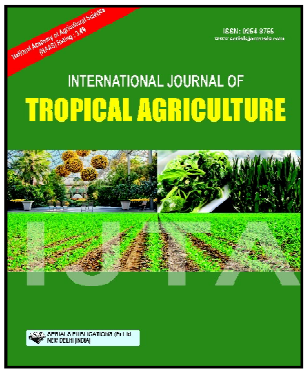

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Community Participation in Landscape based Agroforestry Management in Tripura

G. S. Raju

IFS (Retired), is the former Chief Executive Officer and Project Director, Tripura Forest Environmental Improvement and Poverty Alleviation Project (Tripura JICA Project)

Abstract: Agroforestry as one of the land uses especially in the degraded areas can play vital roles in meeting the food, fuel, fodder requirements of the people in the context of climate change. It also helps in soil erosion control, conservation of sol moisture and biodiversity and thereby improving the ecosystem services. Strategy to implement agroforestry practices following a landscape based approach can yield much higher benefit and improve the ecosystem functioning of the mosaic landscape. The present study reveals how through active participation of the community agroforestry could emerge as an alternate livelihood option for the marginal tribal communities including the tribal women farmers under Tripura Forest Environment Improvement and Biodiversity Conservation Project and fosters inclusive development. It also shows how the strategy to have a landscape based approach where agroforestry and check dams are in tandem benefits in improving a host of ecosystem services including soil erosion control, biodiversity conservation, creation of micro habitats and water conservation besides diversifying the livelihood options of the people.

INTRODUCTION

The importance of active community participation to arrest deforestation and find option for sustainable livelihood in most of the field of the natural resource management has been well recognized. Of the many, agroforestry interventions for small holder farmers have been advocated particularly for projects related to community managed natural resources. Agroforestry as one of the land uses in a given landscape have vital roles to play in the context of climate change to meet the food, fuel, fodder requirements of the people and help in protection of soil, water resources and biodiversity (State of the World Forest 2005).

Agroforestry in Tripura implemented under Tripura Forest Environment Improvement and Poverty Alleviation Project (TFIPAP) is a unique example of innovation in the area of Joint Forest Management Committees to improve the forest fringe ecosystem and benefit the community by different plantation models based on site suitability and market demand. It has been properly integrated into the process of sustainable livelihood development. Agroforestry systems can provide a wide range of ecosystem services. Apart from supply of food and non food product for meeting sustenance needs and earning income it also provides hosts of ecosystem services such as help is pollination and carbon cycling as supporting services, acting as wind breakers, improve water quality, nitrogen fixation as regulatory services. (FAO 2017, Smith 2010). Agroforestry practices have demonstrated the potential to be regenerative, improve biodiversity and soil health, check soil erosion and increase income at the farm and landscape level, while improving farm productivity and profitability.

In general the agriculture as monocultures and livestock farming are important sources of economic activities. But increased intensification of agriculture is causing loss of biodiversity and making the soil more sterile with irrational application of chemical fertilizers (Struik and Kuyper 2017). All these are projected to create resource constraints over water, soil, biodiversity and land that would adversely affect agricultural systems (Pretty and Bharucha 2014). Sustainable agro ecosystems are those tending to have a positive impact on natural, social and human capital, while unsustainable systems feed back to deplete these assets, leaving fewer for the future. In agroforestry practices trees are introduced in the agro ecosystems and communities could meet their basic needs for food, fuels, raw materials for construction and handicrafts directly from the agroforestry practices. The biodiversity of these traditional agro-ecosystems and the additional resources of their neighbouring area have secured the livelihoods and well-being of many (Bucheli and Bokelmann 2017). Biodiversity helps to prevent climate change, achieves ecological balance at the household farm level, attains food security, and increases the communities' market possibilities ((Claverías and Quispe 2001).

Women's participation has been found crucial in community participation in natural resource management related activities (UNDP 2013, Singh 2015). Since there is variation in inter and intra-cultural practices of any forestry based livelihood activities there is also variation in management of agroforestry systems such as different roles played across the social sector perception of the economic benefits from different components of the system.

The present study illustrates how the communities adopted agroforestry as one of the components of the landscape in Tripura under the TFIPA project, has been managed in tandem with adjoining water bodies to enhance the livelihood of the community and improve the sustainability of forest. The study reveals how the communities cultivate and manage tree species, agricultural and horticulture crops, livestock and other livelihood components. Women in tribal community are more active in field than non-tribal but their contribution is less recognised. The present study shows how the tribal women of Tripura have come forward to introduce agroforestry in their farmland and have started earning income.

MATERIALS AND METHODS

The present study is conducted based on primary data collected from the farmers who follow agroforestry practices in their land by applying both quantitative and qualitative methods. Total 67 agroforestry sites were visited.

The study employed a qualitative research strategy involving Focus Group Discussion and semi structured interviews with the agroforestry practitioners and other villagers. These have helped

in understanding the perception of the people on how the agroforestry practices have brought changes in their social and economic conditions and on the ecosystems and the associated ecosystem services as well. Beyond the interviews, additional data were collected through direct field observation of the agroforestry plots. Transect walks were done in two ways (i) those within the farms, where the household heads showed the species and explained their names and uses, and (ii) those in the villages, where active JFMC provided similar information.

PROJECT AREA & LOCATION OF STUDY

Tripura, the third smallest state of India is located in the North Eastern part of the country in between latitudes $22^0$56' N and $24^0$32' N and longitudes $91^0$09'E and $92^0$20'E. TFIPAP was implemented with a financial assistance from JICA between the years 2007 to 2017 covering seven districts namely Gomati, South, Sepahijola, West, Khowai, Unakoti and North. The present study was conducted covering all the seven districts and the samples were selected from 67 locations.

RESULTS

Under TFIPA project agroforestry was introduced from the year 2013-14. Till the end of the project in 2017 agroforestry plantation was raised in 8747.65 ha of land covering all the seven districts of the state. Nine models with different crop combinations were implemented based on site suitability, preference of the people and market demand. The crop combinations under different models were as follows:

Different Agroforestry Models implemented

Model Number	*Main Crop*	*Intermediate Crop*
Model 1	Bamboo and Jackfruit	Pineapple and Maize
Model 2	Gamai and Lemon	Arhar and Ginger
Model 3	Areca nut and Bamboo	Sesame, Maize and Black Peeper
Model 4	Accacia and Litchi	Lemon, Maize and Turmeric
Model 5	Teak and Jackfruit	Maize and Ginger
Model 6	Mango and Bamboo	Pineapple and Maize
Model 7	Areca nut and Agar	Black pepper and Turmeric
Model 8	Banana and Accacia	Turmeric
Model 9	Orange	Papaya and Turmeric

Model Number 6 is mostly introduced across all the districts followed by Model 3, 8 and 4.

Though people used to raise trees in their homestead land but agroforestry in a systematic and scientific manner was introduced for the first time by the project in the area.

Developing a new institutional arrangement for implementation

Community participation and institution building is the foundation for sustainability of any new interventions. Participatory management includes participation of the stakeholders in identifying the problems, set the goal and take charge to implement the action plans (Roy and Mukhopadhyay 2015). Agroforestry plantations are raised in the privately owned lands. Individuals with adjoining lands approximately ranging between 4 – 15 ha and have common interest to initiate agroforestry were identified and facilitated to form a group known as Joint Liability Group (JLG) who select a President among themselves. Same type of model is implemented in the lands of the JLG members. A

total of 1576 JLGs were formed with 10002 numbers of beneficiaries. The project supports the JLG by providing seedlings and other inputs like fertilizers, fencing etc. Members of the JLG were made responsible for nurturing and taking care of the plants. Thus though the model is implemented in the individual plot but instead of targeting individual beneficiary it has created stake of a group of people.

The project has also developed a strategic convergence with one of the biggest Rural Development program in the country, Mahatma Gandhi Rural Employment Guarantee Scheme (MGNREGS) for providing the labor components. The land leveling works, fencing and other labor costs are converged through MGNREGS. The unit cost per ha of agroforestry plantation was between Rs 52000/- to 56,000/- per ha as per the Models specified of which Rs 22,000/- was allotted from the project and rest is arranged through convergence with MGNREGA.

Strategic planning for capacity building

Capacity building of the JLG members was done through series of trainings organized by the project. These trainings focused upon imparting knowledge and skills on new agronomic practices, input management, crop management, harvesting and replanting methods. The rigorous hand holding trainings have helped in confidence building of the people.

Landscape based interventions

A landscape perspective was taken into consideration in order to establish the interdependence of the biodiversity of the agroforestry plantations and the adjacent check dams developed under the same project. These check dams are constructed with the basic purpose of checking soil erosion and water conservation, improvement of soil moisture content and water recharge in the lower reaches. However, in the total landscape where agroforestry and the check dam were found in tandem on spatial patterns have significant impact on each other. The agroforestry plantations located in the lower reaches of the check dams are benefitted through better soil moisture condition and availability of water. The check dams on the other are benefitted through checking of soil erosion by the agro forestry plantations and thus sedimentation is reduced and the life of the check dam is increased.

Introduction of alternate land use practices to check land degradation

Agroforestry plantation under the project is raised in the degraded forest areas. These degraded forest land areas were allotted to the forest fringe dwellers under the Forest Right Act 2005 particularly to provide them tenural security to improve land based sustainable livelihood opportunities. However, these degraded land areas are mostly located on the hill slopes that are susceptible to soil erosion, suffered top soil loss and lost its productive potentials to a large extent. Shifting cultivation practices with a very close rotation cycle between 3 – 5 years were also followed in the area that had made the land further prone to erosion and biodiversity loss.

With introduction of agroforestry plantation as a new land use practice, efforts are initiated to check soil erosion, water and biodiversity loss.

DISCUSSION

Prior to the implementation of the project the community had experienced increased soil erosion by wind and water. They also faced declining agricultural crop productivity on their lands which has impact on the loss of habitat for livestock and native plants. The soil erosion has caused nutrient loss due to draining of agricultural areas. Due to the break down of the social institutions the degradation of the forest and its fringe areas could not be recovered properly. It has been found that social institutions play a strong role in conserving the forest

and other natural resources and whenever there is erosion of social institution it becomes difficult to recover the forest or other natural ecosystems (Roy and Mukhopadhyay 2015). The study revealed how the ecosystem services are perceived by the community and were changing after implementation of the project.

The understanding of provisioning ecosystem services was primarily based on the perception of material benefits and uses given by the households to the species. For instance, the species used as food were classified under provisioning ecosystem services. The number of species was another indicator to assess the importance of biodiversity for the provision of ecosystem services. Presence of birds, lizards and other faunal species was marked as enrichment of biodiversity, whereas the improvement of soil quality to have impact on the agricultural product has accepted as supporting services. Other benefits mentioned by the villagers relate to reduced soil loss, providing habitat for wildlife like butterfly, moth, birds and crop protection through the formation of a micro climate.

Biodiversity conservation

With the introduction of agroforestry plantations biodiversity conservation is promoted. The land in almost all the cases was degraded and was without vegetative cover. With the introduction of agroforestry the forest, agriculture and horticulture plants are introduced in the area. Apart from the prescribed plants in the models, people have also started introducing some new plants within the model based on the agro climatic condition and market demand. Like in Dhaneswar para village people have introduced Accacia and Banana additionally in Model 6. In Model 3 plantation in Gomoti Kator and Khabaksa villages new crops like pineapple and banana were introduced for better economic return. In Nabachandrapara village turmeric was introduced as a new crop to Model 6 plantation and people have gained profit. With harvesting intercrops people have started earning profits and are gradually abandoning shifting cultivation. This is also helping in conserving biodiversity.

Number of associated plants, herbs including grass and climbers has started regenerating in the area. Like in Shompori bodol village, Muli bamboo has naturally coming up on the slopes and so is Kadam.

Creation of micro habitats

The agroforestry plots have started acting as micro habitats for various birds, insects and micro organisms. Nesting and roosting of birds are found in the locations. Birds are specially coming as these plantations include fruit crops. It is shared by people in almost all the areas that birds have become more visible with the introduction of agroforestry in their area. With increased presence of pollinators it is also helping in pollination in the adjoining agriculture lands and homestead gardens.

The mixed plantings of trees and shrubs have proven to be successful. The tree rows also provide shelter from the wind and a microclimate within which native pollinators can do their work efficiently and effectively.

Nutrient cycling

The trees in the models provide the nutrient cycling services. The leaves from the tress are adding nutrients to the soil. The nitrogen fixing species reported by respondents have been *Acacia sp.* Agroforestry also helped in enriching the soil organic matter on the surface layer, by keeping the woody perennials, improve the soil's capability to sequester carbon.

Checking of soil erosion and run off

With the vegetative cover developed along the slope the erosion and run off are checked. The soil

moisture content has improved. The area is having undulating topography with small ridges interspersed with valleys. The ridges without or sparse tree cover has further accelerated soil erosion. Such lands are now covered under vegetation. It helped in checking the soil erosion. It is also appreciated by the villagers of Dhaneswapara and in Yaprithansa whereby they have shared that agro forestry introduced near river banks and streams are checking land slide and soil erosion.

Economic return

Agroforestry plantation was introduced in the lands where people have received land title under Forest Rights Act (FRA). They all belong to indigenous tribal community and suffer social and economic marginalization. Among the 67.33% of the sample respondents who has received land under FRA, 40.17% are using the land for agroforestry purposes. In most of the cases people have started earning economic returns from harvesting the intercrops like pine apple, turmeric, banana, maize etc. Among the villages, Nelsi has shown very promising result where agroforestry plantation was raised with bamboo, mango and pineapple as intercrop in 10 ha of FRA land with 10 members in the JLG. The members themselves have introduced 60 Areca nut plants, around 50 orange plants and Arhar for nitrogen fixation. They could earn a handsome amount of Rs 8,59,000/-over last three years through selling of pineapple. The JLG members have built two small rooms in the plantation area to look after the site as this is located in a distance of about 5 km from the village. JLG members of Twichakma and Khabaksa villages have also earned more than Rs 1,20,000 through harvesting of pineapple. Nabachandrapara, Upajati colony and North Sangang have also earned profit of about 1,33,000/- and 75,000/- each respectively. Four JLG members in Yaprithansa has earned Rs 60,000 from harvesting of maize.

Inclusion of women

Women in rural areas traditionally are assigned the reproductive role of natural resource use for meeting the sustenance need of their family and their conservation compared to men. They are in daily contact with natural resources such as land, water, forest and wildlife. However, their contribution is mostly un recognized and under reported. They also lack the opportunity and exposure to earn directly from the land based activities. The present study reveals that among the agroforestry users studied 24.9% were women. These tribal women are taking active part in raising the plantation as the JLG members along with their male counterparts. This provides them an opportunity for earning and contributing to their family.

CONCLUSION

Agroforestry can provide a viable solution to improve the productive potentials of the degraded forest fringe land areas. It provides a host of ecosystem services including the provision, supporting and regulatory services. Checking soil erosion, increasing soil water conservation, conservation of biodiversity, maintaining soil fertility and nutrient cycling, support for pollination are some of the important ecological benefits provided by agroforestry practices. Biodiversity conservation is crucial for food security and over all well being of the people. It contributes to the eco restoration and stabilization of the forest mosaic ecosystems and thereby provide sustainable livelihood opportunities and food security in the long run.

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