The Multidimensional Aspects of Agro-biodiversity Management in India: The Case of Mangroves and Millets





Ms. Kara Mohs
Internship at the M.S. Swaminathan Research Foundation
Chennai, India

Table of Contents

Acknowledgements

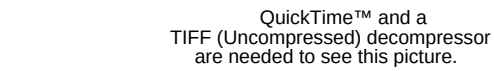
Thanks goes out to all the people who made this paper possible:

- Prof. M.S. Swaminathan for his exceptional advice on biodiversity conservation
- Dr. Swarna Vepa for her excellent guidance and input
- Mrs. Mina Swaminathan, Dr. V. Selvam, Mrs. Ann Bartlet (my composition teacher), and Dr. E.D. Israel Oliver King for patiently giving suggestions
- Ms. N. Krithika and Ms. S. Chandrakala, for being translators and guides for the field visits
- The MSSRF staff of Chidamabaram: Dr. V. Selvam, Dr. K.G. Mani, and Mr. Rosario for helping with research
- Mr. Rajakani at Karaikal for showing me the village
- The MSSRF staff of Kolli Hills: Dr. E.D. Israel Oliver King, Mr. P. Thangavel, M. K. Sivakumar, and Mr. R. Basker for their invaluable input
- Mr. B. Anandakumar for assisting in printing of the report
- The villagers of all the villages visited for giving up their precious time
- The World Food Prize staff: Lisa Fleming, Ambassador Kenneth Quinn, and Justin Cremer for being a connection to the US
- My support system at home: my parents, family, and friends
- God, for leading me to this position

List of Tables

Introduction

The M.S. Swaminathan Research Foundation (MSSRF) was the center of my life for two months in the summer of 2006. It is where I lived, studied, learned, and associated. Personally, I truly believe there couldn't have been a better place to spend my time. The foundation was registered in 1988 as a non-profit trust. Original funds for the project came from the prize monies won by Prof. M.S. Swaminathan in 1987 with his receiving of the World Food Prize.



The very broad goal of the MSSRF is to "promote environmentally sustainable and socially equitable development." They are unique, however, in their approach to achieving this goal. They impart a pro-nature, pro-women, and pro-poor policy in addition to a focus on the true needs of the community, sometimes even discarding all thoughts of technology.

After learning about the policies of the center, I strove to do as much as possible following their example. My project at the MSSRF was based partly on the input of my advisors as well as my own desires. In truth, it took a while to find a topic that all could agree on and that no other intern has attempted before. While originally focusing more on women in natural resource conservation, I quickly observed that this topic was much too broad to do in-depth research on. After some more brainstorming, a happy medium of biodiversity management combined with the agriculture so near and dear to both Iowa and India was reached. Thus, the concept of observing agricultural biodiversity, also known as agro-biodiversity, was born. While there are many studies done in laboratories that focus on this unique topic, my goal was to see how the local people, the small farmers, reacted to attempts at preservation. Also, I hoped to find ways to preserve the diversity of crop species while still taking care of the needs of the locals.

This was accomplished in many steps. First, background research was done on agro-biodiversity as a whole. After, field visits were conducted with surveys of the local Self-Help Groups. Finally, my final research paper was written and presented in front of the staff of the MSSRF.

My first step was to differentiate between biodiversity as a whole from the specific field of agro-biodiversity. This was much harder than originally anticipated. On one hand, biodiversity conservation has quickly become a world-wide concept. An international convention is dedicated to it, and it can be seen everywhere: on television, in book titles, and most importantly, on grant proposals. Biodiversity refers to all living things, the ecosystems in which they survive, and the interaction between them all. Within the complexity of biodiversity a huge debate rages over how best to manage and conserve the world's ecosystems. Almost all government and non-government agencies agree on one thing, though, that biodiversity is rapidly diminishing. Pollution is spreading, natural forests are fading, climate is changing, and numerous species of plants and animals are slowly dying.

On the other hand, the agro-biodiversity I was hoping to study is often overlooked as an important subset of biodiversity as a whole. Many people see agriculture as domestic crops and animals, but agriculture includes much more. The Food and Agricultural Organization of the United Nations (2005) defines agro-biodiversity as

> The variety and variability of animals, plants, and microorganisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry, and fisheries. It comprises the diversity of genetic resources (varieties and breeds) and species used for food, fodder, fiber, fuel, and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agro-ecosystems (agricultural, pastoral, forest, and aquatic) as well as the diversity of the agro-ecosystems. (p. 2)

As an example, agro-biodiversity can include mixed agro-ecosystems, crop species and varieties, livestock and fish species, forests, soil organisms in cultivated areas, wild species as landraces or

with breeding, and cultural and local knowledge of diversity (Food and Agricultural Organization of the United Nations [FAO], 2005).

The link between agro-biodiversity and humans is evident, though: through agro-biodiversity, people are able to obtain food. While biodiversity conservation in and of itself is a good ideal, agro-biodiversity is useful directly to the people. It is also clear that it is in serious danger. Since the 1900s, about seventy-five percent of plant genetic diversity has been lost as farmers worldwide have moved away from the traditional varieties of crops to high-yielding, genetically uniform crops. Thirty percent of livestock breeds are in danger, and six are lost each month. Even more disturbing, seventy-five percent of the world's food is generated from just twelve species of crop and five animal species. Three plant species- rice, maize, and wheat- contribute nearly sixty percent of calories and proteins consumed by humans from plants (FAO, 2004). It is alarming to realize that the food security of the world rests on the continued perseverance of only this many species of crop.

There are many reasons why agro-biodiversity is declining at the rate it is. One reason is that the globalization of food systems and marketing has lead to a competition, which forces species without market value out of farms. Another is the replacement of local varieties by exotic or improved varieties (FAO, 2004). A third view sees the long-standing enmity between environmentalists and agriculturists as a negative impact. The common view sees farmers as a threat to the environment and a detriment to natural ecosystems (Wood & Lenne, 1999).

Globalization, replacement of traditional varieties, and enmity are all contributors to the loss of agro-biodiversity, but all of them can be reconciled. Agro-biodiversity is an important middle ground to mediate between the three sides of agriculture, industry, and environment. While not all cases are the same, agro-biodiversity has been known to have many key benefits. The benefits include increasing productivity, food security, and economic returns; reducing the pressure of agriculture on fragile areas, forests, and endangered species; making farming systems more stable, conserving soil and increasing natural soil fertility and health; improving human nutrition and providing sources of medicines and vitamins; conserving ecosystem structure and stability of

species diversity; and helping to maximize effective use of resources and the environment. These benefits are multi-dimensional, and can benefit all (FAO, 2004).

Participatory Community Conservation and the Role of Women

Before looking into the multidimensional aspects of conservation and the management practices that are currently utilized, it is necessary to understand that agro-biodiversity management has its own set of criteria. Management of agro-biodiversity incorporates the physical aspects of conservation but also includes societal aspects. The definition of management includes meeting three criteria: 1) conservation (the physical act of preserving and/or restoring the resources), 2) maintaining sustainable use (making sure that the use of the resources will not degrade over time) and 3) allowing for equitable sharing of the benefits by all peoples. By meeting these criteria, the programs in question manage to maintain the biological diversity of the Indian landscape while still contributing to the livelihood security of the millions of rural poor, thus conserving and enhancing the resources available. In order for agro-biodiversity to fulfill its goal, it must meet these criteria (Swaminathan, 2006).

Unfortunately, in many management practices, these criteria are not of a high priority, especially the sharing of the benefits. Women on the whole are often excluded as a result of these processes, despite their huge contribution to agriculture and food production. Many women are a part of poor families living in marginal areas that benefit least from the modern high-yielding plant varieties. The remote regions have rich biodiversity and rely on the use of a wide variety of crops, wild plants, and livestock species. These rural areas and their inhabitants are most in need the preservation of the agro-biodiversity. On-farm preservation, preservation of species within a farmer's field, is a highly effective method that also benefits the people. Rural women's key role as food providers and food producers is vital in the management of genetic resources for food and agriculture. These roles have given them unique knowledge of local species and ecosystems that they learned

not from textbooks, but from practical application and years of experience (JRD Tata Ecotechnology Center, 2002).

It is argued that in traditional agricultural communities, this specialized knowledge gave women an important role in decision-making at both the family and community levels, in seed selection, for example. In consequence, some status is attached to women at both levels, contributing to more egalitarian relations between the genders. If modern technology is dominated by men, equitable gender relations typical of many tribal and traditional village communities may change, reducing the involvement of women in management and decision-making. Involvement of women in knowledge based agro-biodiversity conservation is expected to bring about a social change that transcends barriers of social hierarchy and gender discrimination as well as political and economic hurdles. Involving women in participatory conservation activities may restore their lost status. Utilizing their existing local knowledge is one of the key components of achieving agro-biodiversity management (Rengalakshmi, *et al.*, 2006).

In most rural areas at present, however, women have had to stay on the sidelines while men handled almost every aspect of the decision-making process. This concern has not gone unnoticed, and thus came about the concept of women's participation in economic development programs, including natural resource conservation. Participation of women in political, social and economic life outside the home is believed to bring about social change and contribute to the process of development (Dreze & Sen, 2004). Women and men are drawn into development projects via groups known as self help groups. A self help group is a support group that is fully organized and managed by its members, who are usually volunteers. They have common interests and pursue common goals such as obtaining a loan, conserving water, restoring degraded lands, forests etc. for the benefit of all members. Often, as natural resource conservation work brings about long-term benefits, the self-help groups are also involved in

some enterprises called micro enterprises that cater to the village community. They also get group loans from the banks.

Since most of the members of the self-help groups do not have assets and regular income, they are not credit worthy. The government, however, has amended the banking rules to enable the banks to extend the loans to the self-help groups of people who normally do not default on repayment. This is called micro-credit. Many self help groups are involved in the activity of micro-credit and use the funds for petty retailing as well as the production of goods and services needed by the community. Development projects engage non-governmental organizations to promote self help groups, teach the members management of credit, give the members training over skills relevant for conservation work, as well as various enterprises. Tapping the knowledge of these women can contribute greatly to the process. In addition, including women in projects is necessary to uphold the criterion of equitable sharing of the benefits (FAO, 2004). Hence women have been given a special role in biodiversity conservation. Normally the participatory rural development approach combines many activities useful to the community along with agro-biodiversity conservation. All these activities involve women in large numbers. The participatory development approach is a multi-faceted one that promotes involvement in community in conservation work, economic participation in micro enterprises, provisioning of credit, and so on.

The objective of this study is to observe the situations in villages where participatory agro-biodiversity management has taken and is taking place. Also, a feedback from the people about the processes of conservation is sought. Following is a basic background on the projects observed as well as personal observations, reflections, and information gleaned from the villagers.

Mangroves of Pichavaram:

MGR Nagar, Kalaingar Nagar, and Karaikal

Background

Agro-biodiversity management has been tested in several places. One of these cases is the coastal area of the Pichavaram mangrove forest, an ecosystem that is vitally important to the surrounding villages. The forest covers an area of one thousand three hundred fifty hectares and is home to thirteen true mangrove species. Within this area, the people belonging to seventeen hamlets of five revenue villages use the fishery and forestry resources that the Pichavaram wetland provides. A total of one thousand nine hundred fishers are dependent on the fishery resources for their livelihoods (Selvam *et al*, 2003).

The mangroves serve many purposes for these indigenous people, economically and ecologically. They act as a barrier against cyclones and floods, prevent erosion, provide nursery grounds for commercially important seafood, and contribute to economic livelihood by providing wood fodder and grazing ground. In last twenty-five years, however, these wetlands have been exploited and threatened. According to remote sensing data, fifty-four percent of the forest was degraded (Selvam *et al* 2003a).

Before ecological studies were conducted between the years of 1993 and 1995 by the M.S. Swaminathan Research Foundation (MSSRF), no one knew the true causes of the degradation. The government assumed it was due to overusing of the resources by the tribal people. The studies, however, showed that nearly sixty-five percent of the degradation was due to the felling of trees done during colonial rule. Every twenty to twenty-five years, the British government would choose a well-grown mangrove forest of ten to fifteen hectares and systematically cut down every tree in the area. This caused biophysical changes to occur. The water in the soil that the trees grew in evaporated, bringing about shrinkage of the soil. This caused the topography of the area to become trough-shaped. Thus, when the tidal water moved through the degraded area, the water would collect in the trough-shaped area and become stagnant. The stagnant water then evaporated, leaving the soil with doses of salinity lethal to mangroves (MSSRF, 2002).

The MSSRF devised a strategy of regeneration for the degraded areas that included the utilization of the local communities. An eight hectare area of felled mangroves was selected to demonstrate the restoration techniques to the villagers. The plan required that the trough-shaped area be connected to a natural near-by canal by an artificial canal from which a number of feeder canals were dug to cover the entire degraded area. This enabled tide water to flow freely in and out of the mangrove area without becoming trapped. Without stagnant water to evaporate, the salinity of the soil returned to normal levels. When this phase was completed, mangrove saplings were planted in the area as the first step towards a healthy future. This process was then replicated in eight village hamlets (four in Pichavaram and four in Muthupet). When the project ended in 2003, a total area of six hundred seventy-five hectares was restored in Tamil Nadu. In this area, a total of five and a half million saplings were planted, of which an average of sixty-eight percent survived (Selvam *et al.*, 2003).

Findings from Return to Pichavaram

A visit to two of the villages (MGR Nagar and Kalaingar Nagar) in July of 2006 revealed the current situation. An informal group discussion formulated around a pre-designed set of questions was combined with Rapid Rural Appraisal (RRA), a method that involves the participation of the villagers and their opinions, to evaluate the effects of the conservation in the villages of MGR Nagar and Kalaingar Nagar. The group discussion was used in both villages, but due to time constraints on behalf of the researchers, the RRA approach was only used in MGR Nagar. (See Table 1). (For complete results, see Appendix 1).

Table 1: Pre-Designed List of Questions for Informal Group Discussion

1. When did the community start working with the restoration process? Why?
2. What did you expect from the process? (Good and bad)
3. Were there any social impacts that you expected?
4. What sort of work did you see being done during the restoration? What did you do to help?
5. After the restoration process began, were there unexpected surprises?
6. What were some benefits of the restoration?
7. Was there any immediate benefit, or did it take a little longer to see the outcome?
8. What are some disadvantages of the restoration?
9. How has the project affected your access to food?
10. How do you use the outputs from the wetlands in your everyday life?
11. How has the restoration contributed to your livelihoods?
12. What micro-enterprises have been set up?
13. Do you feel that having the SHGs have helped women's position in the community? If so, how?
14. Has there been any change in the expected role of women since this project began?
15. Do you believe, overall, that the process has helped you?

The people of the villages recalled that trusting the MSSRF enough to help with the conservation work was difficult. Due to past experiences with other organizations, the people of the villages were skeptical of the purposes of the MSSRF. In addition, they were outraged that the MSSRF opposed the traditional ways of fishing by the villagers, saying the methods harmed the mangroves. In the end, the people reluctantly approved of the program in late 1995. Although still doubtful, they agreed to contribute due to the immediate economic benefit of a petty sum paid to them to do the conservation work. They also had an interest in the benefits the MSSRF told them would come.

The people of the villages remembered clearly the work they did during the restoration. Men were responsible for the digging of the canals while the women planted the seeds, raised the seedlings in nurseries, and ultimately planted the saplings in the selected area. The saplings are also raised in mangrove nurseries, like the ones run by women in Karaikal. When questioned

about the nature of their work, the villagers wished to express the extent of their labor. Women

vividly recalled trudging through slush chest-high to plant saplings. Men had no machinery to dig the canals, and relied solely upon the use of shovels for the entire process. Despite these disadvantages, the people of the villages were able to restore large areas of mangrove wetlands. MGR Nagar alone restored a seventy hectare area with the support of the MSSRF.

In the eyes of the people, the effects of the process were similar in the two villages. The villagers of both villages mentioned the same three key benefits they have seen and this is especially highlighted in the results of the RRA. (See Table 2).

Table 2: Results of the RRA in MGR Nagar

	1	2	3
Identity in Society	OO	OOOO	OOOOOO
Financial Status	O	OOOOO	OOOOOO
Livelihood Opportunities	OO	OOOO	OOOOOO
Health Status	OO	OOOOO	OOOOOO
Fishing Opportunities	OO	OOOOO	OOOOOO

O-OO = low
OOO-OOOO = medium
OOOOO-OOOOOO = good/more/improved

1) Before the prawn farms (roughly 1996/1997 which is slightly before the biodiversity program reached the village, 2) after the prawn farms (after the biodiversity management program), and 3) after the tsunami.

Source: Representatives of MGR Nagar from Discussion with Kara Mohs

In the people's opinion, the first and foremost advantage has been the increase in fishing opportunities. Before the mangrove restoration began, the people of the mangroves had seen a steady decrease in the amount of fish in the mangrove area. Compared to the catch in and around 1980, only five out of twenty-five species of fish had not shown any reduction in catch. In the case of prawns, previously one or two boats full of prawns (weighing about two hundred

kilograms) were caught by a group of four or five fisherman. At the time just before the management practices, only two to ten kilograms were harvested (Selvam *et al.*, 2003). Now, with more mangroves available, the amount of fish in the wetlands has risen. In addition to this, the villagers are now able to fish in the sea with boats bought with money borrowed through banking systems available through Self Help Groups (SHGs).

This increase has significantly impacted the consumption of the people of the wetlands. In the previous years before the intervention, the people of both villages were primarily nomadic and survived on small-scale fishing, scavenging for wild berries, drinking water mixed with coarse grain powder, and the killing of wild rats. Their staple diet now consists of fish, prawns, and crabs obtained from the mangrove wetlands combined with purchased cereals such as rice (Selvam *et al.*, 2003a).

What they viewed as a second benefit is a better financial status. Before the mangrove conservation began, the people of the villages borrowed anywhere from rupees seven thousand to rupees ten thousand from the traditional fishermen each year. To pay back the loan and interest the villagers were forced to sell their catch back to the traditional fisherman for half the price. Today, the combined effect of the formation of SHGs along with the mangrove conservation and rise in catch and fishing opportunities, about ninety percent of the people previously in the debt traps have managed to free themselves. If they are in need of a loan now, SHGs enable them to obtain one through formalized banking systems with reasonable interest rates. Additionally, they are now able to sell their catch directly into the market rather than through a middle man to achieve higher prices and higher income. Finally, the important process of crab fattening is being used to bring more income into the families. Before, the villagers were forced to sell the small mud crabs they caught at the price of

rupees 40/kg. Now, they keep the crabs in blocked off areas of the canals until they are matured and are able to sell the crabs for a price as high as rupees 450/kg.

Role of Women in Mangrove Conservation

Perhaps the most striking change within the process of conservation, however, has been the shift in the gender roles of the community. Before the management process, there was a specific power structure within the villages. Women were completely absent from decision-making processes, placing all the power in the hands of the societal hierarchy of males. Once the biodiversity management practices began, women were playing a large role, raising the seeds into saplings and planting the saplings. In their eyes, this gave them a sense of self-accomplishment. In addition, the M.S. Swaminathan Research Foundation realized the importance of the women in the village, and made it a priority to try and involve them in the conservation work. Self help groups were formed to enable the women to access formalized credit for self employment and to give them a greater role in the community conservation work by teaching them leadership skills.

These two approaches gave the women a sense of economic and political empowerment. When the SHGs were formed, the women of the community finally had an opportunity to receive formal credit instead of relying on moneylenders. With the help of the MSSRF backing them, they gained greater access to formalized banking. One woman joked about how she was able to buy the gold necklace due to the help of the SHGs. In addition, the MSSRF taught them money-saving techniques, including putting aside petty change to use for community functions and personal expenditures. Not having to rely on men to obtain loans such as these, women were able to have a better economic position.

Secondly, political empowerment is much improved in the women. With an increased sense of empowerment, the women in the room responded as much and even more to the questions than the men of the community. The community of MGR Nagar even has a woman panchayat leader, K. Sengeni, which was absolutely unheard of before. The women feel that they had a greater input both at the community and family level. In Kalaingar Nagar, the women explained how now men and women share in the household chores and how men currently participate in childrearing. Women still do much of the household chores, such as cooking and cleaning, but they are now able to go fishing in the mangroves while the men use the boats to fish in the sea. They feel proud that they are able to actively contribute to the family. Women in MGR Nagar also have taken up other income activities, such as basket-weaving, to provide additional income outside the mangroves.

Analysis

The reason the people, especially the women were questioned is because there needs to be participation by the community simply due to the fact that they are the ones that are wholly invested in the mangroves; they are the ones who have their entire existence lying in the same roots that they planted. Although they stand in the best place to benefit from the efforts, they did not have much inherent knowledge of the mangrove ecosystem. It took specific help and training from the MSSRF for the people to realize the importance of the mangroves.

Overall, though, the benefits gained from the conservation are clear to the people of the villages. Increased better financial status, improved livelihood opportunities, and perceived gender equity have been seen since the intervention of the MSSRF. This is especially being seen in MGR Nagar, where the people are thriving even after the horror of the tsunami. People in both villages

remain wholeheartedly dedicated to preserving the mangrove forest, even leaving their homes during the monsoon to keep cattle from grazing upon the new saplings. They have even gone so far to say that they now recognize the forest as god: without the forest, there is no them.

Many of these advantages, however, especially in the case of Kalaingar Nagar, have been reverted due to the tsunami. The waves crashing through the area pushed all the sand from the dunes on either side of the rivers and canals into the water, making it nearly impossible to use the boats for fishing in these areas. This has caused the catch to decrease in both villages. In Kalaingar Nagar, the villagers report that before the tsunami, there was a lot of catch and profit. Today, there are barely able to make rupees ten to twenty per day. This leads more people back into the debt traps wrought by the traditional fishermen.

They can no longer utilize the fishing grounds of the wetlands due to the sand, sometimes forcing them to exploit the forest itself. This especially harms the women of the community. While the men are still able to use boats to fish in the sea, women who rely on fishing in the mangrove wetlands are left with no more options. Further, many of the SHGs formed have been dismantled. They were only ad hoc SHGs formed at a specific time to obtain needed loans from banking organizations. The SHGs have no more purpose and are broken up.

Unfortunately, there is not much that can be done to remove the sand, especially without the help of heavy machinery, and the wisdom of such an action is questionable. Using machinery to remove the sand from the canals could eventually end up harming the ecosystem itself, altering the shape of the natural landscape. Thus, in this specific case, it is difficult to balance the dual forces of nature protection and providing for the people in this specific case. One thing that could be done is to provide the women alternative livelihood option, such as skill-labor occupations. This is already being done in MGR Nagar, but the people of Kalaingar Nagar were entirely dependent upon fishing. Either training the unemployed or giving them the option of using the knowledge they already have could help to remove them from the debt trap they are falling back

into. So, although benefits have been seen due to the process, more needs to be done in the realm of increasing livelihood options to make the effects more beneficial to the people. If the women cannot use the boats to catch fish in the mangrove areas, they ultimately may revert to the damaging traditional practices just to get a daily income.

Overall, however, the benefits seen from the conservation work are evident in the eyes of the people of the mangroves. What we consider a small step, they consider a giant leap towards a better life. This is especially seen in the women of the community. Although the SHGs and the conservation work have placed some added burden on them, they gladly do the work, reveling in the empowerment they feel from it. In addition, this increased self-confidence and decision-making power has helped to divide the household chores and child rearing.

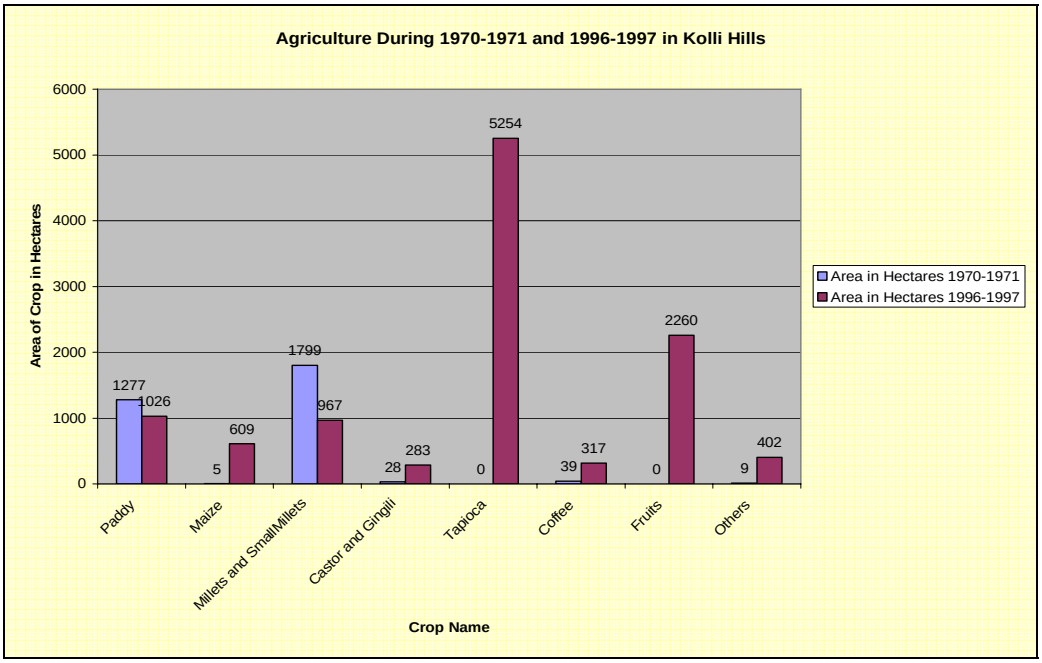
Millet Conservation in Kolli Hills:

Arippalapatti and Koochakkiraipatti

Background

The second case study was conducted in the Kolli Hills region of Tamil Nadu. In contrast to the Pichavaram, Kolli Hills is an agriculture-driven community. This specific area is historically known for its cultivation of several different kinds of millet landraces. Although millets are virtually nonexistent on the commercial market, they are the staple diet of many of the tribal areas of Kolli Hills. However, over the past several years, there has been a trend of the local farmers shifting away from millet cultivation. Since around 1970 and the introduction of tapioca, growing of cash crops has become the norm, with tapioca being the main cultivar. In fact, the land under millet cultivation has reduced by almost half (JRD Tata Ecotechnology Center, 2002). (See Table 3).

Table 3: Change in Agriculture during 1970-1971 and 1996-1997 in Kolli Hills



Source: G Returns for Kolli Hills, Directorate of Agriculture. Taken from JRD Tata Ecotechnology Center 2002

There are several perceived reasons for this change. The first reason is the lack of market linkages for millet. Farmers in Kolli Hills have been able to see how globalization has begun to make agriculture competitive. Thus, they see the growing of cash crops as the only way to

achieve economic security. There is a huge difference in the selling prices of the millets and other crops. The mean output value in rupees per acre of tapioca is nearly five times that of millets. (See Table 4).

Table 4: Productivity and Output Value in Agriculture

Crop	Mean Production in kg per acre	Mean output value in rupees per acre
Paddy	792	1950
Traditional Paddy	1161.6	
Introduced Variety of Paddy	556.8	
Millets	246	1151.1
Tapioca	N/A	5533.8

Source: Household Survey 1999 by MSSRF taken from JRD Tata Ecotechnology Center, 2002

The other reason is the amount of work it takes to process the millet. This is especially hard on the women of the community. The millet seeds have six to seven seed coats, which makes it very hard to remove the rice. The women have to pound the seeds for a very long time, on average about one to one and one half hours per kilogram (Rengalakshmi *et al.*, 2006). With cultivating tapioca and other cash crops, however, they are able to earn cash to buy rice from the Public Distribution System (PDS) to make up their diet. This reduces the drudgery of the women considerably. They feel cultivating millets is an added burden to their already heavy workload.

The MSSRF took steps to help mediate or correct these problems. In 1997, it submitted a proposal for a project that gave stress to cultivation and utilization of the small millets. Their objectives in the study were: "improving the productivity and production of small millets through sustainable agricultural, fortifying food with small millets and integrating them with

conventional food system at household, semi-commercial, and commercial level, developing extension models for popularizing small millet based food and creating appropriate linkages in the market, and evolving extension process for improving the productivity and production of small millets at subsistence level and at commercial level." (JRD Tata Ecotechnology Center, 2002).

Their main steps were to set up a direct market linkage with Tribal Cooperative Marketing Development Federation of India Ltd. (TRIFED) for the sale of the millets (ended by now), market linkages with urban centers, and to install two de-husking mills to reduce the amount of work done by the women in the villages (JRD Tata Ecotechnology Center, 2002). They also set up Community Seed Banks in which they can store the seeds of the millets and paddy varieties. This was set up because ultimately it is up to the farmer's selection of seeds to influence genetic variety. In the area of Kolli Hills, this is primarily done by seed exchange between neighboring farmers as well as through their own supply. This kind of exchange has been decreasing, though, so seed banks were set up to try and keep seeds available to all farmers at all times (Rengalakshmi *et al.*, 2006).

Findings from Return to Kolli Hills

Another return was conducted to Kolli Hills in late July of 2006. While there, a focus was put on looking at all the different agricultural sites of the region as well as talk to a men's and a women's SHG of the area. During this discussion, an informal interaction around a pre-designed list of questions was used, focusing on how the process has affected the consumption, commerce, and cultivation. (See Table 5). (For complete results, see Appendix 2).

Table 5: Pre-Designed List of Questions for Kolli Hills

1. How many men's and women's SHGs are there?
2. What is the function of the SHGs?
3. What benefits have you seen as a whole?
4. How has the process affected your availability of food?
5. Has the process added to your income? How much?
6. What part did/do women play in the conservation?
7. How has this affected you socially, politically, and economically?
8. Has the process specifically benefited you as women? If yes, how?
9. What did you expect from the process, good or bad?
10. What made you decide to join with the conservation?
11. Is there anything you wish the project has/had done that they have not?
12. What did the conservation process consist of?
13. What sorts of micro enterprises were set up?
14. What is your staple diet? What did it used to be?
15. Are you aware of the nutritional benefits of millets?
16. Was there anything unexpected that came out of the process?
17. As women, is there anything remaining that you feel is a hindrance towards further empowerment through the process?

The project for the villagers began in 1997 with the beginning of setting up market linkages with TRIFED. When asked, they said there was no specific benefit or reason that they began working

with the MSSRF staff. No particular promise encouraged them to accept. For the villagers, they were more struck by the awareness that was spread by the staff. Since the MSSRF had been there for some time, they knew that the people really wanted to learn about them, their culture, etc. It was this awareness that convinced them to accept the MSSRF.

The first clear change since the 1970's is in the consumption of the villagers. Before the introduction of tapioca, the people of the villages had a wide variety of food that comprised their diet. They planted their millets in such a way that the different species matured at different times, so there was an almost constant supply of the grain. The millets provided an invaluable source of micronutrients such as protein, iron, and fiber. Since shifting, however, the consumption of the people has reverted to mainly rice purchased through the PDS. This switch is detrimental to the

micronutrient intake of the farmers. When compared with the nutrient value of millets, rice comes in as a clear step down.

Table 6: Nutrient Content of Small Millets

Name	Protein (g)	Fat (g)	Mineral (g)	Fiber (g)	Carb (g)	Calcium (mg)	Phosphorous (mg)	Thiamine (mg)	Iron (mg)
Finger Millet	7.3	1.3	2.7	3.6	72	34.4	28.3	0.42	3.9
Proso Millet	12.8	1.1	1.9	2.2	70.4	14	206	0.2	0.8
Foxtail Millet	12.3	4.3	3.3	8	60.9	31	290	0.59	2.8
Little Millet	7.7	4.7	1.5	7.6	67	17	220	0.3	9.3
Kodo Millet	8.3	1.4	2.6	9	65.9	27	188	0.33	0.5
Barnyard Millet	6.2	2.2	4.4	9.8	65.5	20	280	0.33	5
Rice	6.8	0.5	0.6	0.2	78.2	10	160	0.06	0.7
Wheat	11.8	1.5	1.5	1.2	71.2	41	306	0.45	4.9

Source: Nutrient Composition of Indian Foods (1989) Ed. Narasinga Rao et al. *NIN, Hyderabad. Taken from JRD Tata Ecotechnology Center 2002.*

What made this interesting is the fact that the people of the villages realize that millets are better for them. They do not know the facts of the nutritional value, but they do notice that when they eat millets, they can feel more strength in their bodies. They can feel the extra mileage they can obtain. They know this is lacking in rice, yet they continue to consume it anyway. It is important to note, however, that those farmers who continued to cultivate millets consumed them as well, so there was and is still millet consumption occurring.

The clear benefit at the community level is the economic benefit, in both the men and women's SHGs. The women mentioned an economic benefit to themselves in two respects. Their primary

job is to collect the millet from the surrounding villages in the panchayat and transport the millet to the de-husking mill. By doing this work, they are first able to obtain benefit by making themselves and their families a primary seller, buying their own crop first. In addition, by transporting the millet to the mill, they earn a portion of the sales that the millet brings when sold to the supermarket. The men's SHG is in control of the de-husking mill. Two of the men at a time are in charge of de-husking the millet, packaging, labeling, and ultimately selling it. Due to this work that they do, they also receive a portion of the profit from the millet sales.

The millet is sold to the market at a price of rupees fourteen per kilogram. The maximum retail price set for millets by the supermarket is rupees sixteen point five. The proceeds from the sales are spread around the involved. around rupees five point five to six are paid to the farmer for the initial selling of the millet. Rupees one and a quarter goes to the women for the transportation. Overall, the mill processes around three hundred kilograms of millet each month. (See Table 7).

Table 7: Price Evaluation of Millet Processing

Description	Units	Samai/ Thinai per Kg	For Samai/Thinai Rice per Kg after Processing
Farmer	Rs	6	10
Procurer	Rs	1.5	2.5
Miller	Rs	1.25	2.1
Transport	Rs		1.25
Cleaners and Packers	Rs		
Cleaning	Rs		1
Packing Charge	Rs		0.5
cover cost (2 cards, 2 covers, stickers)	Rs		5
Transport to Food world	Rs		3
Total cost	**Rs**		**25.35**

Source: Dr. E.D. Israel Oliver King, MSSRF Staff

There is another aspect of the project, as well, that has yet to see its potential on a large scale. The MSSRF staff is working very hard to add value to processed millets besides just their rice form. They have experimented with different ways of cooking and packaging the millets so they are more appealing on a market level. (See Table 8).

Table 8: Value Addition Tests and Prices in Kolli Hills of Items

S.No	Millet Product Name	Quantity in gms	Selling Price at Kolli Hills	MRP	Season
1	Samai Rice	500	14	16.5	Whole Year
2	Samai Flour	500	15	17.5	Whole Year
3	Thinai Rice	500	14	16.5	Whole Year
4	Thinai Flour	500	15	17.5	Whole Year
5	Ragi Malt	250	10	12	Whole Year
6	Ragi Flour	500	12	14	Whole Year
7	Samai Uppuma Mix	250	10	12	Whole Year
8	Samai Thinai Bujji Mix	200	12.5	15	Whole Year
9	Millet Health Beverage	250	10	12	Whole Year
10	Thinai Payasam Mix	250	15	17.5	Whole Year
11	Samai Rava Dosai Mix	250	10	12	Whole Year
12	Samai Thinai Murukku	100	10	12	Whole Year
13	Thinai Laddu Mix	100	13	15	Whole Year
14	Samai Thinai Omapodi	100	10	12	Whole Year
15	Samai Ribbon Bakoda	100	10	12	Whole Year

Source: Dr. E.D. Israel Oliver King

Role of Women in Millet Conservation

In Kolli Hills, women are able to play an integral role in millet conservation. They are involved in almost every aspect of the millet cultivation. There is also a set pattern of jobs that men and women play within the cultivation process. Table 9 shows the details.

Table 9: Role of Men and Women in Millet Cultivation

Chore	Men	Women
Chop Weeds	x	x
Burn	x	x
Clear Burnt Vegetation	x	x
Broadcast Seeds in Field	x	
Cover Seeds		x
Thin	x	x
Harvest grains	x	x
Carry bags to treshing yard	x	
Tie and take to threshing yard	x	x
Dry grains		x
Winnow		x
Weigh, Pack, and Label	x	x
Mature Grains Selected and Taken for Seeds (Italian and Finger Millet)		x
Take and Store a Scheduled Amount (Little Millet)		x
Select a Small Portion for Consumption:		x
Pound Grains		x

Source: Villagers of Kolli Hills from Discussion with Kara Mohs

As can be seen, women play an important part in the storage and consumption of millets at the household level. They also play a role and make decisions about numerous other aspects of seeds: keeping the seeds from pests, checking seed quality, managing seed lending, getting back seeds from borrowers, removing stones and unwanted materials, and taking responsibility for storing and using the husks as pig/cattle feed. In addition, women are the exclusive caretakers of the Seed Banks set up. They are responsible for maintaining registers, checking the seed quality, cleaning, drying, insect control, monitoring pests, seed germination, and periodical maintenance, collection/deposition, measurement, and lending to farmers. Thus, women play a huge part in the conservation abilities as well as the cultivation (Rengalaksmi *et al.*, 2006).

The women do feel that there has been benefit to them. The mills have helped to reduce their drudgery from the millets. In addition, the SHG has helped them in society's eyes. They used an example of how a local school member approached them and requested their help with setting up

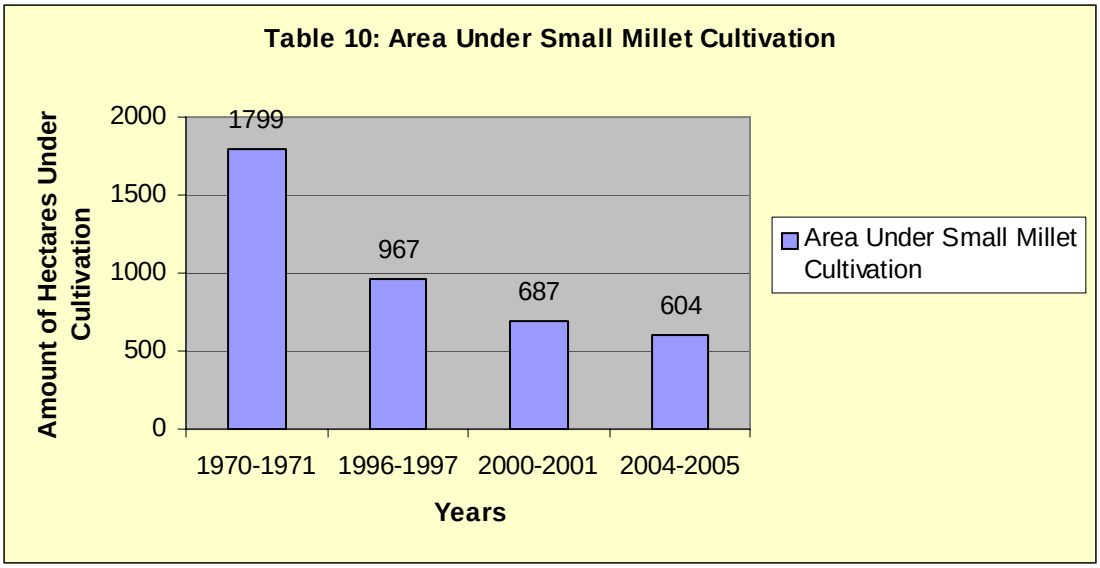
a school for the Panchayat. They were able to go to the management level to try and grant this request, showing their coerciveness in the area. They have great pride in their status now.

However, this same leadership and decision-making increase has had some adverse impacts on the household level. The majority of the men in the village still feel that a woman's job is to stay at home and do domestic chores. When women are required to go do something for the SHG, or go to receive training, the burden of everything domestic now rests on the men. This creates friction within the family. Some men are able to see the benefits and are somewhat pacified, but the tension still remains. Further, women have a varied say in the marketing of the millets. In the earlier direct marketing of the grains, the marketing took place in Kolli Hills itself, which facilitated eight women SHGs in all aspects of marketing. However, in the urban market linkages, women have little to no say. A men's SHG is in complete control of the de-husking machine and mill. Social norms, household work, etc. have hindered them from taking place in this realm of marketing.

Analysis

The benefits for the farmers in creating a market linkage with supermarkets, thus enhancing household consumption of millets on a larger scale, are clear throughout the process. This is evident even to non-researchers who are able to walk into affiliated supermarkets and see the millet for sale on the shelves. The economic benefit is extremely useful to the farmers, and as demand rises, so will the prices continue to rise. Also, since installing the mills, drudgery for women has decreased because of lack of pounding, thus effectively meeting the objectives sought at the beginning of the project. There is an increased income for those who do grow millets that was completely absent before.

However, it remains to be seen whether these benefits are going to be able to last for a significant period of time without the help of the MSSRF. While there has been a slight slowing of millet cultivation declination, the declination still exists despite the best efforts of the MSSRF. In the years 2004-2005, the amount of hectares under cultivation has dropped again to six hundred four. Table 8 illustrates this in detail. (See Table 10).



Source: G. Returns of Kolli Hills, Directorate of Agriculture, Tamil Nadu. Taken from: M.S. Swaminathan Research Foundation. "When is Knowledge Power? Gendered Knowledge and Women's Changing Status in Two Agro-biodiversity-rich Locations." (Mimeograph), 2006.

While this data is for Kolli Hills in general and not specific to the village visited, it is clear that millet cultivation has not substantially increased despite the advantages that were gained from the processes. On perceived reason for this continued dropping of cultivation is the fact that tapioca continues to be the main crop of choice, using all the flat, fertile land. The only spaces reserved for millet growth are the sloped area of the hills. The tapioca is grown until it drains all the fertility out of the soil, making it difficult to switch back to millet cultivation. Thus, the infertile lands are converted into estates of pepper and coffee (King, 2006). Secondly, the economic benefit, while

there, is still somewhat small for what the people involved, especially when compared to the huge amount of money they are able to receive from tapioca. More time is needed to determine whether the sustainability will continue with the impending withdrawal of the MSSRF. Overall, though, it is clear that the benefits from the process have been immensely useful to the people of the villages.

Conclusions

Throughout the research, the reasons for sustaining agro-biodiversity have become clear. Through the cases studied, attacking the problem of declining agro-diversity from different angles has also become a primary focus. These observations have led me to this overarching conclusion: If agro-biodiversity management is to be successful, there must be some incentive to the people responsible, for example farmers in Kolli Hills and fishers in Pichavaram. It is useless to preserve the nature without first saving the people whom the nature is being preserved for. Without the participation of these people, the continued vigor and flourishing of agricultural biodiversity is doomed, so provisions must be made to benefit both parties: nature and humans. Thus, in addition to the practices already in place, a few suggestions can be made for continued success.

1. Continue the value addition of the crops in question.
2. Incorporate multiple livelihood opportunities related to the conservation work for the people involved.

To provide specific examples of these suggestions, for food processing in Kolli Hills, while there is value addition research occurring, more can be done in this realm to make millet products more appealing to the general consumer, not just the health food sector. The reason tapioca is continuing to be produced is the fact that there is a huge demand for different tapioca products by the general public. It can be used in many ways while millets are not being utilized. Ragi malt is just one example of a product that can be produced for a sale. Cakes, bread, and other items can also be experimented with and potentially even shipped to other niches in foreign countries.

This type of research is being done, but ongoing research is needed to promote these strategies so they are successful in creating more of an economic benefit.

As for the second suggestion, this can be utilized in both case studies. Livestock, especially cattle, can be introduced more in Kolli Hills as an added income booster as well as an incentive to grow millet, since the straw can be given to the cattle as feed. In Pichavaram, aquaculture and fish farming can be used to provide a steady income as well as take some pressure off the mangrove forest. Unfortunately, I am not in India long enough to see if the observations I have made will make a significant impact on any conservation efforts. I hope, though, that researchers will take the social aspects into account when doing the conservation so that all sides are benefited.

Personal Experiences,

Looking Back. . .

Experiences of a Lifetime

Now that I'm home, I look back at my work and experiences with such longing and sadness that it is almost overwhelming. I can't help thinking of missing Krithika and Chandra's weddings, not seeing Dr. Vepa everyday, and never being able to take Gopinath out for seafood. However, there are such fond memories from my experience that I know I can never truly be sad, because I know that I will be returning to India someday, even if it takes me my whole life to get there.

My perception of India changed so much in the time I spent there. Despite all my efforts, I went into the experience with some pre-conceived notions of what my life would be like. At first I was not having a good experience or liking India at all. The spicy food made me sick, so I hardly ate. I had no friends. Finally, since I wasn't able to leave the compound without an escort, the long nights alone slowly wore on me.

However, my pessimism did not stay that way for long. I gradually began to like the spicy food, even to the point that when I returned home, everything I was used to seemed bland in comparison. I made a lot of very close friends who would take me to plays, go see movies with me, and even kidnap me and take me to the beach on my last day in India. And finally, the nights no longer seemed so long, because I was able to interact with the kitchen staff and focus on more productive things than my own misery.

There are definitely too many individual experiences to write about them all, but I will say that I learned a lot from my time in India. I entered India with a naïve, little girl attitude about the world. I expected to have a great experience working alongside top-notch researchers and famous scientists. I exited with a changed perspective on life. No matter what else I learned or experienced in India, though, my greatest lessons were not learned from the people with Ph.D.s in the various laboratories. I learned the most from the people of the villages, people with almost no education or literacy. It was the barefoot children running across the sand just to take a picture with me that taught me humility. It was the man who lost his wife, mother, and child in the tsunami who taught me about grieving. And it was the woman who took me into her home when

our car had problems that taught me about giving. I know these things will stay with me at all times.

Yet, knowing all these things, I believe that it's important not simply to focus on the aspect of the poor Indian person when looking back. Because I know that I didn't when I was in India. For whenever I interacted with the villagers, I felt like the poor person. They were so full of life, so eager to learn, and so happy with who they were. They were not always satisfied with their position, but they wanted so much to be able to move up in the world in their eyes. I even had one moment when a woman told me that she wanted her children to be able to go to school so they could go to school and be like me. I almost cried then, and I'm almost crying now, because they shouldn't be admiring me. I am the one who admires them. These people, and these experiences, are what make me so sure that I will be going back to India one day. Now I know that I will never be able to stay away forever.

Appendix 1: Results From Visit to Pichavaram

Source: Discussion with Kara Mohs

Conservation	Initially, the people exploited the forest with no knowledge of the importance
	They only knew of two advantages before the MSSRF intervention: 1) A lot of fish could be found there and 2) They could take shelter there during the rains
	At first, there was a lot of opposition to the MSSRF. The people eventually accepted the proposal due to explanations by the MSSRF about the advantages and also because they received a petty sum for the conservation work.
	After the MSSRF came to them and taught them, they recognized the importance of the mangroves. Now, they even go so far as to say that the mangrove forest is God to them, if there is no forest there is no them.

Cultivation	Men dug the canals while the women were in charge of raising and planting the saplings.
	Now, families take turns camping in the mangroves to protect them from grazing. 12 families at a time guard for 7-10 days.
	The people wished to express that the process of restoration wasn't easy. The women described walking thought slush chest high to plant the saplings. The males dug the canals without the assistance of any machinery other than simple shovels.

Consumption	Before, they were a nomadic tribe, surviving off small-scale fishing and killing wild rats. Now, though, the MSSRF has gotten them land.
	They now survive on a staple diet of fish, prawns, and crabs obtained from the mangroves along with wild fruits such as coconut.

Commerce	Previously, the villagers depended entirely upon the traditional fishermen, who used them as slave laborers and forced the people to sell their catch back to them at half price, placing the people in a
	After the restoration process began and catch increased, the people were able to escape the debt trap and sell their catch for a much higher price directly to the market, releasing nearly 90% from the debt trap
	As an example, crab fattening is now used by the people. Instead of selling the young mud crabs for R.s. 40/kg, they keep them until maturity and sell them for up to R.s. 450/kg.

Other Benefits	Through the process, the people obtained political empowerment. The women are now politically active and even have a woman panchayat leader.
	They have gained recognition from the traditional fishermen
	The Forest Department is now much more trusted by the people and they are actively involved with the community, even paying 2 individuals in MGR Nagar R.s. 20,000 each to implement mangrove restoration
	They are now proud to be able to spread awareness, especially after the tsunami. People from other villages come to them to learn about restoration
	Women are economically and politically empowered through SHG's. Also, they have a more active decision-making role at the family and community level
	The people of MGR Nagar monsoon, they go out in the rain to keep the cattle from grazing the saplings also wished to express their dedication to the project now. Even during the

Appendix 2: Findings From Visit to Kolli Hills

Source: Discussion with Kara Mohs

Conservation	Tapioca introduced around 1970
	Area under millet conservation decreased drastically
	People decided to join due to awareness spread by the MSSRF
	Create an economic incentive to give more value to millets

Consumption	Create an economic incentive to give more value to millets
	Now, mainly rice bought from PDS
	Micro-nutrient deficiency as a lack of variety in diet
	The villagers know that millet is better for them than rice
	Women are in charge of all cooking/food security issues at home

Commerce	MSSRF installed 2 de-husking machines in two villages
	Men's SHG in charge. 2 at a time are resposible for it.
	Millet de-husking machine processes 300kg of millet per month
	Sells millet for rupees 14 per kg, profit spread out throughout the people involved
	Farmers receive about rupees 5 - 5.5 per kg of millet
	Market linkage with TRIFED and with urban centers

Works Cited

Dreze, Jean and Sen, Amartya. *India – Development and Participation.* India: Oxford University Press, 2004.

FAO. "Building on Gender, Agrobiodiversity, and Local Knowledge." FAO, 2004.

JRD Tata Ecotechnology Center. *Bioconservation and the Utilization of Small Millets*. Chennai, India: M.S. Swaminathan Research Foundation, 2002.

King, E.D. Israel Oliver. Personal Interview. 26 July 2006.

M.S. Swaminathan Research Foundation. *The Mangrove Decade and Beyond*. Chennai, India: M.S. Swaminathan Research Foundation, 2002.

Rengalakshmi, R., *et al.* "When is Knowledge Power? Gendered Knowledge and Women's Changing Status in Two Agro-biodiversity-rich Locations." (Mimeograph), 2006.

Selvam, V., K.K. Ravichandran, V.M. Karunagaran, K.G. Mani, and G. Evanjalin Jessie Beula. *Joint Mangrove Management in Tamil Nadu: Process, Experiences and Prospects; Part 1: Situation Analysis – Pichavaram and Muthupet Mangrove Wetlands.* Chennai, India: M.S. Swaminathan Research Foundation, June 2003.

Swaminathan, M.S. ed. *Gender Dimensions in Biodiversity Management.* Delhi, India: Konark Publishers Pvt. Ltd., 1998.

Swaminathan, M.S. Personal Interview. 22 June, 2006.

Wood, D, and Lenne, J.M. ed. *Agrobiodiversity: Characterization, Utilization, and Management.* New York City, New York: CABI Publishing, 1999.