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Economic benefits of crop diversification in India: A case study of West Bengal

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Abstract

This study examines the economic implications of crop diversification among marginal and small farmers in West Bengal, with a focus on how diversification influences profitability. It evaluates whether increases in crop diversification translate into higher financial returns as measured by the Price Index (PI), and further assesses the magnitude of per-unit Crop Diversification Index (CDI) change on PI across districts and over time. Using the Gibbs–Martin CDI and Laspeyres Gross Revenue Index (LGRI) of PI for 2000–01 and 2015–16, the study provides trend projections for 2020–21 based on quinquennial changes. West Bengal, as a study area characterized by a predominance of marginal and small landholders along with comparatively low agricultural income under varied physiographic conditions with limited infrastructural inputs, offers a critical context for this study. The analysis relies on secondary data on cropping patterns and Minimum Support Prices (MSP). The findings indicate substantial spatial variation: while CDI and PI increased in most districts, the strength and direction of the CDI–PI relationship differed, and some districts recorded stagnation or decline. Projections suggest moderate improvement in crop diversification but persistent structural constraints. Overall, the study highlights the need for stronger price-policy measures—particularly the effective implementation of schemes such as Krishak Bandhu—to enhance economic gains from crop diversification and strengthen the resilience of marginal and smallholder agriculture.

Keywords: *Economic dimensions, crop diversification, price index, Gibbs-Martin Index, MSP, price index, spatial variations*

Introduction

Agriculture remains the backbone of livelihoods, food security, and rural employment in developing countries. Yet, the sector has increasingly come under stress due to climate variability, environmental degradation, rising input costs, and declining profit margins. In response to these challenges, policy attention in India has shifted to strategies that can stabilise and enhance farmers' incomes. Among these, crop diversification has emerged as a key national priority. Successive agricultural policy documents, including the ‘doubling farmers’ income’, emphasise crop diversification as a pathway to risk mitigation, better resource use, higher price realisation, and income enhancement.

Within this national context, West Bengal presents a striking paradox. The state has the highest proportion of marginal and small land size farmers in India, yet it reports one of the lowest levels of agricultural income nationally. This contradiction raises critical questions about the income-generating capacity of its existing cropping patterns. Crop diversification could be an important mechanism through which marginal and small farmers improve their revenue, especially in a state characterised by fragmented landholdings, diverse agro-climatic and physiographic conditions. However, the economic outcomes of crop diversification in West Bengal—particularly its price-linked benefits—remain insufficiently explored. Although earlier studies have documented crop diversification trends at national and state scales, rarely any study has directly linked a formal crop diversification index with a price-weighted revenue measure at the sub-state level in West Bengal. The absence of such evidence limits a clear understanding of whether crop diversification contributes to improved profitability, particularly for marginal and small farmers who dominate the state’s agrarian structure.

This study addresses this gap by integrating the Gibbs–Martin CDI with LGRI Price Index to evaluate the relationship between crop diversification and price-weighted agricultural revenue across districts of West Bengal. The core research questions are: Does crop diversification improve profitability for marginal and small landholding categories at the district level? And, what is the marginal revenue return associated with a one-unit increase in the CDI? By providing the first district-level empirical evidence linking crop diversification with price-based revenue outcomes, the study makes both methodological and policy-relevant contributions. The subsequent sections present the literature review, study area, data sources, methodology, results, discussion, and policy implications.

Literature review

Sustainable agriculture has gained central importance in contemporary debates on food security, environmental degradation, declining farm profitability, and climate variability. Within this framework, crop diversification is widely recognized for its potential to enhance economic resilience and ecological stability. The concept encompasses a shift from monoculture toward a broader mix of crops through spatial or temporal combinations, mixed farming, and the introduction of high-value agricultural enterprises (FAO, 2010).

The economic dimension of crop diversification remains critical. A diverse cropping system helps stabilize farm income by distributing risks across crops that differ in their susceptibility to pests, climatic events, and market volatility (Joshi *et al.*, 2004). Evidence from Sub-Saharan Africa indicates that diversified farm households experience greater income stability and food security compared to cereal-dependent farms (Barrett *et al.*, 2001; Benin *et al.*, 2004). Similarly, in Bangladesh, Nepal, and Sri Lanka, a shift toward horticulture, pulses, and livestock-based systems enhances gross returns and reduces vulnerability to price shocks (Rahman, 2009; Ghimire *et al.*, 2015; Kumar & Singh, 2014).

Indian agriculture presents an important case for understanding the role of crop diversification in bringing about economic benefits and sustainability. The post-green revolution states of Punjab and Haryana exhibit soil nutrient depletion, groundwater exhaustion, and reduced biodiversity due to prolonged wheat–rice monoculture (Singh *et al.*, 2017). Scholars therefore advocate crop diversification toward oilseeds, pulses, vegetables, and fodder crops, both to conserve resources and to enhance income (Deshpande & Prabhu, 2005; Chand, 2017). Studies further show that crop diversification enhances resource-use efficiency, especially when supported by irrigation, credit, and market access (Birthal *et al.*, 2015). Region-specific studies in Kerala, Karnataka, Uttar Pradesh, and West Bengal also vindicate that integrated farming systems combining cereals with fruits, vegetables, floriculture, or livestock significantly improve farm income, employment, and food security (Sharma & Jain, 2011; Alam & Rashid, 2018).

Market conditions exert a strong influence on crop diversification choices. Farmers respond positively to profitable opportunities in non-cereal crops when supported by efficient markets, cold storage, processing facilities, and transport networks (Barrett *et al.*, 2001). Evidence from India shows a strong association between crop diversification and market infrastructure such as rural roads, *mandis* (a large wholesale hub for agricultural produce) and input access (Birthal *et al.*, 2015). While price incentives—especially the Minimum Support Price (MSP)—play an important role in shaping cropping decisions, much of the existing literature heavily emphasizes production-side factors such as landholding size, irrigation, and soil conditions. Farmer responses to price dynamics, including relative crop prices and changes in the price index, receive comparatively little attention.

Methodologically, most studies rely on area-based diversification measures such as the Herfindahl Index, Simpson Index, Entropy measures, Gibbs–Martin Index, and Ogive Index. While these indices effectively quantify the spread of crops, they rarely incorporate economic signals such as price trends, profitability, or price volatility. Even studies that relate crop diversification to income often attribute income gains to high-value crops or enhanced resource efficiency without exploring whether crop diversification influences market prices or how price movements contribute to income growth. Thus, even though crop diversification is recognized as an income-enhancing strategy, the economic transmission mechanism—specifically, how crop diversification interacts with output prices—remains insufficiently studied.

Bringing these strands together, it is clear that crop diversification delivers substantial economic benefit across global regions and within India. However, a notable gap persists; while numerous studies explore crop diversification patterns, determinants, and ecological or income outcomes, few examine the link between crop diversification and price dynamics, including the influence of the crop price index and MSP on crop diversification outcomes. By addressing this under-explored linkage between crop diversification and price index movements, the present study advances a more comprehensive understanding of the economic mechanisms through which crop diversification contributes to rural livelihood resilience.

Study area

West Bengal has been selected as the study area because it represents an agrarian system marked by extreme land fragmentation, high rural population pressure, intensive mono-cropping, and persistently low agricultural income despite being India's largest producer of rice and vegetables. In the 18 study districts, marginal and small farmers dominate the agricultural landscape, with over 99 percent operating below two hectares and nearly 83 percent cultivating less than one hectare, far exceeding state and national averages (Agriculture Census, 2015–16). Farm incomes remain critically low, with NABARD (2023–24) reporting an average of ₹6,762 per month, leading to out-migration and slow agricultural transformation. Existing research (Ghosh & Ghosh, 2020; Roy *et al.*, 2020) also highlights multiple structural constraints—declining soil quality, low mechanization, weak investment, and the persistence of subsistence monocropping—underscoring the need to examine crop diversification dynamics in the state.

West Bengal, located between 21°25'24"N – 27°13'15"N and 85°48'20"E – 89°53'04"E, presents a unique combination of physiographic and agro-climatic diversity that strongly influences agricultural patterns and crop diversification. Stretching from the Himalayan foothills in the north to the

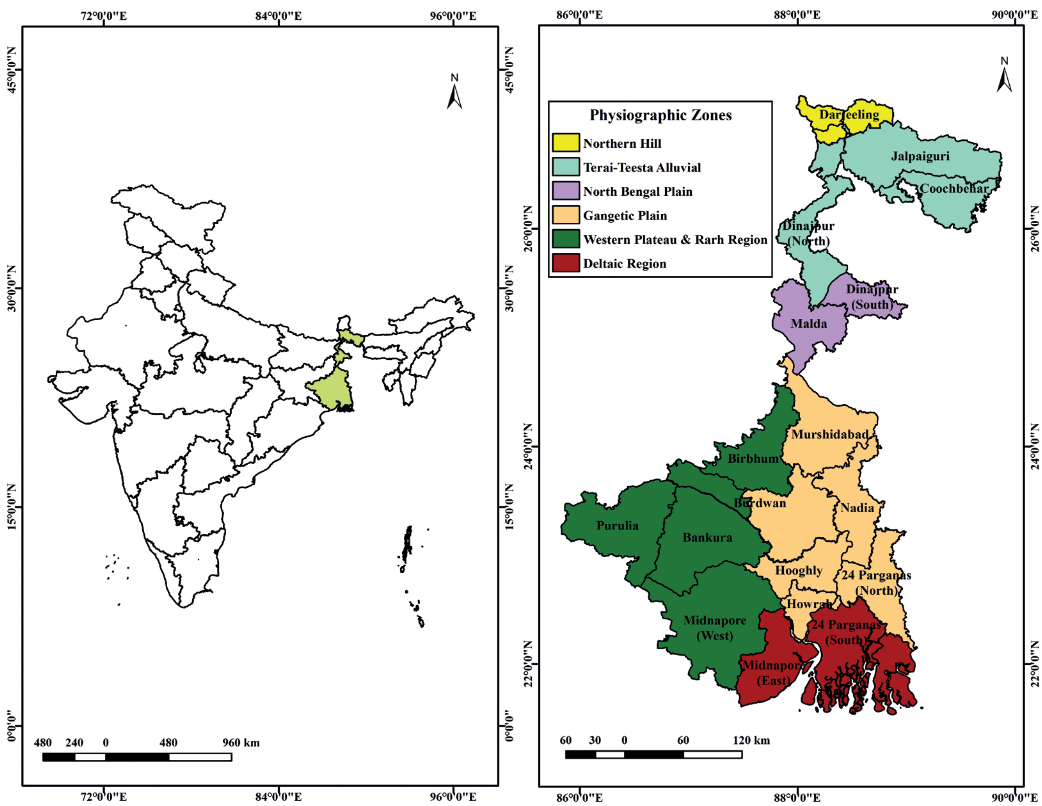

Fig. 1: Physiographic divisions of West Bengal

Bay of Bengal in the south, and from the fertile Gangetic plains to the red lateritic plateau in the west, the state encompasses alluvial, lateritic, saline, and hilly soils. These variations create distinct agricultural environments across its major agro-climatic zones (the Eastern Himalayas, Lower Gangetic Plains, and Eastern Plateau and Hills) and physiographic regions (Fig. 1). Despite this diversity, agriculture remains dominated by intensive paddy monoculture, even though the state cultivates more than 100 crops annually. The state supports nearly eight percent of India's population on only 2.7 percent of its land area, with over 6.5 million rural residents directly dependent on farming. Such demographic pressure, coupled with declining land quality and climate vulnerabilities, makes understanding CDI and price behaviour particularly important.

Objectives

The specific aim of this study is to determine the changing pattern of crop diversification in relation to the price index. The study also examines the impact of a one-unit change in crop diversification on the price index, and vice versa.

Database and methodology

This study is based on published and unpublished secondary data sources. Published data on cropping patterns were obtained from the Agriculture Census, while information on the Minimum Support Price (MSP- is the minimum price at which the government commits to buy crops from farmers, ensuring protection against sharp declines in market prices) was sourced from the Commission for Agricultural Costs and Prices (CACP), Government of India. Since, the MSP for several crops was not listed, price data from *mandis* across 18 districts were collected from unpublished sources. Since production data for all 109 crops were unavailable, only those crops for which both production and gross cropped area (GCA) data were available have been included for the present analysis. Consequently, the MSP-based price index was calculated for 45 crops due to the limited availability of production and GCA estimates.

In the study, the following methods were used:

1. To calculate the Crop Diversification Index (CDI), the Gibbs–Martin (1962) technique has been used, as this method considers the area share of each crop—even when a crop covers as little as one percent or less of the total GCA—as fully represented. Since this technique accounts for the maximum possible coverage of cropped area, it is particularly suitable for assessing the maximum extent of crop diversification among marginal and small farming groups. It is therefore preferred over other existing methods, such as those proposed by Bhatia, Jasbir Singh, Herfindahl, and Simpson. Additionally, the Gibbs–Martin technique is well suited for continuous data.

   $$\text{Gibbs-Martin's Technique} = 1 - \frac{\Sigma}{(\Sigma\ \ )} \quad \ldots\ldots (1)$$

   Here, x denotes the individual crop share in percentage, and the summation of x denotes the percentage area under all different crops.

2. To measure PI, we construct a modified Laspeyres-type Gross Revenue Index (LGRI) using 2000–01 district-level production quantities (q_0) as fixed weights and 2015–16 MSP or mandi

prices (p_1) as current prices and then Crop Revenue Index (CRI) using base-year quantities index calculated as:

$$CRI = \Sigma(p_1 q_0) / \Sigma(p_0 q_0) \times 100 \ldots\ldots (2)$$

This measures how much more (or less) revenue farmers would receive for the same 2000–01 output basket if it were sold at 2015–16 prices.

3. To determine and project the quinquennial trends of CDI and PI, the values of both were extrapolated. To do so, extrapolation was performed first and then the average of the last three years' index was assumed to be the real value of the year.

$$\text{Interpolation} = \frac{\text{Base year data} + (\text{Recent year data} - \text{Base year data})}{\text{Number of years (here Five)}} \ldots\ldots (3)$$

In this study, CDI and PI were projected for 2020-21 (recent year) from the base year (2000-01) and the number of years was five. Due to the outbreak of pandemic, the Agriculture Census of recent years was not conducted.

4. To determine whether one unit of change in CDI equals the unit of change in PI - a simple arithmetic average was calculated.

$$\text{Quinquennial Change (QC)} = \frac{\text{Total increase / decrease}}{\text{Number of quinquennial years}} \ldots\ldots (4)$$

5. To evaluate the inter-temporal shifts in district-level CDI between 2000–01 and 2015–16, the quartile classification technique has been employed.

$$\text{Quartile } (Q_k) = \frac{K(n+1)^{th}}{4} \ldots\ldots (5)$$

Where k is the quartile number (1,2, or 3) and n is the number of the data point.

6. To display the results on the map, ArcGIS 10.3 has been used. The CDI, PI, and QC were calculated using Microsoft Excel.

Limitations

This study has certain limitations that affect its findings. It relies entirely on secondary data from the Agriculture Census and MSP-based price indices. While crop data were available at five-year intervals from 1995–96 to 2015–16, MSP data were inconsistent, preventing price index analysis for five intervals and limiting the study period to 2000–01–2015–16. Another constraint is the absence of marginal- and small-farmer–specific data, which restricted the analysis and prevented the use of regression or factor-based causal modelling. The study also did not include primary survey data, which could have filled this gap. However, this does not affect the overall direction of the findings. Despite these constraints, the study offers strong, data-driven insights into crop diversification patterns, price index behaviour, and per-unit variability and their economic implications.

Results

Crop Diversification Index (CDI)

In 2000–01, West Bengal recorded a CDI of 0.480 across 91 crops. Districts in the Western and central alluvial plains, the Rarh region, and the northern hills showed relatively high diversification, consistent with studies linking CDI with livelihood improvement and income stability. Hooghly (0.749) had the highest CDI, supported by its strong vegetable–horticulture base, expanded cropped area, and high mechanization among small farmers. Similar patterns appeared in Darjeeling (0.733), Cooch Behar (0.721), South Dinajpur (0.685), Howrah (0.638), and Burdwan (0.623), driven by better institutions, technological diffusion, emerging markets, and agricultural innovations.

Table 1: Status of crop diversification index and Laspeyres price index, 2000-01 to 2015-16

Districts	Crop Diversification Index		Price Index	
	2000-01	2015-16	2000-01	2015-16
Bankura	0.400	0.477	100	301.72
Birbhum	0.194	0.402	100	313.48
Burdwan	0.623	0.704	100	295.7
Coochbehar	0.721	0.786	100	298.3
Darjeeling	0.733	0.686	100	281.26
East Midnapore	0.392	0.355	100	281.96
Hooghly	0.749	0.775	100	288.26
Howrah	0.638	0.663	100	294.04
Jalpaiguri	0.451	0.455	100	284.5
Malda	0.144	0.185	100	292.51
Murshidabad	0.267	0.355	100	306.02
Nadia	0.574	0.67	100	308.69
North 24 Parganas	0.575	0.67	100	305.3
North Dinajpur	0.504	0.616	100	297.68
Purulia	0.168	0.289	100	309.97
South 24 Parganas	0.452	0.513	100	293.17
South Dinajpur	0.685	0.725	100	288.9
West Midnapore	0.372	0.414	100	295.11
Total District	0.48	0.541	100	296.48

Source: Calculated by the authors

In contrast, Malda (0.144) recorded the lowest CDI due to weak technology adoption, poverty, and labour out-migration. Naturally stressed districts in the red-lateritic Rarh region—Purulia and Birbhum—also showed low CDI because of degraded soils, rainfall variability, and recurrent droughts. A recent deep-learning GIS study categorizes Purulia as facing very high agricultural distress (Chowdhury & Saha, 2025). Other low-CDI districts include Murshidabad (0.267) in the central plains and East and West Midnapore (0.392; 0.372) in the coastal delta, where socioeconomic constraints and rising non-farm activities limit crop diversification.

Moderate CDI values were observed in North 24 Parganas, Nadia, Jalpaiguri, and South 24 Parganas, sustained by fertile soils, assured irrigation, and abundant labour (CDAP–XII Plan, 2014). These districts serve as key agricultural hinterlands to Kolkata, where continued diversification requires sustained investment, strong extension support, and improved irrigation and input access.

By 2015–16, the statewide CDI increased to 0.541—an improvement of 0.061 units—with 16 of 18 districts. Declines in Darjeeling (–0.047) and East Midnapore (–0.037) were linked to reduced viability of

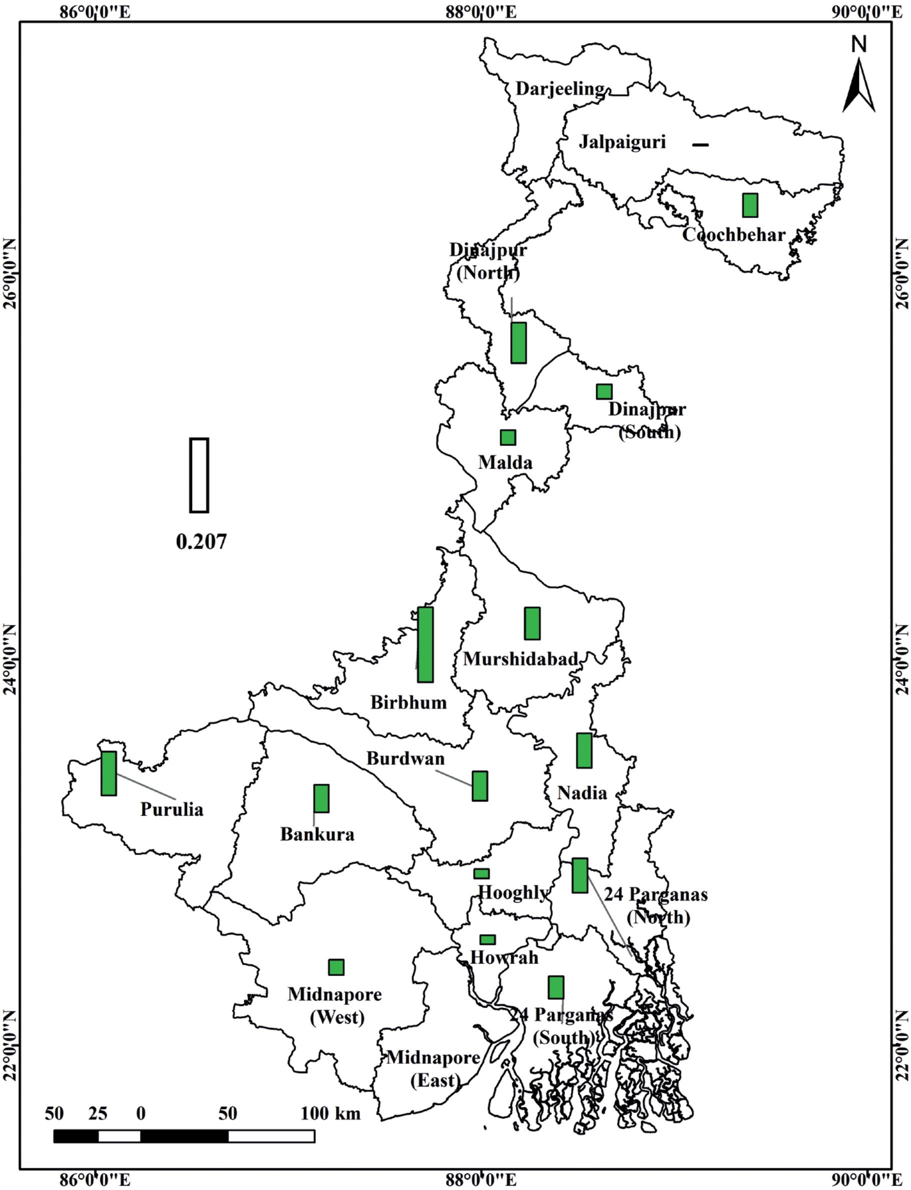

Fig. 2: Change in crop diversification index, 2000-01 to 2015-16

Source – Based on table 1

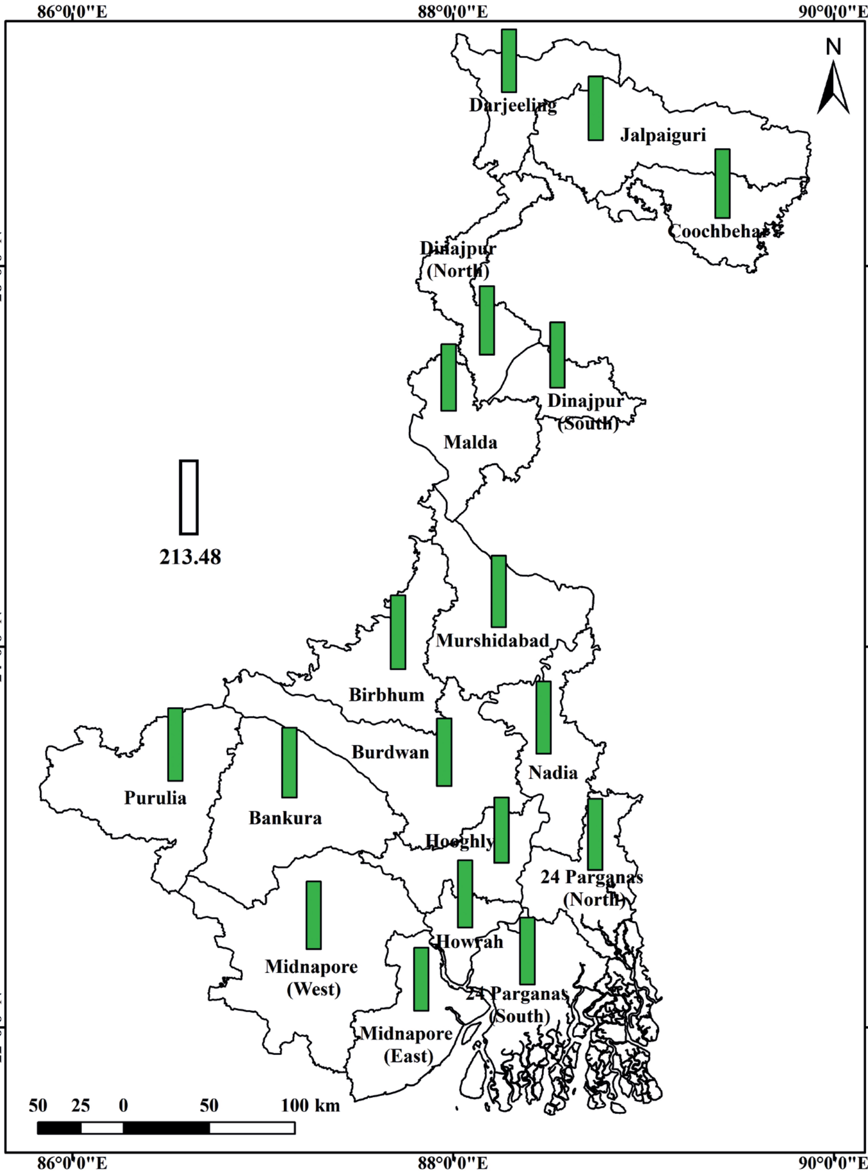

Fig. 3: Change in price index, 2000-01 to 2015-16

Source – Based on table 1

vegetables and horticulture; in Darjeeling, persistent fog (2001–2012) pushed farmers toward pineapple and tea (Gurung & Rai, 2018). The largest gains occurred in Birbhum (0.207), Purulia (0.121), and South Dinajpur, supported by irrigation expansion and government schemes such as *Krishak Bandhu (a farmer welfare program to assist assured annual income on crop share.)* Across the Central and Deltaic plains, Hooghly (0.775), Burdwan (0.704), and South Dinajpur continued to show high CDI due to expanding horticulture, floriculture, and rabi vegetables. In North Bengal, Cooch Behar recorded the highest CDI (0.786), supported by horticulture programmes and Uttar Banga Krishi Viswavidyalaya led technological outreach. Although Malda remained lowest (0.185), it improved through the expansion of vegetables, horticulture, and *makhana* (fox nut- aquatic crop cultivated in shallow water) while Nadia (0.670) showed the most rapid growth among moderately diversified districts.

A comparison of CDI values between 2000–01 and 2015–16 (Table 1) shows that districts below the first quartile (<0.346) declined from four to two, while those in the upper quartile (>0.650) increased from four to eight. Districts in the intermediate range decreased from ten to eight. These shifts indicate a broadly positive trend in crop diversification among marginal and small landholders. The state is gradually moving toward high-income crops and more diversified crop combinations, although traditional cereals continue to dominate. As shown in Fig. 2, five districts crossed above the upper-quartile threshold for CDI change (0.093), while Jalpaiguri, Howrah, and Hooghly remained below the first-quartile threshold (0.030) over the study period.

Price Index (PI)

In Fig. 3, the changes in PI from 2000–01 to 2015–16 are presented. As per Equation 2, the PI includes the MSP and production data for different crops grown across the two time periods. The current PI for West Bengal stands at 296.48 units. Districts located in the Rarh plateau region, such as Birbhum, and parts of the Gangetic plains in central and northern Bengal (e.g., Nadia, North 24 Parganas, Bankura) show higher PI values, reflecting more diversified and profitable cropping systems. Although Purulia records a lower CDI, its PI is comparatively higher, largely driven by a few selected crops.

In contrast, the hilly districts of North Bengal (Darjeeling and Jalpaiguri) and

Table 2: Trends of CDI and PI based on previous and present pattern

Previous trends					
Year	2000-01	2005-06	2010-11	2015-16	2020-21
CDI projected	0.480	0.497	0.512	0.541	0.534
PI projected	100.00	126.53	150.65	196.48	184.48
Present trends					
CDI projected	0.480	0.497	0.512	0.541	0.561
PI projected	100.00	126.53	150.65	196.48	261.97

Source: Calculated by the authors

the eastern coastal/deltaic districts (East Midnapore and South 24 Parganas), display relatively low PI values due to limited diversification, particularly in cash crops and vegetables. Districts in the central Gangetic plains and peri-urban zones (Hooghly, Howrah, West Midnapore, South Dinajpur) exhibit medium-to-low PI, indicating localized but uneven improvements in crop diversification. In the case of Malda, a low CDI alongside a medium PI results primarily from its horticultural base—especially mangoes and *litchi.*

In contrast, the hilly districts of North Bengal (Darjeeling and Jalpaiguri) and the eastern coastal/deltaic districts (East Midnapore and South 24 Parganas), display relatively low PI values due to limited diversification, particularly in cash crops and vegetables. Districts in the central Gangetic plains and peri-urban zones (Hooghly, Howrah, West Midnapore, South Dinajpur) exhibit medium-to-low PI, indicating localized but uneven improvements in crop diversification. In the case of Malda, a low CDI alongside a medium PI results primarily from its horticultural base—especially mangoes and *litchi.*

Overall, higher profitability in the Rarh and Gangetic regions is supported by rising production and MSP-linked incentives for vegetables and horticultural crops, along with the gradual integration of spices, oilseeds, and pulses into existing cropping systems. These factors collectively contribute to improvements in PI across districts.

Crop Diversification Index and Price Index

The positive growth of the CDI and PI indicates a strong relationship between crop diversification and the economic value of crops in West Bengal. Between 2000-01 and 2015-16, the state CDI increased from 0.480 to 0.541, and the PI reached 296.48 units, showing higher overall crop value. In simple terms, even a small rise in diversification resulted in a comparatively larger increase in the economic index, suggesting that diversified cropping systems enhanced farmers' returns.

District-level variations are evident across physiographic regions. In the Rarh plateau (Birbhum), a 0.001-unit rise in CDI led to a 0.969-unit increase in PI, whereas in the North Bengal hills (Darjeeling), the same CDI change was linked to a -0.259-unit shift in PI due to reduced crop diversity and limited production options. Although MSP remains fixed by government policy, total revenue varies with crop area and cropping choices. In Darjeeling, declining crop diversification reduced revenue despite constant MSP.

Projections for 2020-21 show that, if past trends persist, the state CDI and PI may reach 0.561 and 261.97, respectively (Fig. 4), while the quinquennial trend-based projection provides slightly lower estimates (CDI 0.534; PI 184.48) (Fig. 5). Overall, the consistent linear association between CDI and PI suggests that crop higher diversification generally improves economic returns, particularly in regions favourable for cash crops, vegetables, and horticulture.

The trend lines in Fig. 4 point to declining R^2 values for CDI (0.930) and PI (0.927) during 2015–16 to 2020–21, resulting in a negatively skewed projection before the trend

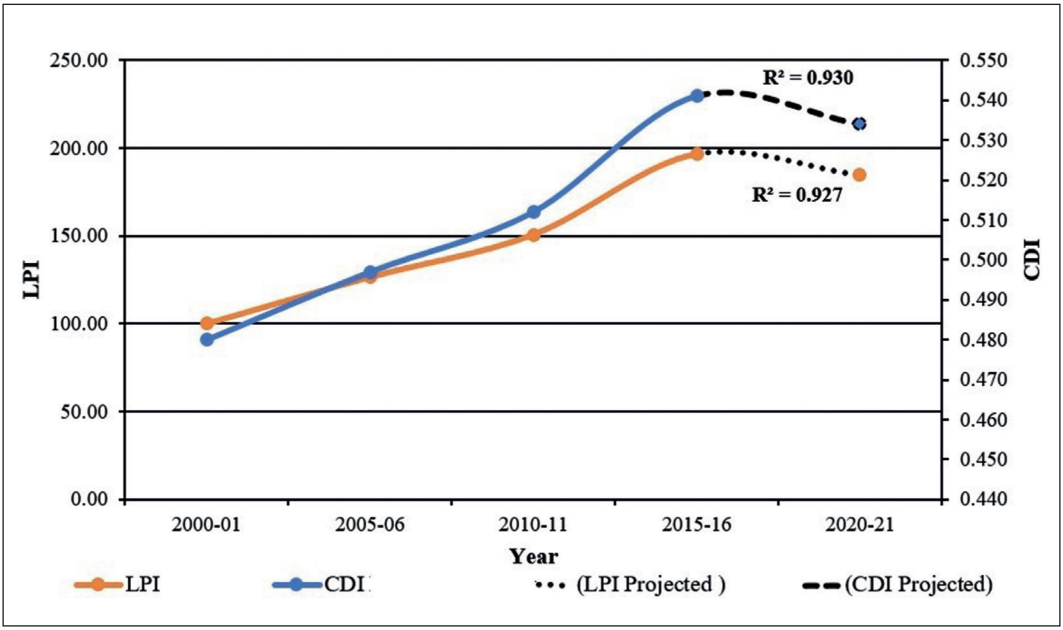

Fig. 4: Trends of CDI and PI based on previous pattern, 2000-01 to 2020-21

Source : Based on table 2

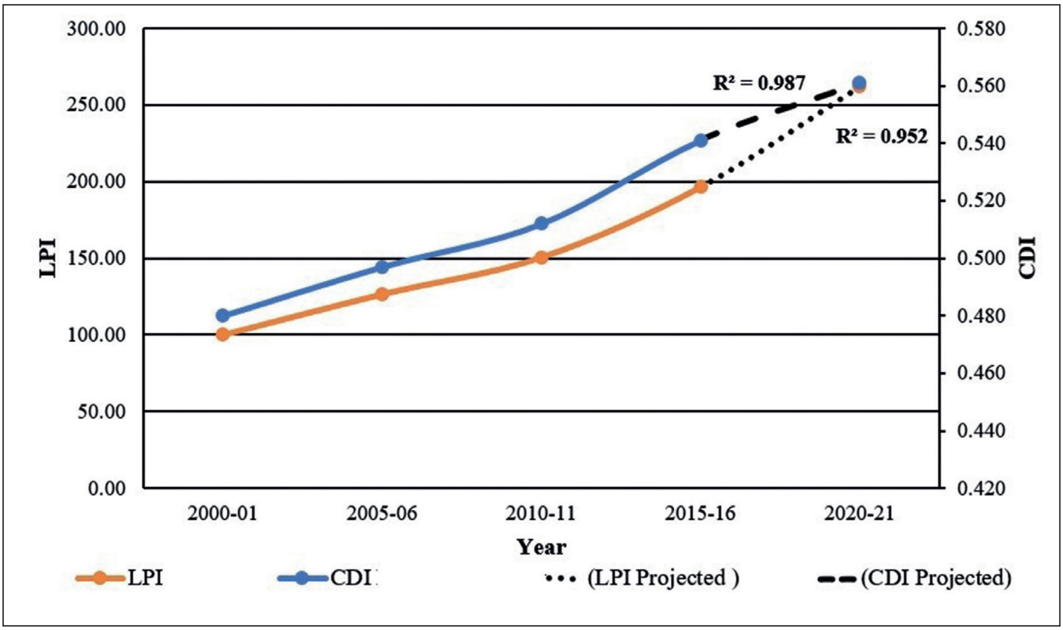

Fig. 5: Trends of CDI and PI based on Present Pattern, 2000-01 to 2020-21

Source : Based on table 2

shifts upward. In contrast, the current rate projections in fig. 5 show steady increases in both indices, with CDI and PI reaching 0.952 and 0.987. This stable linear growth reinforces that increasing crop diversification is strongly associated with proportional gains in the price index and contributes to improved farmer income over time.

Discussion

The study shows a clear and consistent rise in both CDI and PI across most districts of West Bengal over the fifteen-year period. The shift toward high-value cropping systems—especially vegetables, horticulture, floriculture, pulses, and oilseeds—has created new income opportunities for marginal and small farmers. Spatial variations in CDI and PI reflect differences in irrigation access, market connectivity, storage and transport networks, and institutional support. Districts such as Cooch Behar, Hooghly, Jalpaiguri, South Dinajpur, and Burdwan demonstrate particularly strong improvements, similar to diversification-led gains reported in Himachal Pradesh, Punjab, Sikkim, Karnataka, Tamil Nadu, and Andhra Pradesh, where infrastructure expansion and market integration enabled farmers to move toward high-value crops (Birthal *et al.*, 2015; Chand, 2017; Joshi *et al.*, 2004; Singh *et al.*, 2017). Meanwhile, districts in the Rarh region and parts of Central Bengal show uneven but positive progress, supported by schemes such as *Krishak Bandhu*, micro-irrigation programmes, crop insurance, and the *Rashtriya Krishi Vikas Yojana* -a centrally sponsored scheme to incentivise state to increase public investment in agriculture. Overall, the results confirm a strong and robust linear association between CDI and PI, indicating that diversification is a key driver of structural and economic transformation in the state.

A central empirical finding is that even a small increase of 0.100 units in CDI results in a very large rise in PI (about 322 units), amounting to approximately a 350–450 percent marginal revenue gain for marginal and small farmers. When compared with earlier research, these gains are significantly higher. Birthal *et al.* (2015) reported a 70–90 percent rise in income from crop diversification into fruits, vegetables, and livestock in rainfed areas, while Kumar *et al.* (2012) estimated national-level income elasticities of only 0.25–0.40. The markedly higher returns observed in West Bengal can be attributed to its strong reliance on high-MSP or high-market-price vegetables, spices, and floriculture, whose prices have increased faster than cereals. The state's advantage in off-season vegetable production, peri-urban market linkages (e.g., Howrah–Hooghly belt), and expanding cold-chain and storage facilities further enhances price realization and reduces post-harvest losses. These factors collectively amplify diversification's economic impact.

At the same time, districts such as East Midnapore and Darjeeling display stagnant or negative CDI and PI trends due to climate risks, water stress, soil degradation, and weak market infrastructure, which constrain crop diversification and keep cereal dominance in place. Despite these contrasts, the strong CDI–PI relationship suggests that similar income gains could be achieved in ecologically fragile zones—such as the Himalayan foothills, drought-prone Rarh areas, and the North-eastern states—if investments target vegetables, horticulture, pulses, oilseeds, floriculture, and medicinal plants. Overall, the findings show that strengthening CDI substantially boosts PI and farm profitability, making crop diversification a powerful policy instrument for improving agricultural incomes when supported by coordinated infrastructural and institutional interventions.

Conclusion and policy

The study confirms that crop diversification in West Bengal has increased steadily—though unevenly—across districts, and this shift has translated into substantial price-based gains. The strong and consistent linear relationship between CDI and PI demonstrates that crop diversification clearly pays, but only when farmers diversify into crops with effective price support, strong market demand, or stable procurement systems. Vegetables, spices, floriculture, pulses, and oilseeds have driven most of the observed gains, reflecting their high market prices and expanding consumption demand. Districts such as Hooghly, Cooch Behar, Jalpaiguri, Burdwan, and South Dinajpur experienced the largest improvements because they combined crop diversification with better irrigation, storage, transport networks, and institutional support. In contrast, Darjeeling, East Midnapore, and drought-prone Rarh districts lagged due to climate exposure, water scarcity, declining soil health, and weak market infrastructure.

A key insight is that even a modest increase in CDI leads to disproportionately high economic returns—far greater than elasticities reported in earlier Indian studies—because West Bengal's crop diversification is strongly oriented towards high-MSP or high-value crops. These crops receive better price realisation, shorter marketing chains, and stronger peri-urban market linkages, especially around the Howrah–Hooghly vegetable belt. The projected CDI and PI values for 2020–21 further indicate that crop diversification-led gains are durable and likely to persist under appropriate support systems.

Policy action must now focus on deepening these gains and extending them to lagging regions. Priority should be given to strengthening and expanding the *Krishak Bandhu* scheme, ensuring reliable procurement and price support for vegetables, pulses, and oilseeds, and investing in cold-chain and storage infrastructure in high-return districts. Improving market transparency, expanding MSP coverage beyond cereals, and offering targeted credit and capacity-building support for marginal and small farmers will be critical. Region-specific interventions—especially in climate-vulnerable and low-productivity zones—can help unlock untapped crop diversification potential. Overall, the findings provide clear evidence that crop diversification, when supported by strong price policies and robust market infrastructure, is a powerful pathway for raising farm incomes in West Bengal and comparable agrarian states.

Competing interest

The corresponding author declares that they have no conflict of interest.

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