



RESEARCH ARTICLE

When support prices shape crop choices: The influence of minimum support price on diversification in Karnataka agriculture

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Abstract

Minimum support price (MSP) is a key policy instrument in Indian agriculture aimed at ensuring remunerative prices to farmers and maintaining national food security. Although the policy provides price assurance for several crops, its influence on cropping patterns and crop diversification remains widely debated. The present study examines the role of MSP in shaping crop specialisation and diversification in Karnataka, India, using secondary data for the period 2000–01 to 2023–24. Data on crop area, prices and selected socio-economic variables were compiled from official sources, including the Directorate of Economics and Statistics, Government of Karnataka and the Karnataka State Agricultural Marketing Board. Crop diversification was measured using the crop entropy index (CEI), while the determinants of diversification were analysed using a fractional regression model estimated through quasi-maximum likelihood estimation (QMLE), which is suitable for dependent variables bounded between 0 and 1. The results indicate notable changes in cropping patterns over the study period. The share of cereals in gross cropped area increased slightly from 46.32 % in 2000–01 to 47.40 % in 2023–24, while pulses expanded considerably from 16.67 to 31.83 %, reflecting a gradual shift towards pulse cultivation. Regression results show that rainfall, fertiliser consumption and road density significantly influence diversification, whereas larger landholdings and higher adoption of high-yielding varieties tend to promote specialisation. The findings suggest that MSP alone does not determine crop choices; diversification is shaped by both price incentives and agro-economic conditions.

Keywords: agricultural price policy; econometric modelling; farming systems; production incentives; regional agriculture

Introduction

Agriculture remains a crucial sector of the Indian economy as it supports rural livelihoods, ensures food security and contributes significantly to national development. However, the sector is highly vulnerable to price fluctuations, climatic uncertainties and market imperfections, which often result in unstable farm incomes. To address these challenges, the Government of India introduced several policy instruments aimed at stabilising agricultural markets and safeguarding farmers' welfare. Among these, the minimum support price (MSP) has emerged as one of the most important agricultural price policies designed to ensure remunerative prices to farmers and maintain adequate production of essential crops. MSP acts as a price guarantee mechanism that protects farmers from adverse market conditions and encourages production of strategic commodities required for national food security (1, 2).

Since its introduction during the Green Revolution period, MSP has significantly influenced cropping decisions and production patterns across Indian states. Assured procurement of cereals such as rice and wheat under MSP has contributed substantially to India's foodgrain self-sufficiency. However, several studies have pointed out that sustained price support for a limited number of crops may encourage crop specialisation, where farmers allocate larger areas to

MSP-backed crops rather than diversifying into other crops (3, 4). Such specialisation may lead to long-term ecological challenges, including soil degradation, declining groundwater levels and increased production risks.

Crop diversification is widely regarded as an important strategy for improving farm income stability, reducing production risks and promoting sustainable agricultural development. Diversified cropping systems allow farmers to distribute risk across multiple crops, respond to market opportunities and utilise natural resources more efficiently. Previous studies have demonstrated that diversification towards pulses, oilseeds and other high-value crops can improve farm profitability while also contributing to nutritional security and ecological sustainability (5, 6).

Despite the potential benefits of diversification, the extent to which MSP influences farmers' crop choices remains widely debated. Some empirical studies suggest that strong procurement systems tend to encourage specialisation in cereals, particularly in regions where procurement infrastructure is well developed. In contrast, regions with limited procurement and more varied agro-climatic conditions often exhibit greater crop diversification (7, 8). This suggests that cropping patterns are shaped not only by price incentives but also by non-price factors such as rainfall,

irrigation facilities, infrastructure development and access to markets. Karnataka provides a suitable context for examining this issue due to its diverse agro-climatic zones and varied cropping systems. The state cultivates a wide range of crops, including cereals, pulses, oilseeds and commercial crops. In recent years, policy emphasis has increasingly focused on promoting diversification toward climate-resilient crops such as pulses and millets. Understanding whether MSP encourages specialisation or diversification in Karnataka is therefore important for designing balanced agricultural policies that support both farmer welfare and sustainable resource use.

Against this background, the present study examines the influence of MSP on crop specialisation and diversification in Karnataka using district-level secondary data for the period 2000–01 to 2023–24. Crop diversification was measured using the crop entropy index (CEI) and the determinants of diversification were analysed using a fractional regression model estimated through quasi-maximum likelihood techniques. The analysis seeks to provide empirical evidence on the role of price policy and other socio-economic factors in shaping cropping patterns in Karnataka agriculture. The objectives of the study are to analyse trends in cropping patterns and crop diversification in Karnataka agriculture, examine the influence of MSP and other socio-economic factors on crop diversification and assess whether MSP has promoted crop specialisation or diversification in the state. The research hypothesis is H_0 : Minimum support price has no significant influence on crop diversification in Karnataka agriculture and H_1 : Minimum support price significantly influences crop diversification in Karnataka agriculture.

Materials and Methods

Study area

The study was conducted in the state of Karnataka, India, which represents one of the most agriculturally diverse regions in the country. The state encompasses several agro-climatic zones characterised by variations in rainfall, soil types and cropping systems. Major crops grown in Karnataka include cereals, pulses, oilseeds and commercial crops. Such diversity makes the state an appropriate case for examining the influence of agricultural price policies on cropping patterns and diversification behaviour.

Data source

The analysis is based entirely on secondary data compiled from authenticated government sources. Data covering the period 2000–01 to 2023–24 were collected from the following sources: Directorate of Economics and Statistics (DES), Government of Karnataka, Commission for Agricultural Costs and Prices (CACP), Karnataka State Agricultural Marketing Board, Department of Food and Civil Supplies and National Sample Survey Office (NSSO). The dataset includes information on crop-wise area under cultivation, Minimum support price for selected crops and several socio-economic and infrastructural indicators influencing crop choice behaviour.

Selection of crops

The crops considered in the analysis were selected based on their contribution to the gross cropped area (GCA) of Karnataka. The major crops included in the study were grouped as follows:

Cereals: Rice, ragi, jowar and bajra

Oilseeds: Groundnut, sunflower and soybean

Pulses: Redgram, greengram and chickpea

These crops represent the major components of the cropping system in Karnataka and are commonly included in empirical studies analysing crop diversification patterns (5).

Analytical tools

Two analytical approaches were employed to examine cropping pattern dynamics and determinants of diversification:

Crop entropy index (CEI)

The Crop entropy index (CEI) was used to measure the degree of crop diversification. Entropy-based indices are widely used in agricultural economics to analyse diversification because they capture both the number of crops grown and the distribution of cropped area among them (7).

The CEI is calculated as:

$$CEI = - \sum_{i=1}^n p_i \ln(p_i) \quad (\text{Eqn. 1})$$

Where,

p_i = proportion of gross cropped area under the i^{th} crop,
 n = total number of crops cultivated.

The value of CEI ranges between 0 and 1. CEI = 0 indicates complete crop specialisation. CEI approaching 1 indicates maximum crop diversification. Higher CEI values, therefore, reflect a more diversified cropping structure, whereas lower values indicate dominance of a limited number of crops. In the present study, CEI values were computed at the district level to analyse temporal and spatial changes in crop diversification across Karnataka.

Fractional regression model (FRM)

To examine the determinants of crop diversification, a fractional regression model was employed. The dependent variable in the study, CEI, is bounded between 0 and 1, which makes conventional linear regression models inappropriate because they may generate predicted values outside the feasible range. Fractional regression models are specifically designed for dependent variables expressed as proportions or indices limited within the unit interval (4). The general form of the fractional regression model is expressed as:

$$E(y_i/X_i) = G(X_i\beta), \quad 0 < y < 1 \quad (\text{Eqn. 2})$$

Where, y_i = Crop entropy index, X_i = Vector of explanatory variables, β = Vector of parameters to be estimated, $G(\cdot)$ = Link function (logit). In this study, the model was estimated using a generalised linear model (GLM) with a logit link function and binomial family.

Justification for using QMLE

The parameters of the fractional regression model were estimated using Quasi-Maximum Likelihood Estimation (QMLE). This estimation technique provides consistent and efficient parameter estimates even when the dependent variable is not strictly continuous or when the distributional assumptions of standard maximum likelihood models are not fully satisfied (9, 10). QMLE is widely recommended for fractional response models because it ensures that predicted values remain within the 0–1 interval and produces reliable statistical inference under relatively mild

assumptions. For these reasons, QMLE has been extensively used in empirical economic and agricultural research involving proportion-based dependent variables (9).

Variables considered

The explanatory variables included both price-related variables and non-price factors that influence cropping decisions.

These variables capture both economic incentives and infrastructural conditions that influence farmers' crop choice behaviour (Table 1).

Software used

All statistical analyses were performed using STATA software, which was used to estimate the fractional regression model and compute marginal effects.

Results and Discussion

Changes in gross cropped area and crop composition

The distribution of gross cropped area (GCA) in Karnataka showed notable changes during the study period (Table 2). The share of cereals in the gross cropped area was 46.32 % in 2000–01, which declined to 41.92 % in 2010–11, but increased again to 47.40 % in 2023–24. This trend indicates the continued dominance of cereals in the state's cropping pattern despite fluctuations over time. Pulses exhibited a substantial increase in their share from 16.67 % in 2000–01 to 31.83 % in 2023–24, suggesting a gradual shift toward pulse cultivation. Oilseeds recorded a decline from 15.43 % to 12.89 % over the same period, while the share of commercial crops decreased from 10.99 % to 7.68 %.

These changes reflect evolving production incentives and farmers' responses to both market and policy signals. The increasing importance of pulses may partly be attributed to policy support through MSP and growing market demand. Earlier studies have also noted that diversification toward pulses and oilseeds can enhance

farm income and improve soil fertility through biological nitrogen fixation (1,5).

Spatial trends in crop diversification

Crop diversification across Karnataka was analysed using the Crop Entropy Index (CEI). The temporal pattern of CEI across districts is illustrated in Fig. 1A–1C. The results reveal considerable spatial variation in diversification levels across the state. Some districts exhibited relatively higher CEI values, indicating diversified cropping systems, whereas others remained relatively specialised. The average CEI value for the state was 0.74, suggesting a moderate level of diversification. District-level differences in diversification can be explained by variations in rainfall, irrigation availability, soil characteristics and market access (11). Regions with more favourable agro-climatic conditions tend to cultivate a wider range of crops, whereas areas with limited irrigation or market infrastructure often concentrate on a few dominant crops. Similar spatial variations in crop diversification have been reported in earlier studies, which highlight that diversification patterns in Indian agriculture are strongly influenced by agro-ecological conditions and infrastructure development (7).

Descriptive statistics of explanatory variables

The descriptive statistics of the variables used in the fractional regression model are presented in Table 3. The results indicate that the mean proportion of gross irrigated area to gross cropped area was 28.65 %, reflecting moderate irrigation coverage in Karnataka agriculture. The average landholding size was 1.63 ha, indicating the predominance of small and marginal farms in the state. Annual rainfall averaged 1099.59 mm, while fertiliser consumption averaged 121.99 kg/ha. Approximately 37.43 % of the cropped area was under high-yielding varieties (HYVs), indicating moderate adoption of improved crop technologies. The share of small and marginal farmers in total holdings was 75.14 %, highlighting the dominance of smallholder agriculture in the state. Significant variation was also observed in agricultural credit and per capita income across districts,

Table 1. Definition and units of variables used in the fractional regression model

Variable	Definition	Unit
GIA/GCA	Percentage of gross irrigated area to gross cropped area	%
Landholding	Average operational landholding size	ha
Rainfall	Average annual rainfall	mm
Fertiliser use	Fertiliser consumption	kg/ha
HYV area	Percentage of area under high-yielding varieties	%
Per capita income	Per capita income of the district	₹/person
Small and marginal farmers	Share of small and marginal holdings in total holdings	%
Road density	Length of roads per 1000 ha of gross cropped area	km
Agricultural credit	Institutional credit to agriculture	₹
Cereals MSP	Minimum support price of cereals	₹/q
Pulses MSP	Minimum support price of pulses	₹/q
Oilseeds MSP	Minimum support price of oilseeds	₹/q

Table 2. Gross cropped area and % share of each crop group in Karnataka

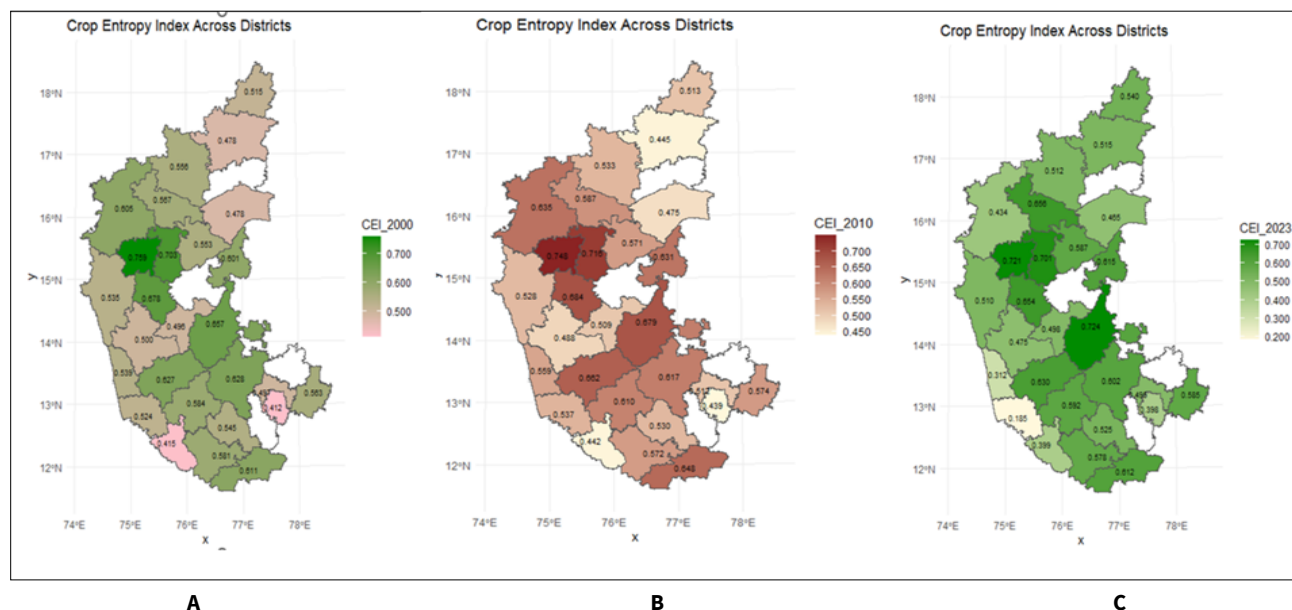
Particulars	Total cropped area (acre)			% share of crops		
	2000-01	2010-11	2023-24	2000-01	2010-11	2023-24
Cereals	5685697	5421783	5038610	46.32	41.92	47.40
Millets	71447	24095	21456	0.58	0.19	0.20
oil seeds	1894104	1622523	1370156	15.43	12.54	12.89
Pulses	2046670	2791062	3383725	16.67	21.58	31.83
Commercial crops	1348593	1319494	815896	10.99	10.20	7.68
GCA	12275620	12934720	10629843	100.00	100.00	100.00

GCA: Gross cropped area

Table 3. Descriptive statistics of selected parameters for fractional regression

Parameters	Mean	STD Dev	CV (%)
GIA to GCA	28.65	3.66	0.13
land holding (ha)	1.63	0.22	0.13
Annual rainfall (mm)	1099.58	116.69	0.11
Fertiliser use (kg/ha)	122.00	32.03	0.26
Percentage of area under HYV	37.43	4.18	0.11
Per capita income (₹/Person)	82948.43	77571.26	0.93
Percentage of small and marginal landholders in total holdings	75.14	4.33	0.06
Roads density (km ² /000' ha GCA)	0.04	0.01	0.20
Credit to agriculture (₹)	3374.60	3127.14	0.93
Cereals_MSP (₹/q)	1139.82	846.07	0.74
Pulse_MSP (₹/q)	3055.54	2091.08	0.68
Oilseed_MSP (₹/q)	2823.24	1846.19	0.65
CEI	0.74	0.07	0.09

CEI: Crop entropy index.

**Fig. 1.** Crop entropy index (CEI) trends across districts. A: CEI 2000; B: CEI 2010; C: CEI 2023.

reflecting regional disparities in economic development. These factors are known to influence farmers' cropping decisions and diversification behaviour (8).

Temporal trends in explanatory variables

The temporal trends of the explanatory variables considered in the regression model are presented in Fig. 2A–L. The figure illustrates noticeable changes in several socio-economic and production-related factors over the study period. Fertiliser consumption and agricultural credit show a gradual increasing trend, reflecting improvements in input use and institutional support for agriculture. Similarly, road infrastructure and irrigation coverage have expanded over time, indicating improvements in rural connectivity and agricultural development. Rainfall patterns, however, show considerable variability across years, highlighting the climatic uncertainty faced by farmers. These changes in production conditions and economic incentives are likely to influence cropping decisions and diversification behaviour in the state.

Determinants of crop diversification

The results of the fractional regression model are presented in Table 4. The model explains 88.65 % of predictions, with a McFadden R^2 of 0.68, indicating a reasonably good model fit.

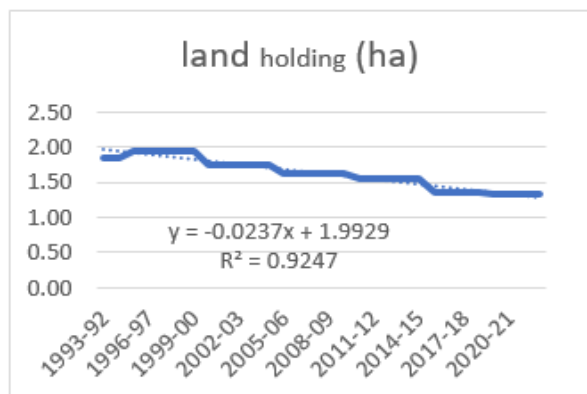
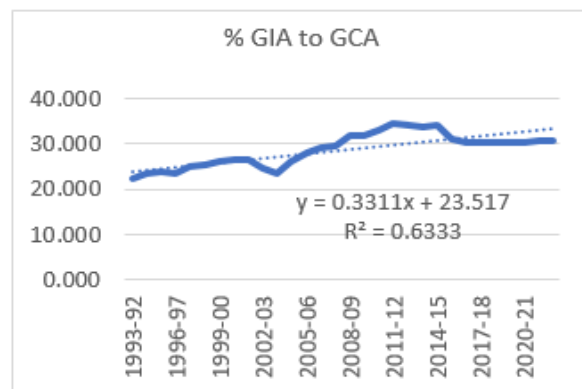
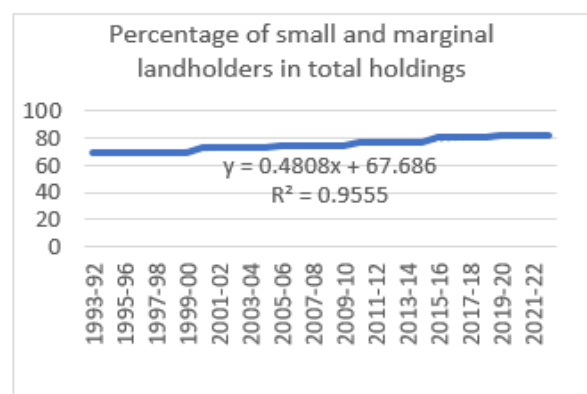
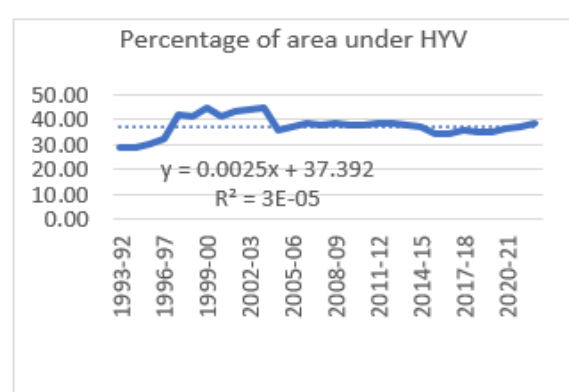
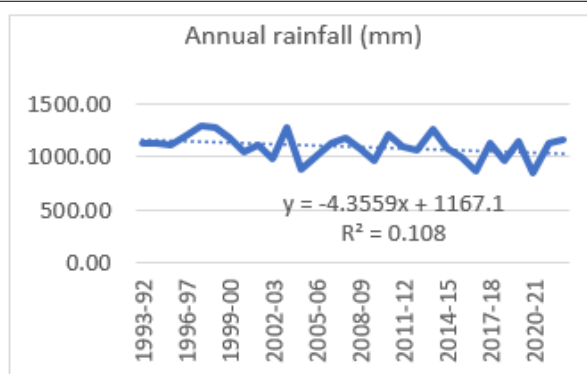
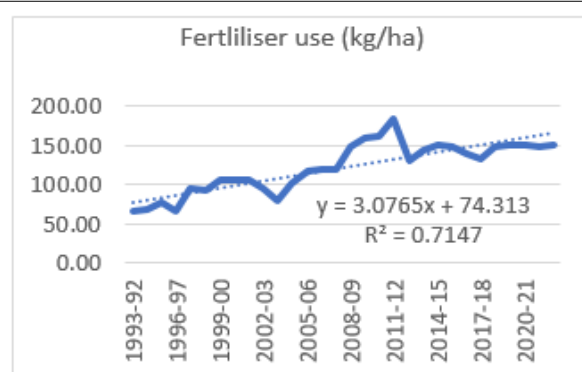
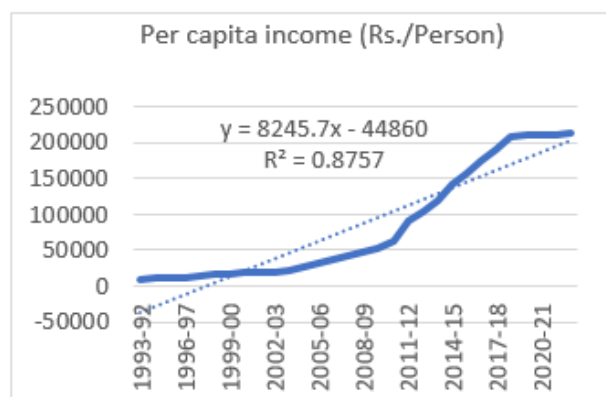
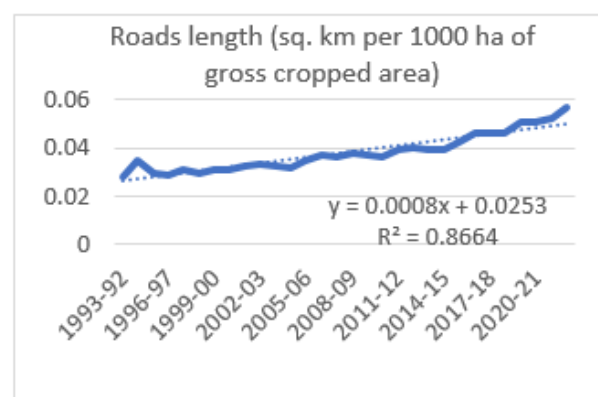
Influence of non-price factors

Rainfall exhibited a positive and statistically significant coefficient (0.18), indicating that higher rainfall encourages crop diversification.

Adequate rainfall enables farmers to cultivate a wider range of crops, particularly pulses and oilseeds, which are often grown in rainfed conditions. Fertiliser consumption also showed a positive and significant influence (0.56) on diversification. Increased use of fertilisers may improve soil fertility and productivity, thereby enabling farmers to diversify their cropping patterns. Similarly, road density exhibited a positive effect on diversification, suggesting that improved rural infrastructure enhances market access and facilitates the cultivation of diverse crops. Per capita income and the proportion of small and marginal farmers also had positive coefficients, indicating that socio-economic factors contribute to diversification. Previous studies have also emphasised that infrastructure, resource availability and institutional support are important drivers of agricultural diversification (3).

Influence of farm characteristics

Average landholding size had a negative coefficient (-0.28), suggesting that larger farms tend to specialise in smaller number of crops. This may be due to economies of scale and mechanisation advantages associated with monocropping systems. Similarly, a higher proportion of area under high-yielding varieties was associated with specialisation, reflecting technology-driven concentration in certain crops. These findings are consistent with earlier studies that reported specialisation tendencies among larger farms adopting modern agricultural technologies (6).

**A.****B.****C.****D.****E.****F.****G.****H.**

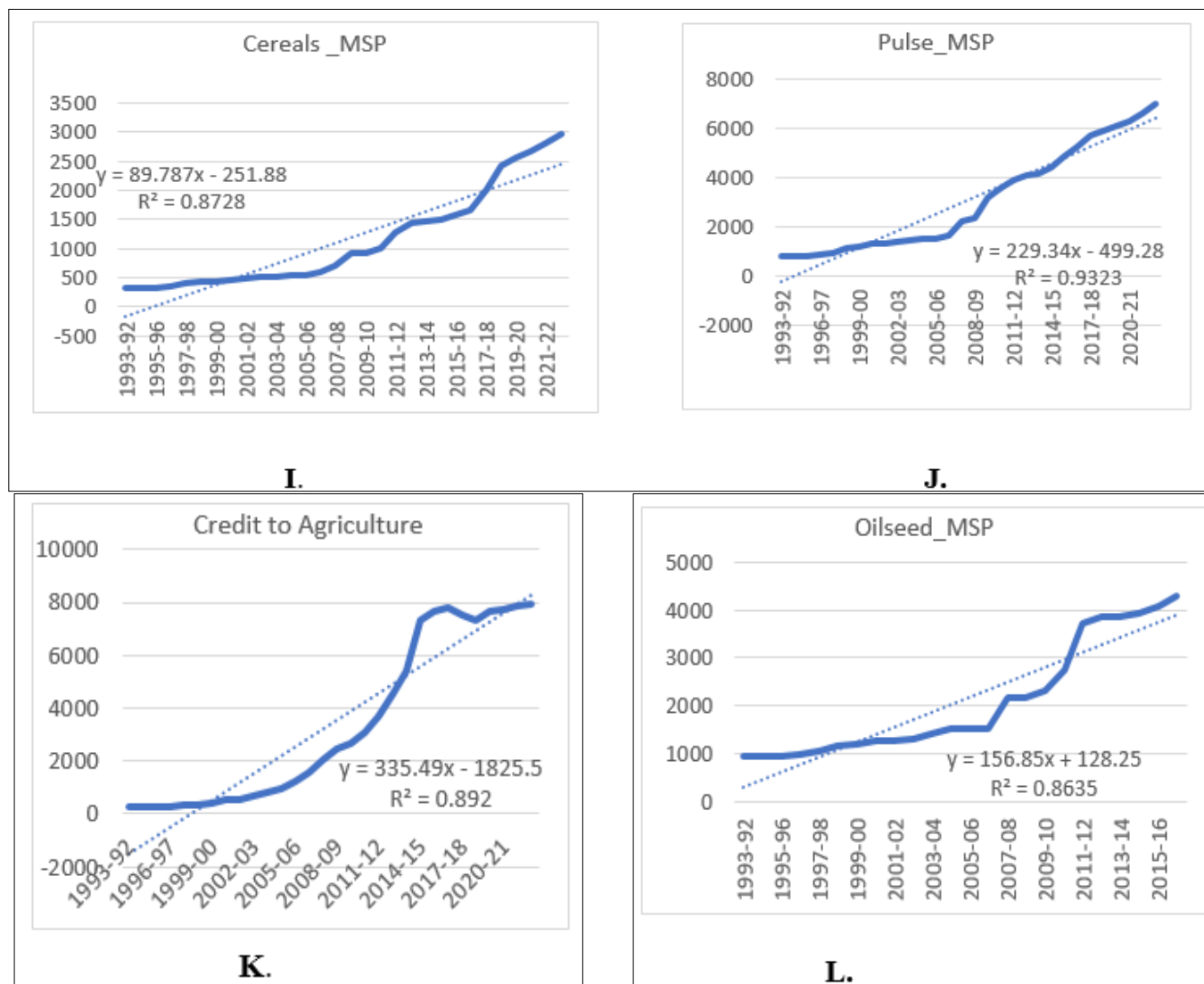


Fig. 2. Temporal trends of explanatory variables.

A: Average landholding size (ha); B: Percentage of gross irrigated area to gross cropped area (GIA/GCA); C: Percentage of small and marginal farmers in total holdings; D: Percentage of area under high-yielding varieties (HYV); E: Annual rainfall (mm); F: Fertiliser consumption (kg/ha); G: Per capita income (₹/person); H: Road density (km per 1000 ha of gross cropped area); I: Minimum support price of cereals (₹/q); J: Minimum support price of pulses (₹/q); K: Minimum support price of oilseeds (₹/q); L: Agricultural credit (₹).

Table 4. Fractional regression analysis

Particulars	Coefficient	Marginal effects	z value	Odds ratio
Dependent variable	CEI			
GIA to GCA (%)	-0.12	-0.36	2.45	0.63
Land holding (ha)	-0.28	-0.52	1.16	0.68
Annual rainfall (mm)	0.18	0.43	5.29	1.85
Fertiliser use (kg/ha)	0.56	0.51	6.77	1.72
Percentage of area under HYV	-0.13	-0.29	2.40	0.62
Per capita income (₹/Person)	0.15	0.29	1.90	1.23
Small and marginal (% to total land)	0.11	0.10	1.92	1.10
Roads density (km ² /000' ha GCA)	0.40	0.73	1.12	1.51
Credit to agriculture (₹)	0.02	0.21	0.46	1.52
Cereals_MSP (₹/q)	-0.13	0.58	0.99	0.65
Pulse_MSP (₹/q)	0.16	0.36	3.86	1.38
Oilseed_MSP (₹/q)	0.26	0.87	2.893\	1.59
Model predictions	88.65			
2 log likelihood ratio	-228.23			
McFadden R ²	0.68			

Influence of MSP variables

The MSP variables exhibited differentiated effects on crop diversification. The coefficient for cereal MSP was negative (-0.13), indicating that higher support prices for cereals tend to reinforce specialisation in cereal crops. This result reflects the strong procurement system and assured market for cereals under the MSP policy. In contrast, MSP for pulses (0.16) and oilseeds (0.26) showed positive and statistically significant effects on diversification. These results suggest that increasing MSP for pulses and oilseeds can encourage farmers to diversify away from cereal-dominated cropping systems. Similar findings have been reported in earlier studies, which indicate that expanding MSP coverage beyond cereals can promote balanced cropping patterns and reduce the dominance of rice and wheat (12).

Policy implications

The results indicate that crop diversification in Karnataka is influenced by a combination of price incentives and non-price factors. While MSP continues to play an important role in shaping cropping patterns, factors such as rainfall, infrastructure, fertiliser use and farm size also significantly influence farmers' production decisions. The findings suggest that policy efforts aimed at

promoting diversification should not rely solely on MSP adjustments but should also focus on improving rural infrastructure, expanding irrigation facilities and strengthening agricultural markets. Expanding MSP support for pulses, oilseeds and millets may further encourage farmers to diversify their cropping systems in accordance with agro-climatic suitability.

Conclusion

The present study examined the influence of minimum support price (MSP) on crop specialisation and diversification in Karnataka using district-level secondary data for the period 2000–01 to 2023–24. The findings reveal noticeable changes in cropping patterns during the study period. Although cereals continue to occupy a dominant share of the gross cropped area, the share of pulses increased substantially, indicating gradual diversification in the state's agriculture. The crop entropy index results suggested moderate diversification with considerable district-level variation. The fractional regression analysis showed that rainfall, fertiliser use and road infrastructure positively influenced diversification, while larger landholdings and higher adoption of high-yielding varieties tended to promote specialisation. The results further indicate that MSP exerts differentiated effects on cropping patterns. Higher support prices for cereals tend to reinforce specialisation, whereas MSP for pulses and oilseeds contributes positively to diversification. These findings highlight that crop choices are influenced by both price incentives and agro-economic conditions. Future research could incorporate farm-level primary data and spatial econometric approaches to better understand farmers' behavioural responses to MSP and other policy interventions influencing crop diversification.

Authors' contributions

C led the econometric analysis, particularly the estimation of MSP responsiveness on crop acreage and specialisation indices and prepared the initial draft of the manuscript. JO contributed to refining the conceptual framework and supported the review of earlier studies on MSP, cropping pattern shifts in Karnataka and conceptualised the research problem, supervised the study design and critically reviewed the interpretation of policy implications. LH was involved in compiling secondary data from official sources, validating time-series consistency and assisting in tabulating changes across kharif and rabi crops. MNV guided statistical procedures such as regression diagnostics and diversification indices and helped strengthen the methodology. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT (OpenAI) to improve the quality of writing and enhance clarity of expression. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content for publication.

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