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ECONOMICAL ANALYSIS OF TURMERIC IN *DALBERGIA SISSOO* BASED AGRISILVICULTURE SYSTEM IN CENTRAL INDIA

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ABSTRACT: -*Dalbergia sissoo* DC. (Family: Fabaceae) is a medium to large deciduous tree, is locally called "shishu" or "Shisham" is a fast-growing, hardy, deciduous rosewood tree native to the Indian subcontinent and southern Iran and also is a multipurpose tree with uses as timber, fuel wood, fodder and shade provides, besides being an excellent nitrogen fixer. The Present investigation was conducted in a *D. Sissoo* turmeric agrisilviculture system to find out Economics of Turmeric. The turmeric crop was sown in the interspace of a 16 year old *Dalbergia sissoo* plantation, planted at a spacing of 5mX5m. The effect of different pruning on fresh yield was found significant. The maximum fresh yield of rhizomes (3385.9 kg/ha) was measured under 25% pruning followed by 50% pruning (3221.3 Kg/ha), no pruning and open conditions. Whereas, the lowest fresh yield of rhizomes (2960.6 kg/ha) was recorded under 75% of pruning. Gross monetary return was more in pruning treatment (i.e. managed Agrisilviculture system) as compared to no pruning treatment (i.e. unmanaged Agrisilviculture system). Among different pruning treatments, 25% pruning gave higher gross monetary return and decreased with increasing pruning intensities resulted 75% pruning recorded the lowest gross monetary return.

Keywords: - Agrisilviculture, turmeric, *D. Sissoo,* Gross monetary, net monetary.

INTRODUCTION

Agrisilviculture is an ideal land use option to increase its productivity, expand tree cover outside forests and reduce anthropogenic pressures on natural forests. It is also a viable option for mitigation of an adaptation to climate change. Many Agrisilviculture systems involving various combinations of woody perennials and agricultural crops has been evolved and successfully tried in field with increased economic and ecological benefits. Dalbergia sissoo based Agrisilviculture system are also some of these successful popular agrisilviculture models.

Madhya Pradesh is the second largest state of the country having geographical area of 30.83 million hectares out of which 49% is under cultivation but arable land is shrinking day by day. Madhya Pradesh is blessed with climatic variability's and diverse soil type. This provides unique opportunity to the farmer to grow multipurpose tree species in the field and wasteland to obtain maximum benefits from them.

Pruning is a common silvicultural practice to increase wood production, improve tree shape and potentially uses to obtain poles and firewood without decrease in wood productivity. It

involves removal of live or dead branches or multiple leaders from the tree. Pruning of tree component is a powerful approach to regulate light, nutrients and other resource competition (Frank and Eduaro, 2003).The pruning treatment can effectively change the micro-climate under canopy (such as increased air temp, soil water content and decrease the relative humidity). Many scientists reported the effect of height and intensity of pruning on biomass production (Das and Dalvi, 1981).Trees has been given different pruning treatments so the differences in growth and development may be observed. It improves wood quality and tree stem shape. Pruning decreased the tree taper and increases the volume and medium pruning intensity has highest volume increment.

Dalbergia sissoo is a medium to large sized tree belonging to family – Leguminosae and subfamily Papilionioideae. It attains a height upto 30m.This genus has about 300species of tropical and sub-tropical timber tree species. It is having multiple uses such as fuel, wood, fodder, shade, and nitrogen fixing ability .The species occur throughout the Sub-Himalayan tract and outer Himalayan valleys from Indus to Assam, usually upto 900m and occasionally ascending to 1500m.

Turmeric (*Curcuma longa L.*)belongs to the family Zingiberaceae is native to South Asia particularly India Curcuminiodes the active principles in turmeric rhizomes is known to have some medicinal properties and has been used efficiently in many medicine and ointment. It is one of the important species grown for its underground rhizomes which are used as condiment dye stuff , drug and cosmetic, volatile oil of the flavoring ingredient of turmeric makes it an indispensable part of every Indian kitchen and is often prescribed against infection of liver, jaundice, and disorder of blood (Subramanian et al.,2004).

Despite its adaptability to varied agro-climatic condition, its monoculture may be somewhat risk prone. Intercropping of suitable agriculture crops with *Dalbergia sissoo* can, therefore, be a better option as it not only reduces the economic risks associated with monoculture by generating extra income but it also results in improved productivity per unit area as a result of more efficient utilization of solar radiation and available soil nutrients.

Tree architecture plays an important role in deciding the growth and performance of under storey crops. Crown spread affects not only the soil properties and micro environment but also performance and yield potential of associated agricultural crops. There is ever increasing need to integrate fast growing multipurpose tree species on farmland to overcome fuel and fodder crisis. The components of the system interact with one other to influence the microclimate and soil conditions (Harper, 1977).The quality of solar radiation transmitted by tree canopy decides growth and productivity potential of the field crops (Fischer and Palmer, 1984). Major agricultural crops grown under trees are shade sensitive, so are bound to be adversely affected on account of shading. Shade intensity and duration both will have strong negative effects on the performance of under storey crops (Singh, 1994).

The present investigation has been carried out at New Dusty Acre area, Department of Forestry, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.)

during Kharif season of 2014-15 in well established 16 years old *Dalbergia sissoo* plantation. The facilities required to conduct the experiment are available on the research farm.

MATERIAL AND METHODS

The present study was conducted in a 16 year old *Dalbergia sissoo* plantation raised at an initial spacing of 5mX5m in a research farm Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Jabalpur, located in Mahakoshal region of Madhya Pradesh state in central India. It is situated at 23.1815^0 North latitude and 79.9864^0 east longitude with an altitude of 411.78 m above mean sea level (msl). The climates dry subtropical with hot dry summers and cold dry winter. The mean annual rainfall is 1315 mm, mostly (about 90%) received during south west monsoon period (mid June to September) with occasional winter rains. June is the hottest month of the year with varying from 26.3^0C to 41.8^0C and January is the coldest month with temperature varying from 5.6^0C to 23.7^0C. The area falls in Kymore plateau and Satpura hills from 5.6^0C to 23.7^0C agro-climatic region and in the wheat-rice crop zone. The soil of the experimental area is clay loam in texture and almost neutral in reaction, the available nitrogen (N), phosphorous (P) and potash (K) in the soil were 207 (medium), 16.26 (medium) and 172 (very low) kg/ha, respectively.

Experimental detail:

Treatments:

A. Main treatment	**Tree pruning management**
P_0	Un pruned
P_1	25% (pruned *Dalbergia sissoo)*
P_2	50% (pruned *Dalbergia sissoo)*
P_3	75%(pruned *Dalbergia sissoo)*
Open condition	No tree (Crop only)
Design	- Strip Plot Design
Replication	- 4
Total No. of plots	-76
Number of tree per plot	- 1
Gross plot size	- 4 m X 4 m
Net plot size	- 3 m × 3 m
Distance between row to row	- 50 cm
Distance between plant to plant	- 15 cm
Variety of turmeric	- Suroma
Seed rate of turmeric	- 2000 kg/ha
Tree species	: *Dalbergia sissoo*
Tree spacing	: 5 m x 5 m
Row direction	: East – West
Year of plantation of shisham	: Kharif, 1998
Recommended doses of fertilizers:	
For plot (tree +crop)	- 300 : 550 : 100 NPK g/plot
For open	- 900 : 1600 : 250 NPK g/plot

Economics of the treatments

The economics of the treatment have much importance from practical point of view to farmers. Therefore, economics of different treatment was worked out in terms of cost of cultivation, gross monetary returns (GMR), net monetary returns (NMR) and benefit :cost ratio (B:C ratio) to assess the economic viability of the treatments.

Cost of cultivation

The cost of cultivation for each treatment was determined on the basis of different input used in operation performed for raising the crop in one hectare area under different treatments.

Gross monetary returns (GMR)

The values could be realized from the produce obtained under each treatment was computed on the basis of existing market price of the produced. Total values of the produce (rhizomes) will be the GMR per hectare under different treatment.

Net monetary returns (NMR)

After this, NMR per hectare under each treatment was determined by subtracting the cost of cultivation of a particular treatment from the GMR of the same treatment.

Benefit: cost ratio (B:C ratio)

To estimate the benefits obtained from different treatment for each rupee of expenditure incurred. B:C ratio of each treatment was calculated as below :

$$\text{B:C ratio} = \frac{\text{GMR per hectare}}{\text{Cost of cultivation per hectare}}$$

RESULT

Table.01. Economics analysis of different treatments on per hectare area basis

S. No.	Treatments	Cost of cultivation(Rs ha^{-1})	Gross monetary return(Rs ha^{-1})	Net monetary return (Rs ha^{-1})	Benefit: Cost ratio
1	No pruning + T1	130356	267868.9	137512.93	2.05
2	No pruning + T2	130356	250861.3	120505.30	1.92
3	No pruning + T3	130356	227073.9	96717.93	1.74
4	Tree alone (No crop)	4800	42879.55	38079.6	8.6
5	25% pruning + T1	131556	296047.4	164491.35	2.25
6	25% pruning + T2	131556	287089.8	155533.75	2.18
7	25% pruning + T3	131556	261148.8	129592.78	1.99
8	Tree alone (No crop)	6000	46259.70	40259.71	5.02

9	50% pruning +T1	131556	264387.1	132831.05	2.01
10	50% pruning + T2	131556	251027.4	119471.35	1.91
11	50% pruning + T3	131556	233169.1	101613.05	1.77
12	Tree alone (No crop)	6000	48715.73	42715.72	5.27
13	75% pruning + T1	131556	218733.2	87177.18	1.66
14	75% pruning + T2	131556	212784.9	81228.90	1.62
15	75% pruning + T3	131556	205276.7	73720.73	1.56
16	Tree alone (No crop)	6000	32122.08	26122.08	3.61
17	Open crop only T1	125556	189465.0	63909.00	1.51
18	Open crop only T2	125556	183675.0	58119.00	1.45
19	Open crop only T3	125556	169095.0	43539.00	1.35

- Sale rate of turmeric, pruned biomass and tree biomass as fuel @ Rs.60, 4 and 5 per kg, respectively.
- Cost of cultivation of paddy, *Dalbergia sissoo* was Rs. 15645/ha, and Rs. 4586/ha/year respectively.

Economic analysis of treatments

The economic analysis was determined as per hectare area basis, which includes cost of cultivation, gross monetary return, net monetary return and benefit cost ratio (profitability per rupees investment under different treatments). Data pertaining to economic analysis as affected by different treatments are given in Table 15.

Gross monetary return

The value of seed (rhizome) and fresh turmeric yields depending on the existing market rate of each produce, was taken into consideration for determining he gross monetary return (GMR) under particular treatment. Gross monetary return was more in pruning treatment (i.e. managed agroforestry system) as compared to no pruning treatment (i.e. unmanaged agroforestry system). Among different pruning treatments, 25% pruning gave higher gross monetary return and decreased with increasing pruning intensities resulted 75% pruning recorded the lowest gross monetary return.

Net Monetary Return (Rs/ha/year)

Table15.1. Net monetary return (Rs.ha^{-1}) as influenced by different pruning intensities in *D. sissoo.*

	Net Profit		**Tree alone (No crop)**
Pruning Intensities			
P_0 - No pruning	118245.38		38079.6
P_1- 25% pruning	149872.63		40259.71
P_2- 50% pruning	117971.82	116184.46	42715.72

P_3- 75% pruning	80708.93		26122.08
Open condition– (no tree)	**55189.00**		
Mean	104397.6		36794.3

Net monetary return (net profit)

The net monetary return (NMR) of each treatment was determined by substracting the cost of cultivation from gross monetary return (GMR) of a particular treatment.

Different pruning intensities showed significant effect on net monetary return. The 25% pruning recorded significantly higher net monetary return (149872.63ha^{-1}) which was at par with no pruning (Rs118245.38ha^{-1}) but significantly superior to 50% pruning (117971.82ha^{-1}) and 75% pruning (Rs80708.93ha^{-1}). Crop alone recorded the lowest net monetary return (Rs**55189.00**ha^{-1}). Under Managed Agroforestry system turmeric with 25% pruning recorded higher monetary return (Rs149872.63ha^{-1}) as compared to crop alone (Rs**55189.00**ha^{-1}) and tree alone (Rs36794.3 ha^{-1}).

Benefit: Cost Ratio

Table 15.2 Effect of different pruning intensities on Benefits : Cost ratio.

	B:C		**Tree alone (No crop)**
Pruning Intensities			
P_0 - No pruning	1.91		8.6
P_1- 25% pruning	2.14		5.02
P_2- 50% pruning	1.90	1.88	5.27
P_3- 75% pruning	1.61		3.61
Open condition– (no tree)	**1.44**		
Mean	1.8		5.6

Benefit: Cost Ratio

It refers to the net monetary gain under a particular treatment with each rupee of investment. The benefit cost ratio indices as affected by different treatment. The benefit cost ratio was significantly affected by different pruning treatment and revealed that 25% pruning recorded significantly higher B:C ratio (2.14) which was at par with 50 % pruning (1.90) and no pruning (1.91) and significantly superior to 75% pruning (1.61)

Effect of different date of planting on B:C ratio was found significant.

DISCUSSION

Economics of the treatment

The determination of economic factors like cost of cultivation gross monetary return, net monetary return and benefit cost ratio are the most important to evaluate the effect of treatment for practical value in relation to farmers as well as planners point of view. The farmers

are mainly interested to earn more profit per unit area, time and investment while planner's policies are mainly concerned with high productivity. Therefore, economic analysis of the treatment gives valuable information to both planners and growers too. These economic analyses are discussed here by considering the cost of inputs and value of produce on prevailing rates in the locality as per hectare area basis. Although market rate of inputs and outputs to Jabalpur locality may be used on other places and time on the basis of the procedures followed for determining the economic analysis

Net Monetary Return

The net monetary return (NMR) of treatment was determined by subtracting the cost of cultivation from GMR of particular treatment. Different pruning intensities showed significant effect on monetary return. The 25% pruning recorded significantly higher monetary return (Rs 149872.63ha^{-1}) which was at par with no pruning (Rs 118245.38 ha^{-1}) but significantly superior to 50% pruning (117971.82 ha^{-1}) and 75% pruning (Rs 80708.93 ha^{-1}). Crop alone recorded the lowest monetary return (Rs **55189.00** ha^{-1}). Under Managed agroforestry system i.e. turmeric with 25% pruning recorded higher monetary return (Rs 149872.63ha^{-1}) as compared to crop alone (Rs **55189.00** ha^{-1}) and tree alone (Rs 36794.3ha^{-1}). The probable reason of higher return under 25% pruning is due to higher average return from tree biomass and crop biomass as compared to other treatments i.e. in 75% pruning, higher return from crop but low return from tree. Similarly in 50% pruning more return obtained from tree but less return from crop. The probable reason of higher return in managed Agroforestry system, in that sufficient return obtained from both tree and crop component whereas, in tree alone or crop alone, return obtained from only one component either from tree or from crop alone.

Benefit: cost ratio

It refers to the net monetary gain under a particular treatment with each rupee of investment. The benefit cost ratio indices as affected by different treatment. Benefit cost ratio was significantly affected by different pruning treatment. 25% pruning recorded significantly higher B:C ratio (2.14) but at par with 50 % pruning (1.90) and no pruning (1.91) and significantly superior to 75% pruning (1.61)

CONCLUSION

Planting of turmeric cv. Suroma with partially shaded conditions i.e 25% pruning of tree gave maximum fresh rhizome yield (2546.9 kg/ha). Turmeric showed all growth and yield attributes significantly better in partially shaded conditions in comparison to open conditions.The net monetary returns and profitable cost benefit ratio was maximum in 25% pruning of tree with Ist date of planting of turmeric.25% pruning recorded significantly higher monetary return (Rs 151086.12ha^{-1}) .Crop alone recorded the lowest monetary return (Rs **43812.50** ha^{-1}).

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