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Ecological sustainability in *Rabi Sorghum* cultivation: An economic analysis in Bijapur district of Karnataka

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ABSTRACT

Sorghum cultivation is said to be ecologically sustainable as comparatively lesser magnitude purchased inputs are used in its cultivation. The present study was taken up to analyze the economics and ecological sustainability associated with *rabi* sorghum cultivation in comparison with bengalgram crop in Bijapur district of Karnataka, The results indicated that the production cost incurred per quintal of output was comparatively higher in bengalgram (₹ 2427/quintal) compared to *rabi* sorghum (₹ 1834/quintal). With respect to net returns per acre was higher in case of bengalgram (₹ 1930) compared to *rabi* sorghum (₹ 1252). The results clearly indicated that the bengalgram was more profitable than the *rabi* sorghum. Inspite of this, *rabi* sorghum holds a prominent position in the cropping pattern of the district as it is the staple food item in the consumption basket of the population. Along with profitability, sustainability is another important dimension which needs to be considered. The ratios indicating sustainability status of *rabi* sorghum like cost of commercial pesticides and chemical fertilizers to total cost of cultivation was less in *rabi* sorghum (4.94) compared to that in bengal gram (17.97) indicating less dependency on external inputs. Ratio of ecologically non-destructive inputs cost to total cost of cultivation of *rabi* sorghum was higher (48.71) when compared to that in bengal gram (39.71) indicating more use of eco-friendly inputs in *rabi* sorghum cultivation. Similarly, the ratio of returns from fodder to total cost of cultivation was around 16 in *rabi* sorghum cultivation indicating sustainability in terms of fodder security to livestock.

Keywords: Cost of production, Bengalgram, ecological sustainability, fodder, *Rabi* Sorghum

Sorghum is considered as 'camel of desert' for its capacity to withstand drought. Sorghum cultivation is said to be ecologically sustainable as comparatively lesser magnitude purchased inputs are used in its cultivation. Karnataka state is the second largest sorghum producer in India, after Maharashtra, which accounts for around 20 per cent of the total area and 21 per cent of the total production in the country.

Rabi sorghum and bengalgram are the major grown crops during *rabi* season. These two crops mainly compete for the area during *rabi* season and the bengalgram crop is over taking area of *rabi* sorghum in the traditional growing areas. In this regard, the present study was taken up to analyze the economics and ecological

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sustainability associated with *rabi* sorghum cultivation in comparison with bengalgram crop in Bijapur district of Karnataka.

Methodology

The present study was taken up in the Basavana Bagewadi taluk of Bijapur district in Karnataka. The detailed information about quantity of inputs used and their prices, output levels and their prices and other information were collected from a sample of 80 *rabi* sorghum growing farmers and 40 bengalgram growing farmers through personal interview using pre-tested structured schedule. Costs were categorized under fixed and variable cost headings viz., FYM, Fertilizer, PPC, Seeds, Human and Bullock labour, Machine cost and so on. Individual costs were added up to arrive at Total Variable Cost (TVC), Total Fixed Cost (TFC) and Total Cost (TC). Output quantity was multiplied with the price realized to arrive at Gross Income (GI). Net Income (NI) was calculated by deducting total cost from gross income. Gross Income was divided by the total cost to arrive at Return per Rupee of Cost. The cost of cultivation and the return per rupee of investment of the sorghum farmers was compared with that of bengalgram farmers. Similarly, Chahal and Katariya (2005), Kavitha *et al*., (2015) estimated the economics of field crops.

Computation of sustainability Indicators

Ratio Analysis

Ratio analysis and percentages were used to determine the degree of spatial sustainability of *rabi* sorghum cultivation under dryland situation. The indicators used were:

1. Ratio of Cost of Commercial Pesticides and Chemical Fertilizers to the Total Cost of Cultivation of Crop.

   If the cost of commercial pesticides and chemical fertilizers in the total cost of cultivation of the *rabi* sorghum crop is less, then the situation can be considered to be relatively healthy and more sustainable, since the overuse of such inputs deteriorates soil, pollutes the water bodies and creates resistance in pests; thus making the system more vulnerable for pest incidence and crop loss.

2. Ratio of Cost of Ecologically Non-destructive Inputs to the Total Cost of Cultivation of Crop.

   Ecologically non-destructive inputs such as farm yard manure and labour force are found to sustain agricultural production in the long run, by maintaining the production environment relatively healthy (Sreenivas, 2000). The high percentage of these inputs indicates the sustainability of that farming situation.

3. Ratio of Returns from Fodder to the Total Cost of Cultivation of *Rabi* Sorghum Crop.

   If the returns of fodder to the total cost of cultivation of *rabi* sorghum crop is high, then that situation can be considered as sustainable as the crop provides sufficient fodder security for the livestock.

Results and Discussion

Shift in Cropping Pattern in Bijapur District.

It was hypothesised that the transition in cropping pattern in traditional sorghum growing belt has been observed for last five years. Hence the district level data on sorghum area from the year 2000 to 2011 has been subcategorised into two quinquennium. The first quinquennium is from 2000-2005 and second is from 2006-2011. The percentage change in area under sorghum and its competing crops during *rabi* season were computed and meaningful interpretations were drawn (Table 1).

The result indicate that the percentage change in area under major staple food and fodder crop such as Sorghum and Bajra for both the quinquennium (2000-2005 and 2006-2011) are negative. On the other hand, the percentage change in area under Bengal gram is positive for both the quinquennium, which is regarded as competing crop, since both the crops acquire scarce land, the key factor of production during the same time. Similar results were reported by Shankaran (1994) and Basavaraj *et al*. (2005) in their study. The magnitude of

increase in the area of Bengal gram (197 %) is substantial during second quinquennium. The likely reason for such transition would be the remuneration/ profit what the farmers realise from these crops. In this regard the cost of cultivation of both sorghum and *rabi* crops were compared.

Table 1: Change in Area of Different Crops in Bijapur District (2000-01 to 2010-11)

Crops	Area in hect-ares 2000-01	Area in hect-ares 2004-05	% change	Area in hect-ares 2005-06	Area in hectares 2010-11	% change
Sor-ghum	325092	244437	-24.81	237986	190629	-19.90
Bajra	111741	97629	-12.63	83066	65452	-21.20
Wheat	51283	49116	-4.23	51103	63974	25.19
Ben-gal-gram	35955	49658	38.11	52600	156207	196.97

Source: DES, 2011

Cost and Returns of Rabi sorghum Cultivation.

The cost and returns of *rabi* sorghum cultivation per acre is presented in the Table 2. It could be observed from the table that, the variable cost was ₹ 6884 and fixed cost was ₹ 2619 which constitute 72.44 and 24.56 per cent of total cost of cultivation, respectively. Human labour was found to be the major item of variable cost accounting for 32.12 per cent of the total cost of cultivation. Cost of bullock labour, machine cost and fertilizer cost were the next major variable cost items of *rabi* sorghum production accounting for 17.52, 10.40 and 5.14 per cent, respectively.

Rental value of land formed the major item of fixed cost (89.08 %) and its share in the total cost of cultivation was 24.56 per cent. Depreciation, interest on fixed capital and land revenue and taxes were the other components of fixed cost accounting 1.89, 1.00 and 0.12 per cent of the total cost of cultivation in *rabi* sorghum cultivation, respectively.

The total cost of cultivation of *rabi* sorghum worked out to ₹ 9502 per acre and the cost of production worked out to ₹ 1834. The gross returns from main product and by-product were ₹ 9162 and ₹ 1592 respectively. The total gross returns were ₹ 10754 and the net returns realized from *rabi* sorghum cultivation worked out to ₹ 1252 per acre.

Table 2: Per Acre Cost of Cultivation of *Rabi* Sorghum

Sl. No	Particulars	Qty	Cost (₹)	Per cent
I	***Variable cost***			
	Human labour (Mandays)	15.26	3052	32.12
	Bullock labour (BP days)	3.33	1665	17.52
	Seed (kgs)	2.72	148	01.56
	FYM (cartloads)	0.37	102	01.07
	Machine cost		989	10.40
	fertilizer cost		488	05.14
	Plant Protection chemical cost		00	00.00
	Miscellaneous		50	00.53
	Interest on working capital @ 6 per cent		390	04.10
	Total variable cost		6884	72.44
II	***Fixed cost***			
	Depreciation		180	01.89
	Land revenue and taxes		11	00.12
	Interest on fixed capital @ 10 per cent		95	01.00
	Rental value of land		2333	24.56
	Total fixed cost		2619	27.56
III	***Total cost of cultivation***		9502	100.00
IV	***Economics of crop***			
	Main product (Qtl)	5.18	9162	
	By product(cartloads)	1.99	1592	
	Gross returns		10754	
	Net returns		1252	
	Cost of production (₹/Qtl)		1834	
V	***Returns per rupee of expenditure***		1.13	

Cost and Returns of Bengalgram Cultivation

The cost and returns of bengalgram per acre is presented in the Table 3. The results revealed that the variable cost was ₹ 10113 and fixed cost was ₹ 2518, respectively. Human labour was formed the major item of variable cost accounting for 30.44 per cent of the total cost of cultivation. Cost of Plant Protection chemical and cost of bullock labour were the next major variable cost items of bengalgram production accounting for 14.72, and 11.04 per cent, respectively.

The share of rental value of land in the total cost of cultivation was 19.30 per cent. Depreciation, interest on fixed capital and land revenue and taxes were the other components of fixed cost. The total cost of cultivation of bengalgram worked out to ₹ 12089 per acre and the cost of production worked out to ₹ 2427. The net returns realized from bengalgram cultivation worked out to ₹ 1930 per acre.

Table 3: Per Acre Cost of Cultivation of Bengal Gram Crop

Sl. No	Particulars	Qty.	Cost	Per cent
I	***Variable cost***			
	Human labour (mandays)	18.40	3680	30.44
	Bullock labour (pair days)	02.67	1335	11.04
	Seeds (kg)	24.33	815	06.74
	FYM (cartload)	00.31	90	00.74
	Machine cost		880	07.28
	fertilizer cost		399	03.30
	PP chemical cost		1780	14.72
	Misc.		50	00.41
	Interest on working capital @ 6 per cent		542	04.48
	Total variable cost		10113	79.15
II	***Fixed cost***			
	Depreciation		92	00.76
	Land revenue and taxes		11	00.09
	Interest on fixed capital @ 10 per cent		81	00.67
	Rental value of land		2333	19.30
	Total fixed cost		2518	20.85
III	***Total cost of cultivation***		12089	100.00
IV	***Economics of crop***			
	Main product (Qtl)	04.98	14019	
	Gross returns		14019	
	Net returns		1930	
	Cost of production (₹/Qtl)		2427	
V	***Returns per rupee of expenditure***		1.16	

Comparative Cost and Returns of Rabi sorghum and Bengalgram

The cost and returns of bengalgram cultivation per acre were compared with *rabi* sorghum and the results were presented in the Table 4. The results revealed that the cost of cultivation of bengalgram was higher than that of *rabi* sorghum i.e., ₹ 12089 and ₹ 9502 respectively. Among the variable cost, plant protection chemicals cost accounts ₹ 1780 which constitutes 14.72 per cent in the total cost of cultivation of bengalgram but this component is not account in the sorghum cultivation. The net returns per acre was higher in case of bengalgram (₹ 1930) compared to *rabi* sorghum (₹ 1252) and also the returns per rupee of expenditure was estimated to be higher in case of bengalgram (₹ 1.16) than *rabi* sorghum production (1.13).

Table 4: Comparative Cost and Returns of *Rabi* Sorghum and Bengalgram

Sl. No	Particulars	*Rabi* sorghum	Bengal gram
1	Total cost of Cultivation (₹/ acre)	9502	12089
2	Gross returns (₹ /acre)	10754	14019
3	Net returns (₹/acre)	1252	1930
4	Cost of production (₹/Qtl)	1834	2427
5	Returns per rupee of expenditure	1.13	1.16

Resource Use Pattern in Rabi sorghum and Bengal gram Cultivation.

Details pertaining to resource use pattern in *rabi* sorghum (*Rabi*) and bengalgram cultivation have been presented in the Table 5. In *rabi* sorghum cultivation, on an average

sample farmers using 2.72 kg of seeds, 0.37 cartload of FYM, 15.26 mandays and 3.33 BP days. Whereas, in the bengalgram cultivation farmers using 24.33 kg of seeds, 0.31 cartloads of FYM, 18.40 mandays and 2.67 BP days. The cost incurred on the machine, fertilizers and plant protection chemicals in *rabi* sorghum (*Rabi*) and bengalgram cultivation were varies (Table 5). Similar results were reported by Mentesnot Legesse (2000) in his study on economic analysis of jowar production in north Karnataka.

Table 5: Resource use pattern in *Rabi* sorghum and Bengal gram Cultivation (Per/acre)

Sl. No	Particulars	*Rabi* sorghum		Bengal gram	
		Quantity	*Value* (₹)	*Quantity*	*Value*(₹)
1	Human labour (mandays)	15.26	3052	18.40	3680
2	Bullock labour (BP days)	03.33	1665	02.67	1335
3	Seeds (kgs)	02.72	148	24.33	815
4	FYM (cart-load)	00.37	102	00.31	90
5	Machine cost	—	989	—	880
6	fertilizer cost	—	488	—	399
7	Plant protection chemical cost	—	—	—	1780

Ratios Indicating Sustainability Status of Rabi sorghum Cultivation in Comparison with Bengalgram

The ratios indicating sustainability status of *rabi* sorghum (*Rabi*) cultivation are presented in the Table 6. The percentage of cost of commercial pesticides and chemical fertilizers to total cost of cultivation was less in *rabi* sorghum (4.94) compared to that in bengal gram (17.97) indicating less dependency on external inputs.

Ratio of ecologically non-destructive inputs cost to total cost of cultivation of *rabi* sorghum (*Rabi*) was higher (48.71) when compared to that in bengal gram (39.71) indicating more use of eco-friendly inputs in *rabi* sorghum (*Rabi*) cultivation. Similarly, the percentage of returns from fodder to total cost of cultivation was around 16 per cent in *rabi* sorghum (*Rabi*) cultivation indicating sustainability in terms of fodder security to livestock.

Table 6: Ratios Indicating Sustainability Status of *Rabi* Sorghum Cultivation (per acre)

Crop	Ratio of		
	Cost of commercial pesticides and chemical fertilizers to total cost of cultivation	Ecologically non-destructive inputs cost to total cost of cultivation	Returns from fodder to total cost of cultivation
Rabi sorghum	04.94	48.71	16.09
Bengal gram	17.97	39.71	—

Conclusion

The results indicated that the production cost incurred per quintal of output was comparatively higher in bengalgram compared to *rabi* sorghum. With respect to net returns per acre was higher in case of bengalgram compared to *rabi* sorghum. The results clearly indicated that the bengalgram was more profitable than the *rabi* sorghum. Inspite of this, *rabi* sorghum holds a prominent position in the cropping pattern of the district as it is the staple food item in the consumption basket of the population. Along with profitability, sustainability is another important dimension which needs to be considered. The ratios indicating sustainability status of *rabi* sorghum like cost of commercial pesticides and chemical fertilizers to total cost of cultivation was less in *rabi* sorghum indicating less dependency on external inputs. Ratio of ecologically non-destructive inputs cost to total cost of cultivation of *rabi* sorghum was higher indicating more use of eco-friendly inputs in *rabi* sorghum cultivation. Similarly, the ratio of returns from fodder to total cost of cultivation was around 16 in *rabi*

sorghum cultivation indicating sustainability in terms of fodder security to livestock. Therefore Sorghum cultivation is said to be ecologically sustainable when compared to Bengalgram cultivation.

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