Indian Forester, 143 (9) : 812-816, 2017
http://www.indianforester.co.in

ISSN No. 0019-4816 (Print)
ISSN No. 2321-094X (Online)

SOCIO-ECONOMIC ANALYSIS OF AGROFORESTRY SYSTEM AND ITS FINANCIAL EFFICIENCY IN MIZORAM, INDIA

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ABSTRACT

This study was conducted in selected agroforestry farms in Mizoram, India, to find out the outcome of socio-economic diagnosis as well as the financial efficiency of different agroforestry systems like mixed cropping, hedgerow farming, agrosilvopastoral and monocropping as control. Money spent and earned from each of the agroforestry systems were estimated as financial energy. Energy and monetary flows were represented by Megajoules per hectare per year (Mj ha^{-1} yr^{-1}) and Rupees per hectare per year (` $ha^{-1}yr^{-1}$) respectively. Human labour was the chief input system under study. The energy input through human is calculated on the basis of per hour energy expenditure by man using the standard values. The production, consumption and profit were estimated based on the data collected from the sites. Farm income was the main motives of agroforestry adoption followed by enhanced productivity of food crops. Management practices of different components were also recorded through questionnaire survey. The economic efficiency of each system under study was determined by calculating the monetary input: output ratio. All the land use systems showed significant results and positive economic return, which proved to be more favourable than the traditional jhum cultivation land use system. And finally, challenges faced by farmers were also addressed when adopting agroforestry system.

Key words: Agroforestry, Jhum cultivation, Socio-economic, Financial efficiency.

Introduction

Agroforestry is an integrated land use management system following the principle of generating multiple resources from the same unit of land. The production, benefit and progress of agroforestry depend on the choice of species, biophysical causes of land, labour and capital. Lundgren and Raintree (1982) defines Agroforestry as "a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence".

According to Phiri *et al*. (2004) and Keil *et al*. (2005) farmers that are involved in n-farm experimentation of agroforestry technologies with the researchers are more likely to adopt than those who are not. Gladwin *et al*. (2002) and Keil *et al*. (2005) established that the probability of adoption increases when farmers perceive low soil fertility as their current problem.

In Mizoram, people are generally attached to the traditional method of shifting cultivation, the so called '*jhum'* cultivation by the local people (Hmar, 2000), which affects sustainability. Shifting cultivation is also the mainstay of livelihood in rural areas of Mizoram and a principal method of cultivation of rice (Upadhyaya *et al*., 2015). However, several initiatives to promote a more productive system such as agroforestry have been undertaken by the State government. Agroforestry has been included in agriculture policies in Mizoram to sustain livelihood and resources by promoting alternative land use system. Besides this, many research works on agroforestry has been carried out successfully in Mizoram.

In the light of the above interest and significance in promoting a more friendly approach in agricultural system, this paper attempts to explore the socio-economic characteristics of farmers adopting agroforestry system, the type of agroforestry systems adopted, its financial efficiency and the challenges and needs of the farmers.

Methodology

The study was conducted in Muallungthu village, located in Aibawk Tehsil of Aizawl district in Mizoram, India, with a total population of only 1,160 people. A semi-structured interview schedule formed the tool to understand the farmers' socio-economic background, types of system followed as well as the challenges faced by the farmers and their felt needs. A three years data from plot which were hedgerow cropping, mixed cropping, agrosilvipastoral and mono cropping as control were documented to understand the economic impact of the systems. Further, benefit: cost ratio (B/C) analysis was also

Agroforestry has an important role to play in the rural livelihood.

used to find out the financial efficiency of agroforestry system.

The monetary input and output was timely recorded for a period of three years, out of each of the systems, represented by rupees per hectare per year (` ha^{-1} yr^{-1}). The energy input and output was also used to determine the energy efficiency, represented by Mega joule per hectare per year (Mj ha^{-1} yr^{-1}). All the energy and money spent represented the input component, and all the energy and money earned gave the output for each system. The energy input through human labaour is calculated on the basis of per hour energy expenditure by man using the standard values of 0.679 Mj and 0.5223 Mj respectively. Monetary input and output was calculated on the basis of the prevailing local market price for each item. The financial efficiency of each system under study was determined by calculating the NET Present Value (NPV) and Benefit: Cost. If the NPV is more than positive (more than zero) and the ratio is more than one, it indicates that the output is more than the input. Thus, higher the value of the NPV and B/C ratio, greater will be the efficiency of the system.

Results and Discussion

Socio-Economic characteristics of farmers

Majority of the farmers might have enough or sufficient knowledge about farming and the experience in adopting the practice. But most of them studied till high school level while a significant number (26.7%) had qualification till middle level only. It can be concluded that the educational level of farmers is relatively low. The farmers had mainly medium sized family (66.7%) followed by large sized family (26.6%) and small sized (6.7%). Majority of them had income below `45,000 followed by above `20,000 (33.3%) and then ` 30,000-40,000 (13.3%). From this finding, we can see that the lands owned by the farmers are comparatively large in size. More than half (66.7%) own land with an area between 1.5-2 ha while more than fourth (26.7%) have land with an area between 1-1.5 ha. Less than tenth (6.7%) own land with an area between 2-2.5 ha. All the respondents have electric connection while a significant number (66.7%) do not even have water connection. Most of them (73.3%) have to employ labours who were hired either local or members of the family. Only few (26.6%) did not employ labours as they volunteering from their families was available. Farming is the primary occupation for all families, while few have secondary occupation including teaching (6.7%), poultry (46.6%), labour (66.7%) and other small local business (66.7%).

Table 1: Socio-economic profile of farmers.

Particulars		Frequency	Percentage
	Level		
Educational Level	Middle	6	26.7
	High School	14	73.3
Family Size	*Size*		
	Small	1	6.7
	Medium	13	66.7
	Large	6	26.7
Annual Income	*Income (` yr^{-1})*		
	10000-15000	1	6.7
	15000-20000	1	6.7
	20000-30000	7	33.3
	30000-40000	3	13.3
	40000-45000	8	40.0
Land Owned	*Area(in ha)*		
	1-1.5	6	26.7
	1.5-2	13	66.7
	2-2.5	1	6.7
Household Asset	Electric connection	20	100
	Water connection	13	66.7
Labour Employment	Not employing	6	26.7
	Employing	14	73.3
Nature of occupation	Farming	20	100
	Teaching	1	6.6
	Poultry	9	46.6
	Labour	13	66.7
	Small business	13	66.7

Adoption of agroforestry

In recent years, the fallow period of shifting cultivation has drastically been reduced to 2-3 years, which leaves insufficient time for the land to restore its fertility to support new crops. This has led to the adoption of agroforestry system. The site under study is dominated by horticultural fruit trees and agricultural crops, mainly to provide food for household and income from market. Farmers need less area of land to sustain their livelihood because of biological and economic productivity of the agroforestry system. There is no irrigation system what so ever, all the farms are rain fed. In all the systems, fruit trees will be the primary source of income in later years and food crops will become additional income. The strong advantage of the village is its easy accessibility to the city.

Agriculture has been the main profession of the farmers from generations and they have had more than 20 years experience on farming. Table 2 implies that there is probably more awareness about the potentials of agroforestry practices among the farmers in the study area. The level of adoption of agroforestry by the framers therefore becomes very important since it determines the success of agroforestry practices. It was seen that out of the total agroforestry farmers, mixed cropping is practiced by majority of the farmers (40%), followed by hedgerow cropping (33.3%), monocropping (20%) and

agrosilvopastoral (6.7%). It is observed that various tree species ranging from leguminous and non-leguminous, medicinal plants to agricultural crops were planted by the farmers in their farm land. Their dependency on the farm is very high, as indicated by the farmers, in terms of timber (60%), source of income (100%), medicinal (50%), food security (100%) and soil fertility (66.7%). These were the main factors influencing the adoption of agroforestry. Many of the farmers however, are facing some constraints. These include transportation, financial, irrigation, equipment, marketing and lack of improved vairieties. Financial constraints (86.7%) ranked the highest among the problems followed by lack of equipment (53.3%). The rugged terrain and slope creates difficulty in promoting mechanized agriculture on sloping land. Improved varieties of seeds are readily not available to farmers.

Financial evaluation of the land use systems

All the land use systems i.e, hedgerow, mixed cropping, monocropping and agrosilvopastoral, showed positive results. Energy output and monetary output was calculated only from agricultural components in the study site during the first three years of establishment. The output increased mainly due to increased agricultural production. There was no production from silvicultural components yet. The trees will potentially provide income to farm household during times of low crop production.

The cost-benefit analysis as well as the Net Present Value (NPV) of all the agroforestry systems for a period of three consecutive years was worked out (Table 3). The discounted rate selected was 10% for all the systems. It was seen that the economic efficiency increases year by year in this study which shows the sustainability of the agroforestry systems. The NPV is high in mixed cropping (`36,217.14) due to crop diversification. The Benefit: Cost (B/C) ratio was lowest for agrosilvipastoral (1.44) because of the monetary input through livestock. Sugarcane was selected as monocropping system and considered as control. The B/C ratio and energy efficiency were found highest in case of monocropping due to sufficient resources in Mizoram, production was large but is not a sustainable system because of nutrient depletion by sugarcane. Although the NPV and B/C ratios are low, all the land use system show positive results and ratios, more than one, indicating their financial viability.

Table 2: Awareness and adoption of Agroforestry.

Particulars		Frequency	Percentage
Knowledge/experience of farmers	Yes	10	50.0
	Sufficient	10	50.0
	No	0	0.0
Type of Agroforestry Practiced	Hedgerow	7	33.3
	Mixed cropping	8	40.0
	Monocropping	4	20.0
	Agrosilvopastoral	1	6.7
Purpose of Agroforestry	Timber	12	60.0
	Source of income	20	100.0
	Medicinal plants	10	50.0
	Food security	20	100.0
	Soil improvement	13	66.7
	Source of employment	14	73.3
Challenges faced by farmers	Transportation	3	13.3
	Financial constraints	17	86.7
	No irrigation facilities	8	40.0
	No equipment	11	53.3
	Market	4	20.0
	Improved varieties	11	53.3

Conclusion

The study reveals that the socio-economic status of the farmers is poor. The main driving force for agroforestry adoption was assured income. Their dependency on farming is high, besides fulfilling the requirement of food, but of timber, non-timber and charcoal. It has proved that the potential to benefit not only economical but also ecological especially in case of hedgerow farming where energy outflow occurred through the combination of fruits harvest and pruned leaf biomass from nitrogen fixing trees. Nevertheless, it can be concluded that all the systems had positive financial and energy efficiencies that indicates that the system is sustainable for future generation and can be further developed and expanded as an alternative land use system to the age old practice of shifting cultivation. Agroforestry has an important role to play in rural livelihoods and thereby meet more of the farmer's basic needs than it presently does. It is always easier to improve existing systems than to invent new ones.

Table 3: Financial evaluation of different land use systems.

Particulars	Hedgerow	Mixed cropping	Monocropping	Agrosilvipastoral
Net Present Value (NPV) (`)	21,361.38	36,217.14	44,057.00	18,238.62
Benefit : Cost ratio (B/C)	2.22	2.24	2.87	1.44
Discounting rate selected	10%	10%	10%	10%
Total duration	3 yrs	3 yrs	3 yrs	3 yrs
Energy efficiency (Energy output/Energy input)	7.89	9.53	35.55	7.64

Table 4: Component and Management features of different land use systems.

Particulars	System			
	Hedgerow	Mixed cropping	Monocropping	Agrosilvopastoral
Area	2 ha	1.5 ha	1 ha	1 ha
Land slope	45-75 degrees	45-75 degrees	20-35degrees	25-35 degrees
Agricultural-Component	*Musa paradisiaca, Curcuma longa, Cucurbita pepo Vigna unguiculata, Zea mays,*	*Musa paradisiaca, Oryza sativa, Zea mays, Brassica juncea, Vigna unguiculata, Cucurbita pepo , Capsicum annuum, Zingiber officinale, Eryngium foetidum*	*Sugarcane (Saccharum officinarum)*	*Musa paradisiaca, Brassica juncea, Phaseolus vulgaris*
Silvicultural	*Mangifera indica, Citrus medica, Parkia timoriana, Senegalia pennata*	*Xanthoxylum rhetsa, Clerodendron coolebrokianum, Carica papaya*		*Citrus medica, Mangifera indica, Ananas comosus, Parkia timoriana, Litchi chinensis, Psidium guajava, Citrus reticulate*
Use of HYV	No	No	No	No
Weeding	2-3	2	2	2
Irrigation	No	No	No	No
Manure	Yes	No	Yes	Yes
Planting arrangement	Hedgerow	Intimate mixture	Rows	Mixture/pattern
Spacing	Between hedgerows 5x4	Depends on degree of slope	Depends on degree of slope	Depends on degree of slope
Common No. of species				
Woody-	4	3	-	7
Food crop-	5	9	1	3

Acknowledgement

The authors thank the farmers of Muallungthu for their cooperation and to all respondents of the study.

मिजोरम, भारत में कृषि वानिकी प्रणाली विश्लेषण एवं इसकी वित्तीय क्षमता का सामाजिक-आर्थिक विश्लेषण

जार्जोलियानी, लालनूनडेंगा एवं एफ. लालरिलियाना

सारांश

मिश्रित शास्योत्पादन, बाड़पंक्ति कृषि, कृषि वन संवर्धन-चरागाही और नियंत्रण के रूप में एकधान्य कृषि जैसी विभिन्न कृषि वानिकी प्रणालियों के सामाजिक-आर्थिक निदान साथ ही साथ वित्तीय क्षमता के परिणामों का पता लगाने के लिए मिजोरम, भारत में चयनित कृषि वानिकी फार्मों में अध्ययन किया गया। प्रत्येक कृषि वानिकी प्रणालियों से अर्जित एवं खर्च राशि को वित्तीय ऊर्जा के रूप में आकलित किया गया। ऊर्जा और आर्थिक प्रवाह का प्रतिनिधित्व क्रमशः मेगाजोल्स प्रति हैक्टेयर प्रति वर्ष ($mj\ ha^{-1}\ yr^{-1}$) और रुपये प्रति हैक्टेयर प्रति वर्ष ($` ha^{-1}\ yr^{-1}$) द्वारा किया गया। अध्ययन के अन्तर्गत मानवीय श्रम मुख्य निवेश प्रणाली थी। मानक मानों का उपयोग करके मनुष्यों द्वारा प्रति घण्टे ऊर्जा व्यय के आधार पर मानवों के जरिए ऊर्जा निवेश को परिकलित किया गया। स्थलों से एकत्रित आँकड़ों के आधार पर उत्पादन खपत और लाभ आकलित किया गया। फार्म आय कृषि वानिकी अंगीकरण का मुख्य उददेश्य थी इसके बाद खाद्य फसलों की वर्धित उत्पादकता थी। विभिन्न घटकों की प्रबंधन पद्धतियों को भी प्रश्नावली सर्वेक्षण के जरिए अभिलिखित किया गया। अध्ययन के तहत प्रत्येक प्रणाली की आर्थिक क्षमता का निर्धारण आर्थिक निवेशः उत्पादन अनुपात का परिकलन करके किया गया। सभी भूमि उपयोग प्रणालियों ने महत्वपूर्ण परिणामों और सकारात्मक आर्थिक प्राप्ति को प्रदर्शित किया, जो पारम्परिक झूम खेती भूमि उपयोग प्रणाली की अपेक्षा ज्यादा अनुकूल सिद्ध हुआ। अन्त में कृषि वानिकी प्रणाली को अपनाते समय कृषकों द्वारा महसूस की जा रही चुनौतियों का भी समाधान किया गया।

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