Original Research Article

Production Efficiency of Fodder Crops in Karnataka: An Economic Analysis

ABSTRACT

Livestock is a vital component of subsistence farming which adds to the livelihood of rural poor in India. The maintenance, health and nutrition of livestock are mainly associated with the fodder available and provided. The total feed cost accounts for 60 to 70 per cent of livestock production. Considering this, the study was conducted to analyse the economics of fodder production in Karnataka which includes cost incurred in production, returns associated with it, resource use efficiency and marginal productivity of fodder. The study was conducted in all four revenue divisions of Karnataka by selecting one district from each revenue division. Purposive sampling technique was followed in selection of respondents. A total of 240 respondents were interviewed by a pre tested interview schedule. The cost associated with per acre production of fodder sorghum and fodder bajra were analysed and found that Hassan district showed highest cost of cultivation in both fodder sorghum and fodder bajra with a cost of Rs 23096 per acre for fodder sorghum and Rs 18059 per acre for fodder bajra. The resource use efficiency was analysed by production function estimates and the allocative efficiency of resources were also analysed in the study. The information generated may be helpful for livestock holders and policy makers for proper management of fodder and costs associated with it.

Key words: Sorghum, Bajra, Cost, Resource Use Efficiency, Marginal Value Product

Introduction :

India is basically an agricultural country and nearly three-fourth population depends on agriculture, livestock and allied sectors for livelihood. Crop economy continues to be a dominant sector contributing about 55 per cent of total agricultural income (Chand and Singh 2023). Animal husbandry and dairying are considered to be supplementary to crop production. Livestock plays an important role in the rural economy of the country. Livestock is a key source of supplementary income and livelihood especially for small landholders and landless rural poor households (Sekaran et al. 2021).India accounts for a total livestock population of 535.78 million and state of Karnataka accounts for a livestock population of 29 million (Anonymous 2019). Traditionally, in India, agriculture and livestock are intertwined in such a manner that it ensures sustainable livelihood to a large proportion of rural population. The productivity, nutrition and efficiency of livestock are associated with the fodder available and cultivated. Because of competition for resources utilized in the production of food crops, farmers' practices of growing green fodder has been severely restricted in the state. However, farmers are becoming more aware of the need to cultivate green fodder on their farms in order to provide better feed for their animals, as a result of changes in crops and crop management techniques brought about by market forces (Kannan 2012).

Fodder refers to any agricultural food stuff used to feed domesticated livestock such as cattle sheep goats pig etc.Fodder crops refer to the cultivation of plant species specifically for feeding animals in the form of green fodder, silage, hay etc. India is a land of genetic

diversity with 245 genera and 1256 species of Poaceae, of which one third is considered to have forage value and nearly 24 genera of leguminosae have been identified to be useful for forage (Roy et al. 2019). The main fodder crops grown in Karnataka include Maize, Lucerne,

Bersem, Sorghum, Oats, Bajra, Napier etc (Anonymous 2023). There is very scarce literature on production efficiency of fodder crops in the state. Hence, the present study was conducted to analyse the cost of cultivation of fodder crops and their production efficiency.

MATERIALS AND METHODS

Study area: Karnataka is the eighth largest state in India with an area of 1, 91,791 sq. km. It is situated between latitude15° 00' North and longitude 75° 00' East in the Southern Plateau. According to 2011 census, Karnataka has a total population of 61.38 million with an overall literacy rate of 75.60 per cent. The rural and urban population stands at 37.88 and 23.52 million, respectively (Anonymous 2011). The average annual rainfall in the state is 1366 mm (Anonymous 2019) from both South-West and North-East monsoons. The mean temperature ranges from 10.0 0C to 44.0 °C.The present study was undertaken in four revenue divisions of Karnataka that is Bengaluru revenue division, Belgaum revenue division, Kalaburagi revenue division and Mysuru revenue division.

Data: One district from each revenue divisions of Karnataka was selected based on the maximum livestock population and ease of data availability in the district. Raichur district was selected in Kalaburagi revenue division, Belgaum district was selected in Belgaum revenue division, Hassan in Mysuru revenue division and Chikkaballapura in Bengaluru revenue division. From each of these districts two talukas were selected based on maximum fodder growers. The selected talukas included Sindhanur and Manvi talukas from Raichur, Gokak and Chikkodi talukas from Belgaum, Chennarayapatna and Hassan talukas from Hassan, Chintamani and Shidlaghatta talukas from Chikkaballapura. In the next stage, two villages were selected randomnly from each taluk. Purposive random sampling technique was followed in the selection of respondents. A sample of 15 respondents from each selected villages were interviewed there by making a sum of 60 respondents per district. The total sample size for the micro level study was 240 respondents.

*Tools:*The costsassociated were calculated by using the total variable cost and total fixed cost. In the variable and fixed cost following items were included:

Total Variable Cost = Value of human labour (hired and family) + Value of machine labour + Value of seeds (owned and purchased) + Value of manure (owned and purchased) + Value of fertilizer + Value of pesticides and insecticides + Irrigation charges + Depreciation on farm building and implements + Interest on working capital (@ 7 per cent)

Total Fixed Cost = Value of land and buildings + Interest on fixed capital (@9 per cent) + Land revenue

Total Cost = Total variable cost + Total fixed cost

Gross Return = Quantity of produce x Price of produce

Net Return = Gross return – Total cost

*Resource Use Efficiency:*The Cobb-Douglas production function is the most widely used form of production functions for fitting agricultural production data, because of its

mathematical properties like ease of interpretation and computational simplicity apart from, unlike other functional form, the input coefficients constitutes the respective elasticity. The original function is

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} e^n$$

But the above equation is modified to log-linear form for ease of calculation

$$\text{In } Y = \text{In } a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + u$$

Where,

Y = Gross income (₹)

a = Intercept,

X1 = Cost of Labour (₹)

X2 = Cost of machine labour (₹)

X3 = Cost of seeds (₹)

X4 = Cost of manure (₹)

X5 = Cost of fertilizer (₹)

X6 = Irrigation charges (₹)

e^n = Stochastic error term

*Marginal Productivity Analysis:*To decide whether a particular input is used rationally or irrationally, its marginal value product (MVP) and marginal factor cost (MFC) were computed. The marginal value product was calculated at the geometric mean levels of variables by using the formula:

$$MVP_i^{th} \text{resource} = b_i \bar{Y} / \bar{X}_i$$

Where,

$\bar{Y}$: Geometric mean of gross income

$\bar{X}_i$: Geometric mean of i^{th} independent variable

b_i : Regression co-efficient of i^{th}independent variable

In order to determine the efficiency of allocation of resources, the value of the marginal product obtained by multiplying the product by the price of the product was compared with its marginal cost. The criterion for determining optimal resource use was:

MVP/MFC > 1: Underutilization of resources

MVP/MFC = 1: Optimal use of resources

MVP/MFC < 1: Overutilization of resources

RESULTS AND DISCUSSION

Cost and returns of fodder sorghum: Table 1 presents an overview of the costs and returns associated with cultivating fodder sorghum across study districts. The results regarding cost of various inputs, yield and cost of production were analysed and presented in the table. It was found that cost of hired labour showed relatively consistent pattern across study districts with an overall hired labour cost of Rs 2110 per acre and that of family labour with Rs 2329 per acre. Machine costs exhibited some variations, with Raichur respondents experiencing slightly lower expenses. Seed cost was found to be highest in Raichur district while lowest in Belagavi district. FYM cost was found to be highest in Hassan and lowest in Belagavi. The total variable cost was found to be Rs 12815 in Belagavi district, Rs 13033 in Chikkaballapur district, Rs 13074 in Hassan district and Rs 11839 in Raichur district. The results showed that the total cost of cultivation was highest among Hassan respondents with Rs 23096 per acre followed by Chikkaballapur respondents with Rs 22538 per acre, Raichur respondents with Rs 20600 per acre and Belagavi respondents with Rs 20564 per acre.

Yield and price per quintal showed considerable variations among the study districts. Hassan district showed higher yield followed by Belagavi, Raichur and Chikkaballapur district with an overall average yield of 205. The price per quintal, which resulted in the higher gross returns, was found to be highest in Chikkaballapur while lowest in Belagavi. The cost of production per quintal varied across study districts ranging from Rs 117 per quintal to Rs 100 per quintal. Belagavi and Raichur respondents experienced lowest cost of production with Rs100 per quintal while Chikkaballapur respondents experienced highest cost of production with Rs 117 per quintal.

Table 1: Costs and returns in cultivation of fodder sorghum

(Rs/acre)

Particulars	Belagavi	Chikkaballapur	Hassan	Raichur
Variable cost				
Hired Labour	2132	2153	2121	2035
Family Labour	2465	2387	2362	2104
Machine	2732	2589	2591	2237
Seed	1863	1932	1942	2012
FYM	1128	1326	1532	1129
Fertilizer	1082	1174	1043	1040
Plant protection	0	0	0	0
Irrigation	575	620	628	508
Interest on variable cost (7%)	838	852	855	774
Total variable cost	12815	13033	13074	11839
Fixed cost				
Land Revenue	300	300	300	300
Depreciation	354	489	538	560
Rental value of land	6456	7932	8357	7081
Interest on fixed capital (9%)	639	784	827	820
Total fixed cost	7749	9505	10022	8761
Total cost	20564	22538	23096	20600
Yield and returns				

yield (q)	206	192	218	205
Price (₹ /q)	130	154	149	141
Gross returns	26780	29568	32482	28905
Net returns	6216	7030	9386	8305
Cost of production (₹ /q)	100	117	106	100

Resource use efficiency in cultivation of fodder sorghum: The results of Cobb-Douglas production function are presented in table 2. The coefficients of cost of machine labour and irrigation were found to be significant at 5 per cent level of significance and positively influenced gross returns in Belagavi district. The coefficient of determination of Belagavi was found to be 0.95 implying 95 per cent of variability was explained by the independent variables in the model. In Chikkaballapur district, the coefficients of cost of human labour and manures were found to be 0.953 and 0.032 which were significant indicating with unit increase in human labour and manures, the gross returns increased by 0.953 and 0.032 units respectively. The cost of seeds was found to be significant implying with unit increase in seeds, the gross returns increased by 2.653 units. The R^2 value was found to be 0.96 which means that 96 per cent of variation in dependent variable was due to independent variables considered in the study.

In Hassan district, costs of seeds, machine labour and irrigation charges were found to have significant positive influence on gross returns. The R^2 of 0.92 in the district showed that 92 per cent of variability in the model was explained by the considered independent variables. Raichur district showed significant positive influence of machine labour and irrigation on gross returns at 5 per cent level. The coefficient of determination of the district revealed that 89 per cent of variation in dependent variable had been explained by the considered independent variables in the study. The adjusted R-squared of 0.82 indicated that around 82 per cent of the variability in gross returns was explained by adjusting the number of variables in Raichur district.

Table 2: Production function estimates of fodder sorghum

Particulars	Belagavi		Chikkaballapur		Hassan		Raichur	
	Coefficients	*p*-value	Coefficients	*p*-value	Coefficients	*p*-value	Coefficients	*p*-value
Intercept	4.662	0.000	1.543	0.000	1.498	0.000	2.653	0.000
Human labour	-0.848	0.293	0.953**	0.043	1.032	0.762	1.873	0.983
Machine labour	0.152**	0.0005	1.234	0.854	0.654**	0.032	0.982**	0.041
Seeds	0.013	0.443	2.653**	0.006	1.432**	0.002	1.432	0.651
Fertilizer	0.011	0.770	1.521	0.764	0.874	0.752	0.653	0.872
Irrigation	0.060**	0.0008	0.764	0.975	1.832**	0.031	0.432**	0.001
Manure	0.023	0.210	0.032**	0.032	0.853	0.198	1.321	0.762
R^2	0.95		0.96		0.92		0.89	
Adjusted R^2	0.91		0.91		0.89		0.82	

** indicates significance at 5 per cent level

Table 3: Allocative efficiency of resources used in production of fodder sorghum in study districts

Particulars	Belagavi		Chikkaballapur		Hassan		Raichur	
	Geometric mean	MVP/MFC	Geometric mean	MVP/MFC	Geometric mean	MVP/MFC	Geometric mean	MVP/MFC
Human labour	4347.99	3.542	4076.43	2.763	4109.98	-1.543	4021.73	1.432
Machine	2145.20	2.983	2034.54	-0.872	2491.73	1.862	2432.76	0.983

labour								
Seeds	1543.62	-0.982	2012.83	0.871	1542.33	-0.653	1098.87	-0.983
Fertilizer	993.32	-2.543	1082.74	-0.124	1327.32	0.824	1232.76	1.432
Irrigation	532.87	0.762	703.82	1.235	542.98	1.219	534.87	-1.832
Manure	1092.53	0.732	1432.76	1.532	1142.84	-2.410	1022.34	2.341

Allocative efficiency in cultivation of fodder sorghum: The table 3 presents the allocative efficiency of different inputs in cultivation of fodder sorghum. The marginal value product was worked out in order to find the allocative efficiency of inputs used in production process. The allocative efficiency was worked out in cost terms and hence, the marginal factor cost was considered to be unity for all inputs. Belagavi district showed over utilization of human labour and seeds while under-utilization of machine labour, manures and fertilizers. Chikkaballapur district showed over-utilization of machine labour while under-utilization of human labour, seeds, fertilizers and manures. Human labour and seeds were found to be over-utilized in Hassan district with machine labour, fertilizers and manures showing under-utilization. The results revealed that human labour and seeds were found to be over-utilized in Raichur district with machine labour, fertilizer and manures being under-utilized. The study revealed that expenses on human labour and seeds were over-utilized in Belagavi, Hassan and Chikkaballapur districts indicating excess expenditure on these inputs. Fertilizers and manures were found to be under-utilized in all the study districts implying lower efficiency of expenses made on these.

Costs and returns involved in cultivation of fodder bajra: Table 4 presents an overview of the costs and returns associated with cultivation of fodder bajra across study districts. Both hired and family labour costs showed some variations across districts. Machine labour costs displayed variations, with Raichur respondents having the highest expenditure of Rs 2402 per acre. This could be due to differences in mechanization practices. Seed costs were found to maximum in Hassan district followed by Chikkaballapur, Raichur and Belagavi. FYM costs showed slight variations among the study districts with highest cost incurred by respondents of Hassan district and lowest by respondents of Belagavi district. Fertilizer costs were found to be highest in Hassan followed by Raichur, Belagavi and Chikkaballapur. The total cost of cultivation was found to be Rs 16398 in Belagavi district, Rs 15840 in Chikkaballapur district, Rs 18059 in Hassan district and Rs 17280 in Raichur district with Hassan district showing the highest total incurred. The total variable cost and total fixed cost in Belagavi was found to be Rs 8971 per acre and Rs 7427 per acre. Chikkaballapur district showed variable cost of Rs 7593 and fixed cost of Rs 8247 while Hassan district and Raichur district showed variable cost of Rs 9472 and Rs 9250 per acre respectively and fixed cost of Rs 8587 and Rs 8031 per acre respectively. The total variable cost obtained in the study was on par with the results obtained by Sharma, 2017 which was found to be Rs 8256.8

The results showed that yield and price per quintal showed variations with Hassan district showing highest yield followed by Raichur, Belagavi and Chikkaballapur. The price of bajra per quintal ranged from 164 to 178 in the study districts. The respondents of Hassan district obtained highest gross returns while that of Chikkaballapur district obtained lowest gross returns. The cost of production per quintal was found to be Rs 107 in Belagavi, Rs 112 in Chikkaballapur, Rs 113 in Hassan and Rs 109 in Raichur.

Table 4: Cost and returns in cultivation of fodder bajra

(Rs/acre)

Particulars	Belagavi	Chikkaballapur	Hassan	Raichur

Variable cost				
Hired labour	1293	1235	1398	1342
Family labour	1421	1143	1465	1410
Machine labour	2354	2032	2321	2402
Seed	1578	1632	1674	1628
FYM	984	1012	1132	1043
Fertilizer	754	643	862	820
Irrigation	0	0	0	0
Interest on variable cost (7%)	587	539	620	605
Total variable cost	8971	7593	9472	9250
Fixed cost				
Land Revenue	300	300	300	300
Depreciation	186	283	269	256
Rental value of land	6328	6983	7324	6812
Interest on fixed capital (9%)	613	681	694	663
Total fixed cost	7427	8247	8587	8031
Total cost	16398	15840	18059	17280
Yield and returns				
Yield (q)	153	141	159	158
Price (₹ /q)	164	173	178	172
Gross returns	25092	24393	28302	27082
Net returns	8694	8553	10243	9802
Cost of production (₹ /q)	107	112	113	109

Resource use efficiency in cultivation of fodder bajra: Table 5 shows that the coefficients of machine labour, manures and fertilizers were found to be significant in Belagavi district. The coefficients indicated that per unit increase in machine labour and manures led to an increase in gross returns by 0.031 and 0.017 units respectively. The coefficient of fertilizer showed that per unit change in fertilizer led to increase in gross returns by 0.015 units in Belagavi district. The R^2 of the district was found to be 0.93 implying that 93 per cent of variability was explained by the considered independent variables in the model.

In Chikkaballapur district, the coefficients of fertilizers and manures were found to be 0.265 and 0.123 respectively and these were found to positively influence gross returns with significance at 5 per cent level significance. Hassan district showed that machine labour and manures influenced positively on gross returns with R^2 of the district being 0.96 implying 96 per cent of the variation in dependent variable was explained by independent variables of the model. Adjusted R^2 of 0.92 showed the number of predictors adjusted for degrees of freedom. In Raichur district, fertilizers were found to influence positively while labour cost was found to influence negatively indicating that increase in unit labour cost led to decrease in gross returns by 0.172 units. The R^2 value (0.91) and adjusted R^2 value (0.86) indicated that the independent variables explained high proportion of the variability in the dependent variable. Adjusted R2 considered the number of predictors and adjusted for the degrees of freedom.

Allocative efficiency of fodder bajra: Table 6 revealed the geometric mean and marginal value product (MVP) to marginal factor cost (MFC) of inputs, which indicates allocative efficiency of input costs. Cost of labour, cost of machine labour, cost of seeds, cost of fertilizers and cost of manures were assessed in order to obtain their allocative efficiency.

The results showed that in Belagavi district, human labour, seeds and fertilizers were over utilized while machine labour and manures were under-utilized. In Chikkaballapur district, human labour, machine labour, fertilizers and manures were under-utilized but seeds were over-utilized. Machine labour and fertilizers were under-utilized in Hassan while human labour, seeds and manures were over utilized. The results of Raichur district showed that except machine labour, remaining all input costs were over-utilized. Under-utilization refers to lower efficiency of the resources in comparison to expenses made on them while over-utilization indicates excess of expenditure spent on the resources

Table 5: Production function estimates of fodder bajra

Particulars	Belagavi		Chikkaballapur		Hassan		Raichur	
	Coefficients	*p*-value	Coefficients	*p*-value	Coefficients	*p*-value	Coefficients	*p*-value
Intercept	4.091	0.000	3.542	0.000	1.432	0.000	2.764	0.000
Human labour	0.362	0.167	1.321	0.142	2.131	0.201	-0.172**	0.021
Machine labour	0.031**	0.042	0.982	0.721	1.521**	0.001	1.243	0.653
Seeds	0.368	0.558	1.231	0.571	0.983	0.328	0.643	0.862
Fertilizers	0.015**	0.0001	0.265**	0.002	0.762	0.541	0.981**	0.042
Manures	0.017**	0.019	0.123**	0.031	0.432**	0.027	1.432	0.432
R^2	0.93		0.90		0.96		0.91	
Adjusted R^2	0.88		0.85		0.92		0.86	

**indicates significance at 5 per cent level

Table 6: Allocative efficiency of resources used for production of fodder bajra in study districts

Particulars	Belagavi		Chikkaballapur		Hassan		Raichur	
	Geometric mean	MVP/MFC	Geometric mean	MVP/MFC	Geometric Mean	MVP/MFC	Geometric mean	MVP/MFC
Human labour	2654	0.982	2031	2.541	2386	-0.098	2176	0.498
Machine labour	2187	1.432	1986	2.654	2541	1.652	2051	2.764
Seeds	1472	-0.972	1732	-1.764	1542	-2.654	1734	-1.234
Fertilizer	872	-2.431	792	1.092	861	1.872	931	-0.982
Manure	1021	1.764	1231	1.864	1432	-0.098	1172	-0.761

CONCLUSION

The study reveals various costs associated with fodder production, resource use efficiency of inputs and allocative efficiency of inputs. The cost of labour and seeds was found to be higher in both fodder sorghum and fodder bajra. The cost of cultivation and net returns both were found to be higher in Hassan than any other districts considered in the study. The average costs associated with fodder sorghum was found to be Rs 21699 per acre and that of fodder bajra was found to be Rs 16894 per acre. The study also revealed that there was no optimal utilization of resources in the study area, the resources were either over utilized or under-utilized.The current cost and efficiency analysis of fodder will help in better fodder management and livestock management decisions.

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