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A SYNTHESIS OF VEGETABLE DYNAMICS IN INDIA

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ABSTRACT

In this paper an attempt has been made to examine the trends, patterns and levels of vegetable production in India. The work is based on secondary sources of data procured from different government publications, websites and offices. The trend of vegetable production in India during last six decades (1961-2017) has been analysed using simple statistical techniques. To observe the decadal as well as yearly variation in the area, production and productivity of vegetables the CAGR and AAGR have been calculated. Maps and diagrams are used for the better visualization of the facts. The study reveals that India achieved tremendous growth in all three dimensions (area, production and productivity) of vegetables after 1991. The country has progress a lot on the productivity but still have to work hard to reach the global level.

Keywords: Vegetable, Production, Productivity, Trends, Growth, Variation

INTRODUCTION

The socio-economic activities in India are fast changing. Although the dependency on agriculture has not reduced much, the nature of agricultural practices has gone through very drastic changes in the due time with the invention of new tools and technologies. The technocratic inventions (inception of HYV seeds, tractor, harvester etc) during the late 60's have changed India's agriculture from subsistence traditional cropping to intensive food crop cultivation. As a result of this revolutionary change in the field of agriculture (Green revolution), India achieved self-sufficiency in terms of food production. Then, during 90's the great economic reforms, liberalization and globalization have brought commercial nature into it. And now in this commercial world of 21st century the 'high-value agriculture' (vegetable and fruits) has gained incessant priority in India. As a result of this India is one of the leading vegetable producing countries next to China. It attracts especially small and marginal farmers the most because vegetable cropping is found more profitable to them. The existing researches related to the economics of crop production done in India as well as abroad revealed that vegetable cropping on a small piece of land gives higher economic return in comparison to other traditional

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crops (Radha et al. 2001; Hasan et al. 2005; Joshi et al 2006; Sidhu et al. 2009 and Zaman et al. 2010). Vegetable farming attracts the smallholders because it absorbs family labour and ensures employment and income security (Rahman et al. 1998; Nichols and Hilmi, 2009) as well as nutrition security to the farmers' family throughout the year (Keatinge et al 2011 and FAO/WHO, 2004). In the densely populated country like India where majority of the farmers are small and marginal vegetable crop production could be an attractive economic activity and play a significant role in the country's socio-economic development process. Moreover, the changing food habit of the fast growing vast population as a result of increasing health consciousness among the urban as well as rural people creates incessantly growing demands for fresh vegetables which indicates a bright future for vegetable growers. So, in a country like India where smallholding agriculture contributes much to the national economy the study on the aforementioned high-value farming will bear immense importance in the geographical research. Therefore, in this paper an attempt has been made to examine the dynamics of vegetable crop production in India.

OBJECTIVES

- To assess trends, patterns and levels of vegetables crop production in India
- To assess the growth in the area, production and productivity of vegetables in India

DATABASE AND METHODOLOGY

The present work is based on the secondary sources of data. The data pertaining to area and production of vegetables for the year 1961 to 1991 have been taken from the technical bulletin no 51 of IIVR. The yearly data for the period 1991 to 2017 have been collected from Ministry of Agriculture and Farmers Welfare, India. The state wise population data for the year 2011 have been collected from the official website of the Registrar general and Census Commissioner, government of India, and been used to calculate state wise requirement of vegetables. Simple statistical tools are used for the analysis of the data. The trends of vegetable production in India during the last five decades i.e. from 1961 to 2017 have been analysed by dividing the whole period into two phases; 'pre-economic reform' phase (before 1991) and 'post-economic reform' phase (after 1991). To observe the decadal as well as yearly variation in the area, production and productivity of vegetables CAGR, AAGR have been calculated and presented through suitable diagram and maps.

Formula used:

$$CAGR^{1} = \{(EV/BV) \wedge (1/Y_0)-1\}$$

$$AAGR^{2} = \sum AGR/Y_n$$

$$AGR^{3} = (EV/BV)-1$$

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[1]*Compound Annual Growth Rate*
[2]*Annual Average Growth Rate*
[3]*Annual Growth Rate*
Wherein EV = End Value, BV= Beginning Value, Y_0 = Difference of Year, Y_n =No. of Years

A vegetable map showing the surplus and deficient states of vegetable has been prepared for the year 2011 on the basis of the difference between the total production and requirement level of vegetables of the respective state considering a standard requirement of 300gms/person/day.

RESULTS AND DISCUSSION

Scenario of Vegetable Production in India

Presently, India is the second largest producer of vegetables in the world after china (NHB, 2014). According to the latest update of the Ministry of Agriculture and Farmers' Welfare, India produced about 176.2 Million Tonnes of vegetables in 2016-17 from 10.3 million ha of land. The vegetables crops in India occupy only 2.8 percent of the total cultivated land, and contribute for 20% of the total agricultural produce. There are more than 70 types of vegetables grown in our country but only 10 to 15 vegetables are popular (Arora and Mangal, 2007) and these vegetables dominate the production portfolio of high value crops. Ten major vegetables including Potato, Tomato, Onion, Brinjal and Cabbage contributed for 3/4 of the total vegetable production of the country. Only three vegetables namely, Potato Tomato and Onion together contribute for more than half of the total vegetable production in India. The table-1 shows the crop wise area and production of major vegetables in India for the year 2016-17. Potato is the leading vegetable crop in India in terms of both area and production. It alone contributes for 27.4 percent of the total vegetable production and is followed by Onion (12.3%), Tomato (11.1%) and Brinjal (6.9%). The other important vegetables are Radish, Peas, Okra/Ladies Finger, Beans, Tapioca, Bottle Gourd, Bitter Gourd, Pointed Gourd, Sweet Potato, Pumpkin, Elephant Foot etc. Apart from these solanaceous vegetables some leafy vegetables such as spinach, lettuce etc. are also grown in different parts of the country for domestic as well as commercial purpose. In recent time a considerable growth in the area and production of some vegetables like Pumpkin, Pointed Gourd, Bottle Gourd and Yam have been noticed.

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Table 1: Top Ten Vegetables in India, 2016-17

Items	Area (in '000 ha)	Production ('000MT)	Productivity MT/ha
Potato	2151 (20.89)	48237 (27.38)	22.4
Onion	1293 (12.56)	21718 (12.33)	16.8
Tomato	799 (7.76)	19542 (11.09)	24.5
Brinjal	727 (7.06)	12323 (6.99)	17.0
Peas Green	540 (5.25)	5252 (2.98)	9.9
Okra/Ladys	501 (4.87)	5783 (3.28)	11.5
Cabbage	394 (3.83)	8720 (4.95)	22.1
Green Chilli	292 (2.84)	3390 (1.92)	11.6
Beans (Green)	230 (2.23)	2408 (1.37)	10.4
Tapioca	203 (1.97)	4421 (2.51)	21.8
Other Vegetables	3165 (30.74)	44383 (25.19)	14.02
Total	**10295 (100)**	**176177 (100)**	**17.11**

Source: www.indiastat.com; Ministry of Agriculture and Farmers Welfare, Govt. of India.

Table 2: Growth Performance of Major Vegetable Crops in India, 2014-17

Items	**Growth Rate During 2014 to 2017**		
	Area	Production	Productivity
Potato	9.01%	16.08%	6.16%
Onion	7.43%	11.94%	4.35%
Tomato	-9.41%	4.30%	15.57%
Brinjal	2.21%	-9.11%	-10.99%
Peas Green	24.54%	35.76%	11.24%
Okra/Ladys	-5.95%	-8.88%	-3.36%
Cabbage	-1.52%	-3.53%	-2.21%
Green Chilli	108.57%	100.91%	-4.13%
Beans (Green)	67.27%	75.74%	4.00%
Tapioca	-11.08%	-45.68%	-38.94%
Radish	17.12%	16.22%	-0.77%
Bottle Gourd	50.19%	41.48%	-5.68%
Sweet Potato	24.53%	35.39%	8.74%

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Bitter Gourd	24.22%	36.97%	10.36%
Pumpkin	263.64%	287.17%	4.27%
Elephant Foot	491.84%	228.69%	-44.49%
Pointed Gourd/Parwal	56.37%	70.54%	9.06%

Source: Ministry of Agriculture and Farmers Welfare (MoA & FW), Govt. of India, (ON1549) & Past Issues.

The table 2 shows the growth performance in the area, production and productivity of some important vegetable crops. Due to the irregularity of the crop wise availability of vegetable data the growth performance of major vegetables have been shown for the period 2014-17 only. The Yam/Elephant Foot gained the highest growth 491.8 % in terms of area which was followed by Pumpkin (263.6 %), Green Chilli (108.6%) and Parwal (56.4%). Although Yam recorded huge growth in area and production, it witnessed the highest negative growth in productivity during the same period. However, the order of growth of production of some important vegetable is Pumpkin 287 %, Yam 229 %, Green Chilli 100%, Beans 75 percent and Parwal (Pointed Gourd) 71 percent. From the growth table it is clear that the maximum growth in both area and production is found among the vegetables of gourd family including Green chilli and Beans. The highest negative growth both in area and production is recorded for Tapioca, Okra/Ladies Finger and Cabbage (Table-2). In 2014 total area under Tapioca was 228.3 thousand hectares and the total production was 8139 thousand tonnes but in 2017 the production of Tapioca radically decreased to 4421 thousand tonnes. This drastic decrease in tapioca is not only the result of decrease in area under the respective crop but also the decrease in the productivity level. The productivity of tapioca is surprisingly decreased by 39 percent during 2014 to 2017. However, overall, there is a positive growth of 8.2 percent in the total production of vegetables during 2014 to 2017 but the productivity decreased by 1.3 % during the same period. It means the country recorded growth in vegetable production mainly because of positive growth in the acres under vegetables.

Trends of Vegetable Production in India (1961-2017)

The vegetable production in India grew from 18.47 million tonnes in 1961 to 48.94 million tonnes in 1990 with an annual average growth rate of (2.1%). After the great economic reform in the 1991 vegetable production in India got accelerated due to technological, economic and social reasons. The high demand for fresh vegetables in the market due to increasing awareness about nutritional security among the people made vegetable farming more economic which in turn attracted especially small and marginal farmers to get into vegetable cropping intensively. As a result the area under vegetables increased from 4.8 million ha in 1991 to 10.2 million hectares in 2017 with an annual average growth rate of 2.77 percent (fig-1) and the total production of

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vegetables increased from 49.97 million tonnes to 176.17 million tonnes with an average annual growth rate of 4.68 percent (fig-2) during the same period. The highest growth both in the area and production of vegetables is recorded during 2001-11 period. Overall, the growth rates in all three dimensions i.e. area, production and productivity of vegetable during 'post economic reform' period (1991-2017) has doubled in comparison with the 'pre-economic reform' time.

Figure-1:
Total Area under Vegetables in India (1991-2017)

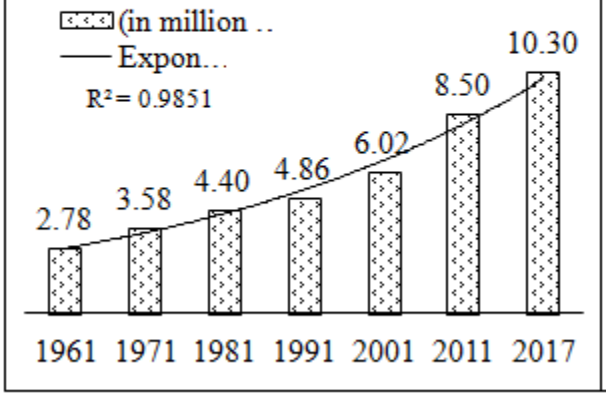
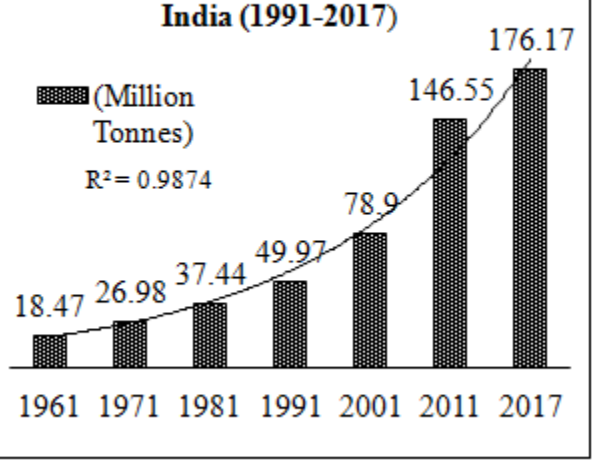


Figure-2:
Total Production of Vegetables in India (1991-2017)



Data Source: Vegetable Stat (2013), IIVR and www.indiastat.com

Table 3: Decade wise CAGR of Area, Production and Productivity of Total Vegetables in India, 1961 - 2017

Year	Compound Annual Growth Rate (CAGR)		
	Area	**Production**	**Productivity**
1961	0	0	0
1971	2.56%	3.86%	1.27%
1981	2.09%	3.33%	1.22%
1991	0.99%	2.93%	1.92%
2001	2.17%	4.67%	2.45%
2011	3.50%	6.39%	2.79%
2017	3.25%	3.12%	-0.13%

Source: Computed by the researcher based on Vegetable Statistics (2013), IIVR & www.indiastat.com

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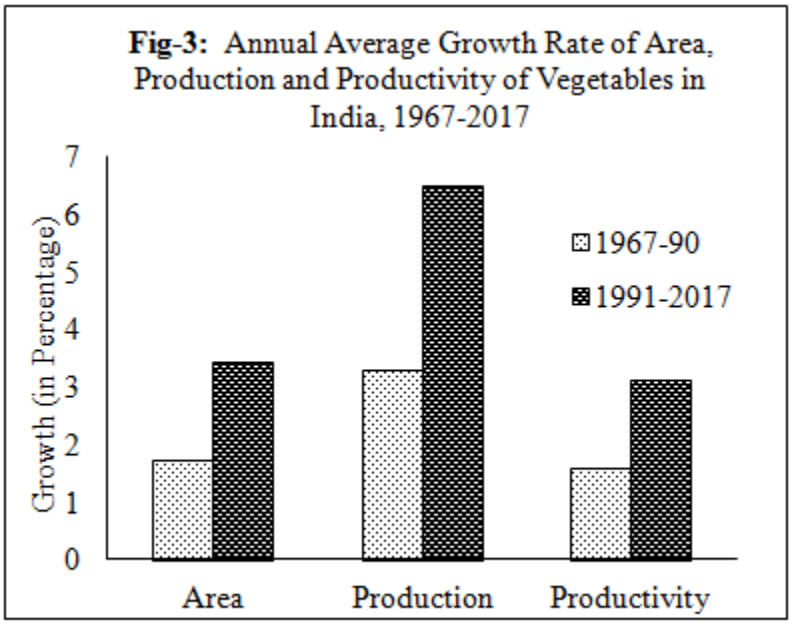
From the table-3, showing the decade wise compound annual growths (CAGR) for area, production and productivity of vegetables, it is clear that the growth rates in all three dimension (area, production and productivity) of vegetables were constantly low during pre-economic reform period. The year 1991 represents the dividend between the low growth of pre-economic reform phase and the high growth post economic reform phase. The annual average growth rate of area, production and productivity during the pre-economic liberalization era (1961-90) were 1.7, 3.3 and 1.6 percent respectively which were increased to 3.4, 6.5 and 3.1 percent respectively during later period (1991-2017).The growth in the area under vegetable crops is the direct result of the involvement of the small and marginal farmers. Vegetable crops attract small and marginal holders because these crops are more profitable in comparison to other cereal crops (Sharma 2009). The growth in the vegetable production in India is not only the result of the increment in the area under vegetable crops rather it is a result of the enhanced rate of productivity level also. The productivity and the area under vegetables increased for about three times during the period 1961 to 2017 which together caused about 9 times growth in the total production of vegetable in the same time (Table-3).

Fig-3: Annual Average Growth Rate of Area, Production and Productivity of Vegetables in India, 1967-2017



Source: Computed by the Author based on Vegetable Statistics (2013), IIVR, and www.indiastat.com data

Regional Variation in Area and Production of Vegetable Crops in India

There is regional variation in the level of area and production and productivity of vegetables in India. More than ¾ of the total vegetable production of India comes from 10 states and more

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than the half of the total comes from top five states namely UP, WB, Bihar, MP and Gujarat. Among the Indian states West Bengal has ranked first in terms of area and production till 2013-14. But after 2014 Uttar Pradesh overtakes West Bengal in both area and production. As per 2016-17 (3rd advance estimate) Uttar Pradesh produced 27.7 million tonnes of vegetables and is followed by West Bengal (25.9 MT), Bihar (14.5 MT), MP (14.4 MT) and Gujarat (13.5 MT). There are some states which produced more than the states' requirement. While some states produced much less than their requirement. A vegetable map of India (showing deficit and surplus states) has been prepared on the basis of the vegetable production data for the year 2010-11 and the vegetable demand for the same period. The state wise requirement of vegetables for the year 2011 has been estimated by taking the standard requirement of 300 grams/day/person (NIN, 2011). All the states have been categorised into two groups and they are vegetable surplus states and vegetable deficient states as presented in the map-3. The vegetable surplus states are those which produced more than the states' minimum requirement while deficient states are those which produce less than the states' requirement.

Table 4: State Wise Area and Production of Vegetables in India

	Area in '000 ha			Production in '000 MT		
State/Year	**2001-02**	**2011-12**	**2016-17**	**2001-02**	**2011-12**	**2016-17**
Uttar Pradesh	777.9	852.1	1435.23	15044.8	18563.7	27696.03
West Bengal	1139	1330.9	1371.96	18075.3	23415.7	25682.01
Bihar	578.9	857	841.91	8022.9	15552.4	14520.97
Madhya Pradesh	136.4	507	815.36	1817.5	10084	14480.47
Gujarat	232.2	517.6	702.8	3278.2	10049.8	13535.4
Maharashtra	402.4	591	700.37	5128.3	8778	10472.72
Odisha	643.4	690.1	639.34	7447.4	9520.6	8760.09
Karnataka	358.1	454.7	469.17	4173.2	7662.5	8617.26
Tamil Nadu	213.8	306.7	262.52	5444.6	9068.5	6790.13
Chhattisgarh	104.1	351.6	489.23	1355.3	4582.6	6728
Andhra Pradesh	222.5	661	242.7	2586.7	12025.3	6223.5
Haryana	150.4	356.8	411.05	2151.9	5068.4	6135.41
Punjab	135	178.2	231.73	2275.6	3674.5	4650.41
Assam	237.4	266	340.69	2935.2	3045.6	3981.72
Jharkhand	158.5	261.2	293.53	1736.3	3902.6	3370
Telangana	***	***	178.18	***	***	3369.7

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Kerala	114.3	149.1	137.19	2541.9	3626	1995.05
Rajasthan	99.3	181.7	197.91	432.5	1287.4	1991.54
Himachal Pradesh	34.6	85.7	93.12	639.1	1561.5	1774.889
Jammu and Kashmir	50.8	63.1	63.26	728.9	1395.5	1400.23
Uttarakhand	93.8	89.3	90.02	737.3	1066.7	948.12
Tripura	31.3	34.2	46.02	353	552.6	785.31
Nagaland	26.3	33	47.1	286	222.6	558.93
Meghalaya	35.7	39.5	50.05	265.9	385	544.38
Manipur	10.6	20.8	42.992	66.1	200.3	311.713
Mizoram	6.8	37.4	37.02	44.1	221.1	179.04
Sikkim	14.2	25	23.4	60	127.7	155.74
Arunachal Pradesh	20.8	6.3	2.23	83.9	83.5	16.92
Goa	7.6	6.5	***	76	78.2	***

Source: www.indiastat.com; Ministry of Agriculture and Farmers Welfare, Govt. of India.
*Note: *** Data not available*

From the map (1) it is clear that the entire central-Western India excluding Gujarat produced much less than their requirement. Four NE states i.e. Assam, Manipur, Nagaland and Arunachal Pradesh are also vegetable deficient states. The climatic extremity and the other geographical factors have deterred the growth of vegetable production in these states. The extreme monsoon (excessive rainfall) in the east and the scanty of water (low irrigation facility) in the central-western states are the most probable factors of low growth of vegetable production. Because vegetable crops are highly sensitive crops, therefore, their production gets affected in either case of low water or excessive water. However, the expansion of canal irrigation the states like U.P, Rajasthan, M.P and Chhattisgarh in the recent decades have caused a positive change in the area, production and productivity of vegetables. And now Uttar Pradesh became the leading state in terms of both area and production of vegetables in 2016-17. In the years between 2011 and 2017 many deficient states have recorded tremendous growth in area, production and productivity of vegetables. As far as the growth in area under vegetable is concerned, the state of Manipur recorded highest positive growth of 106.7% during the year between 2011 and 2017, and is followed by U.P (68.4%), M.P (60.8%), Nagaland (42%) and Chhattisgarh (39%). Interestingly, the growths in production in these states have not followed the same pattern as in the growth in the area under vegetable crops. This is because of the differential growth of productivity levels of vegetables in different states. However, all the vegetable deficient states have recorded higher growth rates in comparison to vegetable surplus states. The highest growth in the production of vegetables was recorded in Nagaland (151%), followed by Manipur (55%), Rajasthan (54%),

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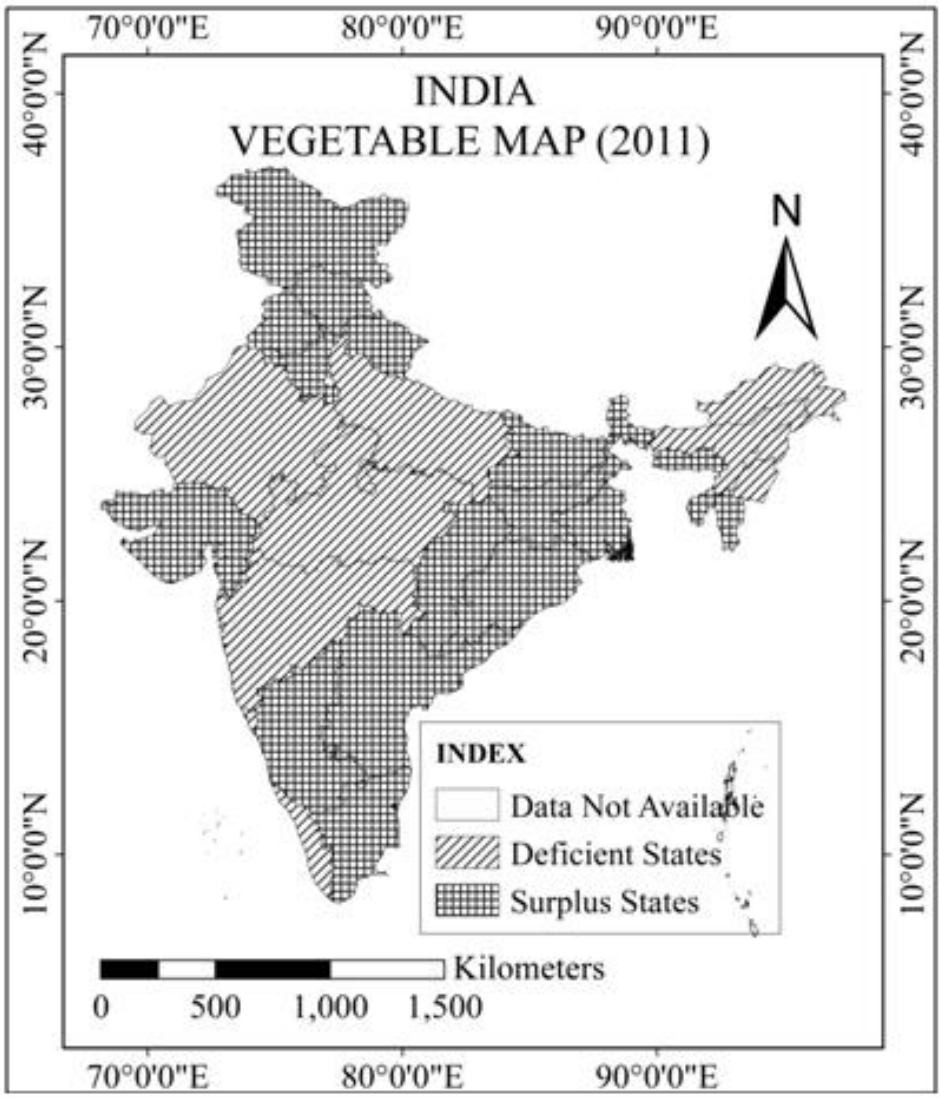
U.P (49.2%), Chhattisgarh (46%), M.P (43%) and Tripura (42%). There are few states including Arunachal Pradesh, Andhra Pradesh, Tamil Nadu, Odhisa and Kerala where the negative growth in the area and production of vegetables has been recorded.



Map-1: Prepared by the Researcher based on Vegetable Statistics (2013), IIVR and Census of India, 2011

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Variation in Productivity of Vegetable Crops in India

Although India is the second largest vegetable producing country in the world, the productivity of vegetable is very low as compared to the developed countries. Since the last decades the country has made some improvement but still we are far behind. As on 3rd advance estimate, 2017 India's average productivity rate of vegetables stands at 17MT/ha against the worlds average of 19.7MT/ha (2013). There is significant variation in the average productivity of vegetables among Indian states due to the considerable variation in physico-cultural attributes across the country. According to the 3rd advance estimate (2017) Tamil Nadu recorded highest productivity of 25.8 MT/ha followed by Andhra Pradesh (25.6 MT/ha), and Punjab 20 MT/ha. The largest vegetable producing states including Uttar Pradesh, West Bengal, Bihar, Gujarat, Madhya Pradesh and Karnataka have medium level of productivity (15-20 MT/ha). The states with low productivity level (below the national average) include Maharasthra, Odhisa, Chhattisgarh, Rajasthan, Kerala and the whole N-E hilly states except Tripura. The unfavourable climate and weather condition, soil and low consumption of chemical fertilizers in these states are responsible for low productivity. While the high productivity in T.N, Punjab, and Andhra Pradesh is the combined result of good soil, favourable weather conditions and higher level of fertilizer consumption and pest control materials.

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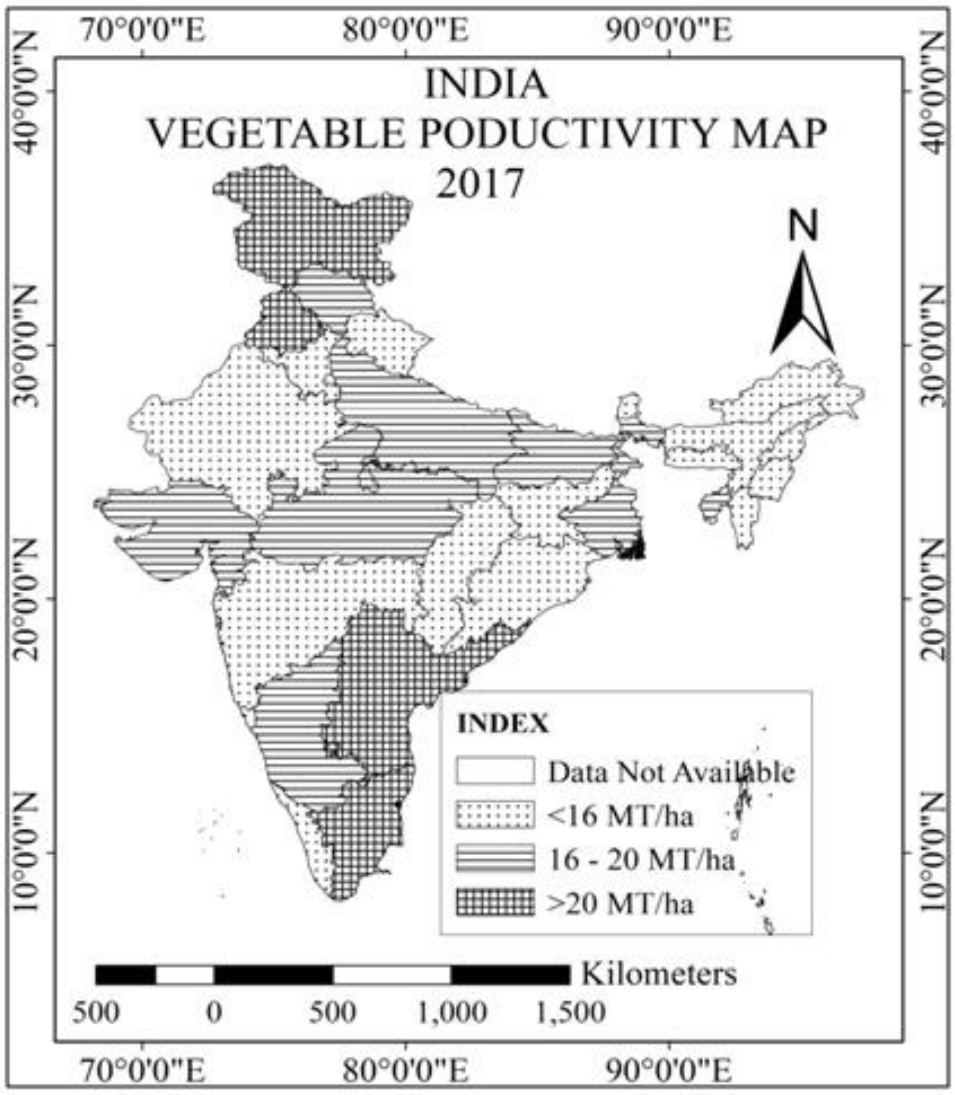
Map-2: Productivity Variation of Vegetables in India



CONCLUSION

The up escalating population growth along with fast urbanisation, rising per-capita income have created a good demand for the constant supply of fresh vegetables in India and the other developing countries of the world. More importantly, there is a pressing need to diversify the traditional 'cereal- cereal' production system for the agricultural sustainability as well as to diversify the diet table of the country. The existing researches have proved the very fact that the introduction of vegetable cropping along with the cereal cropping could effectively diversify the agriculture production system and so the diet table of the people (Joshi et al. 2007 and Thapa, G.

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2009). Hence, attention should be given to enhance the vegetable production and for this research on vegetable crop needs to be encouraged. The resource allocation for the vegetable research should be based upon their share in farm product value not based on their share in total cropped area. At present 10.2 million ha land is under vegetable crops. To feed a minimum of 300gms/person/day India must maintain an average annual growth of 2.3% in vegetable sector. But keeping in mind the growth performance of productivity of vegetable crops in the last three years it can be said that India must increase its area under vegetable crops by 40 % in 2030 if the country fail to work on the productivity rate. The growth of vegetable production by increasing the area only under vegetable crops cannot be a healthy solution for long time because agriculture lands are limited, not expanding rather decreasing day by day. So India should emphasise on the development of agriculture technology. The researches should be promoted to focus on the all-weather, pest resistant and stress tolerant high yielding seeds to cope with the problem of seasonality in vegetable crop production. Although many technologies are available at present but these are either very expensive for smallholders or environmentally unfriendly. Therefore, priority should also be given to the cost of the technology so that every farmer irrespective of their size of landholding could avail of these technologies and draw optimum benefit out of it.

Vegetables are highly perishable product. So, they, after being harvested, need careful and immediate marketing and storing. But unfortunately, India's marketing system is mostly unregulated in nature and has very poor infrastructural base. According to an estimate more than 1/3 of the total vegetable production of India gets wasted every year due to the lack of storage, inefficient transportation and poor marketing facility (Arora & Mangal, 2007). So, a mere increase in the production level without minimising the post harvest loss of vegetables will not solve the problem. The post harvest loss of vegetables can be minimised by establishing efficient cold storage, fast and efficient transportation facility and developing a good network of well regulated market channels. The domestic trades (intra of inter-state) for vegetables should also be promoted.

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