Research Journal of Chemical and Environmental Sciences
Res J. Chem. Environ. Sci. Vol 8 [1] February 2020: 52-55
Online ISSN 2321-1040
CODEN: RJCEA2 [USA]

Website: www.aelsindia.com/rjces.htm

RJCES

ORIGINAL ARTICLE

Economic Analysis of Organically Grown and Scientifically Managed Maize-Mulberry Based Agroforestry System

Shashi Kumar MC[1*], CL Thakur[2], Dhanyashri PV[3],Stanzin Namdol[4], Girish Shahpurmath[5]
[1, 2, 4]Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan (H P),
[3]Birsa Agriculture University, Ranchi, Jharkhand
[5]College of Forestry, Sirsi UAS Dharwad
[*]**Corresponding Author: -**drmcshashikumar@gmail.com

ABSTRACT
Economics of an agroforestry system in relation to production function is studied by quantification of multiple products from the system. Agroforestry being a complex system of multiple end products its assessment based on costs incurred and returns acquired are studied in this study. Greater economic returns are always from well manured and managed crops hence different organic manures and tree lopping intensity are undertaken in present research. Present study had income from both the components i.e maize and mulberry along with some cost of production are studied. Various activities involved and their economic aspects are included and quantified to evaluate the monetary aspects of different organic manures and different regime of tree loppings. Benefit cost ratio of growing maize with mulberry ranged from 0.7 to 4.5 with tree lopping of 75% resulting in better economic results compared to other lopping intensities. From the study, it is concluded that integrating maize with Morus alba Loffers an excellent opportunity for diversification and high income generating when trees are lopped successfully (75%) and manure treatment S_2(Jeevamruth) is suggested as cost effective nutrient module for getting direct and indirect benefits from maize under mulberry based agroforestry system on sustainable bases with good soil health.
Keywords: *Agroforestry, production function, lopping, organic manure, and benefit cost ratio.*

Received 20.12.2019 Revised 03.01.2020 Accepted 13.02.2020

INTRODUCTION

Agroforestry being a system comprising of two or more than two components in it is always complex both in its economic as well as ecological sense. Because of presence of more than one component its nutrients, light, water and other requirements are also ample such requirements can only be met by scientific management and artificial applications. Usually application of chemical fertilizer is common practise leading to many problems including deteriorating soil health and increasing cost of cultivation. Maize being a cereal crop and fodder crop its whole biomass is used economically and its combination with mulberry, a winter fodder tree which is multipurpose tree (silk rearing, wood for sport goods) along with supplanting the soil fertility can be a fodder-alley cropping system that can support livestock and leading to multiple diary and farm products. Agri-silviculture system has to be scientifically managed in order to reduce competition between components for scarier resources like light, water and nutrients etc. Present study with organically grown artificially irrigated maize under tree of mulberry that are lopped in various intensities to study appropriate lopping regime suitable for maize undercropping. Instead of using chemical fertilizers that are costly as well as harmful the potential of organic manures should be utilized by using farm and livestock waste to produce various organic manures like FYM, Vermicompost, Jeevamruth and panchmruth etc. so that the cost can also be reduced and sustainable self-sufficient models can be developed. Bijarpas *et al.,*[2] conducted the economic studies on different agroforestry systems and it has been found that there was a significant difference between NPV gained from monoculture system and different agroforestry systems. Dhillon and Chauhan [3] evaluated the performance and economic returns of growing onion and garlic under poplar based multistorey systems and stated that it maximized the use of land and nutrients and improved microclimatic conditions. It is well known that it has both productive and protective role to play but because of lack of suitable quantification measures to exactly quantify its ecological benefits its total value is always under estimated. Presently, the economic benefits like grain and fodder produced from the system by keeping

tree as a principal due to its long rotatation its interim benefits along with other components and the cost of cultivation acquired are considered to work out benefit-cost ratios.

MATERIAL AND METHODS

Present study was conducted in agroforestry experimental farm area of Dr. Y.S Parmar University of Horticulture and Forestry, Nauni, Solan during the year 2018-2019 with lopping as main and organic manures as sub treatment. Before the starting of experiment soil samples were collected from field and analysed for later comparison. Randomised Complete block design was laid out with three replications under mulberry trees that are spaced 9m*3m apart and are lopped at varying intensities (T_0 (unlopped /Control), T_1 (25%), T_2 (50%) and T_3 (75%). Before sowing the maize seeds three trees in each row were selected for lopping at the intensities of (0%, 25%,50% and 75%) and were lopped according to subjective judgment in all three rows and four beds of size 4m*2m were prepared under each lopping intensity and in case of control no lopping was carried out just four beds were prepared. Under each lopping intensity different organic manures *viz* T_0 (No manure), T_1 (FYM), T_2 (Jeevamruth) and T_3 (Vermicompost) were applied as per recommended dose (Quantity of organic manures were calculated on N equivalent basis). Manures were equally distributed and mixed thoroughly. Maize seeds were sown at spacing 45*20cm spacing during second week of June 2018 as a kharif crop in the beds prepared in interspace between two rows of trees. Crop was irrigated and cultivated as per standard package of practices and was harvested after maturity. Total treatment combinations were T_0S_0, T_0S_1, T_0S_2, T_0S_3, T_1S_0, T_1S_1, T_1S_2, T_1S_3, T_2S_0, T_2S_1, T_2S_2, T_2S_3, T_3S_0, T_3S_1, T_3S_2, and T_3S_3. Separate economic analysis for each treatment was carried out under following sub heads and results are presented in the table.

Cost of cultivation (Rs ha^{-1})

Cost of cultivation of maize- mulberry based agroforestry system was worked out on the per hectare basis. The requirement of labour and expenses on different operations such as lopping, ploughing, weeding, harvesting and threshing were calculated on the prevalent rates. Cost of inputs like seeds, and manures were calculated on the basis of actual amount used in the land use.

Gross returns (Rs ha^{-1})

The prevailing local market prices (Rs kg-1) were used to convert the yield of field crops and tree into gross returns in rupees per hectare.

Net returns (Rs ha^{-1})

Net returns were calculated by deducting total cost (Rs ha-1) from the gross returns (Rs ha^{-1}). Net return (Rs. ha^{-1}) = Gross returns – Cost of cultivation

Benefit-cost ratio

Benefit-cost ratio was computed by dividing gross returns obtained from the system with total cost of cultivation of the same on basis of following formula:

$$\text{B:C ratio} = \frac{\text{Gross returns (Rs ha}^{-1})}{\text{Total cost (Rs ha}^{-1})}$$

RESULTS AND DISCUSSION

The economical parameters such as cost of cultivation, gross returns, net returns and benefit cost ratio of maize were assessed according to different treatments applied on per hectare basis

Cost of cultivation (Rs ha^{-1})

The cost of cultivation of maize under morus based agrisilviculture system was calaulated and results are presented in Table 1. Among all the lopping intensities the cost of cultivation was highest in T_3 (75% Lopping) and cost of cultivation increased with increasing lopping as it requires more labour for carrying out lopping.Among the organic manure treatments the cost of cultivation was highest under treatment S_3 (Vermicompost) due to more cost per unit of manure with treatment S_0 (No manure) being minimum.Treatment combination T_3S_3(75% lopping intensity + Vermicompost) costing the highest expenditure of total expenditure of 85325 Rs/ha due to more cost of manure and labour for lopping and the treatment combination T_0S_0 (0% lopping+No manure) incurring lowest cost of cultivation 13650 Rs/ha because no manre cost and labour cost was added. Among organic manure application, Jeevamruth incurred minimum cost as similarly reported by Kasbe *et al*. [4] and Thakur [7]. Similar results for increase in cost of cultivation for increasing lopping were reported by Meena [5], Nayak H [6] and Singh [1].

Gross returns (Rs ha^{-1})

The gross returns from the system is the combined returns from both tree component (mulberry) from its leaf as fodder and its stems as stalking and firewood material and crop (maize) grain and stover yield.

Gross returns from crop was maximum at treatment combination T_3S_3(75% lopping intensity + Vermicompost) i.e 87799.17Rs/ha and minimum in T_0S_0 (0% lopping +No manure) i.e 30523.92 Rs/ha. Whereas the tree volume is not taken in to account as it is a long-term asset which can further add the income making system much more viable.

The gross returns from the agrisilviculture system (Maize+Mulberry) were estimated and presented in table 1. Gross returns from crop and tree component was calculated separately and were complied. Treatment combination T_3S_3(75% lopping intensity + Vermicompost) yielded highest combined gross returns of 130811.67 Rs/ha as the yield was maximum in case of crop with minimum combined gross returns were obtained in treatment combination T_0S_0 (0% lopping intensity + No manure) with 30523.92Rs/ha as the crop yield was minimum and there was no income from tree.

Net returns (Rs ha^{-1})

Net returns from the system was calculated by deducting cost of cultivation from gross returns and were complied. Treatment combination T_3S_2 (75% lopping intensity + Jeevamruth) yielded highest net returns of 85006 Rs/ha due to decreased cost of cultivation by application of jeevamruth along with improved crop yield. Minimum net returns were obtained in treatment combination T_0S_3 (0% lopping intensity + Vermicompost) with -23106.5 Rs/ha as nothing was harvested from tree component with shade decreasing the crop yield coupled by increased cost of cultivation due to application of vermicompost made the system economically nonviable. Similar results were obtained by Yadav *et al.,* [8].

Benefitcost ratio(B:C):

B:C of growing maize under mulberry based agrisilviculture system with different tree loppings and organic manures were calculated. Highest B:C ratio (4.5) was obtained in treatment combination T_3S_0 (75% lopping +No manure) followed by T_2S_0 (50% lopping +No manure) i.e 3.9 and T_3S_2 (75% lopping +Jeevamruth) i.e 3.6 proving that agroforestry can yield maximum returns even without application of manure as the income from tree is more and cost of cultivation gets reduced due to no manure costs whereas the minimum B:C ratio (0.7) was obtained in T_0S_3 (0% lopping intensity + Vermicompost). Among organic manure application of jeevamruth has proved economically more viable because of low cost per unit and among the lopping intensities the 75% lopping of tree canopy has proved best as it provides tree products along with improved crop yields compared to unlopped trees. Kasbe *et al*., [3] also reported that application of jeevamrutha is one of the cheap and efficient organic substitutes for other organic manures like vermicompost in integrated approach for high crop yield and profitability, besides improving the nutrient status of soil. Results found are in line with Meena [5], Nayak H [6], Singh [1] and Thakur [7]. Hence, it proves that carrying out tree canopy management activities like lopping not only increase crop yield but also gives economic returns leading to increased B: C ratio from the system.

Table 1:- Bio economic appraisal of Maize under Mulberry based agroforestry system

Treatments	Cost of cultivation (Rs ha^{-1})	Gross returns from crop (Rs ha^{-1})	Gross returns from tree (Rs ha^{-1})	Total gross returns	Total net returns from system (Rs ha^{-1})	B:C ratio
T_0S_0	13650	30523.92	0	30523.92	16873.92	2.2
T_0S_1	49400	51992.00	0	51992.00	2592	1.0
T_0S_2	27150	50179.63	0	50179.63	23029.63	1.9
T_0S_3	80325	57218.50	0	57218.50	-23106.5	0.7
T_1S_0	16150	34332.38	18278	52610.38	36460.38	3.3
T_1S_1	51900	66560.38	18278	84838.38	32938.38	1.6
T_1S_2	29650	63121.00	18278	81399.00	51749	2.8
T_1S_3	82825	77481.63	18278	95759.63	12934.63	1.2
T_2S_0	17400	38144.17	29674	67818.17	50418.17	3.9
T_2S_1	53150	71681.75	29674	101355.75	48205.75	1.9
T_2S_2	30900	66670.25	29674	96344.25	65444.25	3.1
T_2S_3	84075	79348.75	29674	109022.75	24947.75	1.3
T_3S_0	18650	40909.50	43012.5	83922.00	65272	4.5
T_3S_1	54400	82137.00	43012.5	125149.50	70749.5	2.3
T_3S_2	32150	74143.50	43012.5	117156.00	85006	3.6
T_3S_3	85325	87799.17	43012.5	130811.67	45486.67	1.5

CONCLUSION

Bio-economics of the system revealed that the economic returns like gross returns, net returns and B: C ratio can be increased by tree lopping and organic manure application compared to unlopped and no manure application. Among organic manures application of Jeevamruth and among lopping intensities 75% proved economically most suitable. Also carefull selection of inputs is very important for getting maximum benefits. Intercropping of maize (*Zea mays* L) with mulberry was found to be more beneficial if it is lopped scientifically when compared to unlopped condition and suitable organic manures were used. Diversification along with socio economic upliftment can be achieved by such organically grown and scientificallt mnaged agroforestry systems. Hence it can concluded that Maize (*Zea mays* L) can be grown successfully grown under Mulberry (*Morus alba* L) by lopping the trees in subtropical climatic conditions. Ecological benefit quatification studies have to taken up in future for complete recognition of economic aspects of agroforestry.

REFERENCES

1. Singh,A., (2014). Impact of Variable Pruning Intensities, Fertilizer Doses and Seed Rate on Crop Yield and Wood Production under Dalbergia sissoo Roxb. Based Agri-silviculture System.*M.Sc. Thesis Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidyalalya, Jabalpur,* pp178.
2. Bijarpas, M.M., Shahraji. T.R. and Limai, S.M., (2015). Socioeconomic evaluation of agroforestry systems. *Agroforestry systems*, 61:478-484.
3. Dhillon, WS and Chauhan, S.K., (2012). Intercropping of fruit crops, spices and poplar trees pose high profits for farmers. *Asia-Pacific Agroforestry Newsletter* 40: 3-4.
4. Kasbe, SS., Joshi,M. and Bhaskar S., (2009). Characterization of farmer's jeevamrutha formulations with respect to Aerobic rice. *Mysore J. Agric., Sci.,* 43 (3):570-573.
5. Meena and Babu,M., (2008). Effect of different pruning intensities and doses of fertilizers on the growth and productivity of wheat under agri-silviculture (shisham+wheat) practice.*M.Sc. Thesis (Agronomy), College of Agriculture, JNKVV, Jabalpur:* pp 52-55.
6. Nayak, H., (2011). Differential responses of pruning on growth and yield of paddy undaer Dalbergiua sissoo Roxb.based agrisilviculture system.*M.Sc. Thesis. Department of Forestry. Jawaharlal Nehru Krishi Vishwa Vidyalalya, Jabalpur*.178 p.
7. Thakur,P., (2018). *Performance of Phaseolus vulgaris (Pencil bean var. Shreya) under Peach based agroforestry system*. M.Sc. Thesis. Department of Silviculture and Agroforestry.Dr. Y.S. Parmar University of Horticulture and Forestry.
8. Yadav, Y.S., Lal, S.B. and Mehra, B.S., (2014). Productivity and economics of wheat (*Triticum aestivum*) under poplar (*Populus deltoides*) plantation with different fertility levels. *Trends Biosciences* 7: 2845-2848.

CITE THIS ARTICLE

Shashi Kumar MC, CL Thakur, Dhanyashri PV, S Namdol, G Shahpurmath. Economic Analysis of Organically Grown and Scientifically Managed Maize-Mulberry Based Agroforestry System. Res. J. Chem. Env. Sci. Vol 8 [1] February 2020. 52-55