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Bioeconomic Appraisal of Marigold under *Mangifera indica* Based Agroforestry System in Submontane and Low Hill Subtropical Zone of Himachal Pradesh

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Abstract

The experiment was conducted during the month of October–March in the year 2020–2021. The bio-economic appraisal of marigold study primarily focused on land use options as a means to ensure sustainable livelihood security. The experiment was laid out in randomized block design (factorial) with nine treatments i.e. FYM, Nitrogen and no manure with nine organic manure doses and control with three trees spacing viz., (Sp_1)–2×2 m^2, (Sp_2)–2.5×2.5 m^2, (Sp_3)–3×3 m^2 under *Mangifera indica* based agroforestry system. The results in general indicated that the overall net returns were found to be the maximum of 7.18 lakh ha^{-1} in (Sp_1)–2×2 m^2 tree spacing and highest B:C ratio (5.34) was observed in the application of T_2: FYM 40 t ha^{-1}+Nitrogen 400 kg dose to the marigold as under crop. Monocropping neither provides gainful employment opportunity nor generates sufficient income to meet the family expenses. This study aims at evaluating the performance of *Mangifera indica* based agroforestry in terms of income, employment and environmental impact from the farmers' perspective. *Mangifera indica* – based agroforestry is economically important and more profitable than many of the crop rotations followed in the lower hill regions. This land-use system is also capable of providing employment opportunities on farms. Improvement in marigold yield and higher economic returns indicated that combination of *Mangifera indica* and marigold can be a viable option for farmers of subtropical areas of Himachal Pradesh for the upliftment of their socioeconomic status. In comparison to traditionally grown wheat crop, flower annuals were found profitable under *Mangifera indica* fruit-based system.

Keywords: Agroforestry system, FYM, mango, marigold, nitrogen management

1. Introduction

Indian agriculture is facing diverse challenges and constraints due to growing demographic pressure, increasing food, feed and fodder needs, natural resource degradation and climate change. Therefore, diversification of land use systems with agroforestry is a necessary strategy for providing variety of products for meeting requirements of the people, insurance against risks caused by weather aberrations, controlling erosion hazards and ensuring sustainable production on a long-term basis, particularly in view of the effects of climate change (Anonymous, 2013). Agroforestry vast prospective in India, the acceptance rates are sluggish because existing challenges reduce the benefits of agroforestry like lack of market infrastructure, deficiency of superior planting material, processing, wood transportation, insufficient research, cumbersome and frustrating legislation in respect of tree Sharma et al. (2017). The agroforestry system was the main part of reducing the pressure on the forests by growing the tree cover in the landscapes. Higher potential to increase environmentally and economically returns to the local society for major distribution in agriculture to get food, fodder, fibre, fuelwood, and timber for the developing socioeconomically status Bijalwan et al. (2011). One of the goals of agroforestry in economical aspect is to ensure improvement in the availability, diversification and sustainability of food Magcale Macandog et al. (2010). Agroforestry systems have proven their financial viability and attractiveness as important land use alternatives in various setting throughout the world (Garrett, 1997). On one hand Agri Horti system is developing as one of the sustainable and valuable option to satisfy the ever-growing demand of fodder to livestock and food to people whereas on the other hand it is also treated as a chance to take full advantage of the land cover under trees. By using the entire growing season, this approaches an adapted indigenous intercropping system in India can greatly enhance the return per unit area and time. It is possible to increase the overall yield, production, and return from land. Choosing short-duration crops to plant in between fruit crop alleys is the primary method of the agri-horticulture system (Dhillon et al., 2012). The farmers of the subtropical region of Himachal Pradesh grows maize- wheat rotation which is not an economically practical proposition. Agroforestry is a practical alternative to attack such challenges and can meet the demands of quickly rising human population along with sustainability and biodiversity conservation. Agroforestry based on fruit trees is a strategy of sustainable agriculture that involves growing annual or perennial crops alongside perennial fruit trees on the same plot of land. To build a more diverse and resilient farming system, this integrated strategy combines the advantages of traditional agriculture with those of agroforestry. Due to the relatively short juvenile (pre-production) phase of fruit trees, the high market value of the products, and the contribution of fruits to household dietary needs, these systems grow significant demand and popularity among producers worldwide. (Sangwan et al., 2015). New tree-crop combinations are evolving with time due to changes in industrial demand and nature of products needed. Such new agroforestry systems need to be analyzed on economic parameters. Establishing orchards in lands with minimum nutritional status can be a viable option for agroforestry system. Additionally, it creates improved employment prospects for marginal farmers and landless laborers. Generally, the systems are profitable from an economic standpoint, with excellent benefit-to-cost ratios and good total system productivity in fruit tree + annual mixed systems. Cultivation of flowers production under tree canopy can be of great significance if suitable crops are selected. There are few species (*Dianthus barbatus, Calendula officinalis, Gamolepis elegans, Phlox drumondii, Verbena hybrida, Coreopsis lanceolata, Chrysanthemum multicaul, Petunia hybrida, Dimorphotheca aurantiaca, Alyssum maritimum, Gazania splendens, Helichrysum bracteatum,* etc.) for which the prevailing high temperature is not conducive and they require partial shade for proper flower production, maturity and viability. Such species can be evaluated for seed production potential under agroforestry systems. The state of Himachal Pradesh yields 0.86 mt (metric tonnes) of flowers from 0.06 thousand hectares of land (Anonymous, 2024). The economic yield of agricultural crops, fruit crop and trees were subjected to economic analysis by calculating the cost of cultivation, gross and net returns per hectare and benefit-cost ratio. These parameters were calculated on the basis of prevailing market prices at the time of the study. All intercultural operations and management practices were done throughout the growing season. Therefore, considering the above facts the present investigation is planned in order to evaluate the performance of Marigold as a agriculture crop under Mangifera indica based multistoried agroforestry systems for its sustainable production.

2. Materials and Methods

Field experiments were conducted during the month from September–March in the year 2020–2021 in 20 years old *Mangifera indica* orchard established at the Regional Horticultural Research and Training Station, Jachh, Pathankot, Kangra, Himachal Pradesh (176 201), India. The study area falls in sub-tropical sub-montane and low hills agro-climatic zone of Himachal Pradesh, India. This is the climatic conditions of winter season of the year 2020. The maximum temperature goes as high as 43.5°C in summer and as low as -0.10 °C during winter months. However, the mean summer and winter temperatures average at 29.30°C and 13.60°C, respectively, at 32°16’54.02”N latitude, 75°51’4.38” E longitude at an altitude of 428 m amsl. The mean annual rainfall received by the area is 1500 mm.

2.1. Experimental methodology

Experiment was laid out in Randomized Block Design with nine organic manure doses *viz*. T_1: FYM 40 t ha^{-1}+Nitrogen 300 kg, T_2: FYM 40 tha^{-1}+Nitrogen 400 kg, T_3: FYM 40 t ha^{-1}+ Nitrogen 500 kg, T_4: FYM 50 t ha^{-1}+Nitrogen 300 kg, FYM 50 t ha^{-1}+Nitrogen 400 kg, T_5: FYM 50 t ha^{-1}+Nitrogen 500 kg, T_6: FYM 60 t ha^{-1}+Nitrogen 300 kg, T_8: FYM 60 t ha^{-1}+Nitrogen 400 kg, T_9: FYM 60 t ha^{-1}+Nitrogen 500 kg and T_{10}: control per tree spacing. The *Mangifera indica* was planted at different spacing *viz.* (Sp_1) –2×2 m^2, (Sp_2) - 2.5×2.5 m^2 and (Sp_3) -3×3 m^2 apart distance of 20×20 cm^2 spacing between plants and rows were used as a tree component for the experiment. Raised nursery beds of dimension 2×1 m^2, were prepared. One month old, uniform and healthy seedlings were transplanted in field in the month of October. Light irrigations were given after sowing to facilitate the germination. The experimental plots were maintained properly and kept free from weeds. FYM and Nitrogen doses in the form of urea were evenly spread with soil after transplanting of marigold. Data for different parameters were collected after harvesting.

2.2. Analytical technique

The whole data of the existing study were statistically analyzed with the help of by using analysis of variance (ANOVA) for Randomized Block Design (RBD) in accordance with the way outlined by Gomez and Gomez (1984), where effects exhibited significance at 5% level of probability and then critical difference (CD) was calculated. The net cultivated area per hectare was used to calculate the cost of growing marigold flowers and harvesting their products. According to the rates used at the experimental farm, the manpower and mechanical power requirements for various tasks like weeding, harvesting, harrowing, and ploughing were computed per hectare. The true amounts applied to the land use system were used to compute the cost of inputs such as nitrogen, farm yard manure and seedlings. Comparably, during the study year, the cost of growing mango trees (*Mangifera indica*) and collecting their fruit was estimated based on the variable costs associated with fruit harvesting per hectare. The yield of marigold flowers was converted into a gross return expressed in rupees per hectare using the prices that were in effect on the local market. The amount of produce multiplied by the going rates in the market yielded the gross return.

Net returns were worked out by subtracting the cost of cultivation from the gross returns.

Net return (₹ ha^{-1})=Gross returns–Cost of cultivation

The net returns per rupee invested ratio were calculated as per following formula:

Net returns=Benefit cost ratio/Cost of cultivation (₹ ha^{-1})

3. Results and Discussion

The economic analysis of *Mangifera indica* and Marigold crop-based Agroforestry systems was done and various factors such as the Cost of Cultivation, Gross Returns, Net Returns and Benefit Cost Ratio of floriculture crops of Marigold were calculated in table 1. Results of the present research in the presence of trees to know the economic productivity of tree-crop combination (Agroforestry) showed that the process of growing of horticulture crops, agriculture crops and medicinal crops under trees is profitable over sole horticulture crop, agriculture crops and medicinal crops cultivation. Agroforestry is an efficient land use system that efficiently utilizes space and other limiting factors like light, nutrients, and moisture.

In table 1 the economics cost of cultivation in S_1 is maximum in T_9 (169040) and minimum in T_{10} (161040) whereas, the cost of cultivation in S_2 is maximum in T_9 (163172) and minimum in T_{10} (155172), the cost of cultivation in S_3 is maximum in T_9 (160032.52) and minimum in T_{10} (152032.52). In table 1 the Net returns in S_1 is maximum in T_2 (718560) and minimum in T_{10} (665960.3), the Net returns in S_2 is maximum in T_2(586428) and minimum in T_{10} (546828) whereas, the Net returns in S_3 is maximum in T_5 (49723.42) and minimum in T_{10} (434967.5). In table 1, Gross return in S_1 was maximum in T_2 (884000.00) and minimum in T_{10} (827000.33), the Gross return in S_2 is maximum in T_2 (746000.00) and minimum in T_{10}(702000.00) and Gross returns is maximum in S_3 in T_5 (654666.67) and minimum in T_{10} 587000.00).In table 1, the Benefit cost ratio in S_1 is maximum in T_2 (5.34) and minimum in T_{10} (5.14). The Benefit cost ratio in S_2 is maximum in T_2(4.68) and minimum in T_{10} (4.52), Whereas the Benefit cost ratio in S_3 was maximum in T_1 (4.17) and minimum in T_{10} (3.86). Results of the current investigations prove that growing of horticulture crops under trees is profitable over sole horticulture crop cultivation. This represent that Agroforestry is a capable land use system which makes thoughtful use of space and other limiting factors like light, nutrients, moisture, etc. When comparing an agroforestry system to a traditional crop rotation system, Kareemulla et al. (2012) found that the benefit-cost ratio was higher. When compared to single cropping, fruit-based agroforestry systems were more profitable. Dutt and Thakur (2004) found when combining the returns from both intercrop and tree, the agroforestry system produced higher net returns than a solitary crops. Compared to wheat crops that are normally produced in both open spaces and beneath the *Mangifera indica* canopy, all flower crops were shown to be highly profitable. Numerous studies conducted around the nation indicate that agroforestry systems are more profitable than either forestry or solitary agriculture Chandra (1986). Gaikwad et al. (2017) reported the well-known results, showing that the spacing of 5×5 m^2 produced the best monetary returns (Rs 3, 72312 ha^{-1}) and the highest (3.3) B: C ratio, with the spacing of 5×10 m^2 (2.5) coming in second. Awasthi and Saroj (2004) reported that similar results were

Table 1: Bio-economics appraisal of *Mangifera indica*+Marigold based agroforestry systems

T	S_1				S_2				S_3			
	CC	GR	NR	B:C	CC	GR	NR	B:C	CC	GR	NR	B:C
T_1	164840	877333.3	712493.3	5.32	158972	741333.3	582361.3	4.66	155832.5	649333.3	493500.8	4.17
T_2	165440	884000	718560	5.34	159572	746000	586428.0	4.68	156432.5	650000	493567.5	4.16
T_3	167040	882666.7	715626.7	5.28	161172	742000	580828.0	4.60	158032.5	651800	493767.5	4.12
T_4	165840	880866.7	715026.7	5.31	159972	736333.3	576361.3	4.60	156832.5	654000	497167.5	4.17
T_5	166440	879333.3	712893.3	5.28	160572	745000	584428	4.64	157432.5	654666.7	497234.2	4.16
T_6	168040	870666.7	702626.7	5.18	162172	734333.3	572161.3	4.53	159032.5	639333.3	480300.8	4.02
T_7	166840	876333.3	709493.3	5.25	160972	745333.3	584361.3	4.63	157832.5	638666.7	480834.2	4.05
T_8	167440	875333.3	707893.3	5.23	161572	740000	578428.0	4.58	158432.5	641333.3	482900.8	4.05
T_9	169040	875333.3	706293.3	5.18	163172	742666.7	579494.7	4.55	160032.5	639333.3	479300.8	4.0
T_{10}	161040	827000.3	665960.3	5.14	155172	702000	546828	4.52	152032.5	587000	434967.5	3.86

T: Treatment; CC: Cost of cultivation; GR: Gross return; NR: Net return; B:C: B/C ratio found for net returns, indicating that model 2 and 4 had higher gross returns and cultivation costs than did monocropping of mango. Models 1, 2, and 4's NPW demonstrate the superiority of mixed cropping, with employment and returns generated more dispersedly in mixed cropping as opposed to sole mango cultivation. Bhatia et al. (2022) studied the association of growing trees with agricultural crops marginally increased the cost of cultivation; however, substantial increase was noticed with respect to net returns by integrating tree component, which resulted in higher benefit-cost ratio. Among all the tree-crop combinations, highest benefit-cost ratio (2.14) was registered under mash+Aonla while the lowest (1.55) was revealed by sole maize cropping.

3. Conclusion

Agroforestry systems with minimum spacing were found to be more profitable as compared to maximum spacing. On the basis of these conclusions, it can be achieved that although marigold under performed in agroforestry systems but due to high net returns for systems, crops can be grown positively under fruit tree-based agroforestry system.

4. References

Anonymous, 2024. Area and production of horticultural crops for 2023- 2024 (1st Adv. Estimate). Department of Agriculture and Farmers Welfare. https://agriwelfare.gov.in/en/StatHortEst.

Anonymous, 1997. Agroforestry: an integrated land-use management system for production and farmland conservation. Washington: United States Department of Agriculture Soil Conservation Service. Available at: http://www.ists.in/articleFiles/010914053714JTS_I.pdf. Accessed on: December 2013.

Anonymous, 2013. National Research Centre for Agroforestry (NRCAF), Jhansi, 2013, 30. Available at: https://cafri.icar.gov.in/html/CAFRI__Jhansi__Vision_2050.pdf. Accessed on: 2013.

Awasthi, O.P., Saroj, P.L., 2004. Economic analysis of mango multistrata intercropping. Tropical Science 44(1), 43–47.

Bijalwan, A., Sharma, C.M., Kediyal, V.K., 2011. Socioeconomic status and livelihood support through traditional agroforestry systems in hill and mountain agro-ecosystems of Garhwal Himalaya. Indian Forester 137(12), 1423–1431.

Bhatia, A.K., Sharma, K., Pant, K.S., Singh, S., Prakash, P., Kumar, P., Chauhan, S., Sharma, H., 2022. Economic profitability and carbon stock potential of cereals and pulses under harar and aonla based agroforestry systems in the low hill zone of Himachal Pradesh. International Journal of Economic Plants 9(2), 170–173.

Chandra, J.P., 1986. Poplar a cash crop for North Indian Farmers. Indian Forester 112(8), 698–710.

Dhillon, W.S., Chauhan, S.K., Jabeen, N., Singh, C., Singh, N., 2012. Growth performance of intercropping system components and nutrient status of soil under horti-silvicultural system. International Journal of Environment and Resource 1(1), 31–38.

Dutt, V., Thakur, P.S., 2004. Bio-economics of cropping systems combining medicinal and aromatic herbs with commercial timber tree species. Indian Journal of Agroforestry 6(1), 1–7.

Gomez, L.A., Gomez, A.A., 1984. Statistical procedure for agricultural research. John Wiley and Sons, Singapore. p. 680.

Gaikwad, S.P., Chalak, S.U., Kamble, A.B., 2011. Effect of spacing on growth, yield and quality of mango. Journal of Krishi Vigyan 5(2), 50–53.

Kareemulla, K., Rizvi, R.H., Kumar, K., Dwivedi, R.P., Singh, R., 2012. Poplar agroforestry systems of western Uttar Pradesh in northern India: Socioeconomic analysis. Forests, Tree and Livelihood 15(4), 375–381.

Kasbe, S.S., Mukund, J., Bhaskar, S., 2009. Characterization of farmer's jeevamrutha formulations with respect to Aerobic rice. Mysore Journal of Agricultural Sciences 43(3), 570.

Magcale Macandog, D.B., Ranola, F.M.R., Ranola Jr., R.F., Ani, P.A.B., Vidal, N.B., 2010. Enhancing the food security of upland farming households through agroforestry in Claveria, Misamis Oriental, Philippines. Agroforestry Systems 79(3), 327–342.

Sharma, P., Singh, M.K., Tiwari, P., Verma, K., 2017. Agroforestry systems: Opportunities and challenges in India. Journal of Pharmacognosy and Phytochemistry 1, 953–957.

Sangwan, A.K., Dhillon, W.S., Singh, H., Singh, N.P., Chauhan, S.K., Gill, P.P.S., 2015. Influence of horti-silviculture combinations on pre-bearing growth and physiological parameters of pear. Indian Journal of Horticulture 72(1), 21–27. https://www.indianjournals.com/ijor.aspx?target=ijor:ijh&volume=72&issue=1&article=004.