Research Paper

Volume : 4 | Issue : 6 | June 2015 • ISSN No 2277 - 8179

Cost Benefit Analysis and Yield Performance of Agricultural Crops Under Poplar and Fruit Crop in North Western Zone of Punjab, India.

Forestry

KEYWORDS : Benefit-cost ratio, agricultural crop parameters, tree parameters.

S Rani	Himalayan Forest Research Institute, Shimla
A Rajasekaran	Institute of Forest Genetics & Tree Breeding, Coimbatore
D K Benbi	Punjab Agricultural University, Ludhiana
S K Chauhan	Punjab Agricultural University, Ludhiana

ABSTRACT

A field experiment was conducted during 2012-14 at farmer's field at Chabal village, Taran Taran district of Punjab state, India. Results of the study revealed that performance (plant height, no of grains per ear, seed and straw yield) of agricultural crops (wheat and toria) was better in open environment than in association with tree. The poplar growth parameters (tree height, diameter at breast height, crown spread, crown height and tree volume) showed better performance under agroforestry system. Benefit-cost ratio of wheat under poplar (1.26 and 1.32), under hard pear (1.19 and 1.57), and in open environment (2.22 and 2.64) were recorded during period of study. The corresponding values under agroforestry (2.53) and agri-horticulture (oil+fruit crop, 1.74) were recorded after five years. Whereas, benefit-cost ratio of oil seed crop under hard pear was 0.21 and in open environment was 0.73. In comparison to all, agroforestry land use system under wheat and poplar is viable and more profitable.

Introduction

The fast agricultural development in the Punjab region of India has deteriorated the agro-ecosystem through excessive use of natural resources. Heavy depletion of soil health, lowering of water table and high rate of environmental pollution are the matters of great concern for the future of the state Benbi and Brar (2009). Diversification in agriculture in general and a rice-wheat rotation in particular has strongly been advocated in irrigated agro-ecosystems to conserve the natural resources. Tree based land use systems are one of the viable alternative land use systems to diversify the rice wheat rotation, prevent further degradation and obtain biological production on a sustainable basis. This gives considerable scope for intercropping with wide range of agricultural crops. This system provides various products, which contribute to commercial and subsistence agricultural productivity as well as security to farmer's family livelihood. So farmers attracted toward poplar based agroforestry system because it provide attractive financial returns (Chauhan et al., 2012) and also fulfill the requirements of the people and industries. So, there are many sustainable agroforestry systems in vague in many parts of India and among them is poplar based agroforestry system (Puri et al., 2001) is highly beneficial. In addition to this agri-horticulture system also provides higher returns, stability and sustainability to the farming system. The major objectives of the study were to evaluate the performance of wheat and oil seed crop (toria) under tree based land use system and to identify the reasons of farmers to promote the tree based land use systems and estimate the cost-benefit analysis in western region of Punjab state.

MATERIALS AND METHODS

The study was carried out in the farmer's field at Chabal village, Taran Taran district of Punjab state, India, during the year 2012-14. The research site is situated at 219 m above the mean sea level and lies between 310.28'N latitude and 740.58'E longitude, which represent western agro-climatic zone of the state. The climate is sub tropical, semi-arid and hot with a long dry season from April to June and a wet season from July to early September. Mean annual precipitation of 545 mm, most of it falling from July to September. Temperature ranges between the maximum of 43°C and minimum of 4.4 °C across the study area. The soil of the experiment site was silty clay loam with pH of 7.74-8.11, available N= 122-181kg/ha, P=13-31 kg/ha and K=25-430 kg/ha at the experiment site. Wheat crop was raised under three different land use systems during first week of November; under poplar canopy, hard pear and in open conditions. Other agricultural crop, oil seed crop was also raised under hard pear and in the open environment.

Following methodology adopted for agricultural crop yield

The field was divided into 3 blocks and each block was treated as a replication. Grain yield was recorded from $1m^2$ quadrat from nine spots and mean values represented the each replication. The average grain yield of each quadrat was extrapolated to give per acre value in quintals. Data of sole crop was also recorded from the adjacent field as control. Data was collected at harvesting time during both the years. The height of randomly selected plants from each plot was recorded in (cm) from ground level to tip of plant. Number of grains per ear was counted. Grain and straw yield from each plot were recorded and finally yield was extrapolated on a acre basis.

Tree parameters

Height of 25 trees per replication was measured in (m) from ground level to the tip of the main shoot. The diameter at breast height (DBH) was measured in (cm) with digital caliper at 1.37 m above the ground level. The measurements of DBH were taken in two different directions perpendicular to each other and average DBH was calculated. The crown spread was measured in (m) using measuring tape from the tree trunk in east-west and north-south directions and holding two poles touching tip of the opposite sides of the tree. The distance between these two directions was measured with the help of measuring tape and average was calculated. Height of crown was measured in (m) from ground level to lowest shoot of the trees with the help of a graduated measuring rod. Biomass (kg/tree) of poplar was estimated through the regression equations developed for the prevailing conditions by (Sharma et al., 2007). Whereas, in hard pear biomass estimated by following formula: volume x density of wood.

Statistical analysis: Data were analyzed using ANOVA in a completely randomized design Gomez and Gomez (1984) and using CPCS-1 software developed by the Department of Mathematics and Statistics, Punjab Agricultural University, Ludhiana.

RESULTS AND DISCUSSION

Wheat growth

An appraisal of the data presented in Table 1 & 2 revealed the response of agricultural crops for growth and yield under tree canopy and in open condition were significant. Crops differed

significantly with higher values in open than under a poplar canopy and fruit tree. Maximum grain and straw yields of wheat and oil crop were recorded under sole cropping. Similarly in case of oil seed crop, there was higher reduction as compare to sole cropping. In general, yield of agricultural crops decreased with advancing age of poplar due to increased competition for growth resources like sunlight, moisture and nutrients Wani and Malik (2014). Active growth and full foliage of the trees during the rainy season offered maximum competition with crops for growth resources.

Tree parameters

The data on growth parameters of 3th, 4th and 5thyr old poplar tree and 28th, 29th and 30thyr old hard pear are presented in Table 3. Trees showed significant differences for growth and yield parameters during different years. However, significant differences in tree height, dbh, crown spread, crown height and biomass were noticed during the years under poplar canopy but no significant differences were noticed under hard pear. The biomass of poplar followed the trend of tree height/diameter and significant differences were recorded over the years of growth.

Table 1: Wheat yielding parameters

Parameters	Pure wheat crop			Wheat under poplar			Wheat under hard pear			
years	2013	2014	Mean	2013	2014	Mean	2013	2014	Mean	LSD at 0.05%
Height (cm)	79.67	79.33	79.50	76.00	77.17	76.58	56.60	77.17	76.58	1st yr-4.2 2nd yr-6.8
No of grains per ear	70.33	74.67	72.50	46.67	47.33	47.00	35.07	38.00	36.53	1st yr-4.6 2nd yr-5.2
Grain yield(q/ acre)	19.50	20.00	19.75	14.00	13.00	13.50	13.70	14.50	14.10	1st yr-1.3 2nd yr-1.6
Straw yield(q/ acre)	29.85	30.03	29.94	19.60	18.5	19.05	18.5	20.00	19.25	1st yr-1.99 2nd yr-2.3

Table 2: Oil seed crop (toria) yielding parameters 2014

Conditions parameters	Open	Under hard pear	LSD (P=0.05)
Ht of plant (cm)	78.0	49	6.6
No of seeds per pod	24.5	13.5	2.48
No of pods per plant	1258.33	627.67	193.32
Grain yield (q/acre)	6.1	3.5	0.8
Straw yield (q/acre)	6.00	3.95	2.04

Table 3: Growth performance of Populus deltoides and Pyrus pyrifolia

Trees parameters	Populus deltoides				Pyrus pyrifolia			
Age of trees	3rd yr	4th yr	5th yr	LSD (p=0.05)	28th yr	29th yr	30th yr	LSD (p=0.05)
Height (m)	19.67	22.00	24.48	0.66	7.77	7.83	7.89	NS
Dbh (cm)	20.04	23.41	24.86	0.23	32.05	32.58	32.60	NS
Crown spread (m)	5.00	5.27	6.47	0.31	6.50	7.91	8.00	NS
Crown height (m)	5.82	9.73	10.25	0.92	1.97	2.07	1.83	NS
Biomass (kg/tree)	137.92	198.88	244.17	7.76	405.84	425.10	427.97	NS

Table 4: Comparative economics of agricultural crops, fruit crop and poplar tree

Years	Wheat under poplar (q/acre)						
	Grain		Straw				
	Yield (q)	Returns	Yield (q)	Returns	Gross Returns	Net Returns	B:C ratio
2013 (4*)	14.0	18,900	19.60	6,860	25,760	14,352	1.26
2014 (5**)	13.0	18,200	18.50	8,325	26,525	15,117	1.32
	Wheat under hard pear(q/acre)						
2013	13.70	18,495	18.5	6,475	24,970	13,562	1.19
2014	14.50	20,300	20	9000	29,300	17,892	1.57
	Oil crop under hard pear(q/acre)						
2014	4.10	10,250	3.95	356	10,606	1,811	0.21
	Oil seed crop in open(q/acre)						
2014	6.00	15,000	6	540	15,540	6,205	0.71
	Wheat in open(q/acre)						
2013	19.50	26,325	29.85	10,448	36,773	25,365	2.22
2014	20.00	28,000	30.00	13,500	41,500	30,092	2.64
	Agri-silviculture land use system						
2014	-	-	-	-	7,34,982	5,37,977	2.53
	Agri-horticulture land use system						
2014	-	-	-	-	5,61,975	5,17,045	1.76

Gross returns in Rs/acre from 2013-14

The poplar trees showed better growth under agroforestry (Table 3). The higher production of poplar when cultivated with seasonal crops may be due to the benefits drawn by the poplar by the various agricultural inputs. The reduction in the grain yield was due to the reduction in yield contributing factors (plant height, number of grains per ear and 1000-grainweight), which may have been affected by the micro-environmental changes i.e. solar radiation and air temperature Chauhan et al., (2012)

Economic analysis

The economic evaluation in terms of gross return and benefit cost ratio (BCR) varied under different land use systems (Table 4). The gross returns of wheat crop were Rs 25,760 and 26,525 per acre under four and five year old poplar canopy. In case hard pear returns of wheat crop 24,970 and 29,300 during both years whereas, in oil crop Rs10,606 per acre during the year of 2014. Higher returns got under sole cropping i.e Rs 25,365 and Rs 30,092 per acre. Similarly the BCR of wheat under poplar was 1.26 and 1.32 whereas, in hard pear 1.19 and 1.57, in sole wheat crop 2.22 and 2.64, oil crop in (open, 0.73 and under hard pear 0.21). and oil seed crop+fruit crop (1.76) were recorded during period of study. Highest returns were found under agroforestry (wheat+poplar, 2.53) after five years. The higher return from agroforestry systems in comparison to sole cropping has been reported in coconut based farming system intercropped with rice, millet, grain legumes, oilseed crops, root crops, banana, pineapple and chillies Das (1991), sunflower, pigeon pea and pearl millet raised in Leucaena leucocephala and E. hybrid (Ramshe et al., 1994), coconut with ginger, turmeric and colocasia (Sharma et al., 1996), sorghum, groundnut and grass grown under teak and subabul (Mutanal et al., 2006), arable crops like maize, paddy fodder maize and sunhemp raised in horticultural crop sapota and silvicultural crops like E. tereticornis, Albizia molucana, C. equisetifolia, T.grandis and Dalbergia sissoo (Patil et al., 2010), poplar (P. deltoides) based agroforestry system Jain and Singh (2000), Kaushik and Kumar (2003) pearl millets and toria (Brassica tournefortii) in Khejri and coconut and guava based multistoried agroforestry system with medicinal crop like Aloe indica, Asparagus racemosus and Kaempferia angustifolia Bari and Rahim (2012).

Volume : 4 | Issue : 6 | June 2015 • ISSN No 2277 - 8179

Conclusion

Poplar based agroforestry system play an important role in the socio-economic development of farmers. Agricultural crops are more compatible with poplar in the initial years. In the later stages of poplar growth, the yield of agricultural crops is substantially reduced. Similarly as in agri-horticulture system, yield of crops was less as compare to sole cropping. But the income from the system as a whole is increased as the loss in yield of agricultural crops is compensated by increased yield, price of poplar and fruit crop. Poplar based agroforestry systems provide higher returns after five years which is approximately more than the traditional rotation in western zone of Punjab. This has boosted the economy of the poplar growers, and helped in the development of plywood industry in the state. So, poplar based land use system is economically viable and more profitable than many of the other crop rotations.

REFERENCE

Benbi, D, K., & Brar, J. S. (2009). A 25 year record of carbon sequestration and soil properties in intensive agriculture. Agronomy for Sustainable. Development, 29, 257- 265. | Bari, M. S., & Rahim, M. A. (2012). Economic evaluation and yield performance of some medicinal plants in coconut based multistoried agroforestry systems. The Agriculturists, 10 (1), 71-80. | Chauhan S. K., Brar, M. S., & Sharma, R. (2012). Performance of poplar (Populus deltoides bartr.) and its effect on wheat yield under agroforestry system in irrigated agro-ecosystem, India Caspian Journal of Environmental Sciences Vol. (10), 53-60. | Das, P. K. (1991). Economic viability of coconut based farming system in India. Journal of Plantation Crops, 19(2), 191-201. | Gomez, K. A., & Gomez, A. A. (1984). StatisticalProcedures for Agricultural Research. 2nd ed. John Willey and Sons, New York, NY. (pp. 680). | Jain, S. K., & Singh, P.(2000). Economic analysis of industrial agroforestry: poplar (Populus deltoides) in Uttar Pradesh (India). Agroforestry Systems, 49, 255-273. | Kaushik, N., & Kumar, V. (2003). Khejri (Prosopis cineraria) - based agroforestry system for arid Haryana, India. Journal of Arid Environments, 55, 433-440. | Mutanal, S. M., Prabhakar, A. S., Nadagoudar, B. S., & Mannikeri, I. M. (2006). Effect of Teak on yield and yield components of field crops. Indian Forester, 132 (8), 980-985. | Patil, S. J., Mutanal, S. M., Patil, H. Y., Shahapurmath,G., & Maheswarappa, V. (2010). Performance of sapota- Teak based agroforestry system in hill zone of Karnataka. Indian Journal of Agroforestry, 12 (1), 27-34. | Puri S., Swamy S. L., & Jaiswal, A. K. (2001). The potential of poplar (P. deltoides) in the sub-humid tropics of central India: survival, growth and productivity. Indian Forester, 127(2), 182-185. | Ramshe, D.G., Umarani, N. K., Khade, K. K., Walunjkar, R. B., & Tambe, T. B. (1994). Effect of association of tree species on grain production of arable rainy season crops. Indian Journal of Agronomy, 39(2), 188-192. | Sharma S. C., Dogra A. S., Upadhayay A., & Chahal G. S. (2007) Carbon stock and productivity assessment of Populus deltoides Barter. ExMarsh in Punjab. Indian Forester 133, 8-16. | Sharma, R., Prasad, S., Mohan, N. K.., & Medhi, G. (1996). Economic feasibility of growing some root and tuber crops under intercropping system in coconut garden. Horticulture Journal, 9(2), 167-170. | Singh, B., & Shama, K. N. (2007). Tree growth and nutrient status of soil in a poplar (Populus deltoides Bartr.) based agroforestry system in Punjab, India. Agroforestry Systems, 70, 113-124. | Wani N. R., & Malik, T. H. (2014). Role of Poplars in Agroforestry Systems in India. New York Science Journal, 7(2). | | |