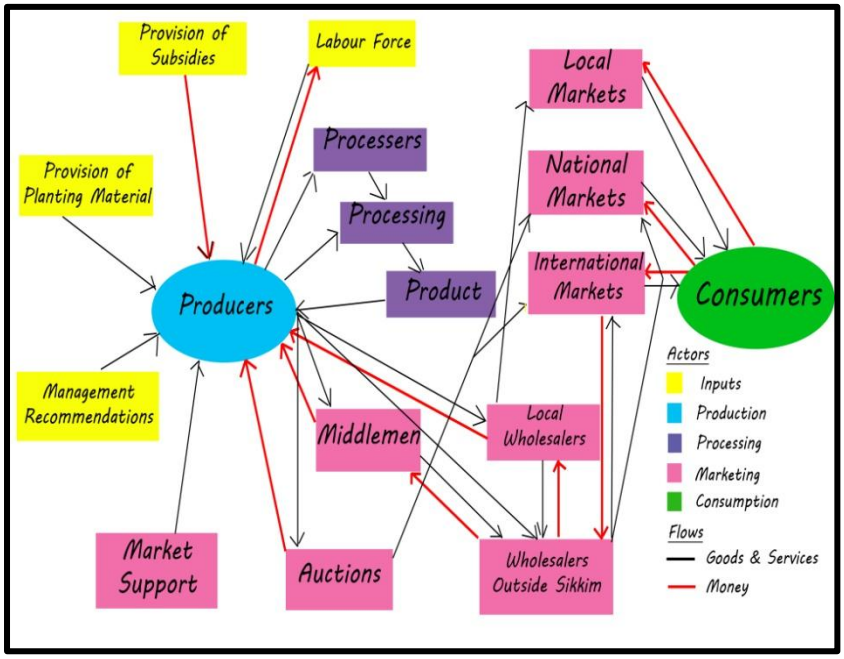
A3. Workshops 1 & 2 Data

PRIME MOVER							SCORING	RANK
Spices Board							5	2
H+CC Dept.	SB						4	3
Farmer Groups	SB	HCC					2	5
Progressive Farmers	SB	HCC	PF				3	4
NGO's	SB	HCC	FG	PF			1	6
International Market	IM	IM	IM	IM	IM		7	1
NERAMAC	SB	HCC	FG	PF	NER	IM	1	6
Local Traders	LT	LT	LT	LT	NGO	IM	5	2

Actors↓ Objectives→	1	2	3	4	5	6	7	8	9	10
Small Farmers	1	1	0	1	0	0	0	0	1	1
Large Farmers	1	1	0	1	0	0	0	0	1	1
Spices Board	0.5	1	0	1	1	1	1	1	1	1
Horticulture Dept.	0.5	1	0	1	1	1	1	1	0	1
Research Institutions	0	1	1	1	0	1	0	0	1	1
NERAMAC	0	1	0	0	1	1	1	0	0	0
NGO's	0	1	1	0	0	1	0	0	1	0
D.S.T.	0	1	1	0	0	0	0	0	0	0
D.C.B.	0	1	0	0	0	1	0	0	1	0
R.M.D.D.	0	1	0	0	0	0	1	1	0	0
I.C.A.R.	0	1	1	1	1	1	0	1	0	1
	3	11	4	6	4	7	4	4	6	6

1	Production & Processing
2	Rural Livelihoods
3	Biodiversity Conservation
4	Improving Plant Prod.
5	Policy Implemenation
6	Extensions/Training
7	Market Development
8	Inputs/Subsidies
9	Innovation
10	Plant Pathology & Physiology

A4. Preliminary Value Chain Model



A5. Newspaper articles

Multiple stakeholder workshop on large cardamom innovation

SE Report

GANGTOK, April 9: A workshop was held in the office of The Mountain Institute-India recently regarding the need for increasing the network of various individuals and institutions working towards the common goal of improving the situation of large cardamom in Sikkim.

The workshop was attended by Dr. Joji Mathew Asst. Dir. Spices Board Development Office; Kuldeep Rai, Field Officer, Spices Board Jorethang; Dr. HK Badola, Lalit Rai, JD Dhakal, Scientists from GB Pant Institute, Sikkim Unit; BA Gudade and HK Biswakarma, Scientists from ICRI, Tadong; S. Tamang from Neramac; and farmers Ugen P. Lepcha of MLAS, an NGO based in Dzongu, and Ghanesh Chettri of Hee Bermiok, West Sikkim.

The programme was facilitated by Benjamin Hunsdorfer, Research Intern at TMI-India, and MSc Agroecology student from the Norwegian University of Life Sciences (UMB) and ISARA in France.

A press release adds that the focus of the workshop was to collectively determine the root causes of the decline in large cardamom productivity, and to identify the relevant and key institutions who play an important role in helping farmers develop innovative practices-from funding and input suppliers, infrastructure development andNGO's, to innovative farmers/farmer groups, marketing resources, biodiversity conservation scientists, and local policy makers.

This workshop was the first in a series of three workshops, based on a participatory approach which seeks to empower actors at all stages of the large cardamom value chain to collectively and constructively work towards a shared vision for the future.

On the occasion, Dr. Mathew stated that "quality improvement from planting material to post-harvest processing is lacking and policy intervention must take place in order for this to happen.

"Many organizations in Sikkim are working towards similar goals of improving rural livelihood and biodiversity conservation related to large cardamom, and I think the outcome of these workshops could result in a convergence of these different organizations which is deeply needed, Kuldeep Rai observed.

The most inspiring input, the release mentions was from Ghanesh Chettri, who himself came from a farming family, and after becoming educated has returned to his home and started cultivating large cardamom at a large scale in addition to developing a quaint ecotourism homestay at Hee Bermiok,

Interested persons or who has life experience related to large cardamom can participate in the second workshop, for which they need to contact Ben.Hunsdorfer@gmail.com, or call him at 7602545802.

Meeting on cardamom held

SIKANDARMARWAH

GANGTOK, April 24: Benjamin Hunsdorfer, who is receiving a double Masters in Agro Ecology, organized a meeting on cardamom here at Krishi Bhavan today. The two masters are received from Norwegian and French Universities.

Hunsdorfer is presently a research intern in "The Mountain Institute", Gangtok.

This second workshop themed "Analysis of Constraints & Opportunities for the Future", he said was aimed at exposing a new methodology for cardamom growers, implying sharing of resources and knowledge dissemination.

The first meet was held on April 19 at the The Mountain Institute, and regarded the identification of the system actors as well as the reasons for the cardamom production decrease. The idea of institutions sharing resources and knowledge was spoken of.

Among the various people connected to cardamom, figured: policy makers, researchers, large and small farmers, scientists, marketing agents, the Indian, the local and the international market, as well as merchants. Various difficulties were raised, such as low market prices, to which salesmen respond by storing their merchandise.

The importance of an "agro-ecological", environment based society was pointed out by Hunsdorfer, organizer and sponsor of this event, which comes under his theses work, mainly themed"A Participatory Approach to Exploring Problems in Large Cardamom Production Systems of Sikkim".

The role of entities such as NERAMAC, Science and Technology Department, Rural Management Development Department, among many others, was explained. As a conclusion, invitees expressed their vision of an ideal situation for cardamom production in Sikkim. Today's meeting was centered on workshop activities, in order to make the audience participate. Four large farmers were present at the meeting.