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An Economic Perspective of Determinants of Crop and Enterprise Diversification in Chamarajanagara District of Karnataka

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Authors Contribution

R. N. Nalinashree : Conceptualization of research work, execution of data collection, analysis of data & interpretation and preparation of manuscript;
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Abstract

Crop and enterprise diversification involves farmers expanding the variety of crops grown and engaging in different income-generating activities beyond traditional farming. This research study investigates the contrasting dynamics of rainfed and irrigated agriculture and their impact on crop and enterprise diversification in Chamarajanagara district of Karnataka. The primary data from 120 farm households in two taluks, namely Chamarajanagara and Kollegala, with equal representation from rainfed and irrigated agriculture was collected. The data was elicited through survey method during 2022-23. The study employed various statistical tools for analysis, which include descriptive statistics, Herfindahl Index (HI) and Tobit model. In the study area, the crops cultivated were sunflower, ragi, maize, horse gram, bengal gram, sugarcane, paddy, banana and maize. Additionally, farmers have diversified their enterprises, engaging in various activities such as crops, horticulture, dairy and small ruminants. The results revealed that, irrigated agriculture had a slightly higher crop diversification index compared to rainfed agriculture. Contrarily, enterprise diversification was observed more in rainfed conditions. The Tobit model indicated that age of head of the family, agriculture land holdings and production of staple food crops for family consumption were significantly influenced crop diversification. As for enterprise diversification, family size, age, irrigation conditions and the number of enterprises adopted were identified as significant determinants. The limited enterprise diversification in irrigated conditions is primarily attributed to the farmers focus on commercial crops, despite ample opportunities for diversification. From the point of view of economic perspective and to improve the economic status of farmers, there is a need to educate farmers on the importance of crop and enterprise diversification and market orientation.

Keywords : Crop diversification, Enterprise diversification, Herfindahl index, Rainfed and irrigated agriculture

The Agricultural landscape of India stands at a pivotal juncture, where the pursuit of sustainable growth and resilience necessitates a re-evaluation of traditional practices. In the context of Indian agriculture, the imperative for crop and enterprise diversification stems from multifaceted challenges. Climate change-induced uncertainties, diminishing land holdings, fluctuating market demands and the imperative to enhance farmer incomes collectively underscore the urgent need for diversification strategies. Crop diversification, involving the cultivation of a variety of crops and enterprise diversification, encompassing the expansion into multiple agricultural or non-agricultural ventures, have emerged as potential pathways towards agricultural sustainability and economic growth.

In general, diversification is a strategy to optimize the use of land, water and other farm resources particularly for risk reduction, stabilization of farm income, augmenting farm employment and overall agricultural development. Diversification is the

process of utilization of the various emerging opportunities created by new market, technology, changes in governmental policies, higher profitability and also stability in the production system. It is a useful strategy for reducing the risk in farming (Berman *et al.*, 2022).

The crop diversification refers to a mix of farming systems rather than the shift from one given enterprise to another (Inoni *et al*., 2021). It refers to the shift from monoculture cropping systems towards a diversified portfolio of crops. Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk (Satishkumar and Umesh, 2017). Similarly, enterprise diversification signifies the expansion of agricultural activities into varied enterprises beyond traditional farming, including livestock, horticulture, agro-processing and non-farm activities. These diversified enterprises offer avenues to boost rural employment, income generation and overall socio-economic development. Diversification of crops has immense potential as an economic driver within the agricultural sector (Kumar and Gupta, 2015).

Chamarajanagara district, situated in the southern part of Karnataka, embodies a unique agricultural landscape marked by diverse crops, varied topography, and a blend of traditional and modern farming practices. It has both rainfed and irrigated farming. This distinctive agricultural contrast provides a compelling backdrop to study diversification extent and its influencers. The district's diverse crops, shaped by varying socio-economic factors, water resources, and market dynamics, emphasize the necessity to explore factors driving diversification choices. Investigating these complex aspects impacting crop diversification in both rainfed and irrigated zones holds immense value in devising strategies for agricultural sustainability, climate risk mitigation and improving farmer livelihoods. In this context, the present study was undertaken to assess the extent of diversification and the economic determinants of crop and enterprise diversification in Chamarajanagara district of Karnataka.

Methodology

The research was conducted in Chamarajanagara district of Karnataka state, employing a purposive random sampling approach to select farmers. The primary data from 120 farm households in two taluks, namely Chamarajanagara and Kollegala, with equal representation from rainfed and irrigated agriculture was collected. To ensure a comprehensive perspective, farmers were chosen from both command and groundwater irrigation areas - Kollegala taluk represented command area irrigated farmers, while Chamarajanagara taluk encompassed groundwater irrigated farmers. The data was elicited through a personal interview method utilizing a well-structured and pre-tested schedule, focusing on factors such as age, education, land holdings, cropping pattern and income for the agricultural year 2022-23. The study employed various statistical tools for analysis, which include descriptive statistics, Herfindahl Index for assessing extent of diversification and Tobit model for estimating determinants of crop and enterprise diversification.

Herfindahl Index (HI)

Herfindahl Index (HI) is a measure of the concentration. It is the sum of square of the proportion of area under each crop to the total cropped area and it is given equation.

$$\text{Herfindahl Index (HI)} = \sum_{i=1}^{N} P_i^2$$

Where, P_i represents the proportion of area under i^{th} crop in the net sown area.

Then based on the index value, inference can be made as region is specialized if the value is closer to one and region is said to be adopting diversified copping pattern if index value approaches zero.

In the present study, the enterprise diversification was computed by taking sum of square of the proportion of income under each enterprise in relation to the total income. A higher value of HI indicates less diversification (*e.g.,* HI closer to 1 signifies high concentration of income among fewer enterprise categories). Conversely, a lower value of

HI (approaching zero) indicates more diversification, signifying income distributed across a wider array of enterprise categories.

Tobit Regression Model

Tobit model, also called censored regression model, is designed to estimate linear relationships between variables when there is either left or right-censoring in the dependent variable (Raghavendra and Suresh, 2018). Tobit model was employed to identify the factors which determine the crop diversification and enterprise diversification in the study area, measured by using Herfindahl Index (Dube, 2016).

Tobit model is a statistical model to describe the relationship between the non-negative censored dependent variable Yi and independent variable Xi. Tobit model can be described in terms of a latent variable Yi*. Yi*is observed when Yi*>0 and Yi* is not observed when Yi*d≤0.

So the observed Yi is defined as: Yi = {Yi* = βXi + e_i, if Yi*>0}

{0, if Yi*d≤0}

where:

Y_i* = dependent variables

βi = regression parameters/coefficients,

e_i = error term,

X_i = vector of explanatory variables listed/ mentioned below.

The model specification for the Tobit regression model for estimation of determinants of crop diversification is given as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + e_i$$

Where,

Y_i = Herfindahl Index (HI) for crop diversification

X_1 = Agricultural land holding (acres)

X_2 = Average family size (No.)

X_3 = Education of household head (=1 if literate, 0 otherwise)

X_4 = Irrigation facilities in the farm (=1 if irrigated, 0 otherwise (rainfed)

X_5 = Age of household head (No. of years)

X_6 = Total off farm income (Rs./ year)

X_7 = Crop production for household consumption (=1 if Yes, 0 otherwise)

X_8 = Access to institutional participation (=1 if Yes, 0 otherwise)

X_9 = Distance from urban place (km)

X_{10} = Taluk of the farmer (0 if Chamarajanagara taluk, 1 if Kollegala taluk)

The model specification for the Tobit regression model for estimation of determinants of enterprise diversification is given as :

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + e_i$$

Where,

Y_i = Herfindahl Index (HI) for enterprise diversification

X_1 = Agricultural land holding (acres)

X_2 = Average family size (No.)

X_3 = Education of household head (=1 if literate, 0 otherwise)

X_4 = Irrigation facilities in the farm (=1 if irrigated, 0 otherwise (rainfed))

X_5 = Age of household head (No. of years)

X_6 = Access to credit (1=Yes, 0 otherwise)

X_7 = No. of different enterprises adopted by farmer

X_8 = Access to institutional participation (1 if Yes, 0 otherwise)

X_9 = Taluk of the farmer (0 if Chamarajanagara taluk, 1 if Kollegala taluk)

Tobit model is also called as censored regression model because some observation are censored, *i.e.* Yi*d≤0.

Results and Discussion

Socio-Economic Profile of Farmers in Chamarajanagara District

It is seen from the Table 1 that, in Chamarajanagara taluk, the socio-economic profile of irrigated farmers reveals a trend where older individuals (>50 years) constitute a significant portion, indicating an ageing farming population engaged in agriculture. These individuals, despite limited educational opportunities, primarily possess primary schooling. Similarly, in rainfed areas within the same taluk, the majority of farmers also belong to the older age group (>50 years), showcasing a shared demographic trend with the irrigated areas.

In case of Kollegala taluk, irrigated farmers exhibit a more diverse age group distribution, suggesting a wider demographic involvement in agriculture, spanning across both older and middle-aged categories. Moreover, a considerable proportion of these farmers have attained secondary education, possibly indicating higher literacy rates compared to Chamarajanagara's rainfed regions. In Kollegala's rainfed areas, the age group distribution aligns with the trend observed in Chamarajanagara, portraying an over representation of older farmers (>50 years). Among different categories of farmers, the rainfed famers are having highest illiteracy (56.67%). However, there's a higher prevalence of primary and secondary education among rainfed other farmers, potentially indicating some progress in educational accessibility or retention of education within this agricultural community. The observed average family sizes, ranging from 3 to 4 members across the study area suggest a predominant trend towards nuclear family structures.

Table 1

Socio-economic profile of farmers in Chamarajanagara district

(n=120)

Particulars	Chamarajanagara (n=60)				Kollegala (n=60)			
	Irrigated (30)		Rainfed (30)		Irrigated (30)		Rainfed (30)	
	No.	% to total	No.	% to total	No.	% to total	No.	% to total
Age group								
a) <35 Years	-	-	1	3.33	2	6.67	1	3.33
b) 35-50 Years	14	46.67	9	30.00	6	20.00	11	36.67
c) >50 Years	16	53.33	20	66.67	22	73.33	18	60.00
Total	30	100.00	30	100.00	30	100.00	30	100.00
Educational status								
a) Illiterates	9	30.00	17	56.67	4	13.33	3	10.00
b) Primary (1st to 7th std)	13	43.33	10	33.33	8	26.67	12	40.00
c) Secondary (8th to10th std)	6	20.00	2	6.67	11	36.67	15	50.00
d) PUC (1st and 2nd PUC)	2	6.67	1	3.33	7	23.33	-	
Total	30	100.00	30	100.00	30	100.00	30	100.00
Average size of family (No.)	4.03	-	3.33	-	3.93	-	4.60	-

Fig. 1, depicts the occupational distribution among farm households in Chamarajanagara district. In Chamarajanagara taluk, under irrigated conditions, the primary occupation for the majority (46.9%) of farmers was agriculture and allied activities, followed by those engaged in both agriculture and agricultural labour (34.4%). Only a small proportion (6.3%) solely practices agriculture. Among rainfed farmers, the predominant occupation (47.1%) was combination of agriculture and agriculture labour services, followed by those involved in agriculture and other activities (26.5%), agriculture and allied activities (17.6%) and mere 8.8 per cent solely dedicated to agriculture.

In Kollegala taluk, within the irrigated areas, the majority of farmers (56.7%) focus exclusively on agriculture, mainly cultivating crops like sugarcane and paddy due to being in the command area. About 16.7 per cent of farmers engage in both agriculture and allied activities, while around 13.3 per cent were involved in agriculture labour services and an equal percentage participate in additional activities alongside agriculture. For rainfed farmers, the primary occupation (53.3%) involves raising dairy and small ruminants alongside agriculture followed by 46.7 per cent of them engage in agricultural labour with agricultural activities and none exclusively rely on agriculture due to water scarcity and limited resources, prompting them to diversify their livelihood sources.

Land Holding Pattern and Sources of Irrigation

In both Chamarajanagara and Kollegala taluks, a distinct disparity in landholding patterns and sources of irrigation emerges between their irrigated and rainfed areas Table 2. In both the taluks the irrigated farmers possess larger landholdings with an average of 3.17 and 2.68 acres in Kollegala and Chamarajanagara taluk respectively, as compared to the rainfed conditions where the average landholding was 2.03 acres in case of Chamarajanagara and 1.92 acres in case of Kollegala. Moreover, in both irrigated areas of Chamarajanagara and Kollegala, the majority of farmers fall into the marginal and small categories, indicating a prevalence of smaller landholdings, particularly in rainfed agriculture where 63.33 per cent of farmers in Chamarajanagara and 73.33 per cent in Kollegala hold less than 2.5 acres.

Regarding irrigation sources, notable distinctions exist in the study areas. In the irrigated areas of Chamarajanagara, bore wells and open wells are the primary sources of irrigation, utilized by 80.00 per cent and 40.00 per cent of farmers, respectively. Similarly, in Kollegala's irrigated regions, open wells (70.00%) and canal (53.33%) serve as the primary sources of irrigation.

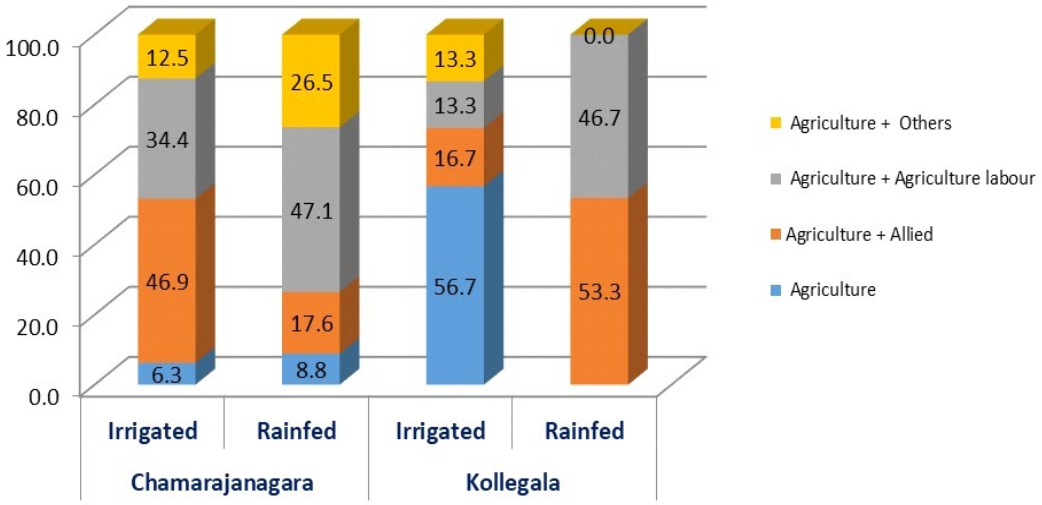

Fig. 1 : Occupational pattern of farm households in Chamarajanagara district

TABLE 2

Land holding pattern and sources of irrigation of farmers in Chamarajanagara district

(n=120)

Particulars	Chamarajanagara (n=60)				Kollegala (n=60)			
	Irrigated (30)		Rainfed (30)		Irrigated (30)		Rainfed (30)	
	No./ Acres	% to total	No./ Acres	% to total	No./ Acres	% to total	No./ Acres	% to total
Average land holding (ac)	2.68	-	2.03	-	3.17	-	1.92	-
Category of farmers (No.)								
a) Marginal (<2.5 ac)	15	50.00	19	63.33	14	46.67	22	73.33
b) Small (2.5-5 ac)	14	46.67	11	36.67	13	43.33	8	26.64
c) Medium (5-10 ac)	1	3.33	-	-	3	10.00	-	-
d) Large (>10 ac)	-	-	-	-	-	-	-	-
Total	30	100.00	30	100.00	30	100.00	30	100.00
Sources of irrigation (No.)								
a) Open well	12	40.00	-	-	21	70.00	-	-
b) Bore well	24	80.00	-	-	-	-	-	-
c) Tube well	-	-	-	-	7	23.33	-	-
d) Canal	-	-	-	-	16	53.33	-	-

Cropping Pattern of Farmers

Fig. 2, represents the cropping pattern in Chamaraja nagara taluk. In the irrigated conditions, majority cultivated crops were sugarcane (41%), followed by banana (22%), bengal gram (9%) and maize (8%). Other cultivated crops were green gram, ragi, coconut and oil palm (Fig. 2a). In case of rainfed conditions, the major crops grown were sunflower (36%), horsegram (20%), Bengal gram (20%), ragi (11%), jowar (7%) and maize (6%) as represented in Fig. 2b.

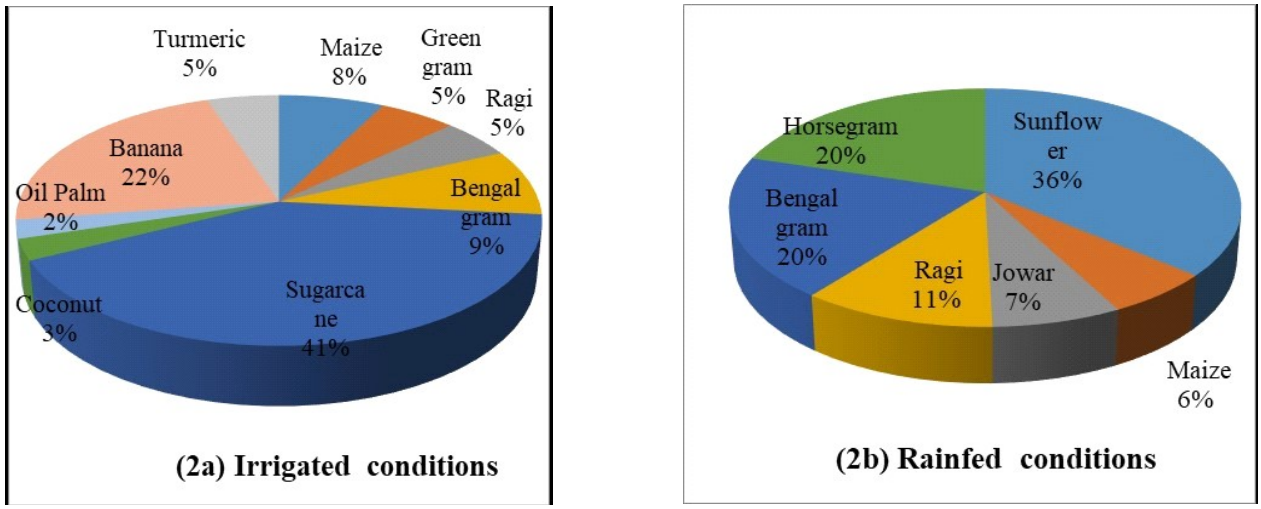

Fig. 2 : Cropping pattern of farmers in Chamarajanagara taluk

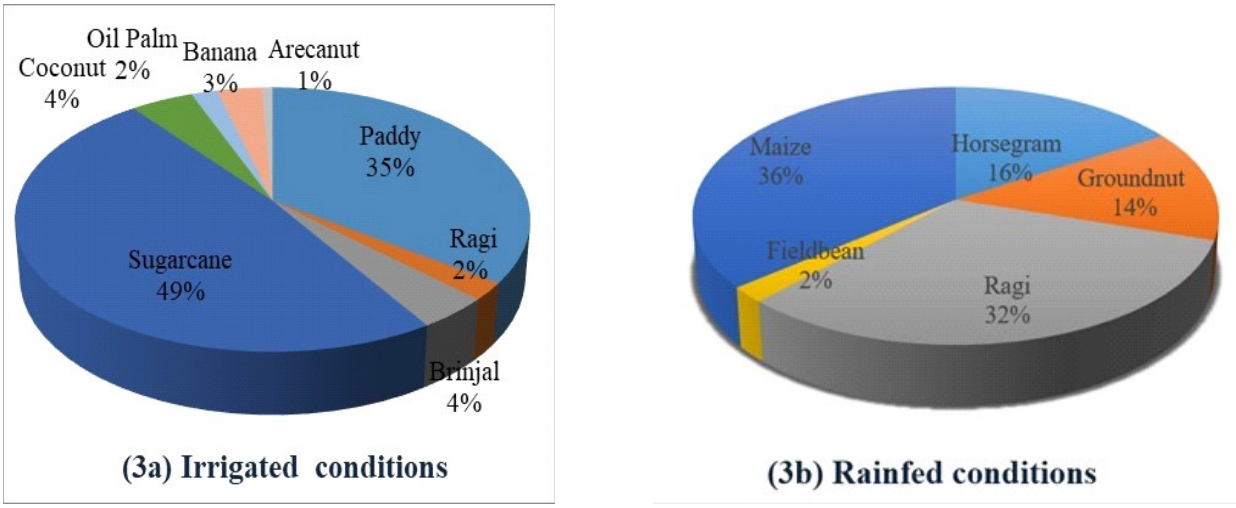

Fig. 3 : Cropping pattern of farmers in Kollegala taluk

Fig. 3, shows the cropping pattern followed by farmers in Kollegala taluk. In irrigated conditions, major crops cultivated were sugarcane (49%) and paddy (35%). Additionally, other crops like brinjal, coconut, banana, ragi and oil palm were cultivated to some extent, as depicted in Fig. 3a. Under rainfed conditions, the prominent crops were maize (36%), followed by ragi (32%), horsegram (16%), groundnut (14%) and field bean (2%), as shown in Fig. 3b. In both taluks, rainfed farmers cultivate crops exclusively during the *kharif* season when rainfall occurs due to the absence of irrigation facilities. It was observed that the number of crops grown by irrigated farmers was more than non-irrigated farmers in both the taluks. Similar results were observed by Basavaraj *et al.*, (2016).

Table 3, represents the enterprise diversification by farmers in Chamarajanagara district. In the district farmers are practicing dairy, small ruminants and

TABLE 3

Enterprises diversification by farmers in Chamarajanagara district

(n=120)

Enterprises	Chamarajanagara (n=60)				Kollegala (n=60)			
	Irrigated (30)		Rainfed (30)		Irrigated (30)		Rainfed (30)	
	No.	% of adoption	No.	% of adoption	No.	% of adoption	No.	% of adoption
Crop	10	33.33	22	73.33	12	40.00	2	6.67
Crop + Horticulture	7	23.33	-	-	7	23.33	-	-
Crop + Horticulture + Dairy	3	10.00	-	-	5	16.67	-	-
Crop + Dairy	8	26.67	6	20.00	5	16.67	18	63.33
Crop + Small ruminants	-	-	-	-	-	-	4	13.33
Crop + Dairy + Small ruminants	2	6.67	2	6.67	1	3.33	6	16.67
Total	30	100.00	30	100.00	30	100.00	30	100.00

horticulture in addition to the agriculture. In irrigated areas of Chamarajanagara, the most prevalent approach among farmers involves a dual focus on crop cultivation and dairy farming, with 26.67 per cent adopting this combination, followed closely by those solely dedicated to crop cultivation constitutes 33.33 per cent. Around, 23.33 per cent engage in both crop and horticulture, while a smaller segment, constituting 10.00 per cent, integrates crop, horticulture and dairy farming. Conversely, in the rainfed areas, a significant 73.33 per cent of farmers predominantly focus on crop cultivation, while 20.00 per cent combine crop cultivation with dairy farming.

In Kollegala taluk's irrigated conditions, crop cultivation emerges as the primary occupation for 40.00 per cent of farmers, followed by 23.33 per cent of farmers involved in both crop and horticulture. Around 16.67 per cent concurrently manage crop, horticulture and dairy farming, while an equal percentage of farmers are involved in both crop cultivation and dairy farming. A smaller segment, constituting 3.33 per cent, integrates crop cultivation, dairy farming and small ruminant rearing within the irrigated areas of Kollegala. In the rainfed conditions, the majority, accounting for 63.33 per cent, adopted a combination of crop cultivation and dairy farming, while 13.33 per cent engaged in crop cultivation and small ruminant rearing. Around, 16.67 per cent strategically integrated crop cultivation, dairy farming and small ruminant rearing. Only 6.67 per cent of farmers primarily focuses on crop cultivation in Kollegala's rainfed areas.

Extent of Crop Diversification and Enterprise Diversification

In Chamarajanagara district, comparing irrigated and rainfed conditions reveals intriguing differences in agricultural dynamics Table 4. In both the taluks the net and gross cultivated area is slightly high in irrigated conditions. Rainfed areas despite having smaller gross and net cropped areas, measuring 2.48 and 2.03 acres in Chamarajanagara taluk and 2.23 and 1.92 acres in Kollegala taluks, respectively, demonstrate a notably higher cropping intensity at 122.17 per cent and 116.15 per cent respectively, when compared to irrigated regions.

Herfindahl Index (HI) is a measure of the diversification, it depicts that the region is specialized if the value is closer to one and region is said to be adopting diversified copping pattern if index value approaches zero. The irrigated farms exhibit slightly higher crop diversification with a HI value of 0.74 and 0.61 in Chamarajanagara and Kollegala taluks compared to rainfed conditions with the HI values of 0.82 and 0.73 respectively. However, the HI for enterprise diversification presents contrasting results. In Chamarajanagara taluk, irrigated farms demonstrate more diversification (0.78) compared to rainfed farms (0.88), potentially due to the shift towards agricultural labour services amidst limited resources. Conversely,

TABLE 4

Crop and enterprise diversification by farmers in Chamarajanagara district

(n=120)

Particulars	Chamarajanagara (n=60)		Kollegala (n=60)	
	Irrigated (30)	Rainfed (30)	Irrigated (30)	Rainfed (30)
Gross cropped area (ac)	2.93	2.48	3.75	2.23
Net cropped area (ac)	2.68	2.03	3.17	1.92
Cropping intensity (%)	104.64	122.17	118.30	116.15
Herfindahl Index for crop diversification	0.74	0.82	0.61	0.73
Herfindahl Index for enterprise diversification	0.78	0.88	0.86	0.63

in Kollegala taluk, rainfed farmers exhibit higher diversification (0.63) due to the engagement in livestock activities, while irrigated farmers specialize more (HI of 0.86) by focusing on commercial crops like sugarcane and paddy, leveraging abundant water resources.

Distribution of Farmers Across Different Levels of Diversification

Table 5 shows the distribution of farmers based on the Herfindahl Index (HI) for crop diversification in Chamarajanagara district. In Chamarajanagara taluk's irrigated conditions, 26.67 per cent of farmers fall into the category of HI less than 0.50, indicating a moderate level of crop diversification, while 23.33 per cent fall within the 0.51-0.75 range and half of the farmers fall under HI value more than 0.90 indicating more specialisation. Under the rainfed conditions, a larger proportion, 63.33 per cent, demonstrate a lower diversification (>0.90), signifying a narrower focus on specific crops. In the irrigated conditions of Kollegala, substantial number of the farmers fall under the HI range of less than 0.75 indicating a moderate diversification. Conversely, rainfed areas in Kollegala demonstrate least crop concentration, with half of the farmers exhibiting HI more than 0.90 followed by 36.37 farmers representing HI value less than 0.5 indicating a moderate diversification.

The distribution of farmers based on the Herfindahl Index (HI) for enterprise diversification in Chamarajanagara district is presented in Table 6. In Chamarajanagara taluk's irrigated regions, only 23.33 per cent of farmers exhibited a low Herfindahl index (<0.50), suggesting a moderate diversified enterprise portfolio, while 26.67 per cent fall with in the 00.51-0.75 range and around 33 per cent showed low diversification with HI value more than 0.90. Rainfed areas in Chamarajanagara showcase a contrasting trend, majority (73.33%) falling in the HI range of <0.90, indicating a more concentrated enterprise structure. In Kollegala taluk, majority of the irrigated farmers fall under HI value more than 0.90 indicating specialisation. Whereas 26.67 per cent farmers fall in HI range of 0.51-0.75, indicating moderately low diversification. And only 13.33 per cent in the <0.50 range indicating a moderate diversification strategy. Conversely, rainfed areas in Kollegala present a different scenario, with 16.67 per cent demonstrating a low Herfindahl Index (<0.50) representing moderate diversification and a substantial majority (66.37%), falls in HI range of 0.51-0.75 indicating moderate diversification. These results underscore varying enterprise diversification strategies between irrigated and rainfed areas with in Chamarajanagara and Kollegala taluks, indicating the influence of water availability and farming conditions on farmer's enterprise choices.

Determinants of Crop Diversification and Enterprise Diversification

Table 7 presents the variables identified as potential influencers on crop and enterprise diversification in

TABLE 5

Distribution of farmers according to Herfindahl diversification index for crop diversification

(n=120)

Herfindahl Index for crop diversification	Chamarajanagara (n=60)		Kollegala (n=60)	
	Irrigated (30)	Rainfed (30)	Irrigated (30)	Rainfed (30)
<0.50	8 (26.67)	6 (20.00)	11 (36.67)	11 (36.37)
0.51-0.75	7 (23.33)	5 (16.67)	13 (43.33)	4 (13.33)
0.76-0.89	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
>0.9	15 (50.00)	19 (63.33)	6 (20.00)	15 (50.00)
Total	30 (100.00)	30 (100.00)	30 (100.00)	30 (100.00)

TABLE 6

Distribution of farmers according to Herfindahl diversification index for enterprise diversification

(n=120)

Herfindahl Index for enterprise diversification	Chamarajanagara (n=60)		Kollegala (n=60)	
	Irrigated (30)	Rainfed (30)	Irrigated (30)	Rainfed (30)
<0.50	7 (23.33)	2 (6.67)	4 (13.33)	5 (16.67)
0.51-0.75	8 (26.67)	6 (20.00)	8 (26.67)	20 (66.67)
0.76-0.89	5 (16.67)	0 (0.00)	6 (20.00)	3 (10.00)
>0.9	10 (33.33)	22 (73.33)	12 (40.00)	2 (6.67)
Total	30 (100.00)	30 (100.00)	30 (100.00)	30 (100.00)

the study area. The mean Herfindahl Index for crop diversification stands at 0.73 and a standard deviation of 0.26 reflecting a range of diversification levels across farmers. Similarly, the mean Herfindahl Index for enterprise diversification at 0.78 and a standard deviation of 0.23, indicating less diversification levels among farmers.

Socio economic variables such as agricultural land holding, with a mean of 2.45 acres and a standard

TABLE 7

Variables description and summary statistics used in the Tobit model

Variable	Description	Mean	Std. Dev.
HHI for crop diversification	Herfindahl Index for crop diversification (ranges between 0-1)	0.73	0.26
HHI for enterprise diversification	Herfindahl Index for enterprise diversification (ranges between 0-1)	0.78	0.23
Agricultural land holding	Total agricultural land holding (acres)	2.45	1.44
Family Size	No. of members in the family	3.98	1.31
Education	Education of household head (=1 if literate, 0 otherwise)	0.73	0.44
Irrigation	Irrigation facilities in the farm (=1 if irrigated, 0 otherwise (rainfed)	0.50	0.50
Taluk	Taluk of the farmer (=0 if Chamarajanagara taluk, 1= Kollegala taluk)	0.50	0.50
Age	Age of household head in years	53.96	10.29
Off farm income	Total off farm income in Rs./year	80500.00	68539.75
No. of enterprises adopted	No. of different enterprises adopted by farmers	1.76	0.69
Crop production for household consumption	crop production for household consumption (=1 if Yes, 0 otherwise)	0.39	0.49
Institutional participation	Access to institutional participation (1=Yes, 0 otherwise)	0.68	0.47
Distance from urban place	Distance from urban place in kilo meter (km)	7.75	1.49
Access to credit	Access to credit (1=Yes, 0 otherwise)	0.88	0.41

deviation of 1.44, demonstrate a moderate average land ownership among farmers, alongside notable variations in land sizes. Family size, averaging at 3.98 members. Moreover, the education level of household heads, with a mean value of 0.73 indicating a higher literacy rate among these decision-makers, presented a varied educational landscape, as indicated by the standard deviation of 0.44. Considering the average annual off-farm income of farm house holds, averaging at Rs.80500.00 with a considerable standard deviation of Rs.68539.75, underscores the wide-ranging additional income sources among farmers. The count of different enterprises adopted (mean: 1.76, standard deviation: 0.69) suggests a moderate level of enterprise diversification among farm households, exhibiting variations in the number of undertaken enterprises. The variable taluk, serves as a proxy to represent two distinct regions with varying irrigation sources.

The presence of crop production for household consumption (mean: 0.39, standard deviation: 0.49) showcases diverse practices regarding self-consumption of crops among farmers. Variables like institutional participation, distance from urban and access to credit were the few other variables taken into consideration for analysing factors influencing diversification strategies. These statistics provide for understanding of the multifaceted influences shaping crop and enterprise diversification among farm households.

The estimated coefficients for agricultural land holding (-0.060), irrigation (-0.090) and crop production for household consumption (-0.144) exhibited a significant negative influence on the crop diversification *i.e.,* they are positively affecting crop diversification. While, age (0.005) had positive influence on specialisation, which means it is negatively influenced crop diversification (Table 8). The education of household head was found not significant, similar result was found by Ibrahim *et al*. (2009). Although family size and institutional participation influenced specialisation negatively but fail to exert any significant influence on the crop diversification.

The chosen independent variables were regressed against the Herfindahl Index (HI) for crop diversification as dependent variable. It could be inferred based on the coefficient for average agricultural land holding of the farmers that as there

TABLE 8

Factors determining crop diversification in Chamarajanagara district

(n=120)

Variable	Parameter	Coefficient	Std. Error	P>t
Agricultural land holding	X_1	-0.060 ***	0.016	0.00008
Family Size	X_2	-0.009	0.017	0.592
Education	X_3	0.024	0.053	0.648
Irrigation	X_4	-0.090 **	0.063	0.032
Age	X_5	0.005 **	0.002	0.019
Off farm income	X_6	0.000	0.000	0.570
Crop production for household consumption	X_7	-0.144 ***	0.047	0.002
Institutional participation	X_8	-0.043	0.047	0.360
Distance from urban place	X_9	0.001	0.035	0.975
Taluk	X_{10}	-0.123	0.347	0.212
Constant	β_0	0.797	0.347	0.024

Note : ***, **, * indicates significance at one, five and ten per cent probability level, respectively

is increase in agricultural land holding, the people tend towards specialisation. As one per cent increase in agricultural land holding would increase the specialisation by about 6 per cent, contrary results was found by Kumar *et al*. (2012). As the irrigation facilities increases by one per cent, it would increase the specialisation by 9 per cent. This finding is in consistent with Pavithra and Gaddi (2022). However, crop production for household consumption increases by one per cent the specialisation would tend to reduce by 14.4 per cent.

Table 9 presents the determinants affecting enterprise diversification within Chamarajanagara district. The regression analysis provides insights into the influence of various independent variables on enterprise's diversification among farmers. Among the several variables considered, only three variables found to be significantly influenced enterprise diversification *i.e.* family size, irrigation facilities and number of enterprises adopted by farmers.

The family size exhibits a significant negative association with specialisation, means it had positive influence on enterprise diversification. As one per cent increase in family size would decrease the specialisation by about 2.4 per cent. Similarly, number of enterprises had negative influence on specialisation. Each additional unit, reduces the specialisation by 20 per cent. The count of enterprises adopted holds substantial significance, showing that a higher number of enterprises adopted by farmers correlates with increased enterprise diversification. However, irrigation facilities positively influenced for specialisation as converse to the crop diversification. As the irrigation facilities increases by one per cent, it would increase the specialisation by 8.20 per cent. The coefficient for the area variable *i.e.,* taluk was deemed insignificant in both cases, suggesting a lack of notable difference between the two taluks.

The agricultural sector, characterized by its seasonal nature and susceptibility to uncertainties such as weather variations, market shifts and inadequate access to irrigation, necessitates diversification as a key strategy. Both crop and enterprise diversification stands as critical methods to stabilize farm incomes and mitigate risks inherent in agricultural practices. These strategies serve as fundamental shields against the inherent volatilities, offering a pathway to cushion the impact of uncertainties on farmer's livelihoods. This study aimed to assess the degree of crop and enterprise diversification and uncover their determinants. Findings revealed that the higher crop diversification in irrigated conditions compared to

TABLE 9

Factors determining enterprise diversification in Chamarajanagara district

(n=120)

Variable	Parameter	Coefficient	Std. Err.	P>t
Agricultural land holding	X_1	0.003	0.011	0.778
Family Size	X_2	-0.024 **	0.012	0.048
Education	X_3	0.017	0.038	0.653
Irrigation	X_4	0.082 **	0.032	0.013
Age	X_5	0.002	0.002	0.158
Access to credit	X_6	-0.035	0.042	0.397
No. of enterprises	X_7	-0.207 ***	0.023	0.000
Institutional participation	X_8	-0.036	0.035	0.313
Taluk	X_9	0.040	0.034	0.235
Constant	β_0	0.878	0.122	0.000

Note : ***, **, * indicates significance at one, five and ten per cent probability level, respectively

rainfed ones. Conversely, enterprise diversification was found lower in areas under command irrigation than in rainfed conditions. Examining factors influencing crop diversification, it was evident that agricultural land holding, irrigation and crop production for household consumption positively influenced diversification, whereas age had a contrasting negative impact. In terms of enterprise diversification, family size and the number of enterprises positively influenced it. Interestingly, contrary to crop diversification, irrigation facilities had a significantly negative impact on enterprise diversification. In order to stimulate diversification among farmers in irrigated areas, it is essential to provide capacity-building initiatives, technical guidance and orientation towards market-driven alternative agricultural practices. While, context-specific crop and enterprise diversification strategies should be offered for rainfed farmers while promoting market linkages.

References

Barman, A., Saha, P., Patel, S. and Bera, A., 2022, Crop diversification an effective strategy for sustainable Agriculture Development [Internet]. sustainable crop production - Recent Advances.

Basavaraj, N. D., Gajanana, T. M. and Satishkumar, M., 2016, Crop diversification in Gadag district of Karnataka. *Agricultural Economics Research Review,* **29** (1) : 151 - 158.

Dube, L., 2016, Factors influencing smallholder crop diversification: A case study of Manicaland and Masvingo provinces in Zimbabwe. *International Journal of Regional Development,* **3** (2) : 1 - 25.

Ibrahim, H., Rahman, S. A., Envulus, E. E. and Oyewole, S. O., 2009, Income and crop diversification among farming households in a rural area of north central Nigeria. *Journal of Tropical Agriculture, Food, Environment and Extension,* **8** (2) : 84 - 89.

Inoni, O. E., Gani, B. S. and Sabo, E., 2021, Drivers of crop diversification: Evidence from small holder farmers in Delta state Nigeria. *Acta Universitatis Agriculture etsilvicultureae Mandelianae Brunensis,* **69** (1) : 59 - 70.

Kumar, A., Kumar, P. and Sharma, A. N., 2012, Crop diversification in Eastern India: Status and determinants. *Indian Journal of Agricultural Economics,* **67** (4) : 600 - 615.

Kumar, S. and Gupta, S., 2015, Crop diversification towards high-value crops in India: A state level empirical analysis. *Agricultural Economics Research Review,* **4** (2) : 339 - 350.

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.

Raghavendra, K. J. and Suresh, A., 2018, Risk management in rainfed agriculture: An analysis of strategies and adaptations followed by farmers in Madhya Pradesh. *Indian Journal of Agricultural Sciences,* **88** (6) : 895 - 901.

Satishkumar, M. and Umesh, K. B., 2017, Dynamics of cropping pattern and crop diversification in southern dry zone of Karnataka - An econometric analysis. *Mysore J. Agric. Sci.,* **51** (2) : 233 - 239.