Bio-economic appraisal of *Phaseolus vulgaris* under *Morus alba*-based agri-silvicultural system

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ABSTRACT

The present study was carried out at the experimental farm of Department of Silviculture and Agroforestry, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during 2019-20. The experiment was laid out in split-plot design. The study was aimed at exploring the possibilities of successful cultivation of *Phaseolus vulgaris* as intercrop under *Morus* along with the use of different doses of organic manures. The experiment comprised four treatments of tree lopping intensities (0, 25, 50 and 75%) and five manure doses treatments (S_1- FYM, S_2- Jeevamruth 5%, S_3- Jeevamruth 10%, S_4- RDF + FYM, S_0- No manure). The main aim of the present study was to determine the best treatment of lopping intensity and organic manure under agroforestry system which was economically viable. The results revealed that *P vulgaris* can be grown successfully under agroforestry system when 75 per cent lopping intensity was adopted along with the application of appropriate rate of combined doses of RDF and FYM. It was not only found beneficial for enhancing the productivity of the vegetable crop but also proved to be economically more viable as compared to the application of other treatments.

Keywords: Agri-silviculture; economics; lopping intensity; organic manures

INTRODUCTION

Agroforestry is a collective approach that incorporates trees into farming system and allows the production of trees and crops or livestock from the same piece of land in order to obtain economic, environmental, ecological and cultural benefits as reported by Thevathasan et al (2004). Diversification of existing farming systems by developing suitable agroforestry models seems to be the exigency of present scenario to fulfill the increasing demand for diversified products.

In northwestern states of India, diversification in traditional crops became popular in irrigated agro-ecosystem due to several socio-economic and ecological problems. Farmers started alternatives to rice-wheat rotation like other crops (pulses, oilseed, fruits, vegetables etc), poultry, pisciculture, piggery, dairy etc but much success has not been achieved because of inadequate marketing, technical and financial support (Chauhan and Mangat 2006). The decreasing profitability from the agricultural production systems is also influencing both socio-economic and environmental conditions and this could be due to monoculture either of agricultural crops or forestry and forage crops.

Agri-silvi system is one of the important components of agroforestry in which the integration of vegetable crops in croplands is practiced. The country has the advantage of growing different vegetable crops in different agro-climatic zones. There is a wide scope to exploit the interspaces of the agroforestry trees. Because of the increasing population pressure and industrialization coupled with topography, shortage of cultivable land has become very common.

In order to meet the multiple needs of both rural as well as urban populations, mixed farming systems with more components like annuals, perennials and livestock in place of monocultures are preferred by the farmers. Thus agroforestry is the only best land use strategy to contribute to food security through diversification and limiting environmental degradation. In addition to this, agroforestry has played a very important role in making the farmers economically efficient.

Over the years, production has increased and the cost of cultivation has decreased as the chemical fertilizers have been replaced with organic manures which are not only economically efficient but are also ecologically stable. The diversified production acts as an insurance for the hard times.

MATERIAL and METHODS

The present research was carried out at the experimental farm of Department of Silviculture and Agroforestry, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during the year 2019-20. The experiment comprised two structural and functional components viz *Morus* trees as woody perennial and *Phaseolus vulgaris* (French bean) as intercrop in agri-silvicultural system. The impact of different intensities of lopping of *Morus* trees and FYM, Jeevamruth and recommended doses of fertilizers on the growth performance of *P vulgaris* (French bean) was studied.

Lopping intensities used were T_1, T_2, T_3 and T_0 (control) with 25, 50, 75 and 0 per cent lopping intensities respectively. Orgnaic manures used were S_1, S_2, S_3, S_4 and S_0 as FYM @ 20 tonnes/ha, Jeevamruth (5%) @ 160 l/ha, Jeevamruth (10%) @ 160 l/ha, recommended dose of fertilizers + FYM and no fertilizer respectively.

The economic analysis was done by calculating the total cost incurred and the gross returns from the system and was further compared with control. The B-C ratio was calculated by dividing the total value of discounted benefits by total value of discounted costs. The bio-economic appraisal was done with the following parameters:

Cost of cultivation (Rs/ha): Cost of cultivation of agri-silvicultural system was worked out on per hectare basis. The expenses spent on the labour and other operations such as lopping, ploughing, weeding and harvesting were calculated on the prevailing rates while the cost of inputs like seeds and manures was calculated on the basis of actual amount used in the land use.

Gross returns (Rs/ha): The prevailing local market price (Rs/kg) was used to convert the yield of trees and crop into gross returns in rupees per hectare.

Net return (Rs/ha): Net return was calculated by deducting total cost of cultivation (Rs/ha) from gross returns (Rs/ha).

Net return (Rs/ha)= Total gross return ×
Total cost of cultivation

Benefit-cost ratio: The benefit-cost ratio was computed by dividing the gross returns obtained from the system with total cost of cultivation of the same.

RESULTS and DISCUSSION

Economic profitability of *Phaseolus vulgaris* under *Morus alba*-based agri-silvicultural system is given in Table 1.

Cost of cultivation (Rs/ha): The highest cost of cultivation was recorded in T_3 (75% lopping intensity) which shows that cost of cultivation increased with increasing lopping intensity due to engagement of more labour. In case of organic manure treatments, the highest cost of cultivation was calculated for the FYM treatment which might be due to high market price.

Among the combinations of treatments, the maximum of Rs 1,55,531.77/ha expenditure incurred in T_3S_4 (75% lopping + RDF + FYM) and minimum of Rs 1,12,555.20/ha in T_0S_0 (No lopping + no fertilizer). The increased cost of cultivation with increasing lopping intensity was also reported by Meena (2008) and Nayak (2011).

Gross returns (Rs/ha): The gross returns from the *Morus*-based agri-silviculture system show that the maximum total gross returns of Rs 3,24,610.50/ha were found in T_3S_4 (75% lopping + RDF + FYM) and minimum of Rs 1,59,840.00/ha in T_0S_0 (No lopping + no fertilizer).

The reason behind higher gross returns in T_3S_4 treatment combination could be the production of more yield per ha and also addion of returns from the tree component.

Table 1. Economic profitability of *Phaseolus vulgaris* under *Morus alba*-based agri-silvicultural system

Treatment	Cost of cultivation (Rs/ha)	Gross returns from crop (Rs/ha)	Gross returns from trees (Rs/ha)	Total gross returns (Rs)	Total net return from system (Rs)	B-C ratio
T_0S_0	1,12,555.20	1,59,840.00	0.00	1,59,840.00	47,284.80	1.42
T_0S_1	1,40,055.20	1,99,000.00	0.00	1,99,000.00	58,944.80	1.42
T_0S_2	1,12,955.20	1,68,640.00	0.00	1,68,640.00	55,684.80	1.49
T_0S_3	1,12,955.20	1,79,220.00	0.00	1,79,220.00	66,264.80	1.58
T_0S_4	1,48,531.76	2,13,480.00	0.00	2,13,480.00	64,948.23	1.43
T_1S_0	1,16,055.20	1,68,660.00	17,020.00	1,85,680.00	69,624.80	1.59
T_1S_1	1,43,555.20	2,14,680.00	17,020.00	2,31,700.00	88,144.80	1.61
T_1S_2	1,16,455.20	1,80,400.00	17,020.00	1,97,420.00	80,964.80	1.69
T_1S_3	1,16,455.20	1,83,640.00	17,020.00	2,00,660.00	84,204.80	1.72
T_1S_4	1,52,031.76	2,37,280.00	17,020.00	2,54,300.00	1,02,268.23	1.67
T_2S_0	1,17,805.20	1,76,560.00	31,524.00	2,08,084.00	9,02,78.80	1.76
T_2S_1	1,45,305.20	2,27,480.00	31,524.00	2,59,004.00	1,13,698.80	1.78
T_2S_2	1,18,205.20	1,88,460.00	31,524.00	2,19,984.00	1,01,778.80	1.86
T_2S_3	1,18,205.20	1,94,140.00	31,524.00	2,25,664.00	1,07,458.80	1.90
T_2S_4	1,53,781.76	2,66,180.00	31,524.00	2,97,704.00	1,43,922.23	1.93
T_3S_0	1,19,555.20	1,81,120.00	44,270.50	2,25,390.50	1,05,835.30	1.88
T_3S_1	1,47,055.20	2,52,160.00	44,270.50	2,96,430.50	1,49,375.30	2.01
T_3S_2	1,19,955.20	2,00,060.00	44,270.50	2,44,330.50	1,24,375.30	2.03
T_3S_3	1,19,955.20	2,02,920.00	44,270.50	2,47,190.50	1,27,235.30	2.06
T_3S_4	1,55,531.77	2,80,340.00	44,270.50	3,24,610.50	1,69,078.73	2.08

T_0S_0: No lopping + no fertilizer, T_0S_1: No lopping + FYM, T_0S_2: No lopping + Jeevamruth 5%, T_0S_3: No lopping + Jeevamruth 10%, T_0S_4: No lopping + RDF + FYM, T_1S_0: 25% lopping + no fertilizer, T_1S_1: 25% lopping + FYM, T_1S_2: 25% lopping + Jeevamruth 5%, T_1S_3: 25% lopping + Jeevamruth 10%, T_1S_4: 25% lopping + RDF + FYM, T_2S_0: 50% lopping + no fertilizer, T_2S_1: 50% lopping + FYM, T_2S_2: 50% lopping + Jeevamruth 5%, T_2S_3: 50% lopping + Jeevamruth 10%, T_2S_4: 50% lopping + RDF + FYM, T_3S_0: 75% lopping + no fertilizer, T_3S_1: 75% lopping + FYM, T_3S_2: 75% lopping + Jeevamruth 5%, T_3S_3: 75% lopping + Jeevamruth 10%, T_3S_4: 75% lopping + RDF + FYM

The results are in conformity with those of Kumar et al (2009) who reported that combination of organic and inorganic manures gave more gross returns in French bean.

Net return (Rs/ha): A sum of Rs 1,69,078.73/ha was obtained as maximum net return in treatment combination of T_3S_4 (75% lopping + RDF + FYM) whereas minimum of Rs 47,284.80/ha in T_0S_0 (No lopping + no fertilizer).

Although cost of cultivation was maximum for T_3S_4 yet more net return was also obtained from the same treatment and it might be possibly due to higher production of green pods per unit area along with return from trees.

The results are in conformity with the findings of Kurbah and Thomas (2017) who reported that highest net return was obtained when treatment of 100 per cent NPK + FYM + *Rhizobium* was applied.

Benefit-cost ratio: The benefit-cost ratio for *P vulgaris* + *Morus*-based agri-silviculture system was highest of 2.08 in treatment T_3S_4 (75% lopping + RDF + FYM) and therefore it is recommended that by increasing lopping intensity along with the application of RDF + FYM, the agroforestry system yields maximum return as it ensures tree products along with high crop yield.

The results are in conformity with the work of Kamble et al (2016) who reported highest B-C ratio in plots treated with combination of organic and inorganic manures as that of other treatments. Thus combination of organic and inorganic manures leads to higher economic benefits.

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