

Is Crop Diversification Impacting the Trade Basket of the Indian Economy?

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ARTICLE INFO

Received: 18 Oct 2024

Revised: 10 Nov 2024

Accepted: 15 Dec 2024

ABSTRACT

Agriculture is important in the Indian economy, with more than half of the rural population. Agriculture is imperative for the Indian economy, with over half of the rural population relying on agriculture and interrelated activities as their foremost source of income. The introduction of New Agricultural Technology in the mid-1960s brought about significant changes in Indian agriculture, leading to further alterations in the following years. Since the 1990s, there has been a perceptible growth in diversification within the agriculture sector in India. Farmers have adopted crop diversification to reduce their vulnerability to risks and challenges in agriculture while also aiming to lift their farm income. The alteration towards more profitable and high-value crops in Indian agriculture reflects deviations in the country's consumption patterns. The study highlights the impact of crop diversification on trade, which is measured by using the share of the agriculture sector in India's exports and imports. To check the impact of crop diversification on agriculture sector growth, a share of agriculture in GDP has been taken. The study's objective is to check the direction of the impact of crop diversification on the variables: agriculture's contributions to the GDP and India's exports and imports. The Shannon index is used to identify the crop diversity in India. Share in GDP, import, and export are taken from various Government sites such as the Department of Commerce, Ministry of Statistics, and program implementation and agriculture statistics at a glance. The results are analyzed by using a multiple linear regression model. The results show a positive impact of crop diversification on GDP and Exports and a negative impact on imports..

Keywords: Crop Diversification, Trade, Export, Import, GDP, Shannon Index

Introduction¹

Crop diversification involves transitioning from single-crop farming to cultivating various crops or engaging in complementary economic activities. This approach enhances farmers' resilience to economic and environmental shocks while promoting sustainable resource utilization (Singh & Patel, 2023; Chand, 2004; Ralte, 2023). In India, diversification has gained momentum as farmers increasingly adopt high-value crops and livestock products to align with shifting consumer demands influenced by urbanization, rising incomes, and dietary diversification (Kumar et al., 2024; Joshi et al., 2004; Singh et al., 2022).

Diversification also contributes to rural economic development by enabling communities to explore alternative income streams and adapt to market demands (Gupta & Sharma, 2023; Radhakrishna & Reddy, 2004; Felix & Ramappa, 2023). It has been recognized as a vital strategy for addressing multiple challenges in agriculture, including food security, income enhancement, and poverty alleviation (Verma & Das, 2024; McCaalla & Valdes, 1999; Paroda, 2022). Furthermore, crop diversification reduces reliance on monoculture, mitigating risks associated with market fluctuations, pests, and environmental uncertainties (Chaudhary et al., 2023; Bhatia, 1965).

¹ GDP – Gross Domestic Product

Driving Forces Behind Diversification

The growing demand for a broader range of agricultural products, including cereals, vegetables, fruits, oilseeds, sugarcane, and livestock products, is one of the primary drivers of diversification (Chand, 2004; Gupta & Sharma, 2023; Brown et al., 2023). High-value crops and livestock products, such as dairy and poultry, offer higher economic returns, encouraging farmers to shift from traditional cropping systems (Joshi et al., 2004; Kumar et al., 2024; Felix & Ramappa, 2023). Diversification allows farmers to meet these demands while reducing their dependency on single crops, enhancing income stability (McCaalla & Valdes, 1999; Verma & Das, 2024; Singh & Sinha, 2019).

Geographical and climatic factors significantly influence diversification potential. Regions with diverse agro-climatic zones and adequate access to irrigation facilities are better suited to implement diversified farming systems (Radhakrishna & Reddy, 2004; Chaudhary et al., 2023; Bhatia, 1965). Socio-economic factors, including access to markets, availability of credit, and technological advancements, also play a critical role in determining the success of diversification efforts (Singh & Patel, 2023; Kumar et al., 2024; Singh et al., 2022).

Challenges and Strategies

Despite its benefits, diversification faces several challenges, including small and fragmented landholdings, inadequate infrastructure, and limited access to technology and financial resources (Verma & Das, 2024; Ralte, 2023). Climate change adds complexity, as erratic weather patterns and natural resource degradation threaten agricultural productivity (Kumar et al., 2024; Singh et al., 2022). Addressing these challenges requires investments in research and development, capacity-building programs, and policy interventions prioritizing sustainable practices (Gupta & Sharma, 2023; McCaalla & Valdes, 1999; Paroda, 2022). Public-private partnerships can significantly overcome these challenges by fostering innovation, improving market linkages, and providing farmers access to modern technologies (Chand, 2004; Singh & Patel, 2023; Singh & Sinha, 2019). Building robust value chains and enhancing rural infrastructure will be crucial for ensuring the success of diversification initiatives (Chaudhary et al., 2023; Brown et al., 2023). Crop diversification offers significant potential for enhancing rural livelihoods, ensuring food security, and promoting sustainable development. By adopting diverse cropping patterns and exploring alternative income-generating activities, farmers can reduce vulnerabilities, improve their incomes, and contribute to national economic growth (Joshi et al., 2004; Kumar et al., 2024; Ralte, 2023). Policymakers must prioritize investments in infrastructure, technology, and market development to create an enabling environment for diversification (Verma & Das, 2024; Singh & Patel, 2023; Singh & Sinha, 2019).

Objectives of the study

1. To check the impact of crop diversification on the GDP of the agriculture sector.
2. To identify the impact of crop diversification on the agricultural trade basket.

Review of Literature

Early studies, such as Bhatia (1965), explored crop concentration and diversification patterns in India, highlighting the geographical and climatic factors influencing cropping patterns. These studies laid the groundwork for understanding the relationship between resource availability and agricultural practices. Singha and Sinha (2019) emphasized the quantitative impacts of crop diversification on economic growth in India, demonstrating that diversified farming systems contribute to higher income levels and rural development. Similarly, Joshi et al. (2004) argued that diversification toward high-value crops and livestock products significantly enhances economic opportunities for South Asian smallholders. Recent research by Felix and Ramappa (2023) further investigated the economic dynamics of diversification in Karnataka, India, underscoring its role in improving farmers' profitability and reducing vulnerability to price shocks. These findings align with Paroda (2022), who advocated diversification as a pathway to sustainable agricultural practices. Diversification's role in achieving sustainability and food security has been widely acknowledged. Radhakrishna and Reddy (2004) suggested that diversified agricultural growth enhances the purchasing power of the poor, thereby addressing food insecurity. More recently, Kumar et al. (2024) highlighted the importance of diversification in adapting to climate change and preserving natural resources. Singh et al. (2022) used panel regression analysis to demonstrate that crop diversification in South Asia mitigates risks associated with monoculture farming while ensuring ecological balance. Brown et al. (2023) provided a

multi-metric assessment of farming systems in the Eastern Gangetic Plains, showing that diversification enhances resilience to environmental and economic fluctuations. The role of policy and infrastructure in facilitating agricultural diversification is a recurring theme in the literature. **Chand (2004)** and **Gupta & Sharma (2023)** discussed how targeted policies, such as subsidies and market development, can incentivize farmers to adopt diversified farming systems. As suggested by **Verma and Das (2024)**, public-private partnerships are also crucial in creating robust value chains and enhancing rural infrastructure. Despite its benefits, diversification faces numerous challenges, including fragmented landholdings, limited technological access, and inadequate infrastructure. **Singh (2013)** noted that horticultural diversification, while profitable, requires significant investments in market linkages and cold storage facilities. **Ralte (2023)** echoed these concerns, calling for capacity-building programs to empower farmers with the necessary skills and resources. In a study conducted by **Ansari (2018)** on crop diversification in India, it was revealed that the agricultural sector's contribution to India's GDP has been falling steadily, accompanied by a decline in the number of agricultural workers in the economy. Moreover, a significant majority, around 67%, of farmers in the sector were classified as marginal. The proportion of gross cropped area dedicated to non-food crops has increased at the expense of food crops, and crop production has shifted mainly towards horticulture crops, with a particular emphasis on fruits and vegetables. **Anuja et al. (2020)** explored the effect of crop diversification on the economic well-being of agricultural households in eastern India. An advanced matching estimation approach and household data were utilized to obtain the outcomes. The results indicated that crop diversification towards high-value crops contributed to an increase in income and consumption, as well as a poverty reduction. This suggests that crop diversification is crucial in enhancing farmers' general welfare. The study also recommended that farmers allocate 40% of their land to high-value crops. The research conducted by **Singh and Sinha (2020)** discovered the correlation between diversification and growth of the economy. Secondary data was utilized to obtain the findings. The study revealed no causality linking crop diversification to economic growth in the short term. Nevertheless, the variation of crops had the potential to exert a favorable impact on economic growth. The results suggested a requirement for appropriate policies to encourage farmers to adopt crop diversification. Such policies could consequently lead to economic growth, specifically through augmenting income and employment opportunities within the agricultural sector. **Pawar and Kalamkar (2020)** examined the tendencies and configurations of agricultural growth and production in India. The investigation outcomes showed that the production of key crops in the agricultural sector has been expanding steadily over time. In particular, since 2000, implementing more effective agricultural policies combined with the adequate supply of essential resources such as power, research, and fertilizer consumption has resulted in a continuous increase in agricultural development within Gujarat. Recent studies, such as those by **Chaudhary et al. (2023)** and **Felix and Ramappa (2023)**, point to emerging trends in diversification, including the integration of non-agricultural activities like agro-tourism and renewable energy. These innovations provide additional income opportunities and reduce farmers' reliance on traditional agricultural practices.

The literature on crop diversification reveals a consensus on its potential to transform rural economies, ensure food security, and promote sustainable development. However, its success depends on addressing structural challenges through targeted policy interventions, investments in infrastructure, and the adoption of modern technologies. Future research should focus on region-specific strategies and the long-term impacts of diversification on socio-economic and environmental outcomes. This review demonstrates the evolving understanding of crop diversification as a critical component of sustainable agriculture and rural development.

Research Methodology of the study

The paper's results have been based on secondary data from various official sources. The data regarding GDP has been collected from the Ministry of Statistics and program implementation. The data on export and import was collected from the Department of Commerce Government of India. The area under different crops is gathered from agriculture statistics issued by the Ministry of Agriculture and Farmers Welfare of India. The data has been collected from 1990-91(advent of LPG policy) to 2022. These data have been collected for decades, and after 2022, the Government will not release trade data.

Shannon Index

The Shannon Index of Diversity, introduced by **Shannon (1948)**, is grounded in entropy, a measure from information theory that has become foundational in ecological biodiversity studies. This index quantifies the diversity within an ecosystem by accounting for species richness and the evenness of species distribution. **Singh et al. (2022)** applied the Shannon Index to assess crop diversification in South Asia, quantifying the diversity of crops and their contribution to sustainable agriculture. **Felix and Ramappa (2023)** used the Shannon Index to analyze the dynamics of cropping patterns in Karnataka, India, highlighting how crop diversification contributes to economic sustainability in the region.

$$\text{Shannon Index} = \sum_{i=1}^n p_i \ln p_i$$

Here p_i Is the area under each crop in the total gross cropped area.

Multiple Linear Regression

Multiple Linear Regression (MLR) is a statistical technique used to model the relationship between two or more explanatory variables (independent variables) and a continuous dependent variable (response variable). The model assumes the relationship between the dependent and independent variables is linear. In MLR, the goal is to estimate the coefficients of the independent variables, which reflect their impact on the dependent variable.

The multiple linear regression method has been used to check crop diversification's influence on GDP. We have one independent variable, the crop diversification index, and three dependent variables, GDP, export, and import.

The SPSS tool has been used to analyze the data.

Regression Equation

$$G = \alpha + \beta X_1 \dots\dots\dots (1)$$

Equation first shows the impact of X_1 (Crop diversification) on G (Gross Domestic Product). A is the intercept, and β is the slope coefficient in this equation.

$$M = C + \theta X_1 \dots\dots\dots (2)$$

Equation second shows the effect of crop diversification on Imports (M). C is the intercept term in this equation and θ Is the slope coefficient.

$$X = B + \gamma X_1 \dots\dots\dots (3)$$

Equation third shows the impact of crop diversification on Exports (X). B is the intercept term, and γ is the slope coefficient.

Results and Discussion

Changes in cropping pattern are shown by the change in percent area under each crop in total gross cropped area.

Table 1. The cropping pattern of India since 1990-91 (Percent area under each Crop)

Year	Foodgrains	Rice	Wheat	Jo war	Bajra	Maize	Pulses	Gram	Oilseeds	Rapeseed	Flow ers	Cotton	Sugarcane	Coarse Cereals
1990-91	61	20	12	7	5	3	12	4	12	3	1	4	2	17
2000-01	62	23	13	5	5	3	11	3	12	2	1	4	2	16
2011-12	60	21	14	3	4	4	12	4	13	3	0	6	2	13
2012-13	60	21	15	3	4	4	12	4	13	3	0	6	2	12
2013-14	60	21	15	3	4	4	12	5	13	3	0	6	2	12

2014 -15	61	22	15	3	4	4	11	4	12	3	0	6	2	12
2015 -16	61	21	15	3	4	4	12	4	13	3	0	6	2	12
2016 -17	62	21	15	3	4	5	14	5	12	3	0	5	2	12
2017 -18	61	21	14	2	4	5	14	5	12	3	0	6	2	12
2018 -19	61	22	14	2	3	4	14	5	12	3	0	6	2	11
2019 -20	60	21	15	2	4	5	13	5	13	3	0	6	2	11
2020 -21	60	21	14	2	4	5	13	5	13	3	0	6	2	11
2021 -22	60	21	14	2	3	5	14	5	13	4	0	5	2	10

Source: Agriculture Statistics at a Glance ²

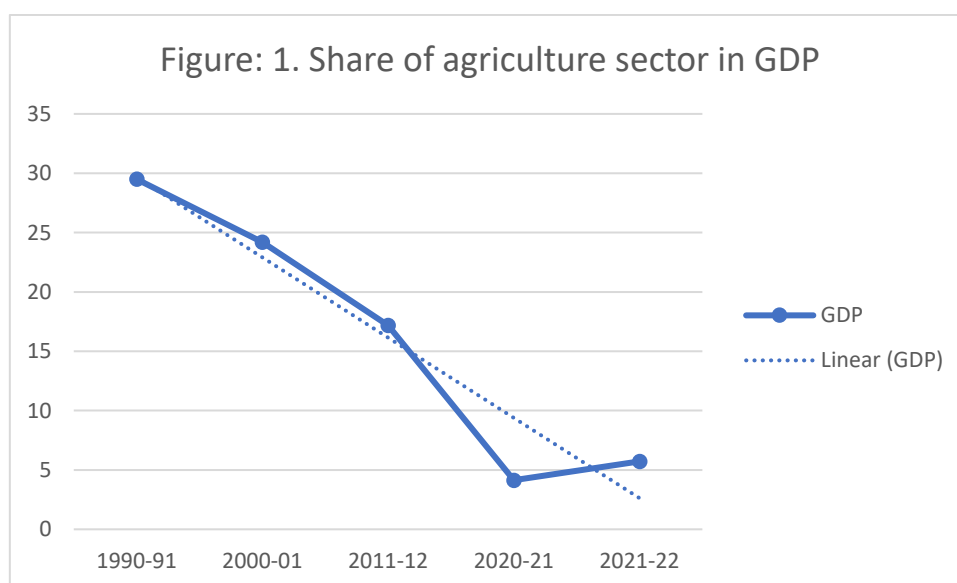
Table 1 depicts the percent of total gross cropped area under each crop. The table shows that the area under food grains has been the highest over the years, with rice and wheat occupying a significant share. Pulses and oilseeds are other crops with the second largest share in the cropped area. Flowers have the least share, followed by sugarcane.

Table 2: - Percent share of the agriculture sector in GDP year-wise

Year	GDP
1990-91	29.5
2000-01	24.2
2011-12	17.19
2020-21	4.14
2021-22	5.72

Source: Ministry of Statistics and Programme Implementation

Table 2 highlights the component of the agricultural sector in gross domestic product, which is declining continuously. In 1990-91, the share of this sector in GDP was 29.5 percent, which reduced to 5.72 percent in 2021-22. Figure 1 shows a trend line depicting the part of the agriculture sector's decreasing GDP.



² LPG- Liberalization Privatization Globalization

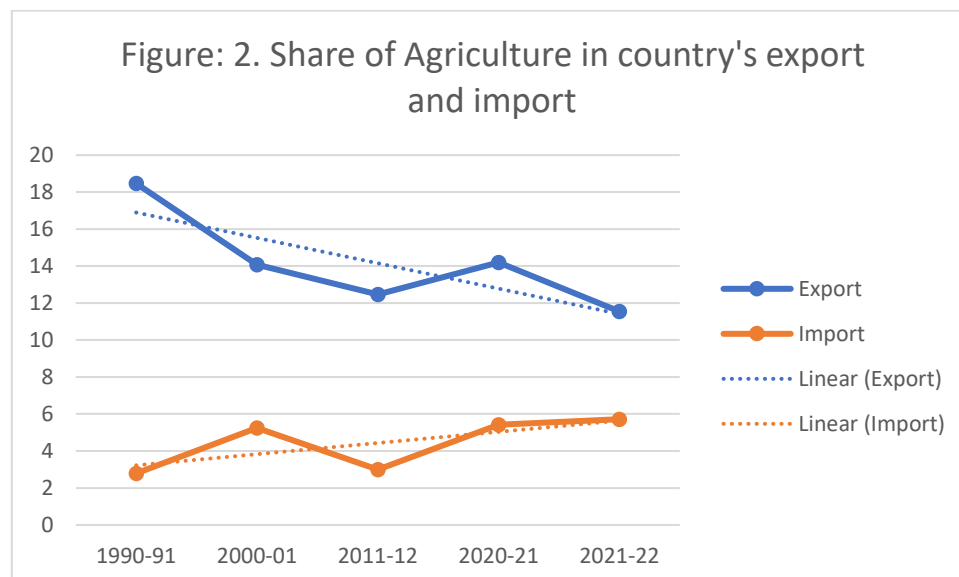
Source: Data taken from table no. 2

Table no.3: - Percent portion of the agriculture sector in India's Export and Import

Year	Export	Import
1990-91	18.47	2.79
2000-01	14.08	5.24
2011-12	12.47	2.99
2020-21	14.20	5.42
2021-22	11.55	5.72

Source: Department of Commerce (Government of India)

Table 3 shows the agricultural sector's share of the country's imports and exports. Share in exports is declining, which was 18.47 percent in 1990-91, and it becomes 11.55 percent in 2021-22. This is also shown by the trend line of exports in Figure 2. The share of imports is increasing, which was 2.79 percent in 1990-91, and it will become 5.72 in 2021-22.



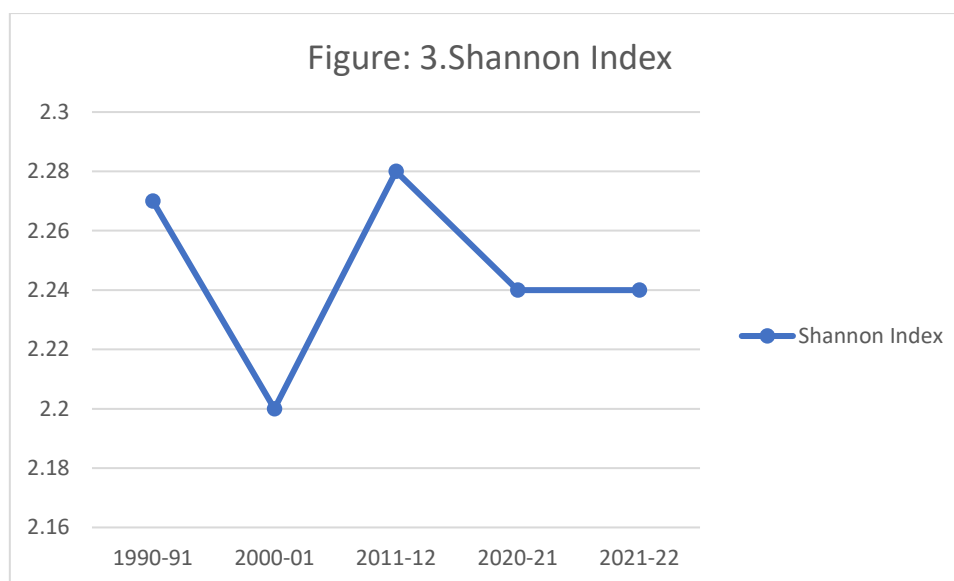
Source: Data taken from table no. 3

Table no. 4. Crop Diversification Index

Year	Shannon Index
1990-91	2.27
2000-01	2.20
2011-12	2.28
2020-21	2.24
2021-22	2.24

Source: Researcher's calculations based on secondary data

Table no. 4 shows the value of the crop diversification index over the years. It shows that the crop diversification index decreased in 2000-01 and increased in 2011-12. After 2020, it remains stable and shows no change in the cropping pattern.



Source: Data used for the plot is taken from Table 4

Figure 3 shows the tendency of diversification in India. In 1990-91, the value of the index was 2.27, but it fell in 2000-01, and it is 2.2. Then again, it increased from 2011 to 12; it stagnated from 2020 to 2022. The value of the index lies in the moderate diversification index. The diversification level in India is moderate, and the major crops produced in India are wheat and rice.

Table No. 5: - Results of the Regression Model

	Independent Variable (Crop Diversification Index)		
Dependent variables	Coefficient	Standard Error	Adjusted R Square
GDP	369.679	451.552	0.090
Import	-104.702	19.410	0.875
Export	71.773	111.969	0.173

Source: Authors compilation

Table 5 shows the regression results in which the dependent variables are in the first column and the independent variable in the first row. The results show that diversification positively impacts GDP, which shows a positive coefficient that depicts that when one unit change in diversification occurs, GDP will increase by 369.67. The negative coefficient of import shows that when one unit increases in diversification, then the import will fall by 104.7. This means that when diversification increases, imports from the agriculture sector decrease, and the country is on the way towards self-sufficiency. Due to that, our payment account balance will become favorable. When one unit increases in diversification index, agriculture sector exports increase by 71.77. Diversification has a positive impact on agriculture exports.

Conclusion

The study conducted a comprehensive analysis and concluded that crop diversification is crucial in enhancing various economic factors within the agriculture sector. Specifically, as farmers diversify their crop production, they experience significant increases in both Gross Domestic Product (GDP) and export levels, while imports tend to decline. This positive correlation benefits the local economy and strengthens the balance of payments (BOP). Increased exports and reduced imports lead to a more favorable BOP, which in turn enhances the terms of trade for the country. Furthermore, crop diversification has the potential to effectively address the challenges related to BOP deficits. Surplus agricultural products are produced by fostering greater self-sufficiency, ultimately contributing to a more resilient and sustainable agricultural sector. This multifaceted approach boosts economic performance and helps ensure food security and stability for the nation.

Policy Implications

Policy frameworks have increasingly emphasized agricultural diversification for sustainable development and rural economic growth (Chand, 2004; Verma & Das, 2024; Ralte, 2023). Initiatives to support high-value crop cultivation, improve market infrastructure, and develop robust supply chains have been central to these strategies (Radhakrishna & Reddy, 2004; Gupta & Sharma, 2023; Paroda, 2022). Efforts to integrate non-agricultural activities, such as agro-tourism and renewable energy generation, provide additional income opportunities for rural households (Kumar et al., 2024; Felix & Ramappa, 2023). "Agricultural policies must consider the diverse challenges farmers face, including fragmented landholdings, limited access to modern technology, and climate change impacts," highlights Singh & Patel (2023). Addressing these challenges requires targeted subsidies, financial incentives, and infrastructure investments to enable farmers to transition to diversified farming systems (Chaudhary et al., 2023; Brown et al., 2023).

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