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RESEARCH PAPER

Economics of crop and non-crop enterprises in central dry zone (CDZ) of Karnataka

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Abstract: The story of Indian agriculture, in particular dryland agriculture, appears as an annoying twist in the plot. The gap between irrigated and dryland agriculture has steadily widened, with the productivity of the latter being less than half of the former. Karnataka state has second largest area under rainfed agriculture after Rajasthan. Rainfed agriculture in Karnataka accounts for nearly 55 per cent of total food grains and 74 per cent of oil seeds production. The present study attempts to estimate cost-return profile of various crop and non-crop enterprises. Multistage random sampling procedure was adopted to evaluate the objectives of the study. The Central Dry Zone (CDZ) of Karnataka was purposively selected for the study. The study is based mainly on the primary data collected from a sample of 100 farmers, selected at the rate of 10 farm households from 10 villages randomly chosen from five tahsils selected randomly from the selected Zone. The study revealed that, maize, groundnut and onion were the most suitable crops in terms of soil, water and other resources in the study area which enabled them to occupy first three ranks with 17.43, 15.11 and 12.96 per cent of the gross cropped area, respectively. Coconut has provided the highest average net return of Rs.1,69,000 per acre in a year with a B:C ratio of 5.98 followed by pomegranate (₹ 1,51,000 and 4.96, respectively). Sheep and goat or the livestock enterprise was the major non-crop enterprises in the dry zones because of its minimum care requirement, less management cost and high unit returns per year compared to cattle and buffalo, among others. Diversification of farming by adopting perennials, annual and livestock enterprises is need of the day to maintain sustainable income in dryland farming.

Key words: Crop, Dryland, Economics, Enterprise

Introduction

Dryland farming may be defined as "a practice of growing profitable crops without irrigation in areas which receive an annual rainfall of 750 mm or even less". The story of Indian agriculture, in particular dryland agriculture, appears as an annoying twist in the plot. The gap between irrigated and dryland agriculture has steadily widened, with the productivity of the latter being less than half of the former. Nonetheless, dryland agriculture offers scope to contribute to the growing food needs of future particularly looking into the several resource management problems emerging in irrigated regions (Anon., 2011). Rainfed agriculture accounts for 53 per cent of total cropped area, 48 per cent of area under food crops, 68 per cent of the area under non-food crops and 66 per cent of total livestock population in the country.

Dry farming is an exercise of constrained optimisation of multiple objectives. These include household food security, fodder and firewood needs, minimum cash flow, use of available household labour, etc. Traditional cropping systems use diverse strategies like mixed-cropping and inter-cropping for rainfall insurance. The crop combinations and sequences are often highly complex and have come up taking into consideration minute variations in soil type, depth, crop maturity and susceptibility to rainfall fluctuations and household needs.With the dynamics of reduction in size of arable land, high climate variability, declining size of operational holdings, and burgeoning population, India is faced with a challenge on the agriculture front in terms of feeding her population with two square meals a day. By 2025 AD, India will have to produce 300 million tonnes of food grains to feed her population. This target cannot be realized from irrigated areas alone as we have irrigation potential for 178 million ha alone, which is a function of rainfall received (Alexandratos and Bruinsma, 2012).

The state of Karnataka has been divided into 10 agro-climatic zones based on rainfall, soil, elevation and vegetation. Out of these, 5 zones lying on the eastern side of the Western Ghats are put under dry farming zones and which receive an average rainfall of less than 700 mm. The state has second largest area under rainfed agriculture after Rajasthan. Nearly 55 per cent of total food grains and 74 per cent of oil seeds production come from rainfed agriculture in Karnataka. The present study aims to estimate the cost and returns of crop and non-crop enterprises in the study area, with an objective of analysing the profitability of different crop and non-crop enterprises and the combinations there-of.

Material and methods

Multistage random sampling procedure was adopted to evaluate the objective of the study. The Central Dry Zone (CDZ) of Karnataka was purposively selected for the study. From the zone, five tahsils were chosen randomly. From each tahsil, two villages were selected at random. From each village, 10 farm households were chosen randomly. These respondents include all farmer categories, namely, marginal, small, medium and large. The study relies mainly on primary data elicited from the rural households of the study area using a well-designed and pre-tested schedule. The descriptive statistical tools, namely, mean, ratio, per cent, etc. were usedto estimate cost and returns of various enterprises.

Results and discussion

Land use pattern of sample respondents

Land use pattern of sample farms is presented in Table 1. Maximum area was under field crops (70.55%) in the study area followed by horticulture crops (29.45%). In particular to rainfed land, area allotted for field crops was about 98.08 per cent of total cultivated area, whereas for horticulture crops, it was just 1.92 per cent only. However, in case of irrigated land, average area under field crops was 35.54 per cent of total cultivated area as compared to significant share of 64.46 per cent for horticulture crops. This indicated that major portion of the sample household's farm in drylandwas occupied by field crops, whereas in case of irrigated land, relatively larger area was under horticulture crops. Hence, we could say that the availability of irrigation facility was the main driving force for taking up horticultural crops in the study area. The study of Sharma *et al.* (2016) put forwarded similar result.

Irrigation source of sample farms

Irrigation water is one of the very important resources for optimization of dryland agriculture. It was evident from the Table 2 that the major source of irrigation in the Central Dry Zone was bore well (80.56% of farm households) followed by open well (8.33%). It was observed that around 5.56 per cent each of sample farmers were using both open well as well as bore well for irrigation. There were only limited natural water sources like river, lakes, etc. in the Zone. So farmers were forced to exploit ground water resource for irrigating their farms. These results are in conformity with the findings of Batchelor *et al.* (2003).

Cropping pattern of sample respondents

Maize, groundnut and onion were the most suitable crops in terms of soil, water and other resources in the study area which topped the list occupying 17.43, 15.11 and 12.96 per cent of the gross cropped area, respectively. Also, it was noticed that, wherever the farmers had some irrigation facility, they could go for arecanut crop (fourth rank in terms of per cent of gross cropped area) due to its relatively better net returns compared to other crops. A parallel finding has been mentioned by Yadav (2009).

Costs-returns profile of crop enterprises

The costs-returns profile of crop enterprises taken up by the sample households are presented in Table 4. The results indicated that among the 23 crops grown in the study area,

Table 1. Land use pattern of sample farms (Acres)

Sl. No.	Particulars	Chitradurga (n=20)		Hiriyur (n=20)		Davanagere (n=20)		Sira (n=20)		C.N.Halli (n=20)		Overall (n=100)	
1	Rainfed (Acres)	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
	a) Area under Field crops	1.63	95.32	8.25	100.00	3.76	93.76	3.34	100.00	0.91	100.00	3.58	98.08
	b) Area under Horticulture crops	0.08	4.68	0.00	0.00	0.25	6.24	0.00	0.00	0.00	0.00	0.07	1.92
	c) Area under Permanent fallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	1.71	100.00	8.25	100.00	4.01	100.00	3.34	100.00	0.91	100.00	3.65	100.00
2	Irrigated (Acres)												
	a) Area under Field crops	1.08	43.55	1.58	29.37	1.00	34.72	1.18	54.63	0.26	17.81	1.02	35.54
	b) Area under Horticulture crops	1.40	56.45	3.80	70.63	1.88	65.28	0.99	45.37	1.20	82.19	1.85	64.46
	c) Area under Permanent fallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	2.48	100.00	5.38	100.00	2.88	100.00	2.16	100.00	1.46	100.00	2.87	100.00
3	Total (Rainfed+Irrigated)												
	a) Area under Field crops	2.70	64.59	9.83	72.12	4.76	69.08	4.51	82.00	1.17	49.37	4.60	70.55
	b) Area under Horticulture crops	1.48	35.41	3.80	27.88	2.13	30.92	0.99	18.00	1.20	50.63	1.92	29.45
	c) Area under Permanent fallow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	4.18	100.00	13.63	100.00	6.89	100.00	5.50	100.00	2.37	100.00	6.52	100.00

Table 2. Irrigation source of sample farms

Source of Irrigation	Chitradurga (n=20)		Hiriyur (n=20)		Davanagere (n=20)		Sira (n=20)		C.N.Halli (n=20)		Overall (n=100)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Open well	0	0.00	2	11.76	0	0.00	4	26.67	0	0.00	6	8.33
Borewell	9	81.82	11	64.71	13	100.00	10	66.67	15	93.75	58	80.56
Canal	2	18.18	0	0.00	0	0.00	1	6.67	1	6.25	4	5.56
Open well & Borewell	0	0.00	4	23.53	0	0.00	0	0.00	0	0.00	4	5.56
Total	11	100.00	17	100.00	13	100.00	15	100.00	16	100.00	72	100.00

Table 3. Cropping pattern of sample households

Crop	% of gross cropped area											
	Chitradurga		Hiriyur		Davanagere		Sira		C.N.Halli		Overall	
	%	R*	%	R	%	R	%	R	%	R	%	R
A. Seasonal Crops												
Maize	8.33	4	1.28	10	64.99	1	5.41	7			17.43	1
Groundnut	13.10	3	28.27	1			14.01	2			15.11	2
Onion	47.62	1	15.20	2							12.96	3
Ragi			2.14	9	1.49	7	30.57	1	36.66	1	8.60	5
Sorghum	2.98	6	10.71	3	2.23	6	8.92	5	4.32	5	6.83	6
Tur			9.85	5	3.72	4	13.38	3	0.48	8	6.65	7
Sunflower	18.45	2	9.85	5							6.61	8
Soybean			10.28	4							4.12	9
Greengram							5.1	8	16.31	3	2.15	10
Bengalgram			2.57	8			1.27	10			1.20	13
Tomato					4.47	3			1.92	6	1.20	13
Banana			1.28	10	2.98	5					1.20	13
Horsegram							5.73	6			0.77	16
Cotton			1.07	14							0.43	17
Foxtail millet	2.38	7									0.34	18
Watermelon (seeds)			0.86	15							0.34	18
Sugarcane					1.49	7					0.34	18
Brinjal					0.74	10					0.17	21
Paddy									0.96	7	0.09	22
B. Perennial Crops												
Arecanut	5.95	5	1.28	10	16.01	2	13.06	4	30.71	2	9.57	4
Coconut	1.19	8	1.28	10	0.37	11	2.55	9	8.64	4	1.89	11
Pomegranate			3.85	7	1.49	7					1.89	11
Tuberose			0.21	16							0.09	22
Gross Cropped Area (Acres)	84.00		233.50		134.25		78.50		52.10		582.35	

Note: R*= Rank

coconut fetched highest net returns per acre (₹1,69,014) followed by pomegranate (₹1,51,500) and banana (₹ 1,32,000). However, in terms of undiscounted Benefit-Cost Ratio, tomato topped with 6.22 followed by brinjal and coconut with 6.00 and 5.98, respectively. Hence it was evident that perennial crops such as coconut, arecanut andpomegranate, etc. provided better yield, net returns and comparatively good B:C ratio. The average area under these crops was generally high as compared to other kharif and rabi crops. Moreover, prices of the produce from these perennial crops were higher as compared to other seasonal crops. So, all these factors led to higher net returns in case of perennial crops. These findings are in line with Nagaraj et al. (2014).

Season-wise costs and returns of crop enterprises

The costs and returns of crop enterprises in different seasons (*kharif, rabi,* annual and perennial) in selected tahsils as well as overall zone are presented in Table 5. It was found that compared to seasonal crops, perennials provided better net returns per acre (₹ 1,16,004) with a B:C ratio of 4.48 across all the selected tahsils. Similarly, second best net returns per acre was in the case of annual crops (₹ 1,12,667) and third was for rabi crops (₹ 22,702) with a B:C ratio of 4.61 and 2.79, respectively. Perennial crops in the study area include horticulture crops, namely,coconut, arecanut, pomegranate, etc. and annual crops include banana, sugarcane, etc. The average area under these crops was more compared to other seasonal crops and these crops were largely cultivated under irrigation. This led to high production and productivity of these crops. Also, prices of produce from these crops were higher compared to other seasonal crops. These all factorsled to higher net returns per acre as well as higher B:C ratio fetched by the perennial and annual crops in the study area.These findings are in line with Nagaraj *et al.* (2014).

Costs-returns profile of non-crop enterprises perherd

The non-crop enterprises considered for estimation of cost and returns were livestock enterprises (cow, buffalo, sheep, bulls and sericulture) and it was revealed that across all the selected tahsils in the study area, all these non-crop enterprises provided an average net income of ₹ 47,201 per year with a recurring cost of ₹ 35,401 per year. Among the five selected tahsils, Hiriyur respondents earned highest average net income per year (₹ 1,08,250) from these enterprises, followed by Chitradurgatahsil farmers (₹ 28,000). Also, among different enterprises, sheep and goat were the major ones with maximum number of units as well as highest net income per year across all the tahsils in the study area.Hiriyurtahsil contained maximum number of non-crop enterprises including sericulture which enabled the farmers of this tahsil to earn highest net income per

Table 4. Cost and returns of crop enterprises – by crops

Crop	Cropped Area (ac)	Cost of Cultivation (₹/ac)	Gross Returns (₹/ac)	Net Returns (₹/ac)	Yield of Main Product (q/ac)	Yield of By-product (q/ac)	Benefit-Cost Ratio
A. Seasonal Crops							
Bengalgram	3.50	7,571	17,671	9,586	6.00	10.00	2.26
Brinjal		1.00	10,000	60,000	45,000	100.00	6.00
Cotton	2.50	18,000	38,400	16,400	8.00		2.13
Foxtail Millet	2.00	5,000	17,500	12,150	4.00		3.50
Greengram	1.39	5,920	19,524	12,839	4.00	7.00	3.47
Groundnut	4.19	12,148	22,137	7,857	5.00	10.00	1.91
Horsegram	1.13	3,000	5,669	2,296	3.00	6.00	1.84
Maize	3.90	11,857	20,155	4,706	14.00	34.00	1.81
Onion	3.60	18,834	75,960	53,426	47.00		4.59
Paddy	0.50	24,000	34,800	2,400	16.00	40.00	1.45
Ragi	1.79	8,283	13,792	2,743	7.00	16.00	1.71
Sorghum	2.84	4,566	13,284	2,576	5.00	12.00	2.90
Soybean	24.00	8,333	18,958	9,813	5.00		2.28
Sunflower	4.28	7,039	21,662	13,885	6.00		3.75
Tomato	1.75	22,857	1,33,929	1,07,950	49.00		6.22
Tur	2.98	9,123	18,844	8,923	4.00	7.00	2.45
Watermelon (Seeds)	2.00	40,000	80,000	39,980	0.00		2.00
Banana	2.33	35,714	1,85,714	1,32,000	143.00		5.23
Sugarcane	2.00	35,000	96,000	45,000	400.00		2.74
B. Perennial Crops							
Arecanut	2.23	34,852	1,34,156	97,828	7.00		3.75
Coconut	1.10	33,636	2,07,636	1,69,014	19.00		5.98
Pomegranate	2.75	40,909	1,97,727	1,51,500	40.00		4.96
Tuberose	0.50	30,000	50,400	20,040	7.00		1.68

Table 5. Cost and returns of crop enterprises – by seasons and tahsils

Season	Taluk	Cropped Area (ac)	Cost of Cultivation (₹/ac)	Gross Returns (₹/ac)	Net Returns (₹/ac)	Benefit-Cost Ratio
Kharif	Chitradurga	3.42	12,231	47,368	31,976	3.37
	Hiriyur	5.48	10,686	26,697	13,921	3.09
	Davanagere	3.86	12,000	24,791	9,332	2.38
	Sira	1.63	8,549	15,722	4,526	1.96
	C.N.Halli	1.21	8,422	22,902	11,656	2.95
	Overall	3.16	10,846	27,823	14,247	2.67
Rabi	Chitradurga	2.60	11,077	24,754	11,004	3.54
	Hiriyur	4.35	15,487	46,273	28,108	2.83
	Davanagere	1.00	30,000	2,70,000	2,36,400	9.00
	Sira	2.50	8,400	13,348	3,346	1.68
	C.N.Halli	1.04	8,160	15,448	2,688	1.95
	Overall	2.98	13,501	38,875	22,702	2.79
Annual	Hiriyur	3.00	30,000	1,33,333	83,333	4.44
	Davanagere	2.00	38,333	1,82,000	1,27,333	4.66
	Overall	2.25	35,556	1,65,778	1,12,667	4.61
Perennial	Chitradurga	2.00	27,500	1,29,867	1,01,910	4.96
	Hiriyur	3.00	34,000	1,70,667	1,32,523	5.40
	Davanagere	2.88	34,348	1,34,130	98,242	3.76
	Sira	1.53	36,163	1,61,796	1,23,193	4.41
	C.N.Halli	1.46	40,000	1,66,829	1,23,673	4.50
	Overall	2.02	35,544	1,54,087	1,16,004	4.48

year compared to farmers of other tahsils in the zone. Sheep and goat were the major non-crop enterprises in the study area just like usual trends in all zones because of its minimum care requirement, less management cost and high unit returns per year compared to cattle, buffalo, etc. Similar results were reported by Kumar *et al.* (2003, 2006).

Table 6. Cost and returns of non-crop enterprises per herd

Tahsil	Enterprise	No.of Units*	Present Value(₹)	Establi-shment Cost (₹)	Life Span (Years)	Recurring Cost (₹/Year)	Gross Income (₹/Year)	Starting Year of Returns (Years)	Net Income (₹/Year)
Chitradurga	Buffalo	1.50	50,000	42,500	12.00	35,000	52,500	1.75	17,500
	Bullock	1.75	92,500	61,250	10.75	45,000	81,250	1.50	36,250
	Cow	2.00	60,000	53,333	11.33	31,667	55,000	2.33	23,333
	Sheep	15.00	75,000	40,000	6.00	30,000	60,000	2.00	30,000
	Overall	3.10	72,500	53,000	10.70	37,500	65,500	1.85	28,000
Hiriyur	Buffalo	3.00	70,000	55,000	13.50	57,500	1,25,000	2.00	67,500
	Bullock	2.00	70,000	51,667	13.00	36,667	61,667	2.33	25,000
	Cow	1.73	48,182	42,091	11.82	38,091	63,273	2.00	25,182
	Goat	61.50	3,07,500	53,500	6.50	46,000	460,000	1.00	4,14,000
	Poultry	15.50	5,000	1,750	1.50	2,750	9,000	1.00	6,250
	Sericulture	300.00	45,000	50,000	1.00	2,00,000	250,000	1.00	50,000
	Sheep	48.00	2,18,600	71,800	6.60	40,600	328,000	1.00	2,87,400
	Overall	27.88	1,01,654	47,981	9.46	44,019	1,52,269	1.65	1,08,,250
Davanagere	Buffalo	1.00	40,000	30,000	10.00	30,000	55,000	2.00	25,000
	Bullock	2.00	74,000	82,000	10.80	57,000	84,000	1.30	27,000
	Cow	2.00	60,000	52,030	12.00	40,650	62,000	2.00	21,350
	Sheep	1.00	7,000	6,000	7.00	2,000	8,000	1.00	6,000
	Overall	1.88	59,824	56,841	11.24	42,559	64,882	1.74	22,324
Sira	Buffalo	1.50	44,500	40,667	10.67	31,667	47,000	1.92	15,333
	Cow	2.13	54,125	50,500	10.50	36,250	57,500	1.88	21,250
	Poultry	4.00	1,200	700	2.00	500	600	1.00	100
	Sheep	10.00	50,000	35,000	7.00	20,000	45,000	1.00	25,000
	Overall	2.50	46,950	42,731	9.81	31,281	49,225	1.78	17,944
C.N.Halli	Buffalo	1.00	22,000	16,000	12.00	8,000	15,000	2.00	7,000
	Bullock	2.00	60,000	60,500	12.50	25,000	60,000	2.00	35,000
	Cow	1.88	49,375	39,875	10.88	30,750	47,625	1.81	16,875
	Goat	12.50	65,000	30,000	6.50	32,500	70,000	1.00	37,500
	Poultry	10.00	3,250	1,150	3.00	2,350	4,500	1.00	2,150
	Sheep	5.40	25,200	11,200	6.20	6,700	36,400	1.00	29,700
	Overall	4.60	39,975	28,715	8.70	20,360	42,350	1.48	21,990
Overall	Buffalo	1.67	47,417	40,417	11.42	34,417	58,917	1.92	24,500
(CDZ)	Bullock	1.93	76,429	66,500	11.50	44,643	75,000	1.68	30,357
	Cow	1.93	53,450	46,658	11.38	36,413	58,050	1.96	21,638
	Goat	37.00	1,86,250	41,750	6.50	39,250	2,65,000	1.00	2,25,750
	Poultry	11.00	3,540	1,300	2.20	2,140	5,520	1.00	3,380
	Sericulture	300.00	45,000	50,000	1.00	2,00,000	2,50,000	1.00	50,000
	Sheep	22.54	1,03,923	38,154	6.46	22,192	1,48,846	1.08	1,26,654
	Overall	10.34	66,693	44,964	9.83	35,401	82,602	1.67	47,201

*Unit is number of animals except in case of Sericulture wherein it is DFL (Disease Free Layings)

Conclusion

Maize, groundnut and onion were the most suitable crops in terms of soil, water and other resources in the study area. Coconut has provided the highest average net return of ₹ 1,69,000 per acre in a year with a B:C ratio of 5.98 followed by pomegranate (₹ 1,51,000 and 4.96, respectively). Since perennials and non-crop enterprises like sheep, goat, cattle, *etc.,* provided better net returns and B:C ratio, diversification of farming by adopting perennials, annuals and livestock enterprises is need of the day to maintain sustainable income in dryland farming. Considering the crucial role of irrigation in enhancing the productivity ofdrylands, necessary measures are needed from government side for increasing existing command area or providing assistance via subsidies for digging bore wells in order to exploit ground water resource.

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