

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

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ABSTRACT

The studies were conducted to evaluate the pastoral agroforestry systems and economic returns from the systems in Kangra district of Himachal Pradesh. In total 220 farmers were selected randomly by dividing the district into three altitudinal zones namely 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 through pre-tested schedule for the purpose through personal interview with the head of each household and field sampling. The study revealed that three pastoral agroforestry system types were prevalent among farmers in three altitudinal zones viz agri-silvi-pastoral, silvi-pastoral, pastoral-silviculture. Bio-economics of the systems was analyzed by calculating the cost of cultivation, gross return per hectare, net return per hectare and benefit-cost ratio.

Keywords: Pastoral; agroforestry; cost; return; altitudinal zone; farmers

INTRODUCTION

Agroforestry is the most promising land management system helping in the expeditious enhancement of productivity per unit area on sustainable basis. This land management system is seen as an alternative paradigm for rural development worldwide which is centered on species-rich, low-input agricultural techniques including a diverse array of new indigenous tree crops than on high-input monocultures with only a small set of staple food crops (Leakey 1999). Moreover in rural areas agroforestry improves socio-economic conditions by creating job opportunities and providing income thereby reducing the scarcity of food and improving financial state (Goudarzian and Yazdani 2015).

For instance agroforestry so far has been adopted to augment the productivity of the land for mitigating the tangible as well as the intangible deficits of the land and environment reflecting its dual role viz supporting the socio-economic status of the farmers on the one hand and mitigating the adverse climatic

effects of deforestation to a greater extent by increasing the green cover index on the other (Sulaiman 2001).

There are many types of agroforestry systems in use all over the world and common to all these systems, practices and technologies is the deliberate use of trees and shrubs in order to achieve higher productivity, sustainability and diversity of output from land use systems. It has been shown that the socially and culturally valued species in agroforestry systems right across the Himalayan region and elsewhere in the world where traditional agriculture is practiced are invariable ecological keystone species within the ecosystem (Ramakrishnan 2007).

Agroforestry systems can take an almost infinite number of different forms as they have the potential to include any of the crops, animals and tree species used in agriculture and forestry. This tremendous potential variability allows agroforestry systems to meet the needs of farmers under almost any set of environmental, economic and social

conditions and also reduces the risks of farmers' investments as these diversify their crop range and thereby the source of income (Lefroy 2009).

Today pastoral agroforestry systems have generated much enthusiasm among the researchers, policy makers and programme executors throughout the world. There is now full consensus that such traditional systems and practices hold a viable potential to meet the present basic human needs besides addressing several major agro-ecological and socio-economic issues. Such systems ensure sustainable yield potentials, conservation benefits and multiple output possibilities in resource holding units whereas monoculture-based agriculture or forestry may not be feasible or desirable. Therefore there is a need to record the species composition, diversity and productivity in the existing land use systems and bio-economic appraisal of pastoral agroforestry systems to assess the economic significance of them particularly as they effect assessment of optimum productivity under realistic field conditions. So the study was carried out to find out the economics of pastoral 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, India that lies between 31°41' to 32°28'N latitude and 75°35' to 77°04' E longitude having altitude ranges 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 temperatures of the district are 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 in total 220 farmers were surveyed to know about pastoral agroforestry systems practised in the area and their economics was analyzed.

Bio-economics of the systems

Bio-economics of the systems was found by calculating the cost of cultivation and gross and net returns per hectare. All the parameters were calculated

on the basis of market price 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 price was used to convert the yield of all the crop plants into gross return in rupees per hectare. Net return was calculated by deducting total cost from the gross return.

Net return = Gross return - total cost

The net return per rupee invested ratio was calculated as per 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-silvi-pastoral, silvi-pastoral, pastoral-silviculture (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 Kinnaur district 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 total expenses were significantly influenced by different pastoral agroforestry systems, altitudinal zones and their interaction. Significantly highest total expenses under different pastoral agroforestry systems were recorded in agri-silvi-pastoral system (Rs 158729.00/ha/year) following a decreasing trend in silvi-pastoral system (Rs 23510.38/ha/year) and minimum in pastoral-silviculture system

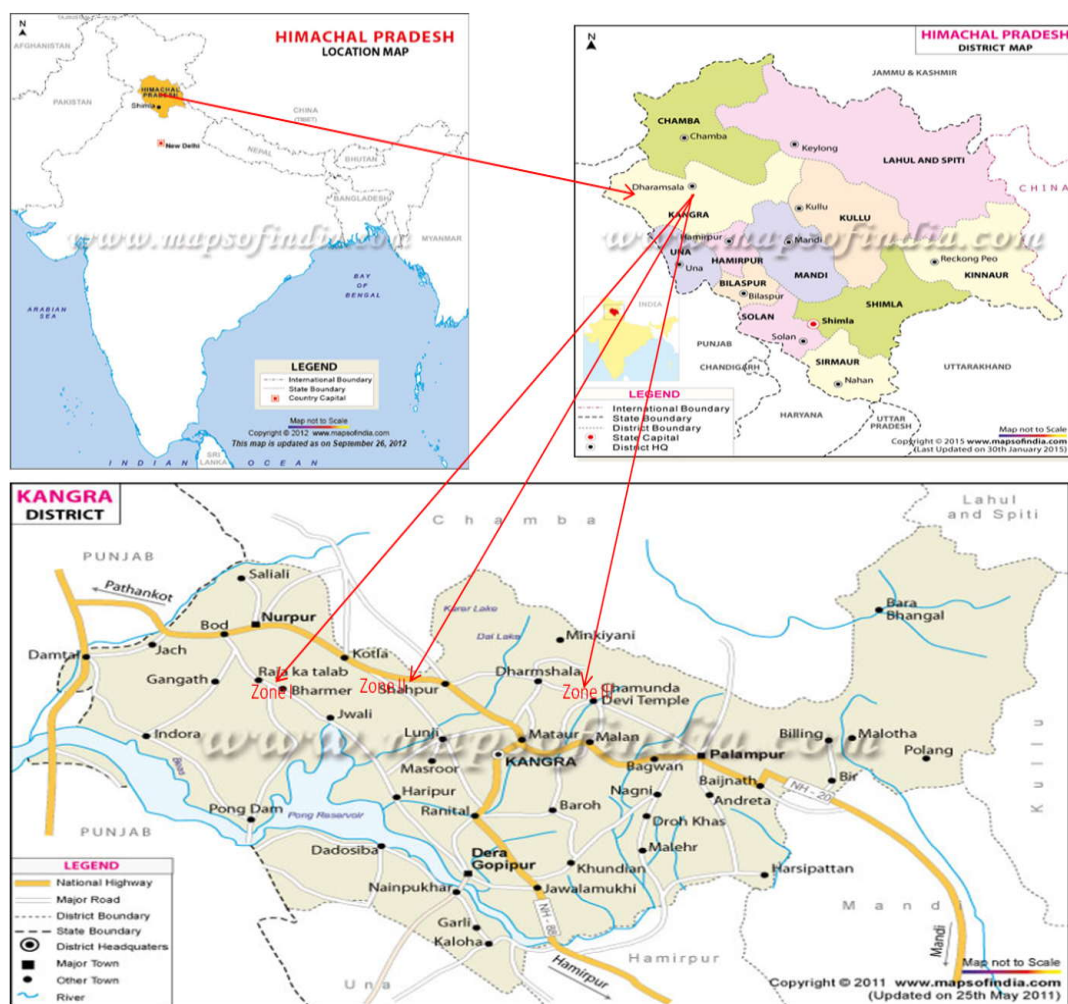


Fig 1. Location map of the study area

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-silvi-pastoral	Existed	Existed	Existed
Pastoral-silviculture	Existed	Existed	Existed
Silvi-pastoral	Existed	Existed	Existed

(Rs 12194.32/ha/year). The total expenses under pastoral agroforestry systems at three altitudinal zones were observed significant in different altitudinal zones with the maximum value found in zone-III (Rs 73848.87/ha/year) followed by zone-I (Rs 67278.83/ha/year) whereas the minimum value was found in zone- II (Rs 53306.01/ha/year). Higher expenses in altitudinal zone-III could be due to the application of costly inputs like fertilizers and seed and equipment

etc. The interaction between pastoral agroforestry systems and three altitudinal zones recorded significant variation in total expenses. The highest total expenses were recorded in agri-silvi-pastoral system in zone-III (Rs 180715.71/ha/year). On the other hand lowest total expenses were recorded in pastoral-silviculture system in zone-I (Rs 11224.45/ha/year) which were found statistically at par with the value found in pastoral-silviculture system in zone-II (Rs 12011.15/ha/year)

Table 2. Altitude-wise total expenses, gross return, net return and benefit-cost ratio of pastoral 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-silvi-pastoral	172404.01	123067.28	180715.71	158729.00
Pastoral-silviculture	11224.45	12011.15	13347.37	12194.32
Silvi-pastoral	18208.04	24839.59	27483.52	23510.38
Mean	67278.83	53306.01	73848.87	-
Gross return (Rs/ha/year)				
Agri-silvi-pastoral	325071.92	221631.04	336357.82	294353.60
Pastoral-silviculture	24281.78	30847.58	33734.81	29621.39
Silvi-pastoral	34433.62	52529.68	55797.60	47586.97
Mean	127929.11	101669.43	141963.41	-
Net return (Rs/ha/year)				
Agri-silvi-pastoral	152667.92	98563.76	155642.11	135624.60
Pastoral-silviculture	13057.33	18836.43	20387.44	17427.07
Silvi-pastoral	16225.58	27690.09	28314.08	24076.58
Mean	60650.28	48363.43	68114.54	-
Benefit-cost ratio				
Agri-silvi-pastoral	1.86	1.78	1.85	1.83
Pastoral-silviculture	2.16	2.58	2.54	2.43
Silvi-pastoral	1.90	2.14	2.07	2.04
Mean	1.97	2.17	2.16	-

and pastoral-silviculture system in zone-III (Rs 13347.37/ha/year).

Gross return

The gross return was significantly influenced by pastoral agroforestry systems, altitudinal zones and their interaction. Significantly highest gross return was observed in agri-silvi-pastoral system (Rs 294353.60/ha/year) followed by silvi-pastoral (Rs 47586.97/ha/year) and lowest in the pastoral-silviculture system (Rs 29621.39/ha/year). Among three different altitudinal zones maximum gross return was observed in zone-III (Rs 141963.41/ha/year) followed by zone-I (Rs 127929.11/ha/year) and minimum in zone-II (Rs 101669.43/ha/year).

The results have been found contrary to the findings of Chisanga et al (2013) who found that gross and net returns increased with increase in altitude in dry temperate Himalayan ecosystem of Kinnaur, Himachal Pradesh. Interaction between pastoral agroforestry systems and three altitudinal zones significantly influenced the gross return. The highest gross return was recorded in the agri-silvi-pastoral system in zone-III (Rs 336357.82/ha/year) and lowest in pastoral-silviculture system in zone-I (Rs 24281.78/

ha/year) which was found statistically at par with the gross return of pastoral-silviculture system in zone-II (Rs 30847.58/ha/year).

Net return

The net return was significantly influenced by pastoral agroforestry systems, altitudinal zones and their interaction. Highest net return among pastoral agroforestry systems was noticed in agri-silvi-pastoral system (Rs 135624.60/ha/year) followed by silvi-pastoral (Rs 24076.58/ha/year) and lowest in pastoral-silviculture system (Rs 17427.07/ha/year). Among three different altitudinal zones the maximum net return observed a decreasing trend from zone-I (Rs 60650.28/ha/year) to zone-II (Rs 48363.43/ha/year) and thereafter it increased in zone-III (Rs 68114.54/ha/year). However the interaction between pastoral agroforestry systems and three altitudinal zones recorded significant variation for net return. The higher net return was recorded in the agri-silvi-pastoral system in zone-III (Rs 155642.11/ha/year) which was statistically at par with the value found in agri-silvi-pastoral system in zone-I (Rs 152667.92) and lowest in pastoral-silviculture system in zone-I (Rs 13057.33/ha/year) which was found statistically at par with the value in silvi-pastoral system in zone-I (Rs 16225.58/

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 with crops and trees (Wise and Cacho 2002).

Benefit-cost ratio

The benefit-cost ratio was significantly influenced by pastoral agroforestry systems, altitudinal zones and their interaction. The highest benefit-cost ratio among pastoral agroforestry systems was recorded in pastoral-silviculture system (2.43) followed by silvi-pastoral (2.04) and lowest in agri-silvi-pastoral system (1.83). The benefit-cost ratio among three different altitudinal zones recorded the increasing trend from zone-I (1.97) to zone-II (2.17) and decreased in zone-III (2.16). However the interaction between pastoral agroforestry systems and three altitudinal zones recorded significant variation for benefit-cost ratio. Maximum was found in pastoral-silviculture system in zone-II (2.58) which was found statistically at par with pastoral-silviculture system in zone-III (2.54) and minimum in agri-silvi-pastoral system in zone-II (1.78). Chisanga et al (2013) also reported higher benefit-cost ratio from pastoral agroforestry systems over other agroforestry systems.

CONCLUSION

From the present study it was found that among various identified pastoral agroforestry systems agri-silvi-pastoral (ASP) system was most profitable agroforestry system in Kangra district. Hence the study showed the economic analysis of existing pastoral agroforestry system which will help the researchers to understand the bioeconomics of pastoral agroforestry system in study area in order to make improvement and develop technologies that will help to increase returns from different systems.

REFERENCES

- Chisanga K, Bhardwaj DR and Sharma S 2013. Bio-economic appraisal of agroforestry systems in dry temperate western Himalaya. *Journal of Tree Sciences* **32**(1-2): 1-7.
- Goudarzian P and Yazdani MR 2015. Climate diversity in line with agroforestry systems: studying technicalities of agroforestry systems and allied components in two diverse climatic regions (warm climate vs cold climate) (Case study: Kazeroun and Sepidan in Fars Province, IR Iran). *Desert* **20**(2): 157-166.
- Kumari A, Sehgal RN and Kumar S 2008. Traditional agroforestry systems practiced in Lahaul (Lahaul and Spiti) and Kinnaur districts of Himachal Pradesh. *Indian Forester* **134**(8): 1003-1010.
- Leakey RRB 1999. Agroforestry for biodiversity in farming systems. In: *Biodiversity in agroecosystems* (WW Collins and CO Qualset eds), CRC Press, New York, pp 127-145.
- Lefroy EC 2009. Agroforestry and the functional mimicry of natural ecosystems. In: *Agroforestry for natural resource management* (I Nuberg, B George and R Reid eds), CSIRO Publishing, Collingwood, Australia, pp 21-36.
- Ramakrishnan PS 2007. Sustainable mountain development: the Himalayan tragedy. *Current Science* **92**(3): 308-316.
- Sulaiman QSM 2001. Agroforestry for NTFPs conservation and economic upliftment of farmers. *Indian Forester* **11**: 1251-1262.
- Wise R and Cacho O 2002. Tree-crop interactions and their environmental economic implications in the presence of carbon-sequestration payments. Working Paper CC11, ACIAR Project, ASEM 2002/066.