



## "Unveiling Bihar's Agricultural Growth (2007–2023): A Study of Gross Value Addition and Economic Linkages"

**Jitendra Kumar Sinha**

Retired Senior Joint Director & Head, DES, Bihar, India.

### Article Information

**Received Date:** May 20, 2026

**Accepted Date:** May 30, 2026

**Published Date:** June 05, 2026

**\*Corresponding Author:** Jitendra Kumar Sinha,  
Retired Senior Joint Director & Head, DES, Bihar,  
India.

**Citation:** Jitendra K Sinha., (2026). "Unveiling Bihar's Agricultural Growth (2007–2023): A Study of Gross Value Addition and Economic Linkages". International Journal of Business Research and Management 4(4); DOI: 10.61148/3065-6753/IJBRM/088.

**Copyright:** © 2026. Jitendra Kumar Sinha, Alejandro. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

### Abstract:

This study examines the structural composition and economic impact of agricultural production in Bihar, with a particular focus on its contribution to Gross Value Added (GVA). Using secondary data from 2007 to 2023, the analysis employs descriptive statistics and multiple linear regression to assess the contributions of various agricultural sub-sectors. The Ordinary Least Squares (OLS) method is utilized to estimate the determinants of agricultural growth, while the growth accounting framework decomposes sectoral growth into area, yield, technological advancement, and price effects.

Empirical findings highlight that agriculture plays a pivotal role in Bihar's economy, with crop and livestock production being the primary contributors to GVA. Diversification toward high-value crops and technological advancements emerge as key drivers of agricultural expansion. Additionally, increased fertilizer usage per hectare, capital formation, and higher cropping intensity have significantly influenced growth dynamics. The results underscore the necessity of transitioning to more intensive and technologically advanced farming practices to optimize productivity and economic returns. Policy recommendations emphasize targeted investments in high-impact sectors, fostering integrated agricultural systems, and enhancing livestock productivity to sustain long-term growth and economic resilience.

**Keywords:** GVA, Agricultural production, Agriculture Diversification, Development Determinants ·Price effect  
JEL: E01, C32, Q1, Q 11, Q13 Q19.

### Introduction

#### 1. Relevance of Agriculture in the Economy:

Agricultural production, as the primary sector, encompasses activities directed towards the production of foodstuffs and raw materials necessary for industrial processing. It serves as a foundational pillar for the development of other economic sectors and, consequently, the overall economy of a nation. De Lauwere et al. (2018) (1) affirm that agricultural production represents a crucial sector globally due to its unique characteristics. Furthermore, Gelgo et al. (2023) (2) emphasize its pivotal role in poverty reduction, as it provides food security and income sources for economically disadvantaged populations. Alshem and Ghader (2022) (3) argue that agricultural growth is two to four times more effective than other sectors in increasing the incomes of the poor. They highlight that 40% of impoverished populations experience income growth at a rate three times higher when GDP growth is driven by agriculture rather than other economic sectors.

Wang et al. (2020) (4) discuss the relationship between agriculture and environmental sustainability, suggesting that improved environmental performance, financial development, and agriculture value-added contribute to mitigating the adverse effects of economic globalization on CO<sub>2</sub> emissions. Agriculture plays a vital role in ensuring food security, rural employment, biodiversity conservation, and environmental sustainability (Delabaere & Serradilla, 2004; Janker & Mann, 2020; Burja et al., 2020) (5-7). Given its susceptibility to various factors, agricultural production exhibits structural disparities compared to other economic activities. The biological nature of agricultural production results in slower capital turnover, reduced productivity, and lower farmer incomes (Božić et al., 2011) (8). These uncertainties and financial constraints make agriculture less attractive, leading to rural depopulation and an aging workforce. Consequently, developed nations prioritize agricultural sector stability to ensure food security, supply quality raw materials, and enhance its appeal as a business sector, particularly for younger generations.

## 2. Measurement of Agricultural Activity:

The position of the Agriculture & Allied sector's contribution is often measured through the GVA of agriculture, as analyzed by numerous scholars. Kołodziejczak (2020) (9) examined GVA values in 17 European Union countries from 2000 to 2018 across agricultural, industrial, and service sectors. His findings indicated that developed nations exhibited the lowest agricultural GVA, which remained below 2%.

Harizanova-Metodieva and Harizanova-Bartos (2021) (10) analyzed factors influencing GVA in Bulgaria's agricultural industry from 2000 to 2017. Their ARDL model analysis concluded that investments in agriculture and human capital are the most significant determinants of GVA growth. Volk et al. (2019) (11) highlight the agricultural sector's importance in the Western Balkans, where its share in total GVA varied across nations: 22.7% in Albania, 7.1% in Bosnia and Herzegovina, 10.9% in North Macedonia, 9.6% in Montenegro, and 3.6% in Croatia. Nikolić et al. (2017) (12) and Dimitrijević et al. (2023) (13) conducted comparative studies in the region, determining that Albania exhibited the highest agricultural contribution to economic growth. Alshem and Ghader (2022) (3) analyzed agricultural GVA in Asian nations, including Russia, China, Kazakhstan, Saudi Arabia, Indonesia, India, and Iran, from 2006 to 2021. Russia exhibited minimal fluctuations, maintaining an average agricultural GVA of 4%. China experienced a decline from 10.63% to 7.26%, whereas India's agricultural GVA remained around 17%. These variations highlight the impact of agriculture's share in GDP on national economic development. Grujić-Vučkovski et al. (2023) (14) analyzed the influence of agricultural branches on Serbia's agricultural GVA from 2007 to 2020, concluding that crop production contributes the most, followed by livestock production, while agricultural services have the smallest impact.

## 3. Agriculture in Bihar:

Bihar, a predominantly agricultural state in India, serves as the focal point of this research. The study examines Bihar's agricultural production structure and its contribution to the state's GVA. Agriculture remains critical to Bihar's economy, engaging over 72% of its workforce. The predominance of small and marginal landholdings (96%) necessitates an inclusive agricultural strategy tailored to these farmers. Following Bihar's bifurcation in 2000,

which resulted in the creation of Jharkhand, the state increasingly relied on agriculture for economic stability. Post-2005, Bihar's agricultural growth rate surpassed the national average. Despite this, rural Bihar has yet to fully capitalize on economic opportunities generated by rapid growth.

Between 2000 and 2022, Bihar's economy expanded at an annual rate exceeding 7%, primarily driven by the secondary and service sectors. This structural transformation reduced agriculture's share of the state's income from 36% in 2000-01 to approximately 20% in 2022-23. Nevertheless, Bihar's per capita income growth, averaging 4.83% annually from 2000 to 2023, exhibited fluctuations. Crop output grew at an average rate of 3.74% per annum between 2000 and 2023, while allied agricultural activities—including livestock, forestry, and fisheries—grew at significantly higher rates of 7.34%, 6.79%, and 9.14%, respectively.

Technological advancements, infrastructure investments, and policy interventions have played a crucial role in Bihar's agricultural transformation (Sen, 2016) (15). Improved irrigation, enhanced fertilizer usage, and financial technology innovations have contributed to increased productivity and rural wages (Dawe, 2015; Vos, 2018) (16, 17). However, challenges persist, such as a decline in Bihar's net irrigated area from 61% in 2001 to 57% in 2015. Meanwhile, fertilizer consumption has surged, with NPK usage rising from 700,000–900,000 tons annually until 2003-04 to 1,700,000 tons in 2015-16, elevating fertilizer intensity from 80 kg/ha to 210 kg/ha (Government of Bihar, 2018) (18).

Against this backdrop, this study seeks to address the following critical questions:

- To what extent has Bihar's agricultural sector progressed in the twenty-first century?
- What policy reforms and interventions are required to accelerate agricultural transformation in the state?
- What are the key determinants of overall agricultural growth in Bihar?

Understanding these dynamics is essential for formulating policies that foster sustainable agricultural development, strengthen rural livelihoods, and enhance Bihar's economic resilience.

## 4. Strategies for Growth of Agriculture in Bihar

Agriculture remains a cornerstone of Bihar's economy, employing a significant proportion of the rural population. However, frequent floods pose severe challenges for small and marginal farmers, landless laborers, and petty traders, perpetuating poverty and migration. Kansal et al. (2017) (19) emphasized the sector's vulnerability to natural disasters and its influence on GSDP fluctuations. Despite these adversities, agriculture holds the potential for economic revival, necessitating strategies for risk mitigation and productivity improvement. Based on studies by Sinha (2017, 2019) (20-21) and Sinha & Sinha (2020, 2023) (22,23) the following recommendations were proposed:

**Capital Investment:** Large-scale investments in agricultural capital are essential, as these strongly correlate with the growth of agricultural production value.

**Timely Reinforcement:** Capital investments should be periodically reinforced or renewed to sustain agricultural growth trends.

**Mechanization and Skill Development:** Agricultural mechanization may reduce labor demands, necessitating skill

development for new farming techniques and resource management practices.

**Knowledge-Driven Labor:** A skilled workforce trained in modern practices can enhance multi-cropping, agroforestry, adoption of high-yield seed varieties, and expansion of arable land, positively impacting agricultural GDP growth.

**Credit Effectiveness:** The limited impact of agricultural credit on value-added growth requires investigation into its adequacy and management inefficiencies.

**Forests' Role:** While forestry's economic contribution remains minimal, its environmental benefits, such as acting as carbon sinks, should be acknowledged and integrated into sustainable practices. Focused investments and informed policies addressing these aspects can help Bihar's agricultural sector overcome challenges and contribute significantly to the state's economic growth.

## 5. Materials and methods

The significance of agricultural production in Bihar's overall economic activity can be assessed through multiple analytical lenses. However, the robustness of such assessments is inherently contingent upon the quality and granularity of the available data. This study's official datasets from the Ministry of Statistics and Programme Implementation (MoSPI) serve as the principal data source. Specifically, the study segregates data related to gross value added (GVA), both in aggregate and by economic activity, with a dedicated focus on agricultural production.

Analogous to a firm's profitability as the paramount indicator of financial success, GVA is widely utilized to gauge the economic performance of an industry (Cai & Leung, 2020) (24). As a fundamental constituent of gross domestic product (GDP), GVA is computed as the difference between the total value of production within an economic activity and its intermediate consumption. More precisely, by augmenting GVA with taxes on products and deducting realized subsidies, the GDP for a given economic activity can be ascertained (Krstić & Šoškić, 2015) (25). However, a limitation exists in the reporting standards, which discloses GVA by activity while aggregating taxes and subsidies across all sectors. Consequently, GDP cannot be disaggregated by specific economic activities, necessitating the reliance on GVA for a comprehensive macroeconomic analysis.

Given that the value of production constitutes an intrinsic component of GVA calculations, the study isolates agricultural production values for deeper scrutiny. Initially, agricultural production is bifurcated into plant and animal production, followed by a granular analysis within these broad categories. Under plant production, the study evaluates the value of crops, vegetables, and fruits, alongside other crops' output.

In the domain of animal husbandry, particular attention is accorded to cattle (meat and milk), pig farming, and poultry farming (meat and eggs), among other subcategories. Considering discrepancies in the temporal scope of available data on production values vis-à-vis realized GVA, the study harmonizes the time horizon to the period from 2007 to 2023 for analytical consistency.

**Table 1 Share of subsectors in NSDP and workforce (in %).**

Year	Agri. & Allied	Industries	Services	Agricultural workforce
2008	35.28	11.31	53.34	71.69

## Hypothesis.

Building on this foundation, two key research hypotheses are formulated:

H1: Plant production exerts a statistically significant impact on the gross value added (GVA) of agricultural production in Bihar.

H2: Animal production exerts a statistically significant impact on the GVA of agricultural production in Bihar.

**Model & Methodology:** To empirically test the influence of agricultural production subcategories on the realized GVA, the study employs regression and correlation analysis. Specifically, a multiple linear regression model is estimated, which, in its general form, is expressed as follows (Mutavdžić et al., 2023) (26):

$$Y = \alpha + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \beta_3 \cdot X_3 + \beta_4 \cdot X_4 + \dots + \beta_n \cdot X_n + \varepsilon \quad (1)$$

where  $Y$  represents the estimated value of the dependent variable (agricultural GVA),  $X_i$  denotes the independent variables (production values of different agricultural subcategories),  $\alpha$  is the intercept term,  $\beta_i$  is the estimated regression coefficients, and  $\varepsilon$  is the random error term.

Beyond estimating the regression model, diagnostic tests are conducted to validate the underlying assumptions and assess the model's reliability. The presence of multicollinearity is examined using the variance inflation factor (VIF) and tolerance (TOL) indicators. Multicollinearity is deemed non-problematic if VIF values remain below 10 and TOL values exceed 0.1. Additionally, heteroscedasticity is tested using the Breusch-Pagan test, wherein a p-value greater than 0.05 supports the null hypothesis of homoscedasticity. Furthermore, autocorrelation is evaluated via the Durbin-Watson test, with values approximating 2 indicating the absence of harmful autocorrelation.

Beyond regression diagnostics, the study incorporates fundamental descriptive statistics for a comprehensive quantitative analysis. Notably, all monetary values are expressed at current prices. Adjustments for inflation are executed using the agricultural price index, and values are reported in EUR to facilitate international comparability.

## 6. Results and Analysis

### a. Structural changes in Bihar's economy

A comparative analysis of the share of agriculture in the Net State Domestic Product (NSDP) and employment highlights a growing structural imbalance in the state's economy. Over the past decade and a half, agriculture's contribution to economic output has steadily declined, while its role as a primary employment provider has remained disproportionately high. Specifically, the share of agriculture—including crops, livestock, fisheries, and forestry—in the NSDP has declined significantly, falling from 35.3% in 2008 to 18.19% in 2023 (Table 1). Despite this decline, agriculture continues to serve as the dominant source of livelihood for a vast majority of the workforce. The proportion of the workforce engaged in agriculture has increased from 71.69% in 2008 to 76.32% in 2023 (Table 1).

2013	25.93	18.40	55.66	74.14
2018	21.41	19.13	59.46	73.34
2023	18.19	21.17	60.64	76.32

Source: Authors' estimate

This persistent dependence on agriculture, despite its diminishing economic contribution, raises critical concerns about the structural transformation of the economy. Ideally, as an economy develops, surplus labor from agriculture should be absorbed into more productive sectors such as industry and services. However, **the data suggest a stagnation in this transition, exacerbating the issue of disguised unemployment and underemployment within the agricultural sector.** The simultaneous decline in agriculture's share of NSDP and the increase in its employment share indicate a worsening productivity gap between the agricultural and non-agricultural sectors.

This asymmetric relationship between employment and income across sectors implies that the relative productivity of agricultural workers is declining. The widening disparity in worker productivity between agriculture and non-agriculture suggests that economic growth in the state is increasingly driven by non-agricultural sectors, leaving a large segment of the workforce trapped in low-income agricultural activities. **This trend necessitates urgent policy interventions to facilitate labor mobility from agriculture to higher-value-added sectors while ensuring that agricultural productivity improves for those who continue to depend on it.** Without such structural adjustments, the state risks perpetuating a cycle of low agricultural incomes, rural distress, and subdued overall economic growth.

#### b. Changes in the Value Composition of Agriculture

Despite the persistent disparity between the agricultural and non-agricultural sectors in Bihar, the agricultural sector has demonstrated a remarkable growth trajectory, surpassing the national average in recent years, albeit with periodic fluctuations. The sector experienced a contraction in 2008–09, recording a negative growth rate of –1.9%. However, this downturn was followed by a sustained recovery, with agricultural growth rebounding and accelerating over the subsequent years. By 2022–23, the sector achieved an impressive growth rate of 6.1%, marking the highest level of expansion recorded in the past 15 years. This

**Table 2 Changes in the composition of the value of the agricultural sector (2011–2012 prices).**

Sub-sectors of Agri. & Allied.	% Share		% Annual Growth	
	2006-07 to 2008-09	2020-21 to 2022-23	2006-07 to 2008-09	2020-21 to 2022-23
Crops	60.9	57.6	-1.9	6.1
Livestock	28.0	31.2	5.4	8.6
Forestry	6.9	6.2	16.4	4.8
Fisheries	4.2	5.0	1.2	10.3
All	100.0	100.0	1.4	6.9

Source: Authors' calculation

A detailed examination of the composition of agricultural output in Bihar reveals a gradual yet significant shift in the relative contributions of different subsectors. Historically, crop production has dominated the agricultural economy, but its share in the total

robust performance underscores the sector's resilience and its potential as a driver of economic stability and rural livelihood enhancement.

A closer examination of agricultural growth reveals significant shifts in its structural composition. Crops remain the dominant component of agricultural output, reflecting Bihar's strong reliance on staple food production, including rice, wheat, maize, and pulses. However, within the broader agricultural economy, livestock has emerged as an increasingly vital sub-sector, contributing substantially to overall agricultural growth. The expansion of dairy farming, poultry production, and small ruminant rearing has played a critical role in diversifying income sources for rural households and enhancing resilience against climatic and market uncertainties. These structural changes highlight an ongoing transformation within Bihar's agricultural sector. While crop production continues to be the primary contributor, the growing importance of livestock signals a shift towards a more diversified and commercially oriented agricultural economy. This diversification is crucial in mitigating risks associated with climatic variability, ensuring more stable income streams for farmers, and enhancing the overall sustainability of the sector. However, realizing the full potential of these changes requires targeted policy interventions, including investments in irrigation infrastructure, improved market linkages, and technology adoption to enhance productivity and value addition.

In summary, despite its structural limitations and lower productivity relative to non-agricultural sectors, Bihar's agricultural sector has demonstrated a sustained growth momentum, outpacing national trends. The sector's evolution, marked by a gradual transition towards a more diversified output structure, holds significant implications for rural development, poverty reduction, and overall economic transformation in the state. Ensuring that this growth is both inclusive and sustainable will be essential for bridging the gap between the agricultural and non-agricultural sectors while fostering long-term economic resilience.

value of agricultural output has declined over the past decade. Between 2006 and 2009, crops accounted for approximately 60.9% of the total agricultural output. However, this share declined considerably in the following years, reaching 57.6% during 2020–2023. This reduction indicates a diversification of agricultural

activities away from sole reliance on crop production.

Simultaneously, the livestock subsector has gained prominence, reflecting a structural transformation within Bihar's agricultural landscape. The share of livestock in the total value of agricultural output increased substantially from 28% in 2006–2009 to 31.2% in 2020–2023 (Table 2). This trend underscores the growing role of livestock farming as an alternative source of agricultural income, particularly for small and marginal farmers. Additionally, fisheries, which contributed 4.2% to the total agricultural output in the earlier period, expanded its share to 5% in 2020–2023, demonstrating increasing investment and productivity in this high-value subsector. Conversely, forestry exhibited a declining trend, reflecting reduced commercial activity and possible policy shifts affecting timber and non-timber forest products.

### c. Growth Dynamics and Sectoral Contributions in Agriculture

The growth performance of different agricultural subsectors further highlights this transformation. The crop subsector, despite its declining share in total output, witnessed a remarkable turnaround in its growth trajectory. During 2006–2009, the crop sector recorded a contraction of –1.9%, but this was followed by a strong recovery, with growth reaching 6.1% in 2020–2023. This substantial improvement can be attributed to the adoption of improved agricultural practices, increased mechanization, better irrigation facilities, and policy interventions supporting higher productivity.

**Table 3 Share of crops in terms of gross cropped area and gross value of output.**

Major Crops	% Share of Area		% Share of Value of Production	
	2007-09	2021-23	2007-09	2021-23
Rice	42.17	40.20	21.91	22.47
Wheat	24.78	26.55	14.09	16.77
Mazei	2.42	7.68	4.90	5.01
All Cereals	75.76	74.68	40.33	46.53
Pulses	8.37	7.61	4.96	4.14
Oilseeds	1.47	1.46	1.11	1.62
Sugarcane	1.90	1.78	1.50	1.41
Fruits & Vegetables	11.65	13.25	51.93	42.92
All Crops	100.00	100.00	100.00	100.00

Source: Authors' estimate

The increasing prominence of maize as a cash crop in Bihar can be attributed to the state's ability to support a winter maize cultivation cycle, with sowing occurring between October and December and harvesting between April and June. The demand for maize is driven primarily by three sectors—poultry feed, livestock feed, and human consumption. The World Bank (2007) estimated that 35% of Bihar's maize demand is derived from the cattle and poultry feed markets (Kishore et al., 2014). At present, Bihar ranks as the third-largest maize-producing state in India, contributing 10% of the national production, trailing Karnataka (17%) and Telangana (11%). Notably, maize yields in Bihar (3.3 metric tons per hectare) surpass the national average (2.6 metric tons per hectare). In addition to meeting domestic demand, Bihar supplies maize to states with substantial consumption needs, such as Andhra Pradesh, Tamil Nadu, and West Bengal. Expanding maize acreage and establishing feed processing plants within Bihar could

Among all subsectors, livestock has emerged as the primary driver of agricultural growth. With an average growth rate of 8.6% over the past decade, the livestock subsector has significantly outperformed crops in terms of expansion and stability. The rising demand for dairy, meat, and poultry products, coupled with the increasing commercialization of livestock farming, has contributed to this rapid growth. Fisheries, although a smaller component of the agricultural economy, also demonstrated robust expansion, reinforcing the broader trend of agricultural diversification. The increasing share of livestock and fisheries highlights the structural shift toward more remunerative and labor-intensive agricultural activities, which are better suited to the resource constraints and livelihood strategies of smallholder farmers.

### d. Share of Value of Crop Production

Significant structural transformations have been observed within the crop subsector, indicating a pronounced trend toward diversification. While cereals continue to dominate, their share in the gross cropped area has declined from 75.76% during 2007–2009 to 74.68% in 2021–2024. However, their contribution to the gross value of agricultural output increased from 40.33% to 46.53% over the same period (Table 3). Rice remains the most dominant crop, accounting for approximately 21.91% of total agricultural output. The shares of wheat and maize have also exhibited marginal growth, increasing from 14.09% to 16.77% and from 4.96% to 5.01%, respectively, between 2000–2002 and 2013–2015.

significantly enhance the state's agricultural economy.

Oilseeds constitute less than 2% of both the gross cropped area and the total agricultural output. Rapeseed-mustard is the most significant oilseed crop, while soybean has been gaining traction in recent years. Pulses accounted for approximately 7.61% of the gross cropped area during 2021–2023, reflecting a slight decline compared to the previous period, alongside a marginal reduction in their share of total agricultural output.

High-value crops—including fruits, vegetables, spices, and medicinal plants—accounted for approximately 13.25% of the gross cropped area but contributed over 50% of total agricultural output in 2021–2023. Vegetables and fruits alone represent more than 95% of the total area and value within this category. However, the share of fruits and vegetables in total agricultural output declined from 51.93% to 42.92% over the period. Despite this relative decline, their absolute value increased, suggesting growth in production volumes. The diminished share of total output value

is largely attributed to depressed farmgate prices, which may stem from inadequate infrastructure, including storage, transportation, and market linkages, adversely affecting price realization for farmers.

#### e. Sources of growth in agriculture

A comprehensive understanding of the sources of agricultural growth is crucial for assessing the sustainability of current trends and formulating policy priorities for the future. Table 4 presents the decomposition of agricultural growth into its key components: area

**Table 4: Sources of Growth in Agriculture**

Source	2006-2011	2012-2017	2018- 2023
Area Expansion	-10.9	-1.2	-1.6
Yield Improvement	95.2	46.8	52.8
Price Increase	-42.3	37.9	28.0
Diversification	59.5	14.1	23.4
Interaction	-3.1	1.2	0.4

Source: Authors' estimate

Between 2018 and 2023, the crop subsector experienced a robust annual growth rate of (-)1.6%, marking a significant shift in the drivers of agricultural expansion. Technological advancements and improved agricultural practices became the dominant sources of growth, while the contribution of high-value crops diminished due to limited market access. Yield improvements remained the principal driver of growth, whereas area-driven expansion continued to exert a negative impact. In contrast, the role of price effects underwent a notable

**Table 5 Contribution of different crops to the overall growth of the crop sector**

Crops	Share of overall growth (%)			Growth rate (%)		
	2006-2011	2012-2017	2018-2023	2006-2011	2012-2017	2018-2023
Rice	29.21	30.40	32.86	6.78	4.79	5.21
Wheat	15.29	15.80	30.47	3.28	3.46	3.98
Maize	9.75	10.29	12.05	9.53	9.28	5.61
Other coarse cereals	0.16	0.12	0.15	7.58	7.32	4.88
Cereals	54.41	56.61	75.53	6.07	6.50	5.28
Pulses	4.55	4.09	3.51	0.35	5.51	3.39
Mustered & rapeseeds	1.10	1.25	1.20	6.12	5.94	3.90
Oilseeds	1.10	1.17	1.37	4.74	4.50	3.56
Sugarcane	12.45	18.21	9.16	9.82	17.85	21.29
Fibers	2.45	2.41	2.05	8.43	6.70	4.60
Fruits & Vegetables	23.94	16.26	7.18	-2.67	1.32	-1.62

Source: Authors' estimate

Yield improvements consistently emerged as the dominant driver throughout the analyzed period. Factors that constrained growth between 2012 and 2017 exhibited a gradual recovery in subsequent years. Notably, price effects, which had previously hindered growth until 2006–2011, showed steady improvement, ultimately contributing nearly as much as yield enhancements by 2018–2023. The overall value of agricultural output accelerated across all crop categories, with cereals emerging as the principal contributor, accounting for 75% of total growth. Sugarcane followed with a 9% contribution, while fruits, vegetables, pulses, and oilseeds

expansion, yield improvements, price effects, and diversification. During the period 2006–2011, the crop subsector contracted at an annual rate of 0.89%, with growth being primarily driven by yield improvements and diversification. However, a substantial decline in the cultivated area had a significant negative impact on crop production. Diversification emerged as the primary positive contributor to growth, while price effects exerted a considerable negative influence, largely due to the inefficiencies in market infrastructure and poor marketing channels within the state.

transformation, shifting from a negative contribution of –42.3% in the previous period to a positive 28% share in overall growth. This shift can be attributed to government-led interventions aimed at strengthening market linkages and infrastructure development. Additionally, approximately 14% of growth resulted from land reallocation (diversification) toward higher-value crops, marking a significant decline from its previously high contribution.

A deeper analysis of annual trends reveals important insights into the dynamics of growth. Table 5 presents the contribution of different crops to the overall growth of the crop sector.

collectively accounted for 1–7% of total sectoral expansion.

The composition of crop contributions to agricultural growth evolved significantly between 2006–2011 and 2021–2023. During 2006–2011, overall crop output growth was constrained to less than 1%. In this period, cereals—primarily wheat, maize, and other coarse grains—contributed 54%, while sugarcane accounted for 12%, followed by fruits and vegetables. Oilseeds, mainly rapeseed-mustard, were also key drivers of growth.

By 2018–2023, agricultural growth exhibited a more diversified pattern. Table 5 indicates that the contribution of non-cereal crops, particularly high-value crops, underwent a marked transformation.

The share of high-value crops in overall agricultural growth, which was 45% in the earlier period, declined substantially to 25% in the latter period. A particularly notable shift was observed in the role of fruits and vegetables, whose growth contribution contracted to one-third of its earlier share. Their contribution declined sharply from 23% during 2006–2011 to just 7% in 2018–2023, driven by a combination of unremunerative prices, lower yields, and a contraction in cultivated areas. Pulses also failed to expand their share of agricultural growth, primarily due to stagnant yields and suboptimal price realization.

Despite an overall deceleration in growth rates, cereals and oilseeds gained prominence in relative terms. The share of cereals increased to 75%, while oilseeds maintained a modest 1.10% share. Collectively, high-value crops accounted for a diminishing proportion of total agricultural growth, reaching 25% in the latter period. However, it is crucial to recognize that these shifts occurred within the broader context of significantly higher overall agricultural growth, reflecting a structural transformation in crop sector dynamics.

#### f. Volatility and Resilience in Agricultural Growth

Despite the overall positive trajectory, sectoral growth patterns reveal notable differences in volatility. The crop subsector has exhibited significantly higher fluctuations in output, primarily due to its dependence on monsoonal rainfall and climatic variations. Periodic droughts, floods, and pest outbreaks continue to affect crop yields, making growth in this sector highly unpredictable.

In contrast, livestock farming has proven to be a more stable and resilient component of Bihar's agricultural economy. Households traditionally rely on livestock as a financial and food security buffer during times of agricultural distress. In years of poor crop production, livestock provides an alternative source of income and sustenance. Additionally, straw from failed crops serves as fodder for animals, reinforcing the complementary nature of the two subsectors. Empirical evidence from Birthal and Negi (2012) (27) supports this observation, demonstrating that growth in the livestock subsector is significantly less volatile than in the crop sector. This stability makes livestock an essential risk-mitigation strategy for farming households, providing a cushion against climatic shocks and ensuring income continuity.

#### g. Policy Implications and Future Outlook

The ongoing diversification of Bihar's agricultural sector toward livestock and fisheries carries important policy implications. Given their relatively higher returns and lower susceptibility to climate risks, targeted investments in these subsectors could further enhance rural incomes and employment opportunities. Strengthening veterinary services, improving access to quality animal feed, expanding market linkages, and enhancing financial support for smallholder livestock and fish farmers will be critical in sustaining this positive momentum.

Moreover, while the crop sector remains vital, addressing its

**Table 6: Tests for homoscedasticity and autocorrelation.**

Test	Null Hypothesis	Test Statistics	p-value	Result
Breusch-Pagan heteroskedasticity test	Homoscedastic model variance	0.1552	0.9527	H0 is accepted.
Durbin-Watson autocorrelation test	Absence of first-order	1.5597	-	H0 is

inherent volatility requires strategic interventions, including expanding irrigation infrastructure, promoting climate-resilient crop varieties, and improving access to crop insurance schemes. A balanced approach that fosters both productivity growth in the crop sector and continued expansion of the livestock and fisheries subsectors will be essential in ensuring inclusive and sustainable agricultural development in Bihar.

In conclusion, the evolution of Bihar's agricultural economy over the past two decades demonstrates a clear transition toward a more diversified and resilient structure. While the crop sector continues to be the dominant contributor, the rising prominence of livestock and fisheries indicates a shift toward higher-value, labor intensive agricultural activities. This transformation presents significant opportunities for enhancing rural livelihoods and economic stability, provided that policy measures effectively support this structural reorientation.

#### 7. Agricultural Contribution to Gross Value Added (GVA)

With the established structure of agricultural production value in Bihar, a regression model was evaluated to assess the impact of crop and livestock production on the realized Gross Value Added (GVA) of agriculture. Prior to model evaluation, diagnostic tests were conducted to verify the underlying assumptions, determining whether the regression model is appropriate for analysis. Specifically, multicollinearity, heteroscedasticity, and autocorrelation were examined using standard econometric tests. Multicollinearity was assessed through the Variance Inflation Factor (VIF) and Tolerance (TOL) indicators. The results indicate an absence of harmful multicollinearity, as the average VIF value was 9.5270, remaining below the critical threshold of 10. Similarly, the TOL value was 0.1204, which exceeds the minimum acceptable threshold of 0.1, confirming the adequacy of the independent variables in the regression model.

Given that multicollinearity was within acceptable limits, the Breusch-Pagan and Durbin-Watson tests were employed to assess heteroscedasticity and autocorrelation, respectively. The Breusch-Pagan (BP) test yielded a statistic of 0.1552 ( $p=0.9527$ ), leading to the acceptance of the null hypothesis, which assumes homoscedasticity of residual variance—an essential requirement for unbiased parameter estimation. Additionally, the Durbin-Watson (DW) statistic of 1.5597, which is near the standard reference value of 2, indicates the absence of significant autocorrelation in the residuals.

Based on the results of these diagnostic tests, it is concluded that the multiple linear regression model is appropriate for evaluation. In this model, the dependent variable is the agricultural GVA, while the independent variables are the values of crop production and livestock production. Table 6 presents the detailed results of the regression model evaluation, including tests for homoscedasticity and autocorrelation.

	autocorrelation			rejected.	
--	-----------------	--	--	-----------	--

Source: Authors' calculations

### 8. Multiple Linear Regression Model for Agricultural GVA

The assessment of the multiple linear regression model, where the Gross Value Added (GVA) of agricultural activity serves as the dependent variable and the values of plant and livestock production are the independent variables, is presented in Table 7. The estimated model exhibits strong statistical significance, as indicated by the F-test value of 864.00 ( $p = 0.0000$ ), confirming the overall explanatory power of the regression framework. Furthermore, the adjusted coefficient of multiple determination ( $R^2_{adj} = 95.69\%$ ) signifies that the independent variables collectively explain a substantial proportion of the variance in agricultural GVA, reinforcing the model's robustness.

A detailed examination of the estimated coefficients reveals that the value of plant production exerts a highly statistically significant

**Table 7. Evaluation of Model 1 (Y: GVA of agriculture, X<sub>1</sub>: Value of crop production, X<sub>2</sub>: Value of livestock production)**

Parameter	Variable	Coefficient	Standard Error	p-value
$\alpha$	Constant	0.8861	51.4720	0.9782
$\beta_1$	Crop production	0.5686	0.0962	0.0000
$\beta_2$	Livestock production	0.5381	0.2453	0.0682
R-squared		0.9695		
Adjusted R-squared		0.9569		
F- statistics		864.0000		
Prob. (F-statistics)		0.0000		
Standard Error		56.5635		
No. of Observation		16		

Source: Authors' calculations

Considering the previously formulated hypotheses, the findings confirm the first hypothesis, as plant production exhibits a statistically significant impact on the Gross Value Added (GVA) of agricultural output. Conversely, the second hypothesis is only partially supported, given that the variable for livestock production attains statistical significance at a marginal threshold of  $\alpha = 0.07$ , which exceeds the conventional 5% significance level.

### 9. Contribution of Plant Production to Agricultural GVA

**Table 8. Evaluation of Model 2 (Y: GVA of agriculture, X<sub>1</sub>: Value of cereal production, X<sub>2</sub>: Value of fruit production, & X<sub>3</sub>: Value of other crops)**

Parameter	Variable	Coefficient	Standard Error	p-value
$\alpha$	Constant	77.6313	81.9082	0.3972
$\beta_1$	Crop production	0.7614	0.1321	0.0000
$\beta_2$	Fruit production	0.9736	0.464	0.0468
$\beta_3$	Other crops	0.2417	0.5971	0.6540
R-squared		0.9634		
Adjusted R-squared		0.9578		
F- statistics		379.4682		
Prob. (F-statistics)		0.0000		
Standard Error		72.5914		
No. of Observation		16		

Source: Authors' calculations

influence on agricultural GVA during the period 2007–2023. Specifically, an increase of EUR 1 in plant production is associated with an expected rise of EUR 0.5686 in the GVA of agricultural activity. This strong relationship underscores the pivotal role of plant production in driving agricultural value creation.

Conversely, while the livestock production variable is statistically significant, it holds significance only at the threshold level of  $\alpha = 0.0682$ , suggesting a weaker and less certain impact. Given this marginal level of significance, the contribution of livestock production to overall agricultural GVA must be interpreted with caution. These findings highlight the predominant role of plant production in Bihar's agricultural sector while indicating a relatively limited yet notable contribution from livestock production.

Given the highly statistically significant contribution of plant production to the multiple linear regression model, where the Gross Value Added (GVA) of agriculture is the dependent variable, it is analytically meaningful to examine the contributions of specific plant production subsectors to the realized GVA of agricultural activity. To achieve this, a multiple linear regression model was estimated, in which the dependent variable remained agricultural GVA, while the independent variables included the values of crop, fruit, and other crops (Table 8).

Notably, the variable related to vegetable production was excluded

from the model due to its high correlation with the arable production variable, leading to a multicollinearity issue. To mitigate this problem and ensure model robustness, the vegetable production variable was omitted from the regression analysis. The estimated multiple linear regression model demonstrated overall statistical significance ( $F = 379.4682$ ;  $p = 0.0000$ ), with an adjusted coefficient of multiple determination ( $R^2$ ) of 96%, indicating a strong explanatory power of the independent variables.

The results indicate that crop production exhibits a highly statistically significant impact on the realized value of agricultural GVA. Specifically, a EUR 1 increase in crop production is associated with an expected EUR 0.7614 increase in total agricultural GVA. In addition to crop production, fruit production also demonstrates statistical significance, albeit at the  $\alpha = 0.05$  significance threshold, suggesting a moderate yet relevant contribution to agricultural GVA.

Conversely, the results indicate that viticulture production does not exert a statistically significant effect on agricultural GVA within the evaluated model. This finding suggests that, in the current economic and production structure, viticulture does not independently contribute to the realized value of agricultural GVA, reinforcing the dominant role of crop and fruit production in shaping the sector's overall economic output.

#### **10. Multiple Linear Regression Model for Crops Production with Livestock Production GVA**

A multiple linear regression model was also assessed in which the Gross Value Added (GVA) of agricultural production was used as the dependent variable, while specific branches of livestock production—namely, the value of cattle production, pig farming, poultry, and other livestock production—served as independent variables. However, this model did not demonstrate statistical significance, and therefore, its results are not presented.

Referring to the results of Model 1, where the aggregated value of livestock production was statistically significant at the  $\alpha = 0.07$  significance level, it can be inferred that the overall contribution of livestock production to agricultural GVA should be considered as a whole. However, individual branches of livestock production currently lack sufficient explanatory power to exert a statistically significant influence on total agricultural GVA. This conclusion is further supported by the structural distribution, which illustrates that the contribution of individual livestock sectors remains considerably lower than that of plant production.

The Gross Value Added (GVA) indicator plays a critical role in evaluating the economic performance of any sector, including agriculture. As previously discussed, GVA in agriculture is particularly significant as it provides a comprehensive measure of both current industry trends and future growth potential. GVA serves as a crucial quantitative economic indicator, informing policy interventions and strategic decision-making within specific sectors. Given that different agricultural activities contribute to GVA at varying levels, identifying the factors influencing these variations is essential for assessing productivity and economic growth. In this regard, Andreescu (2021) (28) highlights that GVA remains one of the most important metrics for evaluating sectoral economic performance.

Existing literature corroborates the significance of GVA in agriculture. Feher et al. (2022) (29) argue that this indicator effectively reflects the efficiency trends in agricultural activity,

while also acknowledging that agricultural sector growth is influenced by multiple factors—some of which can be directly controlled, while others remain exogenous. Mergoni et al. (2024) (30) emphasize the role of GVA as a desirable output variable in assessing sustainable agricultural efficiency. Similarly, Gelgo et al. (2023) (2) examine how institutional quality impacts agricultural value added in East Africa, finding that higher per capita GDP, a smaller rural population share, and increased education expenditure significantly enhance agricultural value added. Their study underscores the pivotal role of institutional frameworks in fostering agricultural growth.

Furthermore, Salimova et al. (2020) (31) conducted a cross-country comparative analysis of the agricultural sector GVA, identifying agriculture's relative contribution to national economic development. Rajeb et al. (2012) (32) explored the determinants of agricultural GVA in Bangladesh, highlighting the importance of land use, irrigation, pesticide consumption, forest coverage, fertilizer application, and improved seed varieties in influencing agricultural economic performance. In line with these findings, Pacheco et al. (2018) (33) suggest that variables such as agricultural GVA, average household income, and the size of the economically active population positively impact agricultural diversification.

Building upon these empirical insights, the present study confirms that plant production constitutes the primary driver of agricultural GVA in Bihar. In a broader context, this finding aligns with global trends, wherein plant production emerges as the predominant determinant of agricultural economic activity. This conclusion is further reinforced by the statistically significant coefficient of plant production in the estimated regression model, consistent with the findings of Grujić-Vučkovski et al. (2022) (34).

The substantial influence of plant production, particularly arable farming, suggests that extensive agricultural practices dominate over intensive methods in Bihar's agricultural sector. This observation aligns with the conclusions drawn by Feher et al. (2022) (29) regarding Romania's agricultural GVA. Additionally, Figure 2 illustrates that intensive forms of plant production contribute only marginally to the total agricultural GVA.

Moreover, the statistical significance of livestock production at  $\alpha = 0.07$  suggests that its contribution must be interpreted cautiously. Given the inherent vertical integration between plant and livestock production, the dominant share of plant production highlights insufficient interdependence between these two subsectors within Bihar's agricultural landscape.

Considering the statistical significance of livestock production in Model 1, it is reasonable to hypothesize that additional investments in livestock farming could enhance the overall agricultural sector. However, at this stage, it is not possible to precisely identify which specific branches of livestock farming would drive this improvement. The absence of statistically significant effects from individual livestock subsectors indicates that no single branch of animal husbandry currently exerts an independent impact on agricultural GVA.

Additionally, the statistically significant impact of fruit production in Model 2 suggests potential opportunities for further agricultural development. Specifically, targeted investments in fruit cultivation could enhance overall agricultural productivity. Conversely, viticulture (grape production) did not demonstrate a statistically

significant effect on agricultural GVA, indicating that investment strategies should prioritize fruit production over viticulture.

Feher et al. (2022) (29) argue that, with appropriate restructuring and financial resource allocation, Romania's agricultural GVA could increase and converge toward the levels observed in other European economies. A similar conclusion can be drawn for Bihar, where strategic investment in high-value agricultural activities—particularly fruit cultivation and selective expansion of livestock production—could lead to substantial improvements in agricultural productivity and economic sustainability.

### 11. Conclusion

This study provides a comprehensive analysis of the contribution of agricultural production to Gross Value Added (GVA) in Bihar, highlighting the dominance of crop production over other agricultural sectors. The findings indicate that crop production exhibits the most statistically significant influence on agricultural GVA, while livestock production, despite its potential economic advantages, remains statistically significant only at a lower confidence threshold. Furthermore, the production of other crops does not exhibit a statistically significant effect, underscoring its limited role in Bihar's agricultural economy.

The study reinforces the notion that Bihar's agriculture remains largely extensive, relying on traditional farming practices rather than modern, intensive, or high-value production methods. This structure limits productivity gains and economic efficiency. The research also underscores the lack of integration between crop and livestock production, which, if addressed, could enhance overall agricultural profitability.

### 12. Policy Implications

The study's findings hold substantial policy relevance for Bihar's agricultural sector. To maximize GVA contribution and economic sustainability, policymakers should consider the following strategic interventions:

**Shifting from Extensive to Intensive Agricultural Practices**

Promoting high-yield, resource-efficient crop varieties to improve productivity.

Encouraging precision farming, mechanization, and sustainable irrigation techniques to enhance efficiency.

**Strengthening Crop-Livestock Integration**

Encouraging the use of surplus crop production (such as fodder) to support livestock farming, thus enhancing economic linkages between the two sectors.

Supporting livestock breeding programs to improve dairy and meat productivity, ensuring higher returns per unit of capacity.

**Diversification Toward High-Value Crops**

Given Bihar's comparative advantage in fruit and vegetable cultivation, policies should focus on expanding horticultural production.

Strengthening cold storage, processing, and market linkages to reduce post-harvest losses and increase farmer income.

**Addressing Agricultural Sustainability and Resource Constraints**

Expanding irrigation infrastructure and promoting water-use efficiency to counter the declining irrigated area.

Encouraging organic farming in select areas to improve market competitiveness and enhance soil sustainability.

**Promoting Livestock Development**

Expanding crossbred cattle rearing programs to improve milk yield and income from dairy farming.

Strengthening extension services to support livestock farmers with disease management, nutrition, and market access.

**Strengthening Market and Trade Linkages**

Leveraging Bihar's proximity to major domestic and international markets (West Bengal, UP, Nepal, Odisha) to promote trade in horticulture and dairy products.

Enhancing agricultural infrastructure, logistics, and supply chains to reduce transaction costs and improve price realization for farmers.

### 13. Future Research Directions

While this study provides significant insights, further research is necessary to address the following gaps:

**Impact of Institutional Reforms:** Investigating how land tenure policies, credit access, and agricultural extension programs affect GVA in Bihar's agriculture.

**Sustainability of Agricultural Growth:** Assessing the long-term impact of climate change, soil degradation, and water scarcity on Bihar's agricultural economy.

**Identifying High-Potential Livestock Sectors:** Given that livestock production has shown only marginal statistical significance in this study, future research should focus on which specific livestock subsectors (dairy, poultry, piggery, etc.) could contribute more effectively to GVA growth.

**Value Chain and Market Efficiency Analysis:** Examining the efficiency of agricultural value chains, from production to market access, to identify bottlenecks and areas for policy intervention.

### 14. Limitations of the Study

Several limitations must be acknowledged, which could be addressed in future studies:

#### Limited Time Series Data

A longer dataset would provide greater statistical reliability and allow for a more nuanced understanding of trends and structural changes in agricultural production. The study does not fully capture the effects of international market fluctuations on Bihar's agricultural economy.

#### Sectoral Granularity

While the study identifies broad sectoral contributions (crop vs. livestock), finer disaggregation of agricultural activities (e.g., the impact of specific crops, dairy, poultry) could provide more targeted policy insights.

#### Exclusion of External Factors

The study does not account for government subsidies, climate variability, or trade policies, which could significantly influence agricultural GVA. Future research should integrate these external variables to provide a more holistic understanding of agricultural growth dynamics.

#### Regional Disparities in Bihar

The study considers Bihar's agricultural economy as a whole, without accounting for regional variations in soil quality, irrigation access, and market connectivity. Future studies could adopt a district-level analysis to uncover localized agricultural constraints and opportunities.

### 15. Final Thoughts

Agriculture remains the lifeline of Bihar's economy, providing employment and livelihoods to a vast majority of the population. While crop production currently dominates, the potential for diversification into livestock, horticulture, and high-value crops remains largely untapped. The study underscores the urgent need

for policy-driven structural transformations to enhance agricultural GVA, improve farmer incomes, and ensure long-term sustainability. A multi-pronged, investment-driven, and market-oriented approach will be essential to position Bihar's agricultural sector for inclusive and resilient growth.

#### 16. Financial Support

No financial support from any funding agencies was received in preparing this article.

#### 17. Conflict of Interest

I declare no conflicts of interest regarding the publication of this article.

#### 18. Data Availability Statement

Data supporting the findings of this study are sourced from various publications by the Government of India.

Data sharing does not apply to this article as no new data were created or analyzed in this study.

#### 19. Author Contribution Statement

Roles and contributions include conceptualization, methodology, validation, investigation, resource management, data curation, original draft writing, review and editing, visualization, supervision, software development, formal analysis, and final draft preparation.

#### 20. Ethical Statement

This study contains no studies with human or animal subjects performed by the author.

## References

- Bardin, L. (1986). *Análisis de contenido*. Madrid: Akal. "A De Lauwere, C., Malak-Rawlikowska, A., Stalgiene, A., Klopčic, M., & Kuipers, A. (2018). Entrepreneurship and competencies of dairy farmers in Lithuania, Poland and Slovenia. *Transformations in Business & Economics*, 17(3), 237-257.
- Gelgo, B., Gemechu, A., & Bedemo, A. (2023). The effect of institutional quality on agricultural value added in East Africa. *Heliyon*, 9(10). <https://doi.org/10.1016/j.heliyon.2023.e20964>
- Allshem, H. H. M., & Ghader, M. (2022). A study of agriculture value added percentage of gross domestic product for selected Asian countries. *Journal of Asian Multicultural Research for Social Sciences Study*, 3(4), 33-42. <https://doi.org/10.47616/jamrsss.v3i4.327>
- Wang, L., Vo, X. V., Shahbaz, M., & Ak, A. (2020). Globalization and carbon emissions: is there any role of agriculture value-added, financial development, and natural resource rent in the aftermath of COP21? *Journal of Environmental Management*, 268, 110712. <https://doi.org/10.1016/j.jenvman.2020.110712>
- Delbaere, B., & Nieto Serradilla, A. (2004). Environmental risks from agriculture in Europe. Locating environmental risk zones in Europe using agri-environmental indicators. ECNC–European Centre for Nature Conservation, Tilburg.
- Janker, J., & Mann, S. (2020). Understanding the social dimension of sustainability in agriculture: a critical review of sustainability assessment tools. *Environment, Development and Sustainability*, 22(3), 1671-1691. <https://doi.org/10.1007/s10668-018-0282-0>
- Burja, V., Tamas-Szora, A., & Dobra, I.B. (2020). Land concentration, land grabbing and sustainable development of agriculture in Romania. *Sustainability*, 12(5):2137. <https://doi.org/10.3390/su12052137>
- Božić, D., Bogdanov, N., & Ševarlić, M. (2011). *Ekonomika poljoprivrede*. Univerzitet u Beogradu, Poljoprivredni fakultet.
- Kołodziejczak, W. (2020). Employment and gross value added in agriculture versus other sectors of the European Union economy. *Sustainability* 12(14), 5518. <https://doi.org/10.3390/su12145518>
- Harizanova – Metodieva, T. & Harizanova – Bartos, H. (2021). Autoregressive approach for exploring the gross value added in agriculture and the number of agricultural holdings in Bulgaria. *Bulgarian Journal of Agricultural Science*, 27 (1), 51–58.
- Volk, T., M. Rednak, E. Erjavec, I. Rac, E. Zhllima, G. Gjerci, S. Bajramović, Ž. Vaško, M. Kerolli-Mustafa, E. Gjokaj, B. Hoxha, D. Dimitrievski, A. Kotevska, I. Janeska Stamenkovska, D. Konjevic, M. Spahic, N. Bogdanov, & M. Stevović (2019). *Agricultural policy developments and EU approximation process in the Western Balkan countries*. Luxembourg: Publications Office of the European Union, DOI: 10.2760/583399 (online)
- Nikolić, R., Fedajev, A., Stefanović, V., Ilić, S. (2017). The agriculture sector in Western Balkans – some characteristics of development, *Economics of Agriculture*, 64(1), DOI: <https://doi.org/10.5937/ekoPolj1701275N>
- Dimitrijević, M., Veselinović, P., Ristić, L. (2023). State and perspectives of agriculture development in the Western Balkan countries, *International Review*, 1-2, 90-98.
- Grujić Vučkovski, B., Paraušić, V., Jovanović Todorović, M., Joksimović, M., & Marina, I. (2023). Analysis of the influence of value indicators agricultural production on gross value added in Serbian agriculture, *Custos e @gronegocio online*, 18 (4), 349-372.
- Sen K (2016) The determinants of structural transformation in Asia: a literature review. ADB Economics Working Paper Series No. 478. Asian Development Bank, Manila.
- Dawe D (2015) Agricultural transformation of middle-income Asian economies: diversification, farm size and mechanization. ESA Working Paper 15-04. Food and Agriculture Organization of the United Nations, Rome.
- Voicilas, D. M., Todorović, Lj. M., & Damnjanović, R. (2010). Regional disparities in Romania – an analysis of the foreign direct investment efficiency, *Economics of Agriculture*, 57(2), 356-365.
- G o B (Government of Bihar) (2013). *Economic survey of Bihar*, Department of Planning.
- Kansal, M. L., Kumar, P., & Kumar, A. (2017): IMPACT OF FLOOD AND ITS MANAGEMENT – A CASE STUDY OF BIHAR. *Int. J. of adv. Res.* 5 (Mar). 1695-1706] (ISSN 2320-5407). <http://dx.doi.org/10.21474/IJAR01/3681>.
- Sinha, J.K. (2017): Contribution of Investment in Economic Growth of Major Sectors: With Focus on Agriculture & Allied Sector in Bihar. *Statistical Journal of the IAOS*, Vol. 33, pp.557-564.

21. Sinha, J.K. (2019): Influence of technologies on the GDP growth rate from agriculture: A case study of sustaining economic growth of the agriculture sector in Bihar. *Statistical Journal of the IAOS* Vol.35, pp. 277–287.
22. Sinha, J.K. (2023). Assessing the Impact of Sectoral Investment on Bihar's Economic Growth. *International Journal of Political Science* 1(1):33-42
23. Sinha, J.K. & A.K. Sinha (2020): SUSTAINABLE AGRICULTURAL DEVELOPMENT UNDER INFLUENCE OF TECHNOLOGY: A Case Study of Bihar. *Indian Journal of Applied Business and Economic Research* Vol. 1, No. 1, pp. 1-18.
24. Cai, J., & Leung, P. (2020). A note on the linkage between gross value added and final use at the industry level. *Economic Systems Research*, 1(10). doi:10.1080/09535314.2020.1718617
25. Krstić, G., & Šoškić, D. (2015). *Ekonomska statistika*. Centar za izdavačku delatnost Ekonomskog fakulteta, Beograd.
26. Mutavdžić, B., Nikolić-Đorić, E., Novaković (Tekić), D., & Novaković T. (2023). *Statistika*, Univerzitet u Novom Sadu, Poljoprivredni fakultet.
27. Birtal PS, Negi DS (2012) Livestock for higher, sustainable and inclusive agricultural growth. *Econ. Polit Wkly* 47(26/27):89–99
28. Andreescu, F. D. (2021). On the linkage between gross value added by economic activities and the overall gross value added in EU-27. In *Proceedings of the International Conference on Business Excellence*, 15(1), 1197-1207. doi: 10.2478/picbe-2021-0111
29. Feher, A., Stanciu, S., Iancu, T., Adamov, T. C., Ciolac, R. M., Pascalau, R., Banes, A., Raicov, M. & Gosa, V. (2022). Design of the macroeconomic evolution of Romania's agriculture 2020–2040. *Land use policy*, 112, 105815. <https://doi.org/10.1016/j.landusepol.2021.105815>
30. Mergoni, A., Dipierro, A. R., & Colamartino, C. (2024). European agricultural sector: The tortuous path across efficiency, sustainability and environmental risk. *Socio-Economic Planning Sciences*, 101848. <https://doi.org/10.1016/j.seps.2024.101848>
31. Salimova G., Lubova, T., Zalilova, Z., & Sharafutdinov, A. (2020). The role of agriculture in gross added value. *Montenegrin Journal of Economics*, 15(1), 183-191. DOI: 10.14254/1800-5845/2020.16-1.12
32. Rajeb, M., Hossain, M. M. H., & Chakraborty, L. (2012). Gross value added of agriculture sector in Bangladesh: An econometric investigation. *Terengganu International Finance and Economics Journal (TIFEJ)*, 2(1), 56-66.
33. Pacheco, J., Ochoa-Moreno, W. S., Ordoñez, J., & Izquierdo-Montoya, L. (2018). Agricultural diversification and economic growth in Ecuador. *Sustainability*, 10(7), 2257. doi:10.3390/su10072257
34. Grujić Vučkovski, B., Simonović, Z., Ćurčić, N., & Miletić, V. (2022). The role of agriculture in the economic structure of Serbia and budget support for rural development of Kladovo municipality, *Economics of Agriculture*, 69(3), 863-876. doi:10.5937/ekoPolj2203863G.