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Horticulture and economic growth in India: An econometric analysis

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Abstract

India's horticulture production has shown manifold increase in the past two decades and the country is ranking second in the world only next to China. Keeping in mind, the increasing trend in horticulture production and individual product, the purpose of the current paper was to study the short run and long run relation between economic growth and horticulture production as a whole. The study used secondary data on horticulture production and Gross Domestic Product (GDP) from 2001 to 2018. The econometric tools used were Granger Causality Test, Johansen Cointegration test, VECM model and OLS. Johansen Cointegration Test showed that there is long run relation between the variables; The Vector Error Correction model and its probability output showed that there is no significant short run relation between variables except one, that is when horticulture production is considered as independent variable and GDP as dependent variable. Granger Casualty Test showed absence of cause and effect relation (both way) between the three variables. Out of all variables, OLS showed a significant relation only between GDP and horticulture production.The study revealed that horticulture production shares a linear relationship with GDP both as dependent and as independent variable, but the association does not satisfy Granger Causality Test, indicating that there was no cause and effect relation between the variables. Given that agriculture is the backbone of Indian economy, the absence of short run relation between horticulture and food grain production and food grain with GDP is a matter of concern.

Key words: India, Granger Causality Test, Johansen Cointegration Test, VECM model, OLS.

Introduction

Horticulture is a sector which has the potentiality to generate multiple sources of income, thereby boosting the economic growth of a country. Horticulture can be undertaken as market driven cultivation of vegetables, fruits and flowers, as eco-tourism, as therapeutic medicinal plant harvesting and as a part of multiple farming to complement the main source of income. Horticulture requires small size of land for cultivation thus making it possible for marginal farmers and bringing about a pro-poor economic growth. The production is adoptable in areas with water scarcity and mountainous regions, thus generating employment in India (Subrahmanyam, 1981) and 'reliable source of livelihood' (Singh *et al.*, 2013 and Singh *et al.*, 2017) to the local farmers, who otherwise had to face difficulty.

Research has also shown that horticulture enhances a country's export and economic growth (Maertens *et al.*, 2012, for Sub-Saharian Africa; McCulloch and Ota, 2002, for Kenya; Maertens, 2009, for Senegal; Belwal and Chala, 2008, for Ethiopia). Indian horticulture has a competitive advantage in the international arena (Mittal, 2007; Birthal *et al.*, 2008; Dastagiri *et al.*, 2013). Horticulture production has helped many states and agricultural regions across India, to grow economically (Chand *et al.*, 2008; Singh and Mathur, 2008; Damodaran *et al.*, 2019; Chand, 1996; Vedwan, 2008; Bijalwan, 2012). At country level, early studies (Mittal, 2007; Bhat, 2019) have pointed out that with adequate research and development, horticulture in India can be considered as a commercial opportunity.

India's horticulture production has shown manifold increase in the past two decades, ranking India second in the world only next to China (Bhat, 2019). Study in India has focused mainly on domestic consumption demand, export and import (Chand *et al.*, 2008). Product specific scientific research on tomato (Javanmardi *et al.*, 2013), mango (Jana *et al.*, 1994), strawberry (Wani *et al.*, 2013), kiwi (Pramanick *et al.*, 2005) has revealed that horticulture can be a profitable business in Indian climate.

Recently, Kulshrestha and Agrawal (2019) using Johnson cointegration test showed Indian agriculture as a whole has been contributing positively towards economic growth of India. A positive contribution of agriculture is actually an aggregate value (positive and negative values balancing each other) of contribution of different components of agriculture clubbed together. Thus the ongoing shift in the production patter of different components of agriculture sector in various parts of India (Vincent and Manivasagam, 2019) can affect differently the economic growth. The question that arises is, will the shift affect the economic growth of India? If yes, then will it affect positively or negatively? Which component will have more impact on economic growth or by how much?

Given the present scenario, there is a need to analyse the relation of various components of agriculture towards GDP separately. The result can help in understanding whether the shift is beneficial to the economy or it is detrimental. Based on the findings, policy makers may choose to augment the shift so as to increase economic growth of the nation.

During literature review, it was found that there is lack of work on horticulture as a complete sector taken together, mostly because the sector gained momentum very recently. A lot has been done using the theoretical, conceptual and statistical tools (Mittal, 2007; Birthal *et al*., 2008; Dastagiri *et al.*, 2013; Singh *et al.*, 2013 and Singh *et al.*, 2017) therefore, to get a fresh perspective, the current work thus used econometric tools to derive the results. One of the reasons for less work in this area may be pre dominance of food grain market over horticulture till 2008. Keeping this in mind the purpose of the current paper was to study the short run and long run relation between horticulture production and economic growth of India, by using econometric tools.

Selection of measurement tools towards quantification of the variable was very important for the accuracy of results. Farmers in India had recently taken keen interest in horticulture products. This has made the market price for fruits and vegetables more volatile (Dastagiri *et al.*, 2013). Keeping this in mind, the current paper used production in horticulture sector across India to represent as a variable for horticulture, instead of price level. For robustness of the tool, a comparative analysis of the role of food grain production in India with GDP was done. Data on GDP was available in nominal and constant price. To eliminate the impact of inflation and normalize time value of money, the GDP at constant price was used.

The paper was broadly divided into two categories. Initially, each component of GDP was analysed using descriptive statistics. Subsequently, econometric tools were used to validate the relationship. The first part deals with role of horticulture towards enhancing national income of India, with respect to its consumption pattern, investment, government spending and net export-import. Each category was analysed separately, along time line. Once the contribution of horticulture to GDP of India has been established using four components of GDP (consumption, investment, government spending and import-export), robust econometric tools were used to substantiate the relationship between the variables in both short and long run.

The study aimed at (i) the analyses of cause and effect relation between horticulture, food grain production and GDP of India. (ii) long run and short run analyses, co-movement between horticulture, food grain and GDP of India. Based on the objectives of the research the hypotheses were framed. The null hypothesis for first objective was presence of causality between variables. The null hypotheses for second objective was, there exist no long run or short run co movement between the variables.

Materials and methods

Database: The study used secondary data from 2001 to 2018, collected from Reserve Bank of India website and Annual Horticulture Statistics at a Glance Report. Based on the requirement of current study Gross Domestic Product was selected to measure economic growth. Secondary data from official website of Reserve Bank of India was used for the study.

Econometric tools: All variables were transformed to their natural log to avoid scaling problem and for stabilizing of variances. The level data from 2001 to 2018, when observed using Eviews had shown the existence of a trend. So while performing the Augmented Dickey Fuller test for unit root test (stationary test) (the use of D in Table 2), trend and intercept had been included in the equation. Since, all the three variables were stationary at their first difference indicating the same order of integration, Johansen co-integration method (Table 3), using Trace Statistic and Max-Eigen Statistic (Table 3), was used to study the long run relationship. After obtaining the results and upon fulfilling the preliminary statistical requirement, Vector Error Correction model (Table 2), was used to test the short run relations. Granger's Causality test was undertaken to identify the cause and effect relation between the three variables-Horticulture production, Food grain production and GDP (Table 1). Finally, OLS was used to calculate the magnitude of association (Table 4).

Results and discussion

Domestic consumption of horticulture products: According to Annual Horticulture Statistics at a Glance Report 2018 (Table 1.5, page 13) food grain production exceeds horticulture production before 2009-10, but post 2010 horticulture production surpassed food grain production (Fig. 1). The gap between the two was seen to be widening.

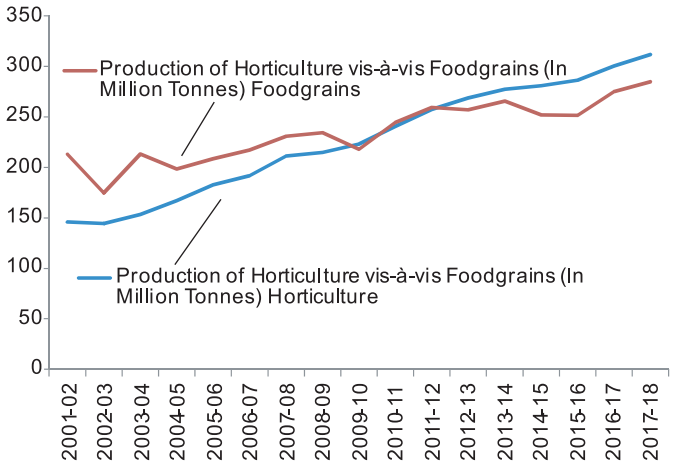

Fig. 1. Shift in horticulture and food grain production in India (2001-2018). Source: Annual Horticulture Statistics at a Glance

There are many reasons behind the shift in market demand from food grain to fruits and vegetables, prominent among them were: (i) Consumption of fruits and vegetables is a direct function of income level (Hall *et al.*, 2009). Increase in average income (as per 6th pay commission recommendation) increased the purchasing power of consumers (Jha *et al.*, 2019). This hiked the market demand for fruits and vegetables in India. (ii) Growing urbanization motivated consumer to experiment with different varieties of diet plan using fruits, and vegetables (Hall *et al*., 2009). (iii) Westernization (vegan culture), the desire to stay fittest among peers and the revival of the yoga practices encouraged people to prefer healthy, natural, light and fresh food, instead of rice (starch content), pulses and spices. (iv) Various international health related reports also stressed on the importance of fruits and vegetables towards reducing health risks (The world health report 2002: reducing risks, promoting healthy life).

India is learning the language of flowers. Agricultural and Processed Food Products Export Development Authority, considered Floriculture as a emerging sector. Major factor being modernization and growing influence of foreign culture and

traditions. In early days, flowers were mainly used for religious or auspicious occasions. Now flowers are gifted on various events like birthday, marriage, Valentine Day, Friendship day, Mother's Day, Father's Day and many more.

Investment in horticulture business: The increase in demand for different varieties of fruits, vegetables, and flowers provided bigger domestic market for horticulture business in India. The farmers obviously took advantage of the situation and invested more in horticulture. When consumption of fertilizers, area under production, production and productivity were taken as yardstick for measuring the output of the investment, the results were as expected. The consumption of fertilizers as an input for production has increased over the study period (Horticulture Statistics at a Glance, 2018, p 370) with increase in area and production. Area under horticulture has increased by 53.2 percent from 2001-2018. Production has increased by 13.8 percent and productivity has increased from 8.79 to 12.26. The level data showed that apart from 2002-03, area under production of commercial floricultural crops has been increasing, the peak points being 2003-04 and 2011-12. Similarly, area under production, production and productivity of fruits and vegetables has also increased.

Hundred percent Foreign Direct Investment is allowed in Horticulture sector through automatic route in India. According to community.data.gov.in portal, in Horticulture Sector there was FDI inflow of US $ 3.8 million, which accounted for 1.5 % of total FDI inflow in Agriculture and in Floriculture Sector, there was FDI inflow of US $ 0.77 million, which accounted for 0.3 % of total FDI inflow in Agriculture" from 2013 to 2017. Thus, horticulture has been successful in attracting from abroad.

Government spending towards horticulture sector: In 2007 government noticed that Indian agriculture was facing a backlog thus Expert Group on Agricultural Indebtedness was found in 2007 headed by R. Radhakrishna. This led the government to implement Agricultural Debt Waiver and Debt Relief (ADWDR) Scheme of 2008, waiving farm loan worth more than sixty thousand crore, thus benefiting lakhs of small and marginal farmers. Specifically in the horticulture sector government increased its plan expenditure post 2011-12. Unfortunately the budget allotment keeps fluctuating each year (Horticulture Statistics at a Glance, 2018, p 108).

Import and export of horticulture products: India's source of import is diversified and it helps in maintaining healthy competition. Export of horticulture product is excelling in India. Dastagiri *et al.* (2013) found, "for all vegetables the Nominal Protection Coefficient is less than 1 indicating they are competitive in the international markets". To quote Horticulture at a Glance, 2018, (page 4) "In addition to the beautification of the local landscape, great scope exists for export of flowers". Among export of fruits, grapes, banana and mango are the top ranker. Among vegetables, export of onion, peas, and potato are rising.

Econometric approach: National income of India has increased smoothly during the study period, except for global financial crisis during 2008-10. During the financial crisis, plan expenditure under horticulture sector was brought down and horticulture production also reduced during the phase.

To find if fall in plan expenditure to be the cause of fall in horticulture production, Granger Casualty Test was adopted with a lag of 2 periods. The test showed absence of cause and effect relation (both way) between the variables (Table 1).

Table 1. Pairwise Granger Causality Tests (Lag-2)

Null Hypothesis	Obs	F- Statistic	Prob.
LOGPRODFOOD does not Granger Cause LOGGDP	15	1.44314	0.2814
LOGGDP does not Granger Cause LOGPRODFOOD		7.62976	0.0097
LOGPRODHOT does not Granger Cause LOGGDP	15	0.52236	0.6085
LOGGDP does not Granger Cause LOGPRODHOT		5.94684	0.0199
LOGPRODHOT does not Granger Cause LOGPRODFOOD	15	5.13347	0.0292
LOGPRODFOOD does not Granger Cause LOGPRODHOT		0.95920	0.4158

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

Granger Casualty Test also revealed a lack of cause and effect relation between food grain production and GDP. The absence of cause and effect relation may be due to diminishing share of agriculture to GDP backed by price volatility and high risk.

Since, fall in plan expenditure and fall in horticulture production happened almost simultaneously, there was a chance of existence of short-run relation between the two variables even though not as cause and effect. To substantiate the supposition Vector Error Correction was used.

Results showed that there was no significant short run relation between variables except one, which was when horticulture production was considered as independent variable and GDP as dependent variable (Table 2). The results corroborate with findings of earlier research (Mittal, 2007) that horticulture production contributes positively to economic growth in India. The result also pointed out that a rise in GDP had no contribution towards horticulture production or food grain production.

Farmers engaged in horticulture enjoy certain benefits over other farmers. Horticulture is highly profitable as it deals with high value output. It has low crop failure chances compared for food grain because of its low water intake, along with the added advantage of multiple cropping facilities. Thus farmers were expected to switch from food grain to horticulture, a more lucrative business opportunity.

Granger Casualty Test indicated that horticulture and food grain production had no cause and effect relation with each other. Vector Error Correction too showed the absence of short run association between horticulture and food grain (Table 2).

Since, development of horticulture and GDP are affected by many dynamic factors, over time, both were expected to share a long run relation to some extent. Johansen Cointegration Test helped to determine the extent of this relation. Trace Statistic and Max-Eigen statistic (Table 3) showed that there was long run relation between the variables.

The current paper tried to fill the gap in literature by using high end econometrics like Granger Causality, VECM and Cointegration to analyse the relationship between horticulture and GDP of India at a macro level. The findings supported the first objective that horticulture production and GDP do not have causality between

Table 2: Vector Error Correction Estimates; Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	Coint. Eq1
LOGGDP(-1)	1.000000
LOGPRODFOOD(-1)	-1.537129
	(0.70598)
	[-2.17730]
LOGPRODHOT(-1)	-1.981906
	(0.33159)
	[-5.97701]
C	5.691719

Error Correction:	D(LOGGDP)	D(LOGPRODFOOD)	D(LOGPRODHOT)
CointEq1	0.098523	0.381113	0.241523
	(0.06267)	(0.14175)	(0.05429)
	[1.57212]	[2.68870]	[4.44915]
D(LOGGDP(-1))	0.829452	1.087255	0.741524
	(0.30467)	(0.68911)	(0.26391)
	[2.72246]	[1.57776]	[2.80973]
D(LOGPRODFOOD(-1))	0.000506	- 0.350220	0.117095
	(0.08343)	(0.18870)	(0.07227)
	[0.00606]	[-1.85598]	[1.62031]
D(LOGPRODHOT(-1))	-0.056504	0.161859	0.013811
	(0.26434)	(0.59790)	(0.22898)
	[-0.21375]	[0.27071]	[0.06031]
C	0.026153	-0.104400	-0.043235
	(0.03259)	(0.07371)	(0.02823)
	[0.80250]	[-1.41635]	[-1.53157]

Vector Error Correction Estimates, Probability result

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.098523	0.062669	1.572120	0.1264
C(2)	0.829452	0.304670	2.722461	0.0107
C(3)	0.000506	0.083427	0.006061	0.9952
C(4)	-0.056504	0.264343	-0.213752	0.8322
C(5)	0.026153	0.032589	0.802504	0.4286
C(6)	0.381113	0.141746	2.688701	0.0116
C(7)	1.087255	0.689113	1.577761	0.1251
C(8)	-0.350220	0.188699	-1.855976	0.0733
C(9)	0.161859	0.597900	0.270712	0.7885
C(10)	-0.104400	0.073711	-1.416348	0.1670
C(11)	0.241523	0.054285	4.449151	0.0001
C(12)	0.741524	0.263912	2.809734	0.0086
C(13)	0.117095	0.072267	1.620311	0.1156
C(14)	0.013811	0.228980	0.060314	0.9523
C(15)	-0.043235	0.028229	-1.531569	0.1361

Equation: D(LOGGDP) = C(1)*(LOGGDP(-1)-1.53712913609*LOGPRODFOOD(-1)-1.98190581789* LOGPRODHOT(-1) +5.69171871463) + C(2)*D(LOGGDP(-1))+C(3)*D(LOGPRODFOOD(-1))+C(4)*D(LOGPRODHOT(-1)) + C(5)

Equation: D(LOGPRODFOOD) = C(6)*(LOGGDP(-1)-1.53712913609*LOGPRODFOOD(-- 1.98190581789* LOGPRODHOT(-1) + 5.69171871463) + C(7)*D(LOGGDP(-1)) + C(8)*D(LOGPRODFOOD(-1)) + C(9)*D(LOGPRODHOT(-1)) + C(10)

Equation: D(LOGPRODHOT) = C(11)*(LOGGDP(-1)-1.53712913609*LOGPRODFOOD(-1)-1.98190581789* LOGPRODHOT(-1) + 5.69171871463) + C(12)*D(LOGGDP(-1)) + C(13)*D(LOGPRODFOOD(-1)) + C(14)*D(LOGPRODHOT(-1)) + C(15)

Source: *Authors own calculation*

them, but at the same time refuted the second objective of absence of linear relation between them. Situation in bordering countries of India also corroborate with our results. Mishra and Kumar (2011) used VECM approach to study the condition in Nepal. They found horticulture and GDP to have long run relation but there was no short run relationship. Alam and Wadud (2017) using econometric approach in Bangladesh detected linear relationship between variables in short run and long run like India but unlike India's absence of Granger Causality their result showed presence of causality in Bangladesh. Rizvi *et al*. (2020) studied the relation in Pakistan and found market imperfection to be the reason behind low contribution of horticulture to national income.

The lack of causality and low contribution to GDP can be a challenge to Government of India plan to double the farmer's income by 2022. Thus policy makers need to focus on it. From practitioners point of view there was a gap between total yield and marketable yield. This was because of on-farm and postharvest losses. On-farm loss occur due to lack of use of modern technology (Birthal *et al.*, 2008) as in case of poor seed quality and chemicals and pesticides. Government should invite private big companies (Roy, 2015) like Tata, Patanjali, Dabur, Reliance, ITC and agro startups to play the major role in the area. The big corporate houses with large funding capabilities (under contract farming) can implement modern technology from the beginning till the end of the process. Agro based technology startups can be rolled in to design models for dealing with pests, sowing and testing of soil and mainly for satellite farming and precision farming. Agro business based on GM crops and tissue culture can also be promoted by government to reduce risk and increase marketable yield.

Among postharvest loss the most important reason was price instability (Jha *et al.*, 2019) which makes micro farmers prone to low price in the market during peak season. Mishra and Kumar (2011) suggested "improved market information system" as a solution to the severe price volatility. Electronic National Agriculture Market has resolved this issue to some extent, yet it is not able to control distress selling of products, because of the high perishable nature of horticulture products. Here supply chain system can be of much help. Product processing companies can help out the Indian farmers at this stage. Europe and North America process eighty five percent of their production, China process fifteen percent of its product, whereas India process only two percent of its product (YES Bank, 2018). Processing of perishable products increases their shelf life and reduces price volatility. Scarce infrastructure specifically cold storage is the second problem (Negi and Anand, 2015). The next hindrance is lack of timely market relevant information (Bowbrick, 1988). Mishra and Kumar (2011) suggested "improved market information

Table 3. Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.791192	42.17600	29.79707	0.0012
At most 1 *	0.577504	18.68089	15.49471	0.0160
At most 2 *	0.318744	5.757248	3.841466	0.0164

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)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.791192	23.49512	21.13162	0.0228
At most 1 *	0.577504	12.92364	14.26460	0.0805
At most 2 *	0.318744	5.757248	3.841466	0.0164

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 GDP.

OLS was calculated separately for three variables taking each variable as independent variable. Out of all the sets of OLS calculated (Table 4), the result showed a significant relation only between GDP and horticulture production. GDP was positively associated with horticulture production (Table 4). Horticulture production growth was greatly affected by GDP of India (Table 4).

Table 4. Least Squares; Dependent Variable: LOGPRODFOOD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.973438	0.273279	10.88060	0.0000
LOGGDP	-0.040736	0.165855	-0.245613	0.8095
LOGPRODHOT	0.560737	0.418762	1.339033	0.2019

Least Squares ; Dependent Variable: LOGGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.169032	1.350507	0.125162	0.9022
LOGPRODFOOD	-0.105324	0.428821	-0.245613	0.8095
LOGPRODHOT	2.554815	0.212722	12.01011	0.0000

Least Squares ; Dependent Variable: LOGPRODHOT

Horticulture production can contribute more towards economic growth of the nation if two things are taken care of. Firstly, there should be increase in processing units and secondly, a strong supply chain management system. Government has to give special attention to these two stages of production process for converting a high investment-high risk horticulture to high value-high return zone.

References

Alam, S. and M.A. Wadud, 2017. Causal relationship between sectoral output and economic growth in Bangladesh: An Econometric Analysis. *Bangladesh J. Political Economy,* 31(5): 133-146.

Belwal, R. and M. Chala, 2008. Catalysts and barriers to cut flower export: A case study of Ethiopian floriculture industry. *Intl. J. Emerging Mkt.*, 3(2): 216-235.

Bhat, H.A. 2019. Trends and growth in area, production and productivity of apples in India from 2001-02 to 2017-18. *Research Ambition*: *An Intl. Multidisciplinary e-J.,* 4 (1): 13-23.

Bijalwan, A. 2012. Structure, composition and diversity of horticulture trees and agricultural crops productivity under traditional agri-horticulture system in mid hill situation of Garhwal Himalaya, India. *Amer. J. Plant Sci.*, 3(04): 480-488.

Birthal, P.S., P.K. Joshi, S. Chauhan and H. Singh, 2008. Can horticulture revitalise agricultural growth? *Indian J. Agr. Economics*, 63(3): 310-321.

Bowbrick, P. 1988. Are price reporting systems of any use? *British Fd. J.*, 90(2): 65-69.

Chand, R. 1996. Ecological and economic impact of horticultural development in the Himalayas: evidence from Himachal Pradesh. *Economic and Political Weekly*, 31(26): A93-A99.

Chand, R., S.S. Raju and L.M. Pandey, 2008. Progress and potential of horticulture in India. Paper prepared for the 68th Annu. Conf. of the Indian Society of Agr. Economics held in November 2008 in India.

Damodaran, T., S. Rajan, R. Gopal, A. Yadav, K. Yadav, P.K. Shukla, M. Muthukumar, N. Kumari, I. Ahmad, S.K. Jha and D. Nayak, 2019. Successful community-based management of banana wilt caused by Fusarium oxysporum f. sp. cubense Tropical race-4 through ICAR-FUSICONT. *J. Appl. Hort.*, 21(1): 37-41.

Dastagiri, M.B., R. Chand, T.K. Immanuelraj, C.V. Hanumanthaiah, P. Paramsivam, R.S. Sidhu, M. Sudha, S. Mandal, B. Singh, K. Chand and B.G. Kumar, 2013. Indian vegetables: production trends, marketing efficiency and export competitiveness. *Amer. J. Agr. For.*, 1(1): 1-11.

Hall, J.N., S. Moore, S.B. Harper and J.W. Lynch, 2009. Global variability in fruit and vegetable consumption. *Amer. J. Preventive Medicine*, 36(5): 402-409.

Horticultural Statistics at a Glance 2018. Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare, Government of India.

https://apps.who.int/iris/bitstream/handle/10665/42510/WHR_2002.pdf?sequence=1Kabir, M. H. (2018). Econometric investigation of short-run and long-run relationships between GDP and agricultural GDP of Bangladesh. *The Bangladesh J. Agr. Economics*, 39(1&2): 1-16.

Jana, M.M., R.S. Nadgauda, K. Rajmohan and A.F Mascarenhas, 1994. Rapid somatic embryogenesis from the nucelli of monoembryonic mango varieties. *In vitro Cellular Dev. Biol.-Plant.*, 30(1): 55-57.

Javanmardi, J. and S. Emami, 2013. Response of tomato and pepper transplants to light spectra provided by light emitting diodes. *Intl. J. Veg. Sci.*, 19(2): 138-149.

Jha, G.K., A. Suresh, B. Punera and P. Supriya, 2019. Growth of horticulture sector in India: Trends and prospects. *Indian J. Agr. Sci.,* 89 (2): 314-321.

Kulshrestha, D. and K.K. Agrawal, 2019. An Econometric analysis of agricultural production and economic growth in India. *Indian J. Mkt.*, 49(11): 56-65.

MacKinnon, J.G., A.A. Haug and L. Michelis, 1999. Numerical distribution functions of likelihood ratio tests for cointegration. *J. Appl. Econometrics*, 14: 563-577.

Maertens, M. 2009. Horticulture exports, agro-industrialization, and farm-nonfarm linkages with the smallholder farm sector: Evidence from Senegal. *Agr. Economics*, 40(2): 219-229.

Maertens, M., B. Minten and J. Swinnen, 2012. Modern food supply chains and development: Evidence from horticulture export sectors in sub-Saharan Africa. *Dev. Policy Rev.*, 30(4): 473-497.

McCulloch, N. and M. Ota, 2002. Export horticulture and poverty in Kenya. Available online at: https://www.ids.ac.uk/files/Wp174.pdf .

Mishra, R. and A. Kumar, 2011. The spatial integration of vegetable markets in Nepal. *Asian J.Agr. Dev.*, 8: 101-114.

Mittal, S. 2007. Can horticulture be a success story for India?. Working paper No. 197. *Indian Council for Res. on Intl. Economic Relations*. Available online at: https://www.econstor.eu/handle/10419/176216 .

Negi, S. and N. Anand, 2015. Issues and challenges in the supply chain of fruits & vegetables sector in India: a review. *Intl. J. Managing Value Supply Chains*, 6(2): 47-62.

Pramanick, K.K., D.K. Kishore and S.K. Sharma, 2005. Easy technique for multiplication of kiwifruit plants to meet the demand. *Adv. Hort. Sci.*, 19(1): 9-12.

Rahman, Z. and M.E. Hossain, 2014. Role of agriculture in economic growth of Bangladesh: A VAR approach. *J. Business Studies*, 7: 163-185.

Rizvi, S.A.A., M. Asim and S. Manzoor, 2020. Issues, challenges, and scope of supply chain management in fruits and vegetables in Pakistan. *Int. European Extended Enablement in Sci., Engi. Magt.,* 8(1): 20-30.

Roy, T.N. 2015. Supply chain management of horticultural crops. Value Addition of Horticultural Crops: Recent Trends and Future Directions. 293-314. Springer, New Delhi.

Singh, M. and V.C. Mathur, 2008. Structural changes in horticulture sector in India: retrospect and prospect for XIth five year plan. *Indian J. Agr. Economics*, 63(3): 332-348.

Singh, S., D.R. Singh, L.B. Singh, S. Chand and R.S. Dam, 2013. Indigenous vegetables for food and nutritional security in Andaman and Nicobar Islands, India. *Intl. J. Agr. Fd. Sci. Technol.*, 4(5): 503-512.

Singh, S., S. Chand, D.R. Singh and S.D. Roy, 2017. Horticulture as a reliable source of livelihood in Andaman and Nicobar islands, India. *Agr. Dev. Fd. Security Dev. Nations,* 222-248.

Subrahmanyam, K.V. 1981. Employment potential of horticulture industry. *Indian J. Ind. Relations*, 16(4): 605-613.

Vedwan, N. 2008. Apple growers' associations in northwestern India: Emergence, success, and limitations in the context of state-society interactions. *Human Org.*, 67(1): 86-96.

Vincent, A. and S. Manivasagam, 2019. A Study on the shift in cropping pattern from agriculture to horticulture in Coimbatore district, Tamil Nadu, India. *Asian J. Agr. Ext., Econ. Sociol.*, 35(4): 1-10.

Wani, R.A., A.B. Jahangeer, H.A. Hakeem, S.R. Qazi, Y.A. Basu, I. Umer, S. Geelani, S. Bashir, M.A. Mir, A.H. Pandit, A. Haq, F.A. Bahar, M. Najeeb, T.A. Malik, B.A. Alie and V.M Prasad, 2013. Influence of differential combinations of fertilizer and manure combinations on vegetative growth, yield and quality of strawberry (*Fragaria x annanassa* Duch.) cv. Douglas. *Intl. J. Current Microbiology Appl. Sci.*, 6(11): 3396-3404.

YES Bank. 2018. CFO Insights: Food & Agribusiness Sector in India: Poised for the Next Big Leap. 12. Available in https://www.yesbank.in/pdf/volume_12_march_2018.

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