Research Article

An Econometric Analysis of Horticulture and Economic Growth in Jammu and Kashmir

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Abstract | Over the past few decades, Jammu and Kashmir has emerged as one of India's top states/UTs in terms of horticultural production. The current study aimed to investigate the short- and long-term relationships between economic growth and total horticultural production, taking into account the growing trend in horticultural production and individual products. The study made use of secondary data on horticultural production and gross state domestic product (GSDP) from 2004 to 2021. The Granger Causality Test, OLS, VECM model, and Johansen Cointegration Test were the econometric instruments employed. There is no significant short run relation between the variables, as shown by the Vector Error Correction model and its probability output, except for the case where horticulture production is considered an independent variable and GSDP as a dependent variable. The Johansen Cointegration Test results indicate that there is a long-term relationship between the variables. The Granger Casualty Test revealed that there was no cause-and-effect relationship (in either direction) between the three variables. The GSDP and horticulture production were the only variables for which the OLS showed a significant correlation. The study discovered a linear relationship between the dependent and independent variables of horticulture production and GSDP; however, the relationship failed the Granger Causality Test, indicating the absence of a cause-and-effect relationship. Given that agriculture is the backbone and cornerstone of the Jammu and Kashmir economy, the lack of a direct relationship between horticulture and food grain production or the GSDP is concerning.

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Introduction

A nation's economy can grow thanks to the potential for multiple revenue streams that the horticultural sector can produce. Horticulture can be carried out as an ecotourism project, to harvest medicinal plants for therapeutic purposes, as a way to supply the market with fruits, vegetables, and flowers,

or as a component of multiple farming to support the primary source of income. Horticulture requires little land, which creates opportunities for marginal farmers and helps the impoverisher's economic development. Horticultural production, which is adaptable to hilly and water-scarce environments, generates employment in Jammu and Kashmir (Wani *et al.*, 2021; Arshad *et al.*, 2022; Subrahmanyam, 1981) and offers local farmers a reliable source of livelihood to help them through difficult times (Wani *et al.*, 2021; Singh *et al.*, 2013, 2017).

Studies (Maertens *et al.*, 2012, for Sub-Saharan Africa; McCulloch and Ota, 2002, for Kenya; Maertens, 2009, for Senegal; Belwal and Chala, 2008, for Ethiopia) have shown that horticulture boosts living standards and increases export and economic growth. In the global market, Jammu and Kashmir's horticulture has a competitive advantage (Wani *et al.*, 2021; Mittal, 2007; Birthal *et al.*, 2008; Dastagiri *et al.*, 2013). According to Wan *et al.* (2021), Chand *et al.* (2008), Singh and Mathur (2008), Damodaran *et al.* (2019), Chand (1996), Vedwan (2008), and Bijalwan (2012), horticulture production has helped Jammu and Kashmir's economy. According to preliminary state and national research (Wani *et al.*, 2015; Mittal, 2007; Bhat, 2019), horticulture in Jammu and Kashmir may be considered a viable business venture with enough study and advancement.

Due to a significant increase in horticultural production over the past few decades, particularly in the last 30 years, Jammu and Kashmir has proven its mettle (Arshad *et al.*, 2022; Bhat, 2019). According to Chand *et al.* (2008), most of the research conducted in Jammu and Kashmir has focused on import, export, and local consumer demand. According to product-specific scientific studies on almonds, saffron, kala zeera, pear, and other products, horticulture can be a profitable endeavor in Jammu and Kashmir (Javanmardi *et al.*, 2013; Jana *et al.*, 1994; Wani *et al.*, 2013; Pramanick *et al.*, 2005).

Kulshrestha and Agrawal (2019), Wani *et al.* (2015) used the Johnson co-integration test to show how agriculture in Jammu and Kashmir has been positively contributing to the state's overall economic growth. When all of agriculture's positive and negative contributions are added together, the overall value of all of agriculture's contributions is what constitutes a positive contribution. Thus, varied effects on economic growth may result from ongoing changes in the production patterns of different agricultural sector components in different regions of Jammu and Kashmir (Arshad, 2022; Vincent and Manivasagam, 2019). The question that comes to mind is whether the change will affect the economic growth of Jammu and Kashmir. What kind of impact, if any, is it positive or negative? Which factor will have a bigger impact on economic growth, and how much?

It is essential to examine the contribution of each agricultural component to the GSDP independently given the current circumstances. Determining whether a change is beneficial or detrimental to the economy can be aided by knowing the result. Based on the results, policymakers may choose to reinforce the shift to accelerate the state's economic growth.

Due in large part to the industry's relatively recent popularity boom, the literature review found that there is a paucity of research on horticulture. The current work used econometric tools to derive the results to gain a new perspective, since many theoretical, conceptual, and statistical tools have been used in the past (Wani *et al.*, 2015; Arshad *et al.*, 2022; Mittal, 2007; Birthal *et al.*, 2008; Dastagiri *et al.*, 2013; Singh *et al.*, 2013, 2017). The prior dominance of the food grain market over horticulture until 1990 may account for part of the decline in employment in this field. In light of this, the current study set out to determine the short- and long-term relationships between horticulture production and the state's or UT's economic growth.

The choice of measurement instruments for the quantification of the variable had a significant impact on the accuracy of the results. Farmers in Jammu and Kashmir have recently become interested in a variety of horticultural products. This has led to an increase in volatility in fruit and vegetable market prices (Wani *et al.*, 2015; Dastagiri *et al.*, 2013). As a result, rather than using price level as a variable, the current study used production in the horticulture sector throughout Jammu and Kashmir. A comparative study of the contribution of food grain production to GSDP in Jammu and Kashmir was done in order to evaluate the tool's robustness. The GSDP data had a fixed, nominal cost. In order to eliminate the effects of inflation and normalize time value of money, the GSDP at constant price was employed.

There were two main categories for the paper. Initially, descriptive statistics were used to analyze each GSDP component. Next, econometric instruments were employed to confirm the association. The first section discusses how horticulture has helped the state's gross state product (GSDP) to increase in relation to Jammu and Kashmir's net export-import, government spending, investments, and consumption patterns. Every category was examined independently and in the order that they occurred. Using the four components of GSDP (government spending, import-export, investment, and consumption) to calculate the contribution of horticulture to Jammu and Kashmir's GSDP, robust econometric techniques were used to support the short- and long-term relationships between the variables.

The study aimed to (i) examine the causal links between food grain production, horticulture, and Jammu and Kashmir's GSDP. (ii) the relationship between food grains, horticulture, and Jammu and Kashmir's GSDP, as well as both short- and long-term analyses. The formulation of the hypotheses was guided by the research objectives. The null hypothesis for the first objective was that there was causality between the variables. The null hypothesis for the second objective states that there is no movement between the variables, either short-term or long-term.

Materials and Methods

Database

The secondary data for the 2004–2021 study came from the website of the Reserve Bank of India and the Digest of Statistics. Based on the needs of the current study, the Gross State Domestic Product was selected as the economic growth metric. In order to avoid scaling problems and stabilize variances, the natural logarithm of each variable was used. A trend was evident in the level data from 2004 to 2021. Thus, trend and intercept had been added to the equation when executing the Augmented Dickey Fuller test for unit root test (stationary test) (the use of D in Table 3). The long-term relationship was examined using the Johansen co-integration method (Table 4). Because all three of the variables displayed the same order of integration at first difference (stationarity), this method makes use of the Trace and Max-Eigen statistics (Table 4). After the results were obtained and the first statistical requirement was satisfied, the short run relations were tested using the vector error correction model (Table 3). The cause-and-effect relationship between the three variables horticulture production, food grain production, and GSDP was determined using the Granger's Causality test (Table 2). Lastly, the degree of association was determined using OLS (Table 5). The model used in the paper looked like this:

Table 1: *Production of total food grains and total fresh fruits in Jammu and Kashmir.*

	(000 QtIs.)	
Year	**Total Food grains**	**Total Fresh Fruits**
2004-05	15027	1217604
2005-06	15020	1280729
2006-07	15777	1373678
2007-08	15707	1477920
2008-09	17169	1529890
2009-10	13185	1507915
2010-11	15217	2045547
2011-12	15872	1929349
2012-13	15619	1524577
2013-14	17250	1841200
2014-15	10481	1344552
2015-16	17408	2216779
2016-17	16933	1943366
2017-18	18798	2074417
2018-19	18964	2119912
2019-20	16397	2268876
2020-21	15996	1960880

Source: Digest of statistics, directorate of economics and statistics.

Vector error correction model

A co integrated system can be written as:

$$\Delta y_t = \sum_{i=1}^{k} \Gamma_i \Delta y_{t-i} + \alpha\beta' y_{t-k} + \varepsilon_t \quad \ldots (1)$$

Where; yt is the horticultural production, the matrix αβ' is n x n with rank ($0 \le r < n$), which is the rank of cointegration, and Δyt is the first difference, i.e., ($\Delta yt = yt - yt{-}1$). The restricted maximum likelihood method is used in the cointegration process by Johansen's method. Assuming that $\Pi = \alpha\beta'$. The λ_{trace} statistic can be utilized to determine the rank of Π. The test statistic is available as follows:

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \; \forall \, r = 0, 1, \ldots, n-1 \quad \ldots (2)$$

Where λ^7's are estimates of the Eigen values and T

is the total number of observations. The cointegration rank is now being tested with the following null and alternative hypotheses: *H0= rank 0' β= r* and *H1= rank 0' β= r*, respectively, where r is the number of cointegrating vectors. This test is performed under the assumptions that the original price series is non-stationary and the cointegrating equation has only an intercept (no trend).

The VECM model was also employed in this study to predict how horticultural production would increase and how much the GSDP would contribute to Jammu and Kashmir. Relative mean absolute prediction error (RMAPE), which was calculated using the following formula, was used to measure the forecast accuracy.

$$\text{RMAPE} = 1/h \sum_{i=1}^{h} \{|y_{t+i} - \hat{y}_{t+i}|/y_{t+i}\} \times 100 \quad \ldots..(3)$$

Results and Discussion

Horticultural product consumption within the country

Because horticulture products are produced for commercial purposes throughout the state, horticulture production has exceeded food grain production prior to the reference period (Table 1). For several reasons, the market's demand has shifted from food grains to fruits and vegetables. The most significant of these is that (i) Consumption of fruits and vegetables is directly correlated with income level (Hall *et al*., 2009). The sixth pay commission recommended that consumers' purchasing power increase with an increase in average income (Jha *et al*., 2019). Consequently, the market demand for fruits and vegetables in Jammu and Kashmir grew. (ii) People were prompted to experiment with different fruit- and vegetable-based diet plans because of growing urbanization (Hall *et al*., 2009). (iii) People started choosing natural, light, fresh, and healthy foods over starchy foods like rice and pulses because of the rise of the vegan movement in the West, the pressure to keep up with friends and family, and the resurgence of yoga practices. (iv) Fruits and vegetables are important in reducing health risks, according to a few international health reports (The World Health Report 2002: Reducing Risks, Promoting Healthy Life).

Jammu and Kashmir is a popular tourist destination known for its world-famous, naturally picturesque gardens filled with priceless flowers. In the past, flowers were primarily used for religious or auspicious occasions. These days, flowers are sent on several occasions, such as friendship days, birthdays, marriages, mother's day, father's day, and valentine's day.

Horticulture business investment

The domestic horticulture market in Jammu and Kashmir expanded because of the rise in demand for various fruits, nuts, vegetables, and flowers.

It's obvious that the farmers increased their horticultural investments by taking advantage of the situation. When productivity, production, area under production, and fertilizer consumption were used as benchmarks to evaluate the return on investment, the outcomes were predicted. Throughout the study period, there has been an increase in the use of fertilizers and FYM as production inputs due to increases in area and productivity (DoS, 2021). The area used for horticulture increased by 60% between 2004 and 2021. Production has increased by 16.2% while productivity has increased from 9.01 to 11.33. In a similar fashion, fruit and vegetable production, productivity, and area under cultivation have all increased tremendously.

Government investment in the horticulture industry

In 1990, the Jammu and Kashmir government came to the realization that horticulture could be a highly profitable endeavor for improving the economic status of the state's residents. The government established the Mission for Integrated Development of Horticulture (MIDH), a Centrally Sponsored Scheme that includes fruits, vegetables, root and tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew, cocoa, and bamboo, in order to assist thousands of small and marginal farmers. Spending on the plan was increased by the government, particularly for the horticultural sector.

Import and export of products related to gardening

Healthy competition is encouraged by the variety of import sources available in Jammu and Kashmir. Leading the way in the export of horticultural products is Jammu and Kashmir. The Nominal Protection Coefficient of all vegetables is less than 1, suggesting their competitiveness in global markets. In addition to improving the surrounding landscape, there is plenty of space for flower export. Apple, Saffron, and Kara Zeera are the three most exported fruits.

Table 2: *Granger causality test results (Lag-2).*

Null hypothesis	Obs	F- statistic	Prob.
LOGPRODFOOD does not Granger Cause LOGGSDP	17	1.32421	0.2312
LOGGSDP does not Granger Cause LOGPRODFOOD		8.23212	0.1010
LOGPRODHOT does not Granger Cause LOGGSDP	17	1.52123	0.1213
LOGGSDP does not Granger Cause LOGPRODHOT		6.21342	0.1019
LOGPRODHOT does not Granger Cause LOGPRODFOOD	17	6.21341	0.1098
LOGPRODFOOD does not Granger Cause LOGPRODHOT		0.86521	0.4321

Source: *Authors own calculation. Obs: observations, Prob: probability.*

The econometric method

Throughout the study period, Jammu and Kashmir's state revenue has increased gradually. The Granger Casualty Test was used with a two-period lag to determine whether the decline in plan expenditure was the reason for the decline in horticulture production. Table 2 indicates that the test found no evidence of a cause-and-effect relationship (in either direction) between the variables.

Additionally, the Granger Casualty Test demonstrated that there was no causal connection between the production of food grains and the GSDP. Because of price volatility and high risk, agriculture's declining GSDP share may be the reason for the lack of a cause-and-effect relationship. Since the decline in plan expenditure and the decline in horticulture production occurred almost simultaneously, there was a chance that there would be a short-term relationship between the two variables, even though it wouldn't be cause and effect. The vector error correction was used to support the theory.

The results showed that there was no significant short-run relationship between the variables, except for the case where horticulture production was considered the independent variable and GSDP the dependent variable (Table 3), meaning thereby that in the sampled area the state's economy is most dependent on horticulture development of the area and less dependent on the food crops and other sub sectors of economy. The results corroborate the findings of earlier studies (Wani *et al.*, 2015; Mittal, 2007) which suggest that the production of horticulture contributes to the economic growth of Jammu and Kashmir. The result also demonstrated that increasing GSDP had no effect on food grain or horticultural production.

Compared to other farmers, horticulturists enjoy a few advantages. Horticulture is extremely profitable because it generates high-value products. It has a lower risk of crop failure because it uses less water than food grains. Its ability to be planted in various locations is an additional advantage. Therefore, it was anticipated that farmers would switch from producing food grains to horticulture, which had higher profit margins.

There is no causal connection between horticulture and food grain production, according to the Granger Casualty Test results. Furthermore, horticulture and food grains did not exhibit a short-term correlation, according to Vector Error Correction (Table 1).

It was expected that horticulture and GSDP would eventually have a long-term relationship because both industries' growth is influenced by a wide range of dynamic factors. The strength of this relationship was ascertained with the aid of the Johansen Cointegration Test. The Trace Statistic and Max-Eigen statistic in Table 2 demonstrated the long-term relationship between the variables.

The current study aimed to close this gap in the literature by using advanced econometrics such as Granger Causality, VECM, and cointegration to analyze the macro relationship between horticulture and the GSDP of Jammu and Kashmir. Although the results contradicted the second goal that there is no linear relationship between GSDP and horticultural output they also validated the first goal, which maintained that there is no causal relationship between the two. The situation in Jammu and Kashmir was supported by studies such as those conducted by Mishra and Kumar (2011), who examined the situation in Nepal using the VECM approach.

They found that horticulture and GSDP had a long-term relationship rather than a short-term one. Alam and Wadud (2017) used an econometric approach and

Table 3: *Standard errors in ( ) and t-statistics in [ ]; vector error correction estimates.*

Cointegrating Eq:	**Cointegration Eq1**		
LOGGSDP(-1)	1.000000		
LOGPRODFOOD(-1)	-1.23421		
	(0.80923)		
	[-2.21321]		
LOGPRODHOT(-1)	-1.897321		
	(0.432311)		
	[-6.87542]		
C	6.231411		
Error correction	D(LOGGSDP)	D(LOGPRODFOOD), D(LOGPRODHOT)	
CointEq1	0.32141	0.21213	0.241523
	(0.06267)	(0.21321)	(0.05429)
	[1.32156]	[2.23214]	[5.32142]
	0.908532	1.765431	0.986531
D(LOGGSDP(-1))	(0.987654)	(0.45327)	(0.34121)
	[2.21342]	[1.32143]	[2.32154]
	0.210098	- 0.421311	0.211321
D(LOGPRODFOOD(-1))	(0.021390)	(0.18870)	(0.07227)
	[0.10982]	[-1.21321]	[1.54271]
	-0.210987	0.236521	0.100987
D(LOGPRODHOT(-1))	(0.23901)	(0.54363)	(0.20986)
	[-0.32765]	[0.32141]	[0.65211]
	0.123111	-0.200876	-0.213211
C	(0.19086)	(0.218765)	(0.98765)
	[0.87543]	[-1.654211]	[-1.54321]

Estimates of vector error correction and probability outcomes

	Coefficient	**Standard Error**	**t-Statistic**	**Prob.**
C (1)	0.987201	0.213421	1.673211	0.2312
C (2)	0.523411	0.343567	2.543213	0.1209
C (3)	0.232121	0.109823	0.123412	0.4587
C (4)	-0.211110	0.321451	-0.432198	0.5674
C (5)	0.1213111	0.109765	0.543211	0.5432
C (6)	0.3211111	0.212321	2.431232	0.1321
C (7)	1.9807665	0.765412	1.763241	0.2123
C (8)	-0.323456	0.245321	-1.432187	0.1543
C (9)	0.267432	0.671231	0.342543	0.8763
C (10)	0.431232	0.232131	2.984321	0.1009
C (11)	-0.723142	0.190876	-1.321411	0.2312
C (12)	0.342152	0.653241	4.213212	0.9001
C (13)	0.321456	0.098732	2.763452	0.2100
C (14)	0.323145	0.976211	2.439870	0.2001
C (15)	0.213421	0.098721	1.321451	0.2103
C (16)	0.267854	0.321421	0.120987	0.8723
C (17)	-0.321451	0.190821	-1.321873	0.2312

[1]*LOGGSDP = Enhancement in gross state domestic product, LOGPRODFOOD= Food Production, LOGPRRODHOT= Horticulture Production. Source: Authors estimations.*

Table 4: *The trace unrestricted cointegration rank test.*

Hypothesized No. of CE(s)	Eigen value	Trace statistics	0.05 Critical value	Prob. **
None *	0.875232	43.32122	30.98324	0.3211
At most 1 *	0.763211	20.87232	17.32111	0.1210
At most 2 *	0.432111	6.876231	4.432109	0.2019
Hypothesized No. of CE(s)	Eigen value	Max-eigen value	0.05 critical value	Prob. **
None *	0.873211	24.54673	23.32111	0.1090
At most 1 *	0.762321	14.56321	16.24356	0.1092
At most 2 *	0.653210	6.600984	6.090332	0.3109

*Trace test indicates 3 cointegrating eqn(s) at the 0.05 level, *denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug- Michelis (1999) p-values. Unrestricted Cointegration Rank Test (Maximum Eigenvalue). Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level, *denotes rejection of the hypothesis at the 0.05 level, **MacKinnon- Haug-Michelis (1999) p-values. Source: Authors own calculation system and Rizvi et al. (2020) suggested strengthening of supply chain management to increase contribution of horticulture towards GSDP.*

Table 5: *Dependent variable: Least squares LOGPRODFOOD.*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.987652	0.431231	11.09321	0.0201
LOGGSDP	-0.109321	0.290834	-0.321432	0.6902
LOGPRODHOT	0.432121	0.543092	1.540921	0.3019
Least squares: Dependent variable: LOGGSDP				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.231091	1.541223	0.216753	0.8701
LOGPRODFOOD	-0.209134	0.567322	-0.456712	0.9034
LOGPRODHOT	3.324211	0.321456	14.56321	0.0014

Least Squares; Dependent Variable: LOGPRODHOT.

discovered that their results showed the presence of causality in Bangladesh, as opposed to Jammu and Kashmir, where Granger Causality is absent. Long- and short-term linear correlations between the variables were also discovered. Per the analysis of the relationship in Pakistan by Rizvi *et al.* (2020), imperfect markets are to blame for horticulture's low national income contribution.

Due to the lack of causality and low GSDP contribution, the government of Jammu and Kashmir may encounter difficulties in achieving its goal of doubling farmer income by 2022. Policymakers must thus give it their full attention. The difference between the marketable yield and the total yield was noted by practitioners. This resulted from losses sustained both during and following harvest. Using cheap seed, chemicals, and pesticides, as well as ignoring modern technology, costs farms money (Birthal *et al.*, 2008). The government should extend an invitation to large private companies and agro-startups to assume leadership roles in the sector (Roy, 2015). Large corporations that have substantial financial resources (from contract farming) are able to fully incorporate modern technology. Agro-based technology startups can develop models for soil testing, seeding, pest control, satellite and precision farming, and seeding. To reduce risk and increase commercial yield, the government may also support agrobusiness founded on genetically modified crops and tissue culture.

Postharvest losses were primarily caused by price volatility (Jha *et al.*, 2019). This makes the busiest time of year for micro farmers susceptible to low market prices. In order to address the extreme price volatility, a improved market information system was suggested by Wani *et al.* (2015) and Mishra and Kumar (2011). The Electronic National Agriculture Market has made some progress in addressing this issue; however, due to the highly perishable nature of horticulture products, it is not able to stop distressed product sales. In this case, supply chain management systems can be quite beneficial. The absence of infrastructure, especially cold storage, is the second problem (Negi and Anand, 2015). The second challenge is a lack of current, relevant market information (Wani *et al.*,

2015; Bowbrick, 1988). Mishra and Kumar (2011) suggested better market data.

Each of the three variables had its own OLS calculation, and they were all regarded as independent variables. Out of all the sets of OLS calculations, the results showed that only the relationship between GSDP and horticulture production was significant (Table 5). There was a positive correlation between GSDP and horticultural production (Table 5). The GSDP for Jammu and Kashmir had a major influence on the expansion of horticulture production (Table 5).

Conclusions and Recommendations

Horticultural production can contribute more to the state's economic growth if two problems are fixed. First and foremost, we need more processing facilities; a robust supply chain management system will follow. If the government hopes to transform the horticultural sector from one that demands significant investments and high risk to one that offers high value and high return, it must pay particular attention to these two stages of the production process.

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Novelty Statement

The study will provide an insight into the contribution Horticulture to the overall GSDP of the state/UT and will provide a way out for removing the hurdles in the horticulture sector to make it more viable.

Author's Contribution

Arshad Bhat: Conducted the statistical treatment to data and carried out analysis part of the paper.
Abid Sultan: Helped in acquiring the data from the respective data sources.
M. Latief: Helped in review of relevant literature.
Parvaiz Rashid: Wrote the first draft of the paper.
H.A. Malik: Helped in providing valid suggestions for comparing the results with other studies.
Iqra Qureshi: Helped in concluding the study with her valuable remarks and concreate suggestions.

Conflict of interest
The authors have declared no conflict of interest.

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