From Farm to Plate: Effect of Commercialization on Diversity of Agriculture in North Karnataka

ABSTRACT

Aim: Agriculture has been the foundation of India's economy for centuries, providing livelihoods for a significant portion of the population.The present study aimed to analyze the impact of agricultural commercialization on diversity of agriculture. Specifically, it assessed the degree of commercialization and determined the diversification index for the study area.

Place and duration of the study: The present study was conducted in Dharwad, Gadag, Belagavi and Bagalkotedistricts of North Karnataka based on the gross irrigated area.The study was conducted for agricultural year 2021-22.

Methodology: The study was based on primary datacollected from 240 farm households using personal interview method. It employed descriptive statistics and calculated the Household Crop Commercialization Index (CCI) to measure the extent of agricultural commercialization, along with the Herfindahl-Hirschman Index (HHI) to assess diversification. The Regression Adjustment (RA) method was employed to analyze how commercialization influences agricultural diversity.

Result and discussion: In regions considered less progressive, the CCI was lower at 89.54 per cent compared to more progressive areas where it reached 96.02 per cent, indicating a disparity in the degree of crop commercialization. Similarly, the HHI was lower in less progressive areas (0.45) compared to more progressive areas (0.66), indicating a less concentrated market structure. In areas characterized by higher progressiveness, farmers predominantly cultivated sugarcane, a crop with strong commercial value, which limited agricultural diversification. Notable gender difference observed at a significance level of 10 per cent. Households with higher levels of commercialization exhibited significantly greater agricultural assets and slightly larger land holdings, indicating improved access to markets and higher agricultural productivity. The RA model in the analysis indicated a substantial ATET coefficient of 0.44, suggesting that increased commercialization strongly promotes agricultural diversity. Conversely, less commercialized households showed a POM coefficient of 0.07, confirming some degree of diversification.

Keywords: Agricultural Commercialization; Diversification; Farm Households.

1. INTRODUCTION

Indian agriculture thrives on centuries of tradition, fueled by modern innovation to sustain a nation. This sector not only ensures national food security but also drives socio-economic advancement. Over time, India’s agricultural landscape has evolved significantly, prominently marked by the transition from subsistence farming to commercial agriculture, where farm households cultivate crops primarily for market sale. Commercialization in agriculture entails farms increasingly engaging with input and output markets, shifting from self-sustaining or integrated farming systems to specialized crop production (Pingali and Rosegrant, 1995). Indian agriculture has undergone notable changes in recent years, marked by significant trends towards commercialization and diversification. These developments include the cultivation of new crop varieties, increased allocation of land to cash crops,

expansion in livestock and fisheries sectors and the adoption of advanced agricultural practices in areas like aquaculture, biotechnology, horticulture and processing (Parihar, 2023).

The commercialization of Indian agriculture, initiated under British colonial policies to serve British industries and generate revenue, began in earnest in the latter half of the 19th century. This shift was propelled by the introduction of a money economy, necessitating cash payments for land taxes, which replaced traditional in-kind payments. As a result, farmers were compelled to sell part of their produce, fostering a market-oriented approach. Cash crops like cotton, indigo, jute, tea and coffee dominated production, aimed primarily at export markets. However, this focus often led to neglect of food crops, contributing to periodic famines such as the 1866 famine in Odisha and Bengal. Despite improvements in transportation infrastructure, including railway expansion and the opening of the Suez Canal, which facilitated exports, agricultural development remained constrained due to insufficient investments in land and technology. Regional disparities in commercialization persisted, influenced by factors such as landholding size, access to irrigation and technological resources, with larger landholdings and better irrigation facilitating greater engagement in commercial agriculture (Deshpande and Prabhu, 2005).

Agricultural diversification is interpreted in various ways within the literature. Some studies view it as mixed or rotational cropping, while others consider agronomic measures like tillage or the spatial and temporal distribution of crops. Joshi *et al.* (2016) provides a comprehensive definition, describing diversification as reallocating resources from a single crop or livestock activity to a broader mix, designed to optimize income. This inclusive definition highlights diversification's role in enhancing economic stability and ecological resilience. Commercialization can incentivize farmers to diversify their crops. When market opportunities for various high-value crops are available, farmers may diversify their production to take advantage of these opportunities (Barrett *et al.*, 2001). Commercialization also improves access to quality seeds, fertilizers and farming technologies, enabling farmers to cultivate a wider range of crops and thus increase diversification (Dorsey, 1999).

Diversification is crucial for managing agricultural risks, as growing multiple crops reduces reliance on a single crop and mitigates risks from market fluctuations and climatic events (Ellis, 2000). However, commercialization can lead to monoculture and crop specialization, sidelining traditional crops that are more nutritious and locally adapted. Intensive commercial farming practices can degrade soil health and reduce biodiversity due to the heavy use of chemical fertilizers and pesticides (Pingali, 2012). The present study defines diversification as the presence of multiple crops in the field, positing it as a potentially effective strategy for achieving commercialization. However, the relationship between commercialization and diversification remains largely unexplored in existing literature, particularly regarding its impact on agricultural diversity in North Karnataka. Therefore, the present study seeks to fill this research gap by examining how agricultural commercialization influences agricultural diversity in the study area.

2. METHODOLOGY

The present study was based on primary data. In order to address the objectives of the study, primary data were collected from the farm households using pre-tested and well-structured

schedule.For collection of primary data four districts of North Karnataka, namely, Dharwad, Gadag, Belagavi and Bagalkote were purposively selected. Belagavi and Bagalkote districts belong to "Progressive Area" and Dharwad and Gadag belong to "Less Progressive Area". In each of these districts, two talukas were purposively chosen based on gross irrigated area and from each taluka three villages were randomly selected. From each village,10 farm households (six small, three medium and one large farmer were purposively selected based on the average proportion of category of farmers in the study area)were randomly selected. Hence, in all, 240 respondents spread across 24 villages of eight talukas in four districts of the North Karnataka formed the sample of respondents.

2.1 Crop Commercialization Index (CCI)

In the present study, household Crop Commercialization Index(CCI) was used to estimate the extent of commercialization. The CCI is an important metric used to assess the degree to which crops produced by a farmer are sold in the market rather than consumed by the household. This index is crucial for understanding agricultural commercialization and its impact on rural economies and household welfare. CCI is defined as the proportion of the output which has been sold (Braun and Kennedy, 1994 and Muriithi and Matz, 2015).

The most commonly used formula for the CCI is:

$$CCI = \frac{\text{Gross value of crop sales}_{hhi}}{\text{Gross value of all crop production}_{hhi}} * 100 \qquad (1)$$

CCI = Household Crop Commercialization Index

hhi = i^{th} household

The value of zero indicates that the farmer is totally subsistence and the value closer to hundred depicts that the farmer is highly commercialized.

2.2 Herfindahl - Hirschman Index (HHI)

To study the extent of crop diversification, Herfindahl - Hirschman Index (HHI)as used by Pal and Kar (2012) was used in the present study.

$$HHI = \sum_{i=1}^{N} P_i^2 \qquad (2)$$

Where,

n = number of crops cultivated

P_i =area under i^{th}crop in total area of cultivation

The index reaches value of one under total specialization and moves towards zero for increasing diversification. Hence, the range of index is zero to one. The farmers with index value less than 0.5 is grouped under zero category indicating diversified farmers and farmers with value more than 0.5 are taken under category one, indicating farmers growing monocrops.

2.3 Regression Adjustment (RA) Method

To assess the effect of commercialization on diversification Regression Adjustment (RA) method was used. Here, commercialization is taken as a non-randomized treatment, where one indicates more commercialized households and zero indicates less commercialized households. Similarly, diversification is indicated by one for specialized and zero for diversified households. The more commercialized farm households could differ significantly on potentially confounding factors, compared to less commercialized farmers. This difference leads to biases, while estimating the impact of commercialization on diversification. Even the randomized treatment assignment may not justify the bias (Freedman, 2008). Henceforth, RA model is used, most commonly utilized and can be very efficient in estimating the effects by minimizing the bias (Myers and Thomas, 2010). Wooldridge and Negi (2018) in their joint work on RA stated that RA possibly improves precision by regressing on covariates that predict the outcome.

Regression Adjustment (RA) is interested in estimating the Average Treatment Effect on the Treated households (ATET), defined as the average difference in commercialization (outcome) of more commercialized farm households with and without the diversification.

Following Horner and Wollni (2011), the ATET is written as:

$$ATET = E\{Y_{iD} - Y_{iN} | T_i = 1\} \quad (3)$$

$$= E(Y_{iD} | T_i = 1) - E(Y_{iN} | T_i = 1) \quad (4)$$

Where,

$E\{.\}$ = expectation operator

Y_{iD} = predicted outcome (diversification) for more commercialized farm household i

Y_{iN} = predicted outcome of the same household under less commercialized situation

T_i = treatment groups (commercialization) status taking zero for less commercialized and 100 for more commercialized

However, while the extent of diversification for the more commercialized household from the commercialized group, i.e., $E(Y_{iD} | T_i = 1)$ can be observed from the data, the counterfactual outcome $E(Y_{iN} | T_i = 1)$, diversification of the same household being less commercialized cannot be observed. RA is used to solve this problem (Horner and Wollni, 2011).

The R software package version 4.3.1 was used to perform RA technique for analyzing the relationship between commercialization and diversification. RA technique creates separate linear regression models for treated and untreated observations, then predicts covariate-specific outcomes for each subject for each treatment status. These predicted average outcomes for each subject and treatment level reflects the Potential Outcome Mean (POM). The difference of these averages provides estimates of ATEs. The ATETs are obtained by limiting the computation of means to the subset of treated individuals. In the study, the difference between projected outcomes in diversified and non-diversified situations are averaged to get average treatment effect. RA equation is expressed as following by Manda *et al.* (2018).

$$ATET_{RA} = n_A^{-1} \sum_{i=1}^{n} T_i [r_D(X, \delta_C) - r_N(X, \delta_N)] \quad (5)$$

Where,

n_A= number of commercialized farm households

$r_i(X)$ = regression model for diversified and specialized farm households with covariate X and estimated parameters $\delta_i(\alpha_i \beta_i)$

3. RESULTS AND DISCUSSION

3.1 Extent of Commercialization and Diversification

Table 1 presents the comparisonbetween less progressive and progressive areas based on the Crop Commercialization Index (CCI) and the Herfindahl-Hirschman Index (HHI). In the less progressive area, the CCI was notably lower at 89.54 per cent, indicating a lower level of crop commercialization compared to the progressive area, where the CCI was higher at 96.02 per cent. This difference is because areas identified as less progressive exhibit lower levels of agricultural commercialization, potentially influenced economic diversification and negatively affected household income generation. This is consistent with findings of previous study that highlighted mean CCI of maize 0.66, potatoes 0.83 and cabbage 0.73 (Zantsi and Nkunjana, 2018). Similarly, the HHI, which measures market concentration, was lower in the less progressive area (0.45) compared to the progressive area (0.66). A higher HHI in the progressive area was due to a more concentrated market structure, which is linked to greater economic efficiency and a competitive advantage in agricultural markets. This result aligns with the prior study findings of Singh *et al.* (2018). The majority of farmers in the progressive area cultivated sugarcane, which is a commercial crop. This concentration also contributed to less diversification in the study area.

Table 1: Extent of Commercialization and Diversification between Less Progressive and Progressive Area Households in the Study Area

Variable	Less Progressive Area (n=120)	Progressive Area (n=120)
Crop Commercialization Index (CCI) (%)	89.54[#]	96.02
Herfindahl - Hirschman Index (HHI)	0.45	0.66[##]

Note: [#], [##] represents less commercialized and less diversified values, respectively

3.2 Effect of Commercialization on Diversity of Agriculture

Mean differences of various factors between less commercialized and more commercialized farm households in the study area based on the CCI is presented in Table 2.There was a minor difference in age between the two groups, with less commercialized households being slightly older on an average. Education levels also showed a slight difference, indicating slightly higher education attainment among less commercialized households, though not statistically significant. Social participation rate was fairly similar between the groups, indicating that these factors do not vary significantly with agricultural commercialization levels in the study area. There was a minor difference in gender distribution between less and more commercialized households; this difference was statistically significant at the 10% level of probability, indicating a meaningful relationship between

gender and the level of agricultural commercialization in the study area. The most pronounced differences appeared in agricultural and economic indicators. More commercialized households exhibited significantly higher agricultural asset values and slightly larger land holdings compared to less commercialized households (significance at the 1% level of probability). This was because higher levels of crop commercialization are associated with greater agricultural investment and potentially larger farm sizes, contributing to higher asset values. More commercialized households likely benefited from enhanced economies of scale, better access to markets and higher agricultural productivity, as indicated by their higher asset values and land holdings. Conversely, less commercialized households faced challenges related to lower agricultural productivity and economic resilience. Similar study conducted by Thejashree (2022) showed thatvariables gender, household size, organizational participation, agricultural asset value and land size were found significantly different among the groups.

Table 2: Mean Differences of the Factors between Less Commercialized and More Commercialized Farm Households in the Study Area

Variables	Less Commercialized Households (CCI < 96.36) (n=120)	More Commercialized Households (CCI ≥ 96.36) (n=120)	Mean Difference
Age (years)	55.32	54.62	0.70 (1.48)
Gender (male = 1; female = 0)	0.98	0.97	0.01* (1.73)
Education (years)	5.84	5.46	0.38 (-1.42)
Family Size (No.)	5.71	5.33	0.38 (-0.05)
Social Participation (participant = 1; non-participant = 0)	0.07	0.02	0.05 (-0.37)
Agricultural Asset Value (₹ in lakh)	8.67	11.37	-2.70*** (3.13)
Agricultural Land (ha)	3.09	3.11	-0.02*** (-3.24)

Note: 1. Figures in the parentheses indicates 't' value of corresponding factors
*2. ***, * represents Significance at 1 per cent and 10 per cent level, respectively*

The results of the Regression Adjustment (RA) model with commercialization as the treatment variable are presented in Table 3. The results revealed that the ATET coefficient of 0.44, with a Z-value of 11.36 and a *P* value of .00 (significance at the 1% level), suggests that the extent of diversification would have been 0.44 if all the farmers were more commercialized. This large and statistically significant coefficient indicates that commercialization has a strong positive effect on the diversity of agriculture. The high Z-value further confirms the robustness of this finding, highlighting the considerable impact of commercialization on agricultural diversification. The POM coefficient for less commercialized households was 0.07, with a Z-value of 2.14 and a *P* value of .03 (significance at the 5% level). This indicates that the average diversification would have been 0.07 more if all the farm households were less commercialized. Thus, the total expected diversification for less commercialized households would be 0.37. The statistical significance at the 5% level suggests that the observed

diversification in less commercialized households was not due to random variation but reflects a genuine effect. The findings confirm that commercialization of farm households was leading to some extent of diversification in the study area. This was due to higher levels of commercialization likely provide farmers with better access to markets, resources and technologies, enabling them to diversify their agricultural activities. This diversification can lead to enhanced farm resilience, reduced riskand improved economic stability and food security. But the study by Thejashree(2022) found a contradictory finding about the impact of commercialization on diversity of agriculture.

Table 3: Effect of Commercialization on Diversity of Agriculture in the Study Area

Diversification	Coefficient	Z	P > |Z|
Average Treatment Effect on the Treated (ATET) (More Commercialized vs. Less Commercialized)	0.44	11.36	0.00***
Potential Outcome Mean (POM) (Less Commercialized)	0.07	2.14	0.03**

*Note: ***, ** represents Significance at one per cent and five per cent level, respectively*

4. CONCLUSION

Indian agriculture, deeply rooted in tradition and bolstered by modern innovations. This sector is crucial for national food security and socio-economic development. Over time, Indian agriculture has transitioned from subsistence to commercial farming, marked by increased engagement in input and output markets, specialized crop production and notable trends toward diversification. This shift, which began during British colonial rule, was driven by the introduction of a money economy and the need for cash crops like cotton, jute and tea for export. However, this focus sometimes led to the neglect of food crops, contributing to historical famines. Despite improvements in infrastructure, regional disparities in commercialization persisted due to varying factors like landholding size and access to irrigation and technology.

Agricultural diversification, defined as reallocating resources from single to multiple crop or livestock activities to optimize income, plays a vital role in enhancing economic stability and ecological resilience. Commercialization can drive diversification by providing market opportunities and better access to quality inputs and technologies. Diversification helps manage agricultural risks by reducing reliance on single crops, thereby mitigating risks from market fluctuations and climatic events. However, intensive commercial farming can also lead to monoculture, soil degradation and reduced biodiversity. The present study explores the largely unexplored relationship between commercialization and diversification in North Karnataka, aiming to understand how commercialization influences agricultural diversity in the region.The findings of the study affirm that commercialization leads to a degree of diversification among farm households. Higher levels of commercialization provide better access to markets, resources and technologies, enabling farmers to diversify their agricultural activities.

The significant findings of the study suggests that there is a need to facilitate stronger market linkages between farmers and buyers, including agro-industries and export markets to promote

commercialization and diversification. Create awareness among farmers for adoption of advanced agricultural practices and technologies, such as biotechnology, precision farming and sustainable farming practices, which would boost productivity and encourage diversification.

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