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Economic Evaluation of Sugarcane Based Agro forestry Systems

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ABSTRACT

The study was taken up to analyse the tangible and intangible benefits derived from traditional sugarcane based agroforestry system followed by farmers. The major objective of the study was to evaluate the sugarcane based agroforestry systems, estimate the Benefit: Cost ratio and to assess the other biophysical benefits of trees. Tree species like *Tectona grandis, Gmelina arborea, Eucalyptus spp., Casuarina equisetifolia and Leucaena leucocephala* are dominant species in traditional agroforestry system (AFS). Teak-sugarcane based agroforestry gave highest B:C ratio of 3.9, followed by *G. arborea* (1.6). Whereas, *Eucalyptus/C. equisetifolia; L. Leucocephala*-sugarcane systems the benefit-cost ratio was 1.4, 1.3 and 1.3, respectively which is nearly equivalent to the B:C ratio for sugarcane sole cultivation. It was found that sugarcane based AFS becomes more profitable especially when it is surrounded by the *T. grandis and G. arborea* as compared to sugarcane alone, *Eucalyptus, C. equisetifolia* and *L. leucocephala.*

INTRODUCTION

Sugarcane is an important commercial crop worldwide, and one of the principal sources of sugar, ethanol, and jaggery (a semi-refined sugar product used in the Indian subcontinent) globally. Sugarcane (*Saccharum spp.* Complex) cultivation is widespread in tropical areas and its worldwide production is about 1877105 Thousand Metric Tons (TMT), Brazil with 739267 TMT is the largest producer followed by India having production of 341 200 TMT from 50.32 lakh ha area. Population pressure of towns and cities are engulfing cultivable land, due to crunch of space, in addition to adverse effects of global warming and climate change, farmers do boundary plantation, as trees provide financial security to small farmers, especially on special occasions in their families. Sugarcane occupies large areas of tropical regions as a single crop, and there is limited documentation about its cultivation in agroforestry systems (AFS). Due to the lack of trials with sugarcane in AFS, the results of simulation models are then strategic to speculate about its potentialities and restrictions in the long term (Lott et al. 2000). Agroforestry is a dynamic,

ecologically based natural resource management system which diversifies and sustains production for increased social, economic and environmental benefits (Leakey 1996). Sugarcane growers need to be guided about suitability of tree species that could be planted along with sugarcane crop. In tropical regions, there may be complementary use of light, water and nutrients by crops and trees, resulting in higher biological production than monocropping (Ong et al.1991). Official neglect of traditional poly-cultural agroforestry systems could be seen as the opposite side of the coin of official emphasis on and encouragement of commercial monocropping and industrial forestry. Therefore, sugarcane based agroforestry systems needs to be studied and evaluated so as to maximize returns from the farmland. Hence the present study was undertaken to evaluate sugarcane based agroforestry systems to compare various tree-crop combination on economic basis.

MATERIALS AND METHODS

Study was conducted at Navsari in South Gujarat, which is geographically located at 20^{0}57' N latitude and 72^{0}54' E longitudes and has an altitude of 10 m above the mean sea level. Agro-climatic conditions is typically characterized by humid and warm monsoon with rainfall around 1500 mm, moderately cold winter and fairly hot and humid summer. The soils derived their characteristics from the basaltic rocks as parts of the district. The basaltic lava flows are covered by black clayey to loamy soil (Kumar 2013).

In this study some important tree species are considered for their economical, while being raised along with main sugarcane crop. Cost of cultivation, yield of sugarcane and selling price of sugarcane of the year 2015-16 was collected (Table 1 and Table 2) from the records of Main Sugarcane Research Station, Navsari.

Table 1. Economics of Sugarcane crop production at Main Sugarcane Research Station, 2015-16

No	Parameters	Sugarcane
1	Cost of production (Rs/ha)	120000
2	Yield (tons/ha)	78.228
3	Selling Price (Rs/ton)	2600
4	Gross Income (Rs)	203393
5	Return/year (Rs)	162714

Input cost required for individual tree species planted on farm borders and their respective maturing age was used in the analysis. System wise economic analysis, was done by calculating cost of cultivation of sugarcane considering cost of human labour, seeds, manure, irrigation, insect pest management, depreciation, bank interest on working capital, rental value of own land, Interest on own fixed capital, whereas, cost of cultivation for tree species was estimated by considering cost of planting material, labour hired and recurring cost of maintenance, especially during initial years. Later, returns from each species were calculated separately and added to returns from sugarcane to calculate benefit cost ratio.

Table 2. Cost, yield and income from the tree species

1	2	3	4	5	6	7	8	9	10
T. grandis	3m	133	29.45	3916.85	20	21.18 cu ft	2293/ cu ft	6459243	322962
G. arborea	3m	133	29.45	3916.85	10-12	2 tons	1500 cu ft	399000	33250
Eucalyptus spp.	1.5m	266	12.47	3317.02	5	266 pole	100/pole	26600	5320
C. equisetifolia	3m	133	25.39	3376.87	5-6	0.039 ton/tree	1500/ton for pulp	7780.5	1296.75
L. leucocephala	1.5m	266	12.64	3362.24	4	0.019 ton/tree	1000/ ton for pulp	5054	1263.5

1=Species, 2=Spacing; 3=No. of trees per ha. (Border); 4=Cost of cultivation for one plant (Rs) 5= Total cost of cultivation (Rs); 6=Harvesting period (Years); 7=Yield per tree 8=Price of wood (Rs); 9=Total Returns (Rs); 10=Return/year

*Cost of cultivation and yield per tree for *T. grandis, Eucalyptus* spp., *C. equistifolia* and *Leucaena leucocephala* quoted from the NABARDs model bankable projects data 2008.

*Cost of cultivation per tree for *G. arborea* was considered similar as of *T. grandis* cultivation in NABARDs model bankable projects data 2008.

* Cost of cultivation was calculated by using inflation percent increase from 2008 to 2015.

The period of harvesting and returns for sugarcane is 15 months and for tree species was considered 20, 12, 5, 6 and 4 for *T. grandis, G. arborea, Eucalyptus, C. equisetifolia and L. Leucocephala,* respectively. For comparative economic analysis of exclusive tree based systems B:C ratio was calculated on hectare basis. The cost benefits analysis of bund system of *T. grandis* plantation with 20 year rotation for a tree density of 133 trees ha^{-1} is given in Table 2.

RESULTS AND DISCUSSION

It was found that the B: C ratio of T. Grandis along with sugarcane crop was 3.9. The average annual net returns were Rs. 4,85,676/- at current prices. On the other hand the comparative net returns from mono sugarcane crop was 1,62,714/- per annum which individually has only 1.36 B:C ratio. The results indicate that growing different tree species along the boundary of sugarcane field is profitable and the analysis also reveals that planting *T. grandis* with Sugarcane is 254% more profitable. Similarly the benefit-cost analysis of *G. arborea*-sugarcane system is shown in Table-3. At 12 years rotation, the B: C was found to be 1.6 with the annual average net return of Rs. 33250 ha^{-1} at current prices.

Table 3. Cost-benefit analysis of Sugarcane and tree based bund AFS

Benefit- Cost analysis of Sugarcane					
Particulars	Value / amount (Rs/ha/year)				
Cost Rs./ha	120000				
Income /year	162714.24				
B:C ratio	1.36				
Benefit- Cost analysis (per year basis) of Sugarcane along with tree species					
	T. grandis	*G. arborea*	*Eucalyptus*	*C. equisetifolia*	*L. leucocephala*
Input cost for trees	3916	3916	3317	3376	3362
Input cost for crops	120000	120000	120000	120000	120000
Total Costs	123916	123916	123317	123376	123362
Return from trees	322962	33250	5320	1296	1263
Return from crops	162714	162714	162714	162714	162714.
Total returns	485676	195964	168034	164011	163977
B:C ratio	3.9	1.6	1.4	1.3	1.3

The benefits per year from the Gmelina is less than mono sugarcane but it added 24 % return to the sugarcane monoculture. Studies show that planting of Gmelina trees in smallholder farms has potential to improve economic situation of small farmers by brining additional income and was reported to improve environmental quality (Damasa et al.1999). In case of *Eucalyptus, C. equisetifolia* and *L. leucocephala* benefit-cost ratio was found to be 1.4, 1.3 and 1.3, respectively (Table 3) which is nearly equivalent to the B:C ratio for sole sugarcane cultivation.

CONCLUSION

The study evaluated the sugarcane based agroforestry systems involving trees like *T. grandis, G. arborea, Eucalyptus, C. equisetifolia and L. leucocephala.* It is concluded that in teak-sugarcane based agroforestry gave highest B:C ratio of 3.9, followed by *G. arborea* (1.6). Whereas, *Eucalyptus/C. Equisetifolia/L. Leucocephala*-sugarcane systems the benefit-cost ratio was 1.4, 1.3 and 1.3, respectively which is nearly equivalent to the B:C ratio for sugarcane sole cultivation. The contribution of the trees in the farming systems certainly add to the diversity dimension by way of income and employment to the farm households besides fulfilling the requirement of wood.

REFERENCES

Benjamin TJ, Hoover WL, Seifert JR and Gillespie AR 2000 Defining competition vectors in a temperate alley cropping system in the midwestern USA: 4. The economic return of ecological knowledge. Agroforestry Systems, 48:79-93.

Damasa B, Magcale Macandog , Ken Menz , Patrick M Rocamora & Canesio D Predo 1999 Smallholder Timber Production and Marketing: The Case of Gmelina Arborea in Claveria, Northern Mindanao, Philippines. International Tree Crops Journal, 10: 61-78.

Kumar Ashok 2013 District ground water brochure Navsari district Gujarat State, Government of India. Ministry of Water Resources Central Ground Water Board, 20 pp

Leakey RRB1996 Definition of agroforestry revisited. Agroforestry Today, 8(1): 5-7.

Lott JE, Howard SB, Ong CK, and Black CR 2000 Long-term productivity of a Grevillea robusta based overstorey agroforestry system in semi-arid Kenya – II. Crop growth and system performance. For. Ecol. Manage., 139:187–201.

Ong CK, Corlett JE, Singh RP and Black CR 1991 Above and below ground interactions in agroforestry systems. Forest Ecology and Management, 45:45-57.

Pinto Luis Fernando Guedes, Bernardes Marcos Silveira and Sparovek Gerd 2003 Feasibility of Cultivation of Sugarcane in Agroforestry Systems. Scientia Agricola, 60(3):489-493.