Economic analysis of existing agroforestry systems in different altitudinal zones of Kangra valley of Himachal Pradesh, India

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ABSTRACT

The studies were conducted to evaluate the existing agroforestry systems and economic returns from the systems in Kangra district of Himachal Pradesh, India. A total 220 farmers were selected randomly from four groups viz marginal, small, medium and large based on landholding capacity by dividing the district into three altitudinal zones viz zone-I (<500 m amsl), zone-II (500-1000 m amsl) and zone-III (>1000 m amsl) for survey and data collection. The data were collected using pre-tested schedule for the purpose through personal interviews with head of each household and field sampling. The study revealed that three agroforestry system types were prevalent among different categories of farmers in three altitudinal zones namely agri-silviculture (AS), agri-silvi-horticulture (ASH), and agri-horticulture (AH). Bio-economics of the systems was calculated by using the cost of cultivation, gross return per hectare, net return per hectare and benefit-cost ratio.

Keywords: Agroforestry; economic analysis; altitudinal zone; farmers

INTRODUCTION

Agroforestry is the deliberate incorporation of trees and woody species of plants into other types of agricultural activities. It is a concept of combining crops, animals and trees on the same piece of land as maximum land use practice (Beetz 2002). The technique offers solution to land shortage, poverty, food insecurity and environmental degradation (Lipper 2002) and also proving their financial viability and attractiveness as important land use alternatives in various settings throughout the world (Garrett 1997).

Agroforestry is the major part of farming systems in Himachal Pradesh and has been practiced over a long period of time and passed on from generations to generations as farmers retained trees on their farmlands either on bunds or boundaries or as intercrop for meeting their basic needs viz food, fodder, fuelwood, timber etc. These are those systems which made hill people self-sufficient and well nourished. Agroforestry can contribute in the improvement of household economic conditions eventually enabling farmers to fulfill their food requirements on hill slopes (Thapa and Weber 1994). It provides opportunity for diversification of existing land use systems, beneficial environmental impacts and higher returns as compared to sole cropping system (Chaturvedi 1991).

However agroforestry systems need to be improved and moulded into a well developed and sustainable form through the use of scientific methods, ecological and management principles, agronomic research etc so that they can contribute to livelihood, ensure food security and generate more economic benefits to the farmers. In an attempt to close the gaps the studies were done to find out the economics of agroforestry systems in Kangra district of Himachal Pradesh.

METHODOLOGY

The present studies were carried out in the 12 Panchayats of Kangra district of Himachal Pradesh

that lies between 31°41' to 32°28' N latitude and 75°35' to 77°04' E longitude having altitude range from 248 to 5861 m amsl (Fig 1). The climate of the district varies from sub-tropical in low-hills and valleys to sub-humid in the mid-hills getting temperate in high-hills. The average annual rainfall in the district varies from 1500 to 1800 mm. Snowfall is also received in upper ridges of the district. Average minimum and maximum temperature of the district is 3 and 45°C respectively.

The entire district was divided into three altitudinal zones viz Zone I (<500 m amsl), Zone II (500-1000 m amsl) and Zone III (>1000 m amsl); in each zone four Panchayats were selected and from each Panchayat as per classification of government of Himachal Pradesh farmers were divided on the basis of their landholding into four categories viz marginal (<1 ha), small (1-2 ha), medium (2-5 ha) and large (>5 ha) and a random sample of five farmers from each category was taken as ultimate unit of the study. Twenty farmers were included in each category in each altitudinal zone except large category in altitudinal zone III as there was no farmer found in large category in the selected Panchayats. In total 220 farmers were surveyed to know about agroforestry systems practised in the area and their economics was analyzed.

Bio-economics of the system was studied by calculating the cost of cultivation and gross and net returns per hectare. All the parameters were calculated on the basis of market prices prevailing at the time of completion of the experiment. Cost of cultivation was worked out on per hectare basis as per the prevalent market rates. The prevailing local market prices were used to convert the yield of all the crop plants into gross return in rupees per hectare. Net return was calculated by deducting total costs from the gross return by the formula given below:

Net return= Gross return - total costs

Benefit-cost ratio

The net return per rupee invested ratio was calculated as per the following formula:

$$\text{Benefit-cost ratio} = \frac{\text{Total discounted benefits (Rs/ha)}}{\text{Total discounted costs (Rs/ha)}}$$

RESULTS and DISCUSSION

Identification of existing agroforestry systems

Irrespective of different categories of farmers and altitudinal zones a total of three agroforestry system types existed in the study area. The agroforestry systems predominant in Kangra district were agri-silviculture, agri-silvi-horticulture and agri-horticulture (Table 1).

These systems were attributed to agro-climatic conditions of the area and need of the farmers viz food, fodder, fuelwood, timber etc. Kumari et al (2008) also reported that the traditional agroforestry practices helped the people to fulfil their basic needs of food, fodder, fuelwood and timber and identified prevalent agroforestry systems viz agri-horticulture, agri-silviculture, agri-silvi-pastoral, pastoral-silviculture and pastoral-horticulture in Lahaul and Spiti and Kinnaur districts of Himachal Pradesh.

Altitude-wise total expenses, gross return, net return and benefit-cost ratio of agroforestry systems in three zones are given in Table 2.

Total expenses

The data reveal that total expenses were significantly influenced by different agroforestry systems, altitudinal zones and their interaction. Significantly maximum total expenses under different agroforestry systems were recorded in the agri-silviculture system (Rs 196763.47/ha/year) followed by agri-silvi-horticulture (Rs 187069.37/ha/year) and minimum in agri-horticulture system (Rs 170764.58/ha/year). Total expenses under agroforestry systems in three different altitudinal zones were observed to be significantly increasing from zone-I (Rs 172199.29/ha/year) to zone-II (Rs 201040.58/ha/year) and thereafter showed significantly declining trend in altitude zone-III (Rs 186654.03/ha/year).

Highest total expenses in zone-II might be due to higher use of fertilizers, seed cost, irrigation cost, equipment cost etc. Interaction between agroforestry systems and three altitudinal zones significantly influenced the total expenses. The highest total expenses were recorded in the agri-silvi-horticulture system in zone-II (Rs 208438.78/ha/year) which were found statistically at par with agri-silviculture system in zone-I (Rs 207710.39/ha/year) and the lowest were

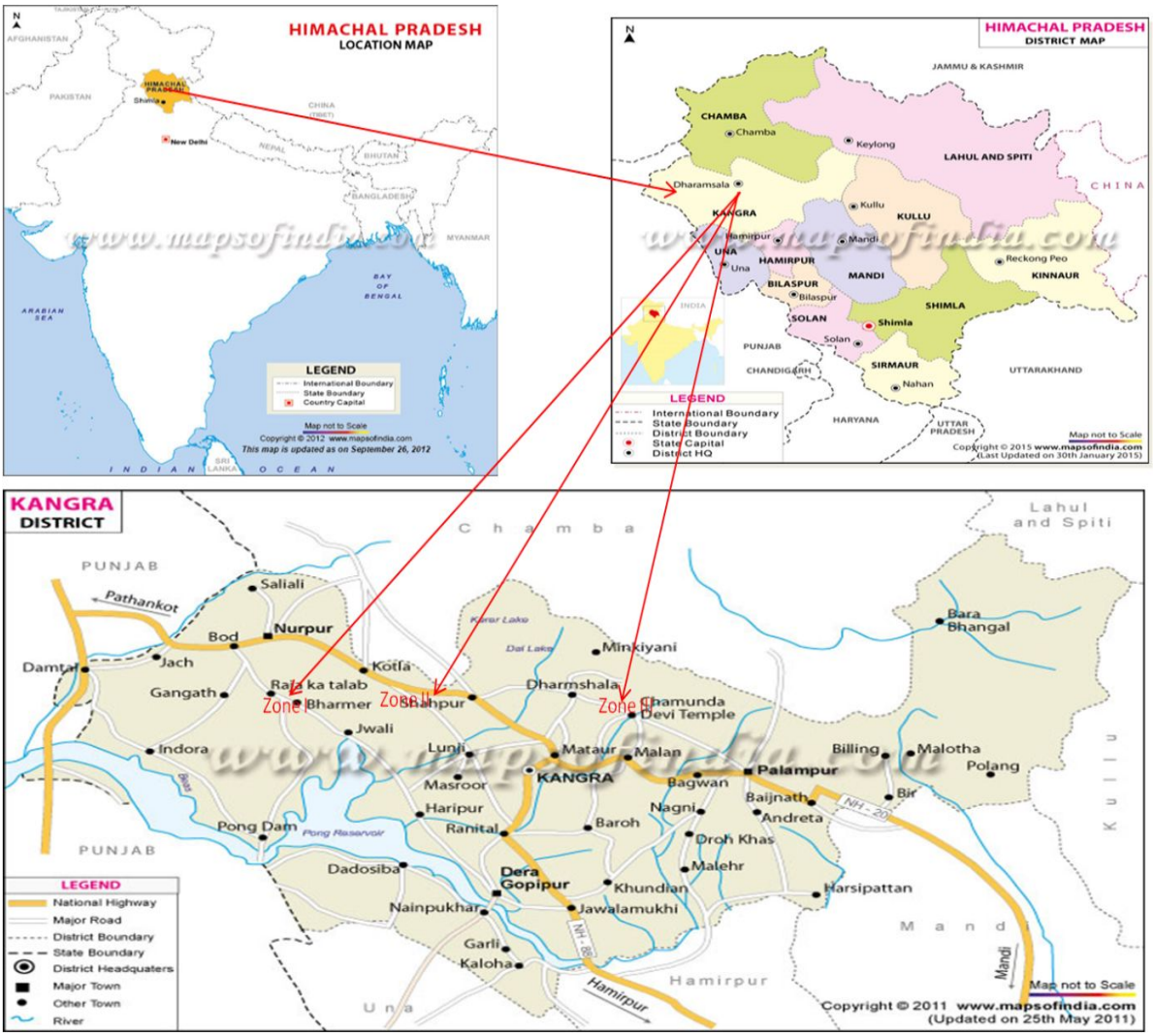

Fig 1. Location map of the study area

Table 1. Comparative status of various agroforestry system types in different altitudinal zones of Kangra district, Himachal Pradesh

System type	Altitudinal zone		
	I (<500 m)	II (500-1000 m)	III (>1000 m)
Agri-silviculture	Existed	Existed	Existed
Agri-silvi-horticulture	Existed	Existed	Existed
Agri-horticulture	Existed	Existed	Not-existed

in agri-horticulture system in zone-I (Rs 147686.32/ ha/year).

Gross return

The data depict increasing trend in gross return from zone-I (Rs 334430.43/ha/year) to zone-II (Rs 383163.01/ha/year) and thereafter decreasing trend in zone-III (Rs 355749.70). The results are contrary to the findings of Chisanga et al (2013) who found that the gross and net returns increased with increase in altitude in dry temperate Himalayan ecosystem of Kinnaur, HP. Interaction between agroforestry systems and three altitudinal zones significantly influenced the gross return. The highest gross return

Table 2. Altitude-wise total expenses, gross return, net return and benefit-cost ratio of agroforestry systems in Kangra district, Himachal Pradesh

System type	Altitudinal zone			Mean
	I (<500 m)	II (500-1000 m)	III (>1000 m)	
Total expenses (Rs/ha/year)				
Agri-silviculture	207710.39	200840.12	181739.90	196763.47
Agri-silvi-horticulture	161201.16	208438.78	191568.15	187069.37
Agri-horticulture	147686.32	193842.84	-	170764.58
Mean	172199.29	201040.58	186654.03	-
Gross return (Rs/ha/year)				
Agri-silviculture	400230.73	385355.84	369681.72	385089.43
Agri-silvi-horticulture	330226.18	399357.32	341817.67	357133.72
Agri-horticulture	272834.39	364775.87	-	318805.13
Mean	334430.43	383163.01	355749.70	-
Net return (Rs/ha/year)				
Agri-silviculture	192520.34	184515.72	187941.81	188325.96
Agri-silvi-horticulture	169025.02	190918.53	150249.52	170064.36
Agri-horticulture	125148.08	170933.03	-	148040.55
Mean	162231.14	182122.43	169095.67	-
Benefit-cost ratio				
Agri-silviculture	1.91	1.91	2.05	1.96
Agri-silvi-horticulture	2.04	1.91	1.78	1.91
Agri-horticulture	1.85	1.88	-	1.86
Mean	1.93	1.90	1.91	-

was recorded in the agri-silviculture system in zone-I (Rs 400230.73/ha/year) which was found statistically at par with agri-silvi-horticulture system in zone-II (Rs 399357.32/ha/year) and lowest in agri-horticulture system in zone-I (Rs 272834.39/ha/year).

Net return

The net return was significantly influenced by agroforestry systems, altitudinal zones and their interaction. Highest net return among agroforestry systems was noticed in agri-silviculture system (Rs 188325.96/ha/year) followed by agri-silvi-horticulture system (Rs 170064.36/ha/year) while lowest was found in agri-horticulture system (Rs 148040.55/ha/year). Among three zones net return followed the increasing trend from zone-I (Rs 162231.14/ha/year) to zone-II (Rs 182122.43/ha/year) and thereafter decreased in zone-III (Rs 169095.67/ha/year). However the interaction between agroforestry systems and altitudinal zones recorded significant variation in net return. The highest net return was recorded in the agri-silviculture system in zone-I (Rs 192520.34/ha/year) which was found statistically at par with agri-silvi-horticulture system in zone-II (Rs 190918.53/ha/year) and lowest in agri-horticulture system in zone-I (Rs 125148.08/ha/year). Higher net return may be associated with financial variables including output prices, establishment cost, labour cost and discount rate. It may also depend on management decisions such as the area planted under crops and trees (Wise and Cacho 2002). The present findings are also comparable with those of Singh et al (2015) who concluded that 80 per cent of total population lived in the villages in Himachal Pradesh and their economy depended on agriculture, horticulture and animal husbandry. They also observed that net return from agroforestry systems decreased in the order of agri-silviculture system (Rs 277415.00/ha/year) >agri-silvi-horticulture system (Rs 270747.00/ha/year) >agri-horti-silviculture system (Rs 269033.00/ha/year) >agri-horti-silviculture system (Rs 225880.30/ha/year).

Benefit-cost ratio

The data show that benefit-cost ratio was significantly influenced by agroforestry systems, altitudinal zones and their interaction. The highest benefit-cost ratio among agroforestry systems was recorded in agri-silviculture system (1.96) followed by agri-horti-silviculture system (1.91) and lowest in agri-horticulture system (1.86). Benefit-cost ratio among three different altitudinal zones observed a decreasing

trend from zone-I (1.93) to zone-II (1.90) and thereafter increased in zone-III (1.91). Under interaction the highest benefit-cost ratio was found in agri-silviculture system in zone-III (2.05) which was found statistically at par with agri-silvi-horticulture system in zone-I (2.04) and lowest was found in agri-silvi-horticulture system in zone-III (1.78).

CONCLUSION

In the present study it was found that among various identified agroforestry systems agri-silviculture system was most prevalent and profitable in Kangra district, Himachal Pradesh. The economic analysis of existing agroforestry systems may help the researchers to understand their bio-economics in study area in order to make improvement and develop technologies that will help to increase returns from different systems.

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