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Spatio-temporal Changes in Area, Production and Productivity of Vegetables: A Review

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ABSTRACT

Vegetable crops have an integral role in Indian agriculture as these provide food, nutritional and economic security along with producing higher returns per unit of area. These crops have higher productivity, shorter maturity cycle, better value leading to nutrition, higher income which ultimately provide improved livelihoods. The purpose of this article is to review the previous studies done on the trends in area, production and productivity of vegetables. Drawing upon the enormous information of various studies conducted between 2002 and 2020, the present article track the growth rates in area, production and yield and economics along with the factors affecting the yield of the vegetable crops. The tools employed in these studies predominantly included computation of compound annual growth rate for different periods, coefficient of variation (CV), percentages, seasonal indices and regression analysis. These studies indicated that growth of area, production and yield of most of the horticultural crops in the states as well as across thecountry was found statistically significant.The demand for vegetables is increasing and to cope up with the increasing demand, it becomes important to decide the strategies to increase the production. The changing pattern and trends in the growth of vegetable crops along with broad policy recommendations needed to boost the growth of horticultural crops in line with shifting demand were also reviewed.

Key words: Economics, Growth rates, Resource use efficiency, Vegetables.

Horticulture sector is increasingly being recognised as a sunrise sector, owing to its potential to raise farm incomes, provide livelihood security and earn foreign exchange through exports. The diverse agro-climatic conditions and rich diversity in crops and genetic resources enable India to produce a wide range of horticultural crops round the year (Jha *et al.,* 2019; Sood and Kumar, 2020; Pundir *et al*., 2024). The importance of horticulture in improving the productivity of the land, generating employment, improving economic conditions of the farmers and entrepreneurs, enhancing exports and above all, providing nutritional security to the desert dwellers, can hardly be overemphasized (Bhandari *et al.,* 2014; Nabi and Bagalkoti, 2017). Horticulture comprises of study of vegetable, fruits, flowers, medicinal and aromatic plants, plantation crops and spices. Out of these vegetables occupied first position in both area and production making it one of the important components of horticulture sector of the nation in particular and of agriculture in general (Devi and Kumar, 2020a). India ranks second in vegetable production in world, after China and is popularly known as Fruits and Vegetable Basket of the world (Gandhi and Namboodiri, 2002; Nabi and Bagalkoti, 2017 and Chotaliya *et al.,* 2022). According to Department of Agriculture, Cooperation and Farmers' Welfare (Third Advance Estimates) during 2020-21, the total horticulture production in India is estimated to be 331.05 million tonnes out of which 197.2 million tonnes is of vegetables. The area under horticulture stood at 27.59 million hectares of which vegetables were cultivated at 10.86 million hectares. Vegetables and fruits play a very important role for human health and economy of the nation (Imtiyaz and Soni, 2013; Harisha *et al*., 2019 and Rajwadi and Pundir, 2022). Various factors have catalysed the growth in area and production of vegetable crops in the country. The productivity of vegetables crops has been continuously increasing during last many years (Chaudhary and Kundal, 2015; Verma *et al.,* 2016 and Ahmad *et al.,* 2018). Being a perishable commodity, the marketing and price related problems play havoc in vegetables crop (Kumar *et al*., 2006). Horticulture requires small size of land for cultivation thus making it possible for marginal farmers and bringing about a pro-poor economic growth (Mitra and Panda, 2020).

Though Himachal Pradesh has come to be recognized as epitome of planned development, yet agriculture and

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allied sectors continue to be the mainstay of majority of population as these provides sustenance to the approximately 50 per cent of the population (Sharma and Kumar, 2012). As per Department of Agriculture Himachal Pradesh, the area and production of vegetables was reported to be 90942 ha and 19.36 lakh tonnes, respectively in 2021-22. The economy of the state is mainly agriculture based as about 46 per cent of the workers depend on agriculture. The state further has a great potential for producing horticultural crops especially vegetables in different seasons under varied agro-ecological conditions. This has made vegetable production highly profitable especially in mid and high hills of the state (Sharma, 2007; Rashmi *et al.,* 2020; Mehta *et al.,* 2020 and Mandla and Vaidya 2022). The demand for vegetables is increasing in the state. To cope up with the increasing demand of vegetables, it is necessary to decide the appropriate strategies to increase the production and productivity. The studies on growth in area, production and productivity help in deciding such strategies. The effective planning can be done by measuring the progress of any particular sector. The pre sent paper reviews the trends and variability in area, production and productivity of vegetables in India as well as different states. High demand of vegetables indicates that there still is scope to increase the production of vegetables.Therefore, appropriate strategies need to be adopted to increase productivity of vegetable crops.

Trends in area, production and productivity

The growth of area and production of different crops over a period is different as some areas witness more variability than others, so it is important to study the trends in of area, production and yield of selected vegetable crops. Ghimire *et al.* (2018) analysed the trend in area, production and productivity of major vegetables in Nepal and found that the areaincreased by 222.8 per cent, production by 728.21 per cent and productivity by 156.6 per cent during 1977-78 to 2016-17. The result also revealed that during the period 2011-12 to 2015-16, solanaceous and cruciferous vegetables had an increasing trend in area, production and yield while cucurbitaceous vegetables had increasing trend in area and production but a declining trend in yield. They concluded that with the limited area for expansion of cultivation area, increasing the production efficiency is the only way to meet the growing demand of vegetables by overcoming several production related barriers such as low scale-lack of commercialization; dependency over traditional crops and local varieties having low yield; inputs and technology associated constraints, *etc*. Also, Ji *et al.* (2018) examined the spatial and temporal changes of vegetable production in China by using Gini coefficient and Moran's Index. The results showed that vegetable production in China had become more geographically concentrated in Huang-Huai-Hai region and Yangtze River Basin. The effect of resource endowment on vegetable production, rural labour is one of the key factors that determine the dynamic changes of vegetable production, while no significant effect of the climate factors was found. A study in Bangladesh by Sharmin *et al.* (2018) assessed the growth in area, production and yield of winter vegetables from 1986-87 to 2015-16. Semi-log regression model was used to assess the growth and trend. The results found that growth of tomato, cauliflower and cabbage production was 5 per cent which was much higher than other winter vegetables because of new technology adoption and different varieties of vegetables grown. Growth of cultivated area was about 3 per cent per annum for most of the vegetables. Bhandari *et al.* (2020) analysed the status of major vegetables grown in Bajura district, Nepal for area, production and yield of total 18 years period from 1999-2000 to 2016-17. The results illustrated that the increment in the rate of vegetable production was higher (258.44 MT/year) than cultivated area (24.599 ha/year) throughout the analyzed period.Concurrently, the yield of major vegetables witnessed anincreasing trend.

A study by Chand *et al.* (2008) examined the various patterns, trends and success achieved in diversification towards horticulture since 1970-71 at national and state level. The results reported that the area under fruits and vegetables increased by 2 million hectare. Horticulture crops, particularly fruits and vegetables, witnessed significant increase in area during 1990s and occupied almost 6 per cent of the total cropped area of the country by 2000-01. Further, Dastagiri *et al.* (2013) estimated production trends and market efficiency of vegetables in India. The study revealed that area under total vegetables increasedby 4.12 per cent and production by 6.48 per cent. The results showed that vegetables had huge potential for exports and suggested that Indian government should give priority to vegetable production, processing and exports. The study conducted by Agarwal *et al.* (2016) estimated growth trend of area, production and productivity of fruits, vegetables and flowers in India. The results revealed that the contribution of area in productivity was higher in all the three crop groups which indicated stress on land in coming years. Also, Nabi and Bagalkoti (2017) and Khan *et al.* (2018) revealed significant growth of area, production and yield of horticulture crops in the country. The value of output for fruits and vegetables was highest, accounting 26 per cent of the total agricultural value of output. The study also showed that there was positive relationship between area and production of horticulture crops in India.

Ananthakumar *et al.* (2019) aimed at addressing the area production and productivity scenario in respect of banana and onion. The study found that Maharashtra and Gujarat were the states having highest average productivity of banana and onion crop. Maharashtra and Gujarat were the states having highest productivity. Though the productivity is higher, it is not comparable to the world level and hence one has to assess the gap in achieving the productivity and appropriate efforts need to be taken in this respect. The growth trends of the horticultural sector in

India were also studied by Jha *et al.* (2019) and found thatfruits and vegetables alone accounted for 19.2 per cent of the overall growth rate of 3.56 per cent in agriculture during 2000-2011. Also, Devi and Kumar (2020b) analysed the trends of area and production of different horticultural crops and found that the area and production of vegetables was highest in India. The overall CAGR of area and production was 2.70 and 4.86 per cent, respectively. Likewise, Priyadarshini *et al.* (2020) examined the growth in area, production and productivity of total horticultural crops in India, Haryana and Odisha from 2005-06 to 2017-18. The CAGR in area, production and productivity in India was found to be 2.39, 4.72 and 2.32 per cent, for Haryana 5.08, 7.55 and 2.34 and for Odisha 0.91, 1.66 and 0.75 per cent, respectively. The percentage change in area and production of horticultural crops in 2017-18 over 2005-06 was found to be highest for Haryana than that of India and Odisha. They suggested strategies to improve the productivity as there is limited scope to increase the area under cultivation beyond a limit, intensive cultivation with a view on keeping the sustainability could be the answer. Towards this, agricultural research and development systems carry a significant role. one prime strategy is to alter the crop duration, which can be suitable to multi-cropping.

Nalegaonkar *et al.* (2020) used CAGR to estimate the growth and Cuddy-Della Valle Instability Index to estimate the instability in area, production and yield of onion for the period 1995-96 to 2018-19 in India. The results revealed that, growth rateswere statistically significant and positive in area, production and yield. The highest instability was observed in production of onion followed by area and yield. The increase or decrease in yield is mainly due to the rainfall and other climatic condition. The release of new varieties and innovative cultural practices developed in recent years were also responsible for the variations in yield.

Furthermore, Das *et al.* (2007) examined the growth trend in area, production and productivity of major horticultural crops of Assam *vis-a-vis* India. The study highlighted better prospects of horticultural crops in Assam and suggested the need to increase the production and productivity by using scientific method to have a sustainable growth in the long run. Similarly, Dutta (2010) calculated the growth rates of major vegetables and fruits of West Bengal during 1997-98 to 2006-07. The findings revealed positive growth rates in area for all the vegetables. Onion showed the highest growth in area and production. Cabbage and cauliflower showed stagnation in productivity. Further, Acharya *et al.* (2012) analysed the growth in the area, production and productivity of different crops in Karnataka for a period from 1982-83 to 2007-08. Growth rates showed a significant positive growth in area and production under pulses, vegetables and spices and fruits and nuts while cereals showed significant negative growth. For vegetables the growth in productivity was non-significant and negative. This is due to advancements in production technology over this time period. They also suggested to make necessary investments to provide farmers with access to high-quality seeds, production methods, irrigation, transportation, communication and marketing facilities at the state and district levels.

Also, Dhakre and Bhattacharya (2013) and Rai (2013) estimated the growth and instability of vegetables in West Bengal. It was observed that the growth of area and production for all vegetables was positive and statistically significant which indicated, there was less risk for cultivation in the state. The performance of the horticultural sector was not very satisfactory as productivity was low, even though area under these crops increased. Likewise, Singha *et al.* (2014) and Nabi and Bagalkoti (2017) have studied growth and diversification of horticulture crops in an inter-district analysis of Karnataka. The study observed that the districts having complete diversification toward horticulture sector were found to have devoted a lesser share of their cultivable area under horticulture crops. Area under vegetables expanded at the rate of 7 per cent per annum. Yield also experienced around 2.7 per cent growth rate, *albeit* significant at 10 per cent level. Tegar *et al.* (2016) revealed positive growth in area, production and productivity of selected vegetables in Bilaspur, Chhattisgarh. Tomato appeared to be most grown vegetable with high coefficient of variation. Cauliflower and cabbage were having maximum growth rates in area as 11.58, 13.62 per cent and in production 18.10 and 17.96 per cent, respectively. The growth in productivity recorded maximum in tomato crop at 5.69 per cent while least in okra crop at 0.69 per cent.

Bidyasagar *et al.* (2017) analysed the supply chain of major vegetables in Darrang district of Assam. The annual growth rate in area was 2.96 per cent, 5.91 per cent in production and 2.86 per cent in productivity where as in *rabi* vegetables the annual growth rate in area was 2.67 per cent, in production 2.86 per cent and in productivity 2.42 per cent. Also, Bokde *et al.* (2017) revealed that growth in area under vegetable cultivation in Uttarakhand had a decreasing trend in the initial years, but it rejuvenated and showed an increasing trend from 2004-05 to 2010-11. The growth in vegetable production over the years fluctuated from 0.58 per cent to 0.85 per cent. Ahmad *et al.* (2018) analysed the comparative production performance of vegetable crops in eastern India and India. The results pointed out positive growth trends in area, production and productivity of vegetable crops in the region and country during the last 16 years.

Also, Chaudhari *et al.* (2018) investigated the trends and variability in area, production and productivity of vegetables in Gujarat for the period from 1996-97 to 2015-16 by dividing it into three periods. During the study period area, production and productivity registered significant growth, except productivity. Kumari *et al.* (2020) analysed compound annual growth in area, production and productivity

of cauliflower in Samastipur, Bihar as well as for the entire state. Significant positive growth was observed in area, production and productivity of cauliflower. Devi (2019) revealed that the growth rate in area and production of the selected vegetable crops in the state of Manipur and Bishnupur district were found to be positive. The growth in area and production was highest for pea and lowest for cauliflower. A study by Sharma and Nandal (2019) analysed the growth pattern in area, production and productivity of selected vegetablesin India and Haryana from 1998-99 to 2017-18. Almost positive growth trends were observed in area and production of vegetable crops in India. There was a fluctuating trend in productivity. In Haryana, tomato observed almost positive trends in area, production and productivity.

According to the study of Devi and Kumar (2020), the trends in area and production of major vegetables in India from 2001 to 2018, revealed thatall the vegetables potato, onion, tomato and brinjal contributed maximum area and production. Further, Zainab *et al.* (2020) assessed growth in area for the state of Karnataka for the period 1998-99 to 2017–18. About 40 per cent increase in area of vegetables has been observed over the period of two decades. Among the vegetables potato, and leafy vegetables recorded negative growth. Sharma (2007) examined the growth and productivity of vegetable crops in Himachal Pradesh and revealed that the area, production and productivity of vegetable crops recorded a significant growth, however, growth in production (7.51%) and productivity (4.65%) was found higher as compared to area (2.85%). Among different vegetable, highest increase in the area, production and productivity was found in tomato followed by cauliflower.

Similarly, Chaudhary and Singh (2018) analysed the variation in acreage, production and productivity of agricultural commodities in Himachal Pradesh from 1988-89 to 2015-16. The findings revealed that the area, production and productivity of vegetables and total fruits have increased except yield of cauliflower. The area increased due to the shift towards high value crops. Also, Sood and Kumar (2020) examined the performance of horticulture in eleven hilly states for the period 2001-02 to 2017-18 with a separate analysis for the state of Himachal Pradesh. The results revealed that the overall area and production under fruit as well as vegetable crops in the mountainous states increased during the study period. The overall productivity of fruits decreased and that of vegetable crops increased in the mountainous states.

To sum it up, it can be concluded that, growth patterns in area, production and yield of vegetable crops vary significantly across different regions, reflecting regional agricultural dynamics. Thegrowth in tomato, cauliflower and cabbage production was much higher in Bangladesh. Various studies revealed that the growth of area, production and yield of horticulture crops in India was found to be statistically significant. The trend analysis have shown wide variation in the growth performance of vegetables across states. In case of onion crop productivity in India was comparatively less when examining the few of the state's average productivity. The results also revealed that the overall area and production under fruit as well as vegetable crops in the mountainous states increased. Increasing trends in vegetable cultivation were witnessed in states like Nepal, Uttarakhand, Karnataka, Chhattisgarh and West Bengal. In case of tomato, there were almost positive trends in area, production and productivity in Haryana state. In Himachal Pradesh, growth of in production and productivity of vegetable crops was found higher as compared to area.

Profitability/ economics and resource use efficiency in vegetables

The information on cost of different inputs in production, cost of cultivation and sale prices of vegetables play an important role in the profit earned from vegetables cultivation. Therefore, it is necessary to study the different economic aspects of vegetable farming. The resource use pattern in vegetables production also affects production and productivity. Efficient resource use plays a significant role not only in increasing production, but also in reducing the cost of different factors of production. A study by Tamboa and Gbemu (2010) estimated the farm production function of tomato in the Dangme West district, Ghana. The study indicated that hired labour, pesticide and farm size were observed to affect tomato output significantly. Seed, land, hired labour, fertilizer and pesticides were underutilized. Enough potential therefore existedto increase the production of tomato in the study area. Further, Adeoye and Balogun (2016) examined profitability and efficiency of cucumber production in Iseyin local government area of oyo state. The result indicated that farm size and volume of agrochemical used significantly influenced cucumber production. Age, educational status of farmers and access to credit were the significant factors determining technical efficiency of the farmers in the study area. Also, Saleh *et al.* (2016) carried out a study on resource use efficiency in tomato production in Jere local government area of Borno State, Nigeria. The results of the regression analysis for tomato production indicated that the coefficient of land, fertilizer, farm size, chemical and seed positively and significantly affected the tomato production. The result of resource use efficiency in tomato production showed that resources such as labour, farm size, chemical, seeds and fertilizer were under-utilized. Further, Ali *et al.* (2017) conducted a study to check the resource use efficiency and return to scale in off-season tomato production in Punjab province of Pakistan. The results of Cobb-Douglas function revealed overall goodness of model from coefficient of determination (R^2) (0.69) and f-statistics (11.88). Underutilization of resource was found for polythene sheet, tractor hours and irrigation. over utilization of input resources was observed for NPK, seed quantity, chemical sprays and labour-man days.

A study by Imtiyaz and Soni (2013) determined the economics of major vegetable and fruits *viz*., tomato, green chilli, cauliflower, brinjal, cabbage apple, guava and Allahabad safeda in Allahabad district. Thesignificantly higher net return were found for apple, guava followed by tomato, cabbage, green chilli, Allahabad safeda, brinjal and cauliflower. The significantly higher Benefit - Cost ratio was found for tomato/apple, guava followed by brinjal/ cabbage/Allahabad safed /green chilli and cauliflower. A study by Lokapur *et al.* (2014) aimed to analyze the resource use efficiency of major vegetables in the Belgaum district. The results revealed that the regression coefficient for seeds was found to be significant in case of all the vegetable farmers and the coefficient of multiple determination (R^2) was 74, 86 and 96 per cent in case of onion, potato and tomato, respectively. In case of onion farmers, the MVP and MFC ratio was found greater than unity. Similarly, Lalrinsangpuii *et al.* (2016) carried out a study in Mizoram during the year 2014-15 to analyse the cost and returns, resource use efficiency and constraints faced by the farmers in the cultivation of underutilized crops. The results indicated that response to land holding and human labour was found to be positive and significant with yield. High cost of inputs was the most serious problem stated by the farmers in crop production followed by unavailability of financial support.

According to Patel and Pundir (2016), the major inputs attributing to cost of cultivation of cauliflower were human labour followed by fertilizer, manure and cakes in middle Gujarat. Production function analysis revealed bullock labour, plant protection and irrigation exerted significant influence on the yield of cauliflower. The study conducted by Priscilla and Singh (2016) in Thoubal district of Manipur state found the deviations from the optimal level of resource use in cabbage, cauliflower and peas which resulted in low productivity and efficiency of various inputs.

Also, Rajput *et al.* (2017) analyzed the resource use efficiency of bottle gourd under contract *vis-à-vis* non-contract farming in the Jaipur district of Rajasthan. The net income per hectare from bottle gourd cultivation was about 32 per cent higher on contract farms as compared to the non-contract farms. The regression results revealed that human labour, machine labour, seed, irrigation and fertilizer were significantly influencing gross return of contract and non-contract farms. Likewise, Kumar *et al.* (2018) carried out a study in 2014-15 to know costs, returns and resource use efficiency of potato and tomato cultivation in Haryana. The farm yard manure had significantly positive impact whereas irrigation had significant negative impact on yield of potato. However, seeds, machine labour and weeding had positive impact whereas human labour had significantly negative impact on yield of tomato. Kumari *et al.* (2020) analysed the resource use efficiency of cauliflower production and found that the farmers in the study area were under or over utilizing the resources causing gap in output of the crop. further, Subedi *et al.* (2020) conducted a study in kapilvastu district to analyze the production economics and resource use efficiency of tomato which was found to be a labour-intensive crop in the area. Cobb-Douglas production function analysis showed positive and significant relationship of cost on labour, seed, FYM, inorganic fertilizer and micronutrients and other associated expenses with the gross income. Resource use efficiency values indicated that all input resources were underutilized in tomato production. A report by Kumar 2013 estimated the cost of cultivation of commercial crops in Himachal Pradesh and found that cost of cultivation for pea was Rs. 66,877 per hectare and for tomato it was Rs. 3,72,089 per hectare. The cost of cultivation was high for tomato, ginger and garlic. While it was primarily due to high labour requirement in ginger and for tomato due to high requirement for performing various farm operations.

To summarize, the studies reviewed above concluded that cost on labour, seed, farm yard manure, inorganic fertilizers and micronutrients showed positive and significant effect with the yield. Farm yard manure (FYM) resource had significantly positive impact whereas irrigation had significantly negative impact on yield of potato. However, seeds, machine labour and weeding had positive impact whereas human labour had significantly negative impact on yield of tomato. The production elasticities for human labour, bullock labour, machine labour charges, seed cost and pesticides were positive and significant where as farm yard manure and fertilizers cost had negative elasticities which showed that increase in these costs results in decreasing the output.

Relationship between arrivals and prices of vegetables

Most of the farm products are prone to both inter and intra-year price fluctuations. It is more in the case of vegetables due to their high degree of perishability that also causes high volatility in arrivals and prices. Due to these factors the producers has no control over prices which leads to price uncertainity. Wadhwani and Bhogal (2003) studied the price behaviour of seasonal vegetables in Uttar Pradesh in India. The wholesale monthly/weekly arrivals and prices for the period from 1987 to 1996 were collected and the study revealed that the prices of vegetables were negatively influenced by their arrivals in U.P. plains and U.P. hill region whereas the arrivals were not influenced by the prices, which was due to perishable nature and lack of storage facilities. Similar results were observed by Kumar *et al.* (2005) in selected vegetable crops (cabbage, cauliflower, tomato and green pea) in metropolitan markets of Delhi, Mumbai, Bangalore and Kolkata. The results of the study have confirmed the negative relationship between market arrivals and prices in terms of correlation coefficients over the years and across months in all the four metropolitan markets, though there were several instances of positive relationship.

A study by Mishra and Kumar (2012) analysed cyclical variation in wholesale prices and autoregressive model to study the relationship between market arrival and price of vegetables in Nepal. It was found that during the post-harvest period, the wholesale price were very low while during the lean period, the prices were quite high which was due to seasonal and perishable nature of the vegetables. The effect of lagged price on current wholesale price was positively significant and significant negative response was observed for the relationship between wholesale price and market arrival for all the vegetables in the market of hill region. Shukla and Rai (2014) collected the data on market arrivals and wholesale prices of selected crops for the period 2001-2010 in Lucknow and Kanpur market. The study confirms the negative relationship between market arrivals and prices of onion, garlic and turmeric over the years in these two markets.

Similarly, Darekar *et al.* (2015) examined the variability pattern of market arrivals and prices of onion in selected markets of Maharashtra for the period 2004-2013. The study indicated that, the arrivals of onion were more consistent in Pune, Pimpalgaon and Yeola market due to more consistency in prices of onion. The study also confirmed the negative relationship between market arrivals and prices of onion over the years in all markets. Chaudhary *et al.* (2019) examined the trends, relationship, as well as seasonal fluctuations in arrivals and prices of selected vegetables in Baijnath, regulated market of district Kangra in Himachal Pradesh for the year 2010-11 to 2015-16. The prices of vegetables moved contrary to arrivals *i.e.* prices increased with decreasing arrivals in the market hence negatively correlated. The study of seasonal fluctuations in arrivals and prices showed that arrivals of most of the vegetables were higher in the peak season and lower in the lean season.

Saha *et al.* (2020) investigated the performance of onion price and market arrivals in major Indian markets. The results revealed that the trends in market arrivals were positive in three markets except Azadpur. Seasonal index showed that the arrivals in different markets remained on the higher side during the peak harvesting season of the particular region and it collided with the low seasonal price index. There was scope for increasing the income of farmers by concentrating on marketing during lean periods. These research findings indicated the behaviour of prices and arrivals, seasonality and variability associated with vegetables in different markets across India and world. The studies also confirms the negative relationship between market arrivals and prices of various vegetables in different markets.

WAY FORWARD

In a predominantly agricultural economy like India, agriculture plays a critical role in not only addressing the food and nutritional needs of the people but also in meeting out the demands of agro-based industries. Despite having diverse agro-climatic conditions, the nation lags behind in terms of production and productivity. This creates a dire situation for marketing and trade, especially when combined with subpar post-harvest management and processing prospects. To promote and maintain the pace of rural economic development, better marketing with higher and guaranteed remuneration is essential. Market intelligence (MI) needs to be improved in order to improve marketing opportunities in agriculture which ultimately will help farmers.

There was wide variation in the growth inyield of various crops and crop groups. Yield improvements through changes in TFP would be a potential factor thatwould determine India's ability to generate exportable surplus, comparative advantage and export growth. There was wide variation in the growth inyield of various crops and crop groups. Yield improvements through changes in TFP would be a potential factor thatwould determine India's ability to generate exportable surplus, comparative advantage and export growth.

CONCLUSION

The main aim of this paper was to review the past studies conducted to examinethe trends in area, production and productivity of vegetable crops in World, India and in several states of the country. Simple statistical techniques like linear trend, R^2, percentages and compound annual growth rates were used. The area and production of vegetables significantly increased in most of the vegetables in India as well as states but it was not the case with yield of the crops. Further, it was observed that log linear production function was the most dominant method used to study theresource use efficiency in vegetable production by taking yield as the dependent variable and per hectare expenditure on seed, FYM, plant protection chemicals, chemical fertilizers, machine and bullock labour, human labour, micronutrients and other associated expenses with the gross income as the explanatory variables. The trend analysis has shown wide variation in the growth performance of various vegetables across states as well as in India. So, the availability of better-quality planting material, mechanization, quality research and development, more public and private sector investments in this sector will be of great use. Generally, the productivity growth at all India level is low, which needs to be addressed. The major strategy towards this is by improving the total factor productivity growth, through research and development. Considering the dominant role of small holders in horticultural production, the public sector research needs to be strengthened to produce improved technology and management practices.

Conflict of interest

All authors declared that there is no conflict of interest.

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