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Analyzing the Economic Dynamics of Farming Systems in the Central Dry Zone of Karnataka

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Abstract

Farming in the Central Dry Zone (CDZ) of Karnataka is predominantly rainfed and majority of farmers are small and marginal, facing numerous challenges. At present situation, diversification becomes imperative to address economic hardships of farmers. The present study was conducted to analyze profitability of major farming systems and socio-economic factors determining their adoption in CDZ. Four major farming systems *viz.,* Crop + Sheep, Crop + Dairy, Crop + Horticulture + Dairy and Crop + Horticulture were considered for in depth analysis using the data collected using pre tested schedules through personal interview from 180 respondents, 45 each practicing these farming systems. Data were analysed using descriptive statistics and suitable functional analysis. The results reveals that, among the four farming systems, Crop + Horticulture + Dairy system was found to be the most profitable with higher per acre net returns (Rs.4,04,757) followed by Crop + Sheep, Crop + Dairy and Crop + Horticulture. Among the different enterprises considered for the study, coconut found to be the most profitable followed by arecanut, while in seasonal agricultural crops, ragi accounted for the highest returns per rupee of expenditure across the farming systems. With respect to employment generation, among crop and livestock enterprises, farmers derived more employment from livestock enterprise (54-84%) followed by horticulture crops (25-58%). The inclusion of livestock and horticultural crops in the farming systems not only provided higher income but also year round employment. Further, in the study the Herfindahl index used to know the diversification in sources of income revealed that the farming systems comprised of diary component were emerged as the most diversified farming systems. The results on multiple linear regression to delineate factors determining farm net income under different farming systems showed that area under annual crops, number of livestock and area under horticulture crops were found to be significant factors in all the farming systems.

Keywords : Farming systems, Diversification, Returns per rupee of expenditure

The agriculture and allied activities sector have been a significant contributor to the India's growth and development. India is projected to witness GDP growth rate between 6.0 to 6.8 per cent during 2023-24 (Anonymous, 2023). The agriculture sector has been growing at an average annual rate of 4.6 per cent over the last six years. India is also emerged as a net exporter of agricultural products, with 6 per cent growth in exports in 2022-23 over previous year. Agriculture sector contributed to 19.9 per cent in the country's GDP and employs a significant portion of the country's labor force, accounting for 45.5 per cent during 2020-21 (Anonymous, 2022).

Despite the agricultural sector's importance and its positive growth during the COVID-19 pandemic, farmers in India often find themselves at the bottom of the economic pyramid. Farmers face various

challenges in production, including inconsistent policy frameworks, unsustainable cropping patterns and limited access to technology and irrigation facilities, inadequate market linkages and vulnerability to exploitation by intermediaries. Addressing these issues and improving the economic condition of farmers for sustainable livelihood and growth is essential. These measures should focus on reducing the cost of agricultural inputs, increasing the value of crops through improved market access and streamlined processes, enhancing crop productivity, promoting sustainable agriculture, diversifying income sources through allied activities and decreasing dependency on agriculture. With limited scope for area expansion for farming, diversification in farming could be a key and viable solution, as it involves adding multiple enterprises to a farm, considering their technical feasibility, economic viability and marketing opportunities. Diversification reduces the risk associated with crops affected by distress factors, optimizes resource utilization, creates employment opportunities and helps smooth income throughout the year, ultimately for better prosperity for farmers. One potential avenue for diversification is the adoption of farming systems approach suitable to prevailing agroclimatic conditions. This approach involves integrating a set of activities within available resources and circumstances to maximize productivity and achieve additional farm income sustainably. This approach consists of interrelated components that are influenced by institutional, political, economic, social and environmental factors. By adopting a farming systems approach, farmers can improve efficiency in production, increase farm income and enhance their overall well-being by satisfying basic needs.

The Central Dry Zone (CDZ) of Karnataka, where agriculture is predominantly rainfed and farmers are mostly small and marginal landholders, faces various challenges. In such circumstances, diversification becomes imperative to address the farmer's economic hardships. In this background, present study was conducted to identify and analyze existing farming systems, assess their profitability and evaluate their impact on the socio-economic conditions of farmers in the CDZ with following specific objectives.

Objectives

1. To identify and estimate the economics of major farming systems in the study area.
2. To know the factors influencing income from different farming systems in study area.

METHODOLOGY

Study Area

The present study was taken up in the Central Dry Zone (CDZ) of Karnataka (Zone-4) which was known for frequent hit by droughts. This zone covers an area of 1.94 million hectares. The annual rainfall ranges from 454-718 mm of which more than 55 per cent is received during *kharif* season. The elevation ranges between 450-900 m and the soils are red sandy loams in major areas, shallow to deep black in the remaining areas.

Sampling Procedure

For the present study purposive multistage random sampling procedure was used. Seven taluks *viz*., Hiriyur, Holalkere and Hosadurga in Chitradurga district, Arsikere taluk in Hassan district and Chikkanaykana Halli, Sira and Tiptur taluks in Tumakuru districts were selected to proportionately represent three study districts of the CDZ. These three districts make up the cynosure of the entire Central Dry Zone. Among the numerous farming systems prevalent in the study area, four major farming systems of *viz.,* Crop + Sheep, Crop + Dairy, Crop + Horticulture + Dairy, Crop + Horticulture were considered for in depth analysis. Primary data were collected from the randomly selected 45 farmers each, who were practicing each of these chosen farming systems using the pre-tested well-structured schedule through personal interview method during May-June, 2023. Data regarding activities of the farming practices like details on cost incurred in cultivation of the field crops and horticulture crops, economics of the livestock enterprises, inventories, details of

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by-products and their usage in other enterprises and output derived from various enterprises including price realised and marketing details were collected from the sample farmers practicing the identified farming systems. The data were analysed using descriptive statistics and various cost and returns concepts. In order to know the degree of diversification of farm, Herfindahl index was used while multiple linear regression model was used to delineate the factors influencing farm income.

Herfindahl Index

It is the sum of the square of the proportion of income from an enterprise to the total income of a farm household.

$$HI = \sum_{i=1}^{N} Yi^2 \quad \text{_____(1)}$$

Where, $Y_i = \frac{Y_j}{Y_t}$

Y_j = Income from j^{th} enterprise for a farm household

Y_t = Total income of a farm household

The index value approaching one indicate specialization and value moving towards zero indicates diversification.

Multiple Linear Regression Analysis

To determine the factors influencing farm income, following form of multiple linear regression model was employed.

Income Model

$$Y = a+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+b_7X_7 \quad \text{_____ (2)}$$

Where,

Dependent variable was Y - Income of the farm household (Rs.)

Independent variables include

X_1 - Age of the head of the household (Years)

X_2 - Area under annual crops (acres)

X_3 - Family size (No.)

X_4 - Education level of the head of the household [Years of schooling]

X_5 - Herd size of milch animal (No.)

X_6 - Herd size of Sheep (No.)

X_7 - Area under horticulture crops (acres)

Results and Discussion

Cropping Pattern on Sample Farms

The information on crops cultivated on the sample farms practicing different farming systems are presented in Table 1, indicated that groundnut, ragi and maize were the dominant crops on the sample farms during *kharif* season, whereas bengalgram and sorghum were the major crops of *rabi* season. Further, the Farmers having borewell irrigation, cultivateded groundnut and onion crops during the summer season. Coconut and arecanut were the two major plantation crops grown on sample farms. For the present study, respondents were chosen in such a way that the crops grown by them were similar to the extent of at least seventy per cent so that they can be compared.

Among the respondents practicing identified farming systems, the cropping pattern followed by C+S system practicing farms revealed that ragi occupied 28.13 per cent of the gross cropped area followed by groundnut (26.49%), while maize (6.55%), red gram (5.06%), cotton (5.06%) and green gram (3.27%) together accounted for about twenty per cent of the gross cropped area in *kharif* season. In *rabi* season, bengalgram contributed for 18.60 per cent of the gross cropped area followed by sorghum (5.65%). In the case of C+D system, 37.29 per cent of the gross cropped area was covered by groundnut followed by maize (16.67), ragi (10.45%), cotton (7.63%), red gram (3.95%) and greengram (2.26%).

In the case of farmers practicing C+H+D system, as expected major share in gross cropped area was under perennial horticultural crops, in which coconut (13.59%) topped the list followed by arecanut (8.71%). Among the seasonal agricultural crops grown in *kharif,* 7.75 per cent was occupied by maize

TABLE 1

Cropping pattern in the study area *(ac)*

Crops	C+S (n=45)	C+D (n=45)	C+H+D (n=45)	C+H (n=45)
Land holding	2.58	3.18	4.36	4.31
Kharif				
Groundnut	44.50 (26.49)	66.00 (37.29)	39.50 (6.88)	22.00 (4.50)
Maize	11.00 (6.55)	29.50 (16.67)	44.50 (7.75)	25.50 (5.21)
Ragi	47.25 (28.13)	18.50 (10.45)	14.50 (2.53)	17.00 (3.48)
Onion	-	-	22.00 (3.83)	15.00 (3.07)
Redgram	8.50 (5.06)	7.00 (3.95)	14.00 (2.44)	4.00 (0.82)
Cotton	8.50 (5.06)	13.50 (7.63)	4.50 (0.78)	-
Greengram	5.50 (3.27)	4.00 (2.26)	3.50 (0.61)	4.00 (0.82)
Rabi				
Bengal gram	31.25 (18.60)	23.25 (13.14)	11.25 (1.96)	8.00 (1.64)
Sorghum	9.50 (5.65)	15.50 (8.76)	19.00 (3.31)	11.50 (2.35)
Summer				
Onion	-	-	6.50 (1.13)	5.00 (1.02)
Groundnut	2.00 (1.19)	-	-	-
Perennial				
Coconut	-	-	78.00 (13.59)	77.00 (15.75)
Arecanut	-	-	50.00 (8.71)	46.50 (9.51)
Banana	-	-	1.52 (0.26)	1.94 (0.40)
Gross cropped area	168	177	574	489
Net cropped area	125	132	304	233
Cropping intensity (%)	134	135	189	210

Note : Figures in parentheses indicate per cent to the gross cropped area under respective cropping systems. C+S: Crop+Sheep, C+D: Crop+Dairy, C+H+D: Crop+Horticulture + Dairy and C+H: Crop+Horticulture

followed by groundnut (6.88%), onion (3.83%), ragi (2.53%) and red gram (2.44%), while in *rabi* season sorghum and bengalgram (1.96%) accounted for about five per cent of gross cropped area. In the case of C+H farming system, of the total gross cropped area, 15.75 per cent was covered by coconut and 9.51 per cent was covered by arecanut, in addition maize (7.75%), groundnut (6.88%), ragi (3.48%), onion (3.07%) and redgram (0.82%) were the other crops grown in *kharif*, while in *rabi* season, sorghum (2.35%) and bengalgram (1.64%) were the crops grown by the farmers in the order of their importance in the gross cropped area.

The analysis of physical efficiency of land use indicated by cropping intensity revealed that the cropping intensity was found to be the highest in the case of C+H system (210%) followed by C+H+D (189%), C+S (135%) and C+D (134%) farming systems. It is evident from the results (Table 1) that groundnut, maize and ragi were the dominant crops in *kharif* season, bengalgram and sorghum were major crops in *rabi* season and coconut and arecanut were the perennial crops grown on sample farms. These results on cropping pattern on sample farms are on par with the general cropping pattern prevalent in the study districts and CDZ.

Livestock Possession of Sample Farmers Practicing Selected Farming Systems

Livestock rearing is a very important subsidiary occupation among farmers and agriculture labour in India. The information on livestock possessed by the farmers practicing different major farming systems is presented in Table 2. The examination of livestock wealth possessed by respondents practicing C+D system revealed that seven farmers possessed nine bullock pair, total of 113 cows reared by the forty-five sample farmers with an average of 2.51 animal per farm, 12 buffaloes were found with four respondents and 11 poultry birds with three farmers. Similarly, in the case of farmers practicing C+H+D system, every respondent possessed cows with an average of 2.71 animal per farm, only two farmers possessed three bullock pairs and two farmer had five buffalo. Six farmers of C+H system had eight bullock pairs.

TABLE 2

Livestock possession on sample farms practicing major farming systems *(Numbers)*

Particulars	C+S(n=45)	C+D(n=45)	C+H+D(n=45)	C+H(n=45)	Over all
Sheep	3259 (45) [325.90]	-	- -	- -	325.90
Goats	250 (21) [25.00]	-	- -	- -	25.00
Bullock pair	7 (5) [7.00]	9 (7) [9.00]	3 (2) [3.00]	8 (6) [8.00]	27.00
Cow(Cross breed + Local)	- -	113 (45) [79.10]	122 (45) [85.40]	- -	164.50
Buffalo	8 (5) [5.60]	12 (4) [8.40]	5 (2) [3.50]	2 (2) [1.40]	18.90
Poultry	16 (6) [0.16]	11 (3) [0.11]	7 (4)[0.07]	23 (8) [0.23]	0.57
TLUs	363.66	96.61	91.97	9.63	561.87
% of TLUs	64.72	17.19	16.37	1.71	100

Note : Figures in parentheses indicate number of farmers possessing livestock. Figures in square bracket represent per cent to Total Livestock Units (TLUs) C+S: Crop + Sheep, C+D: Crop+Dairy, C+H+D: Crop+Horticulture+Dairy and C+H: Crop + Horticulture

Similarly, examination of livestock on farms practicing C+S farming system, they had 3259 sheep while the per cent of respondents possessing other livestock was low with respect to goat (46.67%) and bullock pair (11.11%). In C+D farming system, dairy animals were reared by all the farm households while rearing of other animals was not much popular as they were possessed by a smaller number of respondents like bullock pair (15.56%), buffalo (8.89%) and poultry (6.67%). All the farmers were having dairy animals in C+H+D farming system but only 4.44 per cent farmers were having bullock pair. In the case of C+H system practicing farmers, 13.33 per cent of them had bullock pair to perform farm operations, while poultry (17.78%) and buffalo (4.44%) were reared by few households. The current study focused on ruminants because cattle and small ruminants (sheep and goats) will continue to be the region's predominant livestock, as they constitute approximately 65 per cent, 17 per cent and 16 per cent in the tropical livestock units (TLUs) under the C+S, C+D and C+H+D systems, respectively.

Economic-principal crops grown under the major farming systems were groundnut, maize and ragi in *kharif* season, bengalgram and sorghum in *rabi* season and perennial crops like coconut and arecanut. Among the four farming systems, C+H+D was found to be more profitable with returns per rupee expenditure of 1.35 for all the crops put together (Table 3). Thus, returns from crops were more with farmers practicing diversified farming compared to specialised farmers was accepted. Among the different crops, arecanut (Rs.51,105) accounted for the highest share (55.29%) in the net returns followed by coconut (32.15%), ragi (9.42%), groundnut (6.27%), bengalgram (5.41%), sorghum (4.26%) and maize (2.89%). While, in terms of returns per rupee of expenditure coconut showed the highest value (1.41) followed by arecanut (1.39), ragi (1.37), sorghum (1.30), bengalgram (1.25), groundnut (1.20) and the least was from maize (1.09).

Among the various crops, as expected, the gross returns, total cost incurred and net returns were found

TABLE 3

Economics of principal crops under major farming systems in the study area

(Rs./ac)

Farming systems	Crop	Gross returns	Total cost	Net returns		Returns per rupee of expenditure
				Value	Per cent	
C+S	Groundnut	30,901	26,491	4,410	18.75	1.17
	Ragi	31,202	21,769	9,433	40.10	1.43
	Maize	29,103	27,917	1,186	5.04	1.04
	Bengal gram	22,672	17,551	5,121	21.77	1.29
	Sorghum	16,203	12,828	3,375	14.35	1.26
	Total	1,30,081	1,06,556	23,525	100	1.22
C+D	Groundnut	32,744	27,738	5,006	21.36	1.18
	Ragi	30,511	22,825	7,686	32.79	1.34
	Maize	30,934	28,243	2,691	11.48	1.10
	Bengal gram	23,330	18,633	4,697	20.04	1.25
	Sorghum	16,436	13,077	3,359	14.33	1.26
	Total	1,33,955	1,10,516	23,439	100	1.21
C+H+D	Groundnut	34,432	28,635	5,797	6.27	1.20
	Ragi	32,342	23,634	8,708	9.42	1.37
	Maize	32,356	29,687	2,669	2.89	1.09
	Bengal gram	24,805	19,805	5,000	5.41	1.25
	Sorghum	17,132	13,190	3,942	4.26	1.30
	Arecanut	1,83,022	1,31,917	51,105	55.29	1.39
	Coconut	1,01,883	72,161	29,722	32.15	1.41
	Total	3,59,198	2,66,760	92,438	100	1.35
C+H	Groundnut	33,074	26,789	6,285	7.02	1.23
	Ragi	28,754	21,881	6,873	7.68	1.31
	Maize	32,326	29,687	2,639	2.95	1.09
	Bengal gram	22,038	18,085	3,953	4.42	1.22
	Sorghum	15,512	12,468	3,044	3.40	1.24
	Arecanut	1,80,725	1,29,470	51,255	57.25	1.40
	Coconut	98,478	69,843	28,635	31.99	1.41
	Total	3,49,079	2,59,553	89,526	100	1.34

Note : C + S : Crop + Sheep, C + D : Crop + Dairy, C + H + D : Crop + Horticulture + Dairy, C + H : Crop + Horticulture

to be higher in the case of perennials *viz.,* coconut and arecanut compared to other field crops in both C+H+D and C+H. Since, coconut and arecanut are the commercial crops, fetches higher and relatively stable unit prices compared to other field crops.

Among the different components, the percentage share in net returns from the system as a whole was more from ragi in the case of C+S (40.10%) and C+D (32.79%) farming systems. While in the case of C+H+D and C+H farming systems, the contribution

to net returns was higher from arecanut (55.29% and 57.25%) followed by coconut (32.15% and 31.99%).

Though, arecanut and coconut cultivation is more profitable compared to other field crops, farmers in the study area prefer groundnut, ragi, maize and sorghum over arecanut and coconut because of its lower cost of cultivation and ragi being staple food grains in the study region. In addition, the seasonal crops like ragi, maize, groundnut and sorghum provide fodder as by-product for milch and other livestock enterprises reared by farmers. Lack of irrigation facility and long gestation period were the other reasons influencing farmers not to take up the horticulture crops on a large scale in the study region, in spite of their high profitability.

Economics of Livestock Component under Major Farming Systems

Livestock enterprises constituted for the next major source of farm income after crops. Dairy and sheep were the livestock enterprises largely found in the study area. Among all the enterprises, dairy found to be more remunerative.

Farming system with C+D components showed net returns of Rs.76,656 per dairy animal per annum with Rs.2.12 returns per rupee of expenditure. The respective figures for C+H+D system was Rs.71,040 and 1.91. In the case of C+S system, the net returns realized per sheep was Rs.3,301 per annum. The income contribution from sheep and dairy components was having significant difference than the income contribution from crops to the total income (Table 4). The findings of the study on profitability of per dairy animal was on par with the findings of Saxena *et al.* (2017), who reported that livestock along with crop brings desired growth in farmer's income.

Cost and Return Structure from Different Farming Systems in the Study Area

The details on cost and return structure from the identified farming systems as a whole are represented in Table 5. It could be observed from the Table that C+H+D gave the highest profits (Rs.4,04,757/annum) to the farmer with a net returns per rupee expenditure of 1.46. The C+S system was found to be the next best system with net returns of Rs.2,98,352 per farm/annum and returns per rupee of expenditure of 1.60. These findings are in line with the study conducted by Kavyashree (2016) wherein she reported integrated farming system comprising of Crop + Dairy + Small ruminants was relatively more profitable.

Net returns from C+D and C+H were Rs.2,82,274 per farm/annum and Rs.2,19,180 per farm/annum, respectively, with the corresponding returns of Rs.1.53 and Rs.1.33 for every rupee of expenditure. Single factor Analysis of Variance (ANOVA) used to find out whether there exists any significant difference in cost, gross returns and net returns across farming systems. Results on calculated F values, being greater than Table 'F' values, revealed a significant difference with respect to cost incurred, gross and net returns across various farming systems considered for the study.

TABLE 4

Comparative economics of livestock enterprises under major farming systems

(Rs./animal /annum)

Farming systems	Enterprise	Gross returns	Total cost	Net returns	Returns per rupee of expenditure
C + S	Sheep	6,359	3,058	3,301	2.08
C + D	Dairy	1,45,296	68,640	76,656	2.12
C + H + D	Dairy	1,48,992	77,952	71,040	1.91

Note : C + S : Crop + Sheep, C + D : Crop + Dairy, C + H + D : Crop + Horticulture + Dairy

TABLE 5

Costs and returns of major farming systems in the study area

(Rs./annum)

Particulars	C +S (n = 45)	C + D (n = 45)	C + H + D (n = 45)	C + H (n = 45)	F value
Cost incurred	4,95,072	5,37,455	8,87,486	6,64,879	22.145 **
Gross Returns	7,93,424	8,19,729	12,92,243	8,84,059	22.819 **
Net Returns	2,98,352	2,82,274	4,04,757	2,19,180	30.787 **
Returns per rupee expenditure	1.60	1.53	1.46	1.33	of
Herfindahl Index	0.74	0.63	0.48	0.73	

Note : ** indicates significant at five per cent level of probability; C+S: Crop + Sheep, C+D: Crop + Dairy, C+H+D: Crop + Horticulture + Dairy and C+H: Crop + Horticulture

Diversification in sources of income

Herfindahl index was used to know the extent of income diversification across the farming systems. The results confirmed that C+H+D system (0.48) was found to be the more diversified system followed by C+D farming system (0.63), C+H farming system (0.73) and C+S farming system (0.74). As the diversification index was worked out using net income, so net income from different enterprises in C+D and C+H+D found to contributing more to the farm income as revealed by lower index value. Therefore, it it revealed that the farming system with animal and horticulture components along with crops as components showed more diversity compared to C+H farming system and C+S farming system which were having relatively less components and were specialized systems.

Contribution of different Enterprises to the Farm Net Income and Employment

Crop+Sheep

In the C+S farming system groundnut, maize, ragi in kharif and bengalgram and sorghum in *rabi* were crop enterprises cultivated on an area of 2.58 acres with seventy-two sheep per farm. Crop enterprises have contributed to only around 20 per cent of the total income whereas, due to very high remunerative nature sheep component contributed for about 80 per cent. Similarly, the majority (84.54%) of employment generation (384 days) was by sheep component compared to 70 days (15.46%) from crop enterprises. Further, from the results it is apparent that the returns per day of man employed not only found to be higher in sheep enterprise compared to crop enterprise in but also provided more man-days of employment from sheep rearing.

Crop+Dairy

Under C+D farming system, crop enterprise comprised of groundnut, maize, ragi grown in kharif and bengalgram and sorghum cultivated in *rabi* with an average area of 3.06 acres with an average number of 2.51 dairy animals per farm. In this system crops have contributed for 26.41 per cent and dairy contributed for 73.59 per cent of the total income. Employment generation from dairy unit was 178 days (67.40%) while employment from crop enterprises was 86 man days (32.60%). It is clear from the above results that dairy component (2.71 animals) could able to generate 3 times more income over crop and more than double employment opportunities to the farm families.

Crop+Horticulture+Dairy

Horticulture and dairy components have occupied the prominent position with respect to contribution in total income in C+H+D system, with corresponding share of 40.14 per cent (2.01 acres) and 44.05 per cent (2.51 animals) in the total income. The annual

crop (Rs.63,984/annum) component cultivated on 2.45 acres accounted for just over sixteen per cent the total income. Majority of human employment created was from dairy farming (54.09%) followed by horticulture (25.24%) and crop (20.68%). Thus, farm diversification towards enterprises like dairy and horticulture components together with the crop would generate higher income and employment to the farmers.

Crop+Horticulture

In C+H farming system, 2.28 acres of area was under seasonal crops and 2.09 acres was under horticulture crops. The seasonal crops generated net income of Rs.52,084 per annum while horticulture crops generated net income of Rs.1,67,096 per annum, which accounted for 23.76 per cent and 76.24 per cent of the farm net income, respectively. With regard to employment, seasonal agricultural crops contributed for 42.14 per cent while horticulture crops contributed for nearly two-third portion.

Factors Influencing Annual Farm Household Net Income

To find out the factors influencing annual farm household net income, multiple linear regression was estimated by taking annual farm household net income as dependent variable, age of respondents, landholding size, family size, education level of the respondent, number of dairy animals, number of sheep and area under horticulture crops as independent variables and the results are presented in Table 6.

TABLE 6

Factors influencing annual net income of farm households practicing different farming systems in the study area

Particulars	Parameter	C+S	C+D	C+H+D	C+H
Dependent Variable	y	Annual farm household income (in '000' Rs.)			
Intercept	a	15.50 (0.44)	28.35 (0.82)	47.03 (0.54)	14.67 (0.16)
Age of the respondent (Years)	b_1	-0.09 (-0.37)	0.07 (0.23)	-0.86 (-1.05)	-0.73 ** (-2.06)
Area under annual crops (ac)	b_2	21.13 *** (3.19)	20.71 *** (7.08)	23.57 ** (1.28)	23.09 ** (1.78)
Family size (No.)	b_3	1.39 (1.42)	0.89 (0.74)	1.90 (0.41)	0.81 (0.38)
Education level (Years of schooling)	b_4	0.11 (0.15)	0.59 (0.95)	1.80 (0.84)	0.61 (0.63)
Herd size of Milch animal (No.)	b_5	-	70.93 *** (14.16)	65.26 *** (1.16)	-
Herd size of Sheep (No.)	b_6	2.99 *** (19.93)	-	-	-
Area under Horticulture (ac)	b_7	-	-	76.18 ** (0.65)	74.54 ** (1.10)
R^2		0.91	0.88	0.74	0.80
Adjusted R^2		0.89	0.85	0.73	0.79
F value		76.51 ***	69.32 ***	19.43 ***	15.12 ***

Note : ***- Significant at 1 per cent, **- Significant at 5 per cent, *- Significant at 10 per cent and Figures in parentheses indicate t value. C + S : Crop + Sheep, C + D : Crop + Dairy, C + H + D : Crop + Dairy Horticulture, C + H : Crop + Horticulture

Crop+Sheep Farming System

In C+S farming system, the annual farm household net income was significantly influenced by area under annual crops and number of sheep animals. The coefficients for these inputs were positive and statistically significant at one per cent level of probability. It means as the area under annual crops increases by one acre, the annual net income would increase by Rs.21,130 similarly with addition of one sheep to the existing herd size, the net income would increase by Rs.2,990. The co-efficient for family size variable revealed that if one additional family member works on farm, the annual net income would increase by Rs.370, which appears to be low may be attributable to composition of a greater number of dependents in the family like children and aged parents. The higher value of co-efficient of multiple determination (0.86) indicated variables included in the model sufficiently explained farm household income. The model was found to be good fit to the data as revealed by significant F value (76.51).

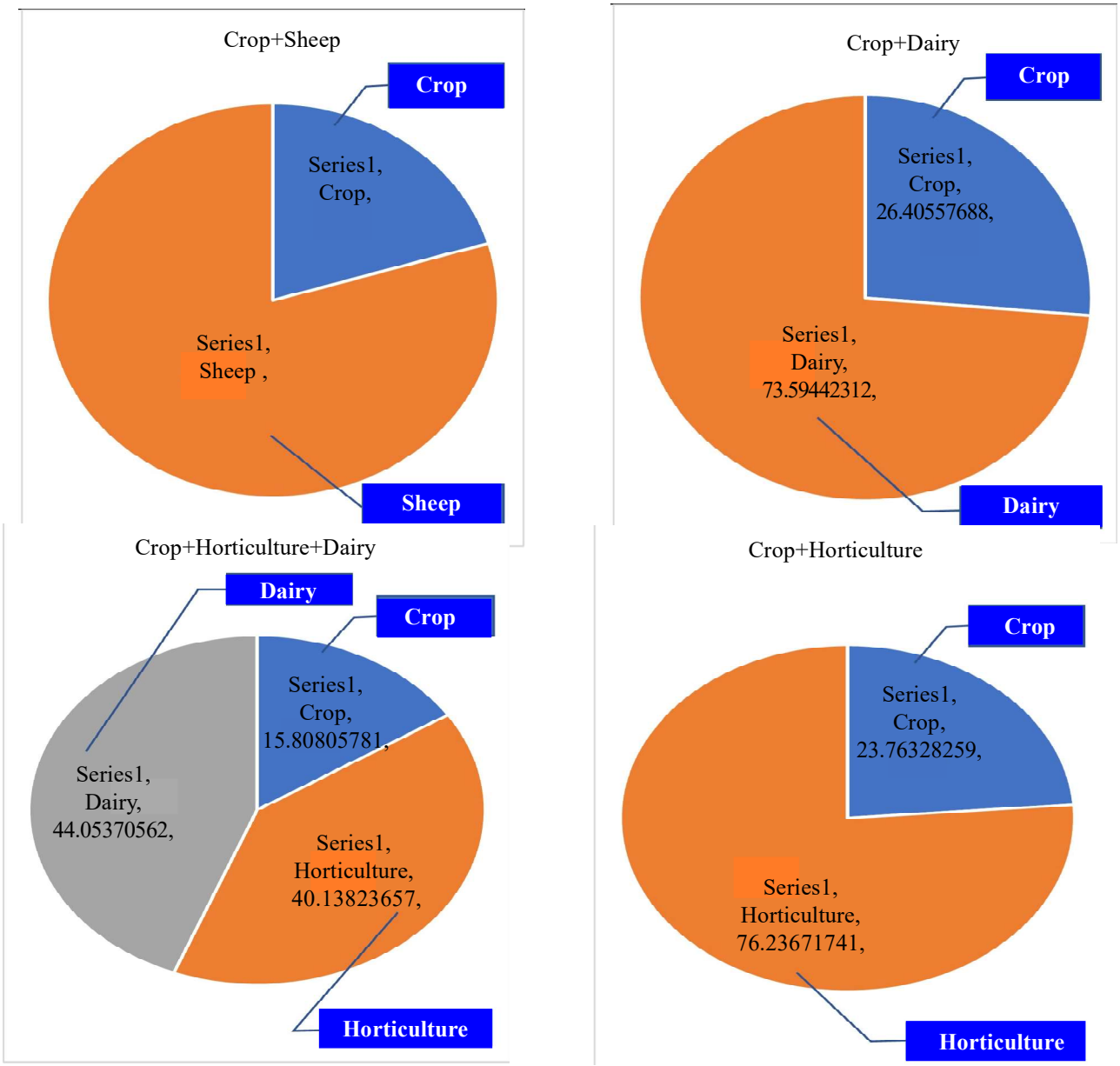

Fig. 1 : Contribution of different enterprises to farm income (%)

Crop+Dairy

Among all the independent variables, the coefficients for area under seasonal agricultural crops and number of dairy animals were found to be positive and statistically significant at one per cent probability level. In other words, as the area under seasonal agricultural crops increases by one acre, the annual net income would increase by Rs.20,710 while addition of one milch animal to the existing herd, the annual net income would increase by Rs.70,930. The co-efficient of multiple determination (0.85) revealed 85 per cent of the variation in annual net income was explained by the variables included in the model and model chosen was found to be a good fit as revealed by significant F-value.

Crop+Horticulture+Dairy

Under this system, area under annual crops, number of milch animal and area under horticulture crops were the major determinants of annual net income. The coefficient for area under annual crops and area under horticulture crops were found to be positive and found significant at five per cent which indicated that with one acre increase in area under field crops and horticulture would add Rs.23,570 and Rs.76,180 to the family net income. For every extra milch animal added to the existing number of milch animal, the annual net income increases by Rs.65,260 and coefficient for this variable was significant at one per cent level of probability. The R^2 value revealed inclusion of relevant independent variables in the model.

Crop+Horticulture

The annual net income under C+H was negatively influenced by age of the family head and positively influenced by land holding and coefficients for these variables were at 5 per cent probability. It demonstrated that, if the age of the family head increase by one year, the annual net income decreases by Rs.730 and for increase in one acre of land holding led to the increase in net income by Rs.23,090. Similarly, if farmers grow horticulture on additional one acre, the annual net income increase by Rs.74,540. The value of R^2 (0.80) demonstrated good fit of the model.

These findings on determinants of net income on farms practicing different farming systems are in line with the findings of Bharath (2020) who reported that farm size and livestock numbers had significant and positive influence on the farmer's income.

After through analysis of the four farming systems considered for the study, it was evident that the C+H+D system stands out as the most financially rewarding. It is crucial to promote such diversified farming approach within the agricultural community, taking into account factors such as resource availability, farmer knowledge and their preferences keeping in mind existing farm challenges. By embracing the highlighted profitable farming system, we have the potential to alleviate the possible distress faced by farmers and enhance their overall well-being.

Policy Recommendations

Promoting an ideal diversified farming system with all feasible components, among farmers residing in the Central Dry Zone of Karnataka and comparable regions is desirable through conduct of front-line demonstrations, training sessions and on appropriate technologies. This strategic approach addresses the existing inefficiencies in resource allocation within current farming systems. By doing so, farmers can effectively mitigate farm-related challenges, leading to minimized distress. Additionally, this approach offers manifold advantages, including cost reduction, income augmentation and decreased reliance on external borrowing.

Greater focus needs to be directed towards prioritising quality production from livestock enterprises due to their land-saving nature and substantial contribution to farmer's income. These endeavours complement crop-based activities by optimizing resource utilization and also serving to stabilize overall farm earnings.

Refrences

Anonymous, 2023, Annual Report (2021-22). MoSPI, national sample survey office, periodic labour force survey, New Delhi, pp. : 58.

Anonymous, 2023, Annual Report (2022-23). Ministry of Finance, Department of Economic Affairs, Economic Division, New Delhi, pp. : 12.

Bharath Kumar, H. E., 2020, Benefits of diversified farming systems: Evidences from a farm level study in Central Dry Zone of Karnataka. *M.Sc. Thesis* (*Unpub.*), Univ. Agric. Sci., Bengaluru.

Bhoi, B. K. and Dadhich, C. L., 2019. 'Agrarian distress in India: Possible solutions*' Indira Gandhi Institute of Development Research, Mumbai working papers 2019-017*, Indira Gandhi Institute of Development Research, Mumbai, India.

Kavyashree, P. V., 2016, Economics of integrated farming system (IFS) in Tumkuru district, central dry zone of Karnataka. *M.Sc. Thesis (Unpub.)*, Univ. Agric. Sci., Bengaluru.

Pavithra, K. N. and G. M. Gaddi, 2023, Vegetable based farming systems In Koramangala - Challaghatta (KC) valley project area: An econometric analysis. *Mysore J. Agric. Sci.,* **57** (1) : 452.

Pavithra, K. N. and Gaddi, G. M., 2022, Drivers of crop diversification: An empirical evidence from eternally drought prone area of Karnataka. *Mysore J. Agric. Sci.,* **56** (1) : 244 - 251.

Saxena, R., Singh, N. P., Choudhary, B. B., Balaji, S. J., Paul, R. K., Ahuja, U., Joshi, D., Kumar, R. and Khan, A. M. D., 2017, Can livestock sector be the game changer in enhancing the farmer's income? Reinvesting thrust with special focus on dairy sector. *Agric. Econ. Res. Rev.,* **30** : 59 - 76.

Udaykumar, M. S., 2017, Utilization and performance of formaland informal sources of credit by farm households across aural urban interface of Bengaluru. *M.Sc. Thesis (Unpub.)*, Univ. Agric. Sci., Bengaluru.

Zainab, N., 2011, Economic analysis of integrated farming systems in central dry zone of Karnataka. *M.Sc. Thesis (Unpub.)*, Univ. Agric. Sci., Bengaluru.