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CULTIVATION OF VEGETABLE CROPS IN HARYANA: GROWTH, SPATIAL DISTRIBUTION AND CONCENTRATION PATTERN

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Abstract

The present study investigates the growth, spatial distribution and concentration of vegetables cultivation in Haryana. The study is based on secondary data obtained from Directorate of Horticulture, Government of Haryana. It has been carried out in the background of changes induced in cropping pattern during post economic reform period and with reference to three points of time, 1990-91, 2002-03, and 2016-17. The study brings out that cultivation of vegetables in the state has expanded remarkably during the period of two and half decades. In the first phase between 1990-91 and 2002-03, the area under vegetables mainly increased in the eastern parts and also stretched to central and western parts. The second phase (2002-03 to 2016-17) also has witnessed intensification of cultivation of vegetables in the eastern region and its expansion continued in western and southern areas. The state on the whole has recorded quite diversified pattern of cultivation of vegetables. Seven vegetable crop regions have been identified on the basis of area under different types of vegetables. There hardly seems a regional specialization in cultivation of vegetables, although the intensity of vegetable crops has been comparatively high in eastern parts. The cultivation of vegetables can provide impetus to intensification of agriculture and crop diversification with crucial institutional support of the government.

Keywords: Vegetable cultivation, Growth, Concentration, Crop diversification, Post liberalization period, Haryana.

Introduction

Vegetables constitute an essential component of the food in India, as these are sources of nutrients for a balanced diet. However, per capita per day availability of vegetables in India is less than 92 grams which is far less than the recommended consumption of 250-300 grams per capita per day (Kumar et al., 2018). The demand of vegetables has increased during last couple of decades due to changes in consumers' preferences from cereals to high-valued agricultural produce such as fruits and vegetables. Therefore, cultivation of vegetables has become popular among farmers due to their short duration of growing period, high yield, nutritional richness, economic viability, and ability to generate on-farm and off-farm employment. The cultivation of vegetables has become remunerative and it is expected to have a promising future (Dastagiri et al., 2013). Cultivation of vegetables is also useful in rotational system of farming to maintain the fertility of soils. Vegetables farming also offer

the opportunity of crop diversification and intensification.

India is the second largest producer of vegetables in the world next to China. The production of vegetables in the country in 2016-17 was about 175 million tons and it was cultivated on an area of 10.29 million hectares (ha). Vegetables are labour intensive crops and require huge labour force, particularly for planting, inter-culture operations and harvesting. The cultivation of vegetable crops not only accrues higher returns but also provides opportunities for employment to the family and surplus labour available in rural areas. Diversion of area under cereal crops to vegetables is due to expansion of irrigation facilities, short cropping seasons, access to better production technologies, development of the market, storage, transport infrastructure, changing dietary habits, higher returns, and small land holdings (Malik et al., 2019). The cultivation of vegetables offers opportunity to farmers to increase agricultural productivity and to fulfill requirement of food and nutritional security as well as poverty alleviation (Singh and Chaubey, 2013). In fact, vegetables production is an emerging economic pursuit in agriculture that would augment income of marginal and small farmers and generate employment opportunities in rural areas (Joshi et al., 2006). Hence, agriculture requires some sort of diversification with high-valued crops, particularly vegetables for generating higher income from farming. The diversification of cropping pattern in favour of vegetable crops is more profitable (Kumar et al., 2013).

The subsidies on micro-irrigation, improvement in cold storage capacity and marketing network have helped to bring more area under vegetables and resulting in increase in their production. The growth of economy since early 1990s has raised the income and living standard of a section of middle class, resulting in more demand for non-food grains including vegetables. In fact, food consumption has become more diversified both in rural and urban households. Haryana is a leading food grain producer in the country. However, cultivation of vegetables has assumed a greater importance during the last two decades. Though, it is a small state in terms of area (21st rank), yet Haryana produces 3.53 per cent vegetables of the country and ranks 9th among vegetables producing states. It is blessed with favorable agro-climatic conditions with three distinct crop seasons, making it possible to produce different types of vegetables. In the light of above, the present study takes stock of the trends of vegetable cultivation in Haryana since early 1990s, the period that roughly coincides with initiation of economic transformation in India.

Objectives

Major objectives of the study are:

- to assess the trends in cultivation of vegetables in Haryana since early 1990s;
- to examine the spatial pattern of cultivation and diversification of vegetables and
- to demarcate the regions of vegetable crops.

Study Area

Haryana is located between 27º 39' to 30º 55' north latitudes and 74º 28' to 77º 36' east longitudes. It is situated in the north-western part of India and is a part of the Indo-Gangtic plains. The total geographical area of the state is 44212 km^2. At present, the state has twenty-two districts. It is a small state and constitutes

only 1.3 per cent of the total area of India. The north-eastern part of the state comprises of lower Shivalik range and piedmont plains sloping towards south and south-west. Likewise, the Aravalli ranges in the south makes the region's slope towards the north.

The state is characterized by semi-arid type of climatic conditions. It is located in the transitional zone between 'Thar' desert in the west and moderately humid upper Ganga plain in the east. The average precipitation varies across the state from 300 mm in Hisar, Sirsa, Fatehabad and Bhiwani districts to as high as 1100 mm in Shivalik foothills of Ambala and Panchkula districts. About 80-85 per cent of rainfall is received during the monsoon season. The remaining rainfall occurs in winter season by western disturbances. Soil moisture deficiency is met by well-developed irrigation system, as about 85 per cent of agricultural land is irrigated. The variations in agro-climatic conditions and availability of means of irrigation make the state suitable for cultivation of a variety of vegetable crops.

Database and Methodology

This study evaluates cultivation of vegetables in Haryana in the backdrop of economic liberalization. It covers a period of 26 years, i.e., from 1990-91 to 2016-17 divided into three periods. The first point of reference is 1990-91, the year before initiation of economic reforms in India. Second point of reference is year 2002-03 which denotes a period just before the initiation of National Horticulture Mission (2005-06). Third point of reference is agricultural year 2016-17, the latest agricultural years for which secondary data on cultivation of vegetables are available. The data have been collected from the Directorate of Horticulture, Government of Haryana and Statistical Abstract of Haryana, Department of Economic and Statistical Analysis, Haryana. In 1990-91 there have been 16 districts in Haryana, while their number increased to 19 in 2002-03, which further increased to 22 in 2016-17.

Simple statistical technique of percentages has been applied to find out the proportion of area under vegetables. To highlight the temporal variations, compound growth rate of area under vegetables has been calculated. The location quotient method has been applied to find out the regional concentration of area under vegetables. It reveals the degree of regional specialization of different crops. It is calculated as:

$$\text{L.Q.} = \frac{\text{Area under vegetable crops in a district}}{\text{Total cropped area of district}} \div \frac{\text{Area under vegetable crops in a state}}{\text{Total cropped area of state}}$$

The degree of diversification of vegetable crops has been computed by using Herfindahl Index (Malik and Singh, 2002; Singh and Mathur, 2008).

$$\textit{Herfindahl Index (HI)} = \sum_{i=i}^{n} p^2 i$$

where, n is the number of vegetable crops and pi represents proportion of area of the i^{th} crop in total cropped area. The crop diversification index has been calculated as:

$$\textit{Crop Diversification Index} = 1 - HI$$

The index value of zero indicates perfect crop specialization, while index value of 1 depicts most diversified cropping pattern. Likewise, the crop combination regions have been identified at district level with the help of $\Sigma\, d^2$, where d is deviation from the theoretical base curve. It uses least sum of deviation to choose the crop combination for the district. Additionally, choropleth maps and tables have been drawn to show the spatial pattern of

concentration and diversification of vegetable crops.

Results and Discussion

Trends in Area under Vegetable Crops

Among horticultural crops, vegetables cover largest area in Haryana. Cucurbits, cauliflower, potato, onion, tomato, radish, cabbage and carrot are main vegetables grown in the state. Fig. 1 shows the trend of area under vegetable crops which has increased consistently at a faster rate during the period 1990-91 to 2016-17. Area under vegetables has recorded three-fold rise from 56 thousand ha in 1990-91 to 163 thousand ha in 2002-03. It has further increased to 411 thousand ha in 2016-17. It indicates that there has been a slow and steady rise till 2000-01 but after that area under cultivation of vegetables has increased at a very faster rate. It may be attributed to the initiation of National Horticultural Mission in 2005-06 which envisaged integrated development of horticulture sector involving production, post-harvest technology, and infrastructure developmental initiatives. Overall, cultivation of vegetables in the state has expanded more than seven times during the period 1990-91 to 2016-17.

Growth in Area under Vegetable Crops

The compound growth rate of area under vegetables in the state has been quite high (9.38 per cent) during the period 1990-91 to 2002-03 (Fig. 2). However, it declined to 6.82 per cent during the period 2002-03 to 2016-17. During the entire study period 1990-91 to 2016-17, area under vegetable crops has increased at the compound growth rate of 7.69

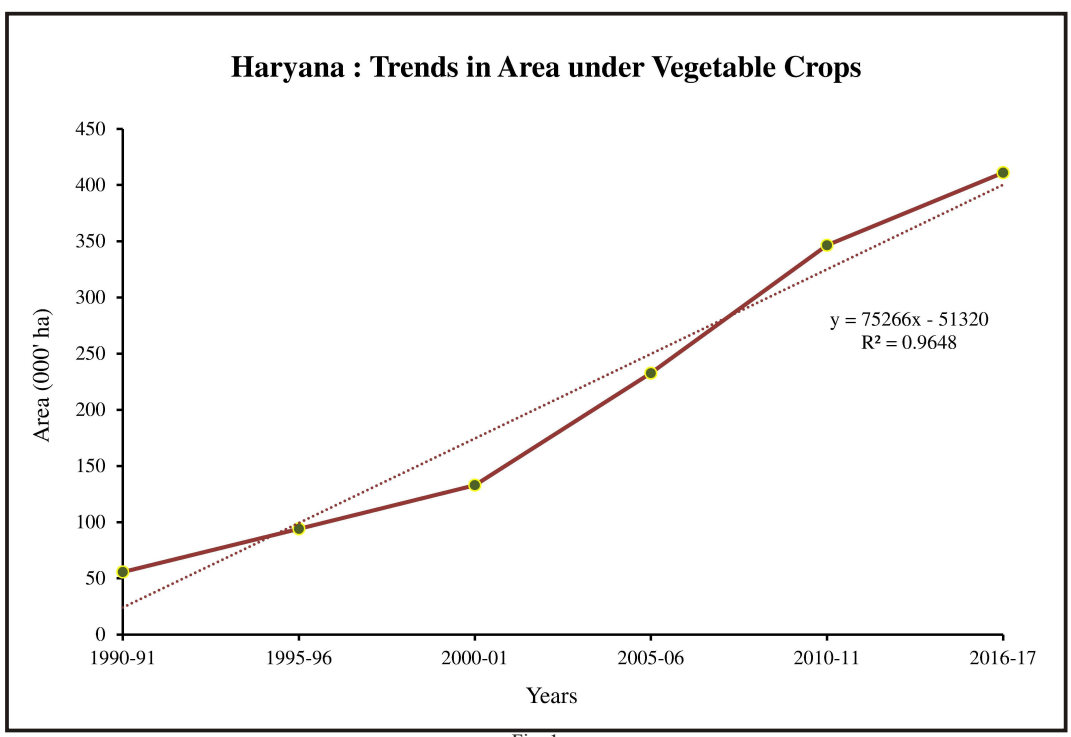

Fig. 1

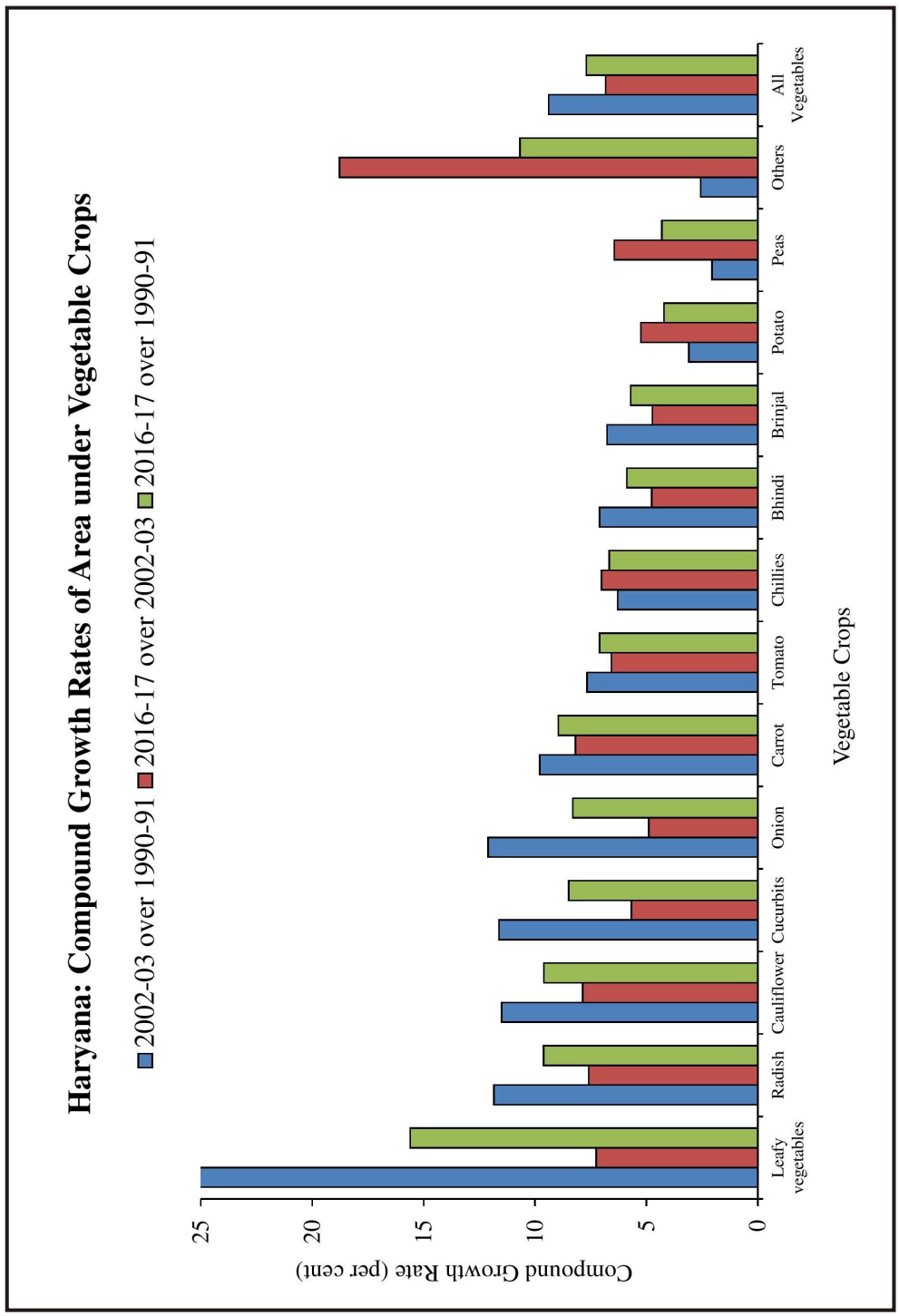
Haryana: Compound Growth Rates of Area under Vegetable Crops
2002-03 over 1990-91
2016-17 over 2002-03
2016-17 over 1990-91
Compound Growth Rate (per cent)
25
20
15
10
5
0
Leafy vegetables
Radish
Cauliflower
Cucurbits
Onion
Carrot
Tomato
Chillies
Bhindi
Brinjal
Potato
Peas
Others
All Vegetables
Vegetable Crops

Fig. 2

per cent, suggesting a faster diffusion of vegetables during post-liberalization period.

Fig. 2 also shows that there are variations in growth rate of area under different kinds of vegetables. Area under leafy vegetables has recorded a very high growth rate of 25.33 per cent during 1990-91 to 2002-03. However, the pace of their growth remained comparatively slower (7 per cent per annum) during 2002-03 to 2016-17. The overall compound growth rate of area under these vegetables during two and a half decades has been 15.60 per cent. The compound growth rate of area under carrot cultivation increased at the rate of 9.78 per cent during the period 1990-91 to 2002-03, while during 2002-03 to 2016-17, it has increased by 8.18 per cent annually. Thus, area under carrot has increased at an impressive growth rate of 8.95 per cent annually. On the other hand, area under peas and potato has increased at a slower growth rate of 2 to 3 per cent during the period 1990-91 to 2002-03 whereas in between 2002-03 to 2016-17, it has recorded a growth rate of more than 5 per cent per annum. During the period 1990-91 to 2016-17, the overall compound growth rate of area under these vegetables has been 4 per cent. Area under radish, cauliflower, cucurbits and onion has increased quite impressively (about 12 per cent) during the period 1990-91 to 2002-03, while their compound growth rate has varied between 5 to 8 per cent during 2002-03 to 2016-17. During the study period (1990-91 to 2016-17) area under these vegetables has increased at the rate of 8 to 9 per cent per annum. However, area under leafy vegetables has shown most impressive growth since early 1990s.

District-wise Share of Area under Cultivation of Vegetable Crops

In 1990-91, the share of Sonipat district has been highest, as it accounted for about one-fifth of the total area under vegetables in the state. Other major vegetables growing districts have been Ambala, Kurukshetra, Karnal and Panipat. These five districts, occupied about two-fifth of area under vegetables. Hisar and Gurugram districts each has accounted for about 8 per cent of area under vegetables, while other districts have been minor vegetables growing areas in 1990-91 (Table 1).

In 2002-03, Sonipat district continued to be the leading vegetables grower by having about 14 per cent of total area under vegetables. It has been followed by Gurugram district, which accounted for about one-tenth of total area under vegetables. Yamunanagar, Karnal and Panipat districts each has recorded about 8 per cent of area under vegetables. Thus, above mentioned five districts accounted for about half of the total area under vegetables. Ambala, Panchkula, Kurukshetra, Jhajjar and Bhiwani have been the other vegetables growing districts.

The cultivation of vegetables has further intensified since 2002-03. There have been seven districts like Sonipat, Panipat, Karnal, Yamunanagar, Nuh, Ambala and Gurugram, which accounted for about three-fifth of area under vegetables in 2016-17. Kurukshetra, Jind, Rohtak, and Fatehabad have been other important vegetables producing districts. The vegetables are also being cultivated in Sirsa, Hisar, Faridabad, Jhajjar, Bhiwani, Palwal, and Panchkula districts.

Thus, the study reveals that cultivation of vegetables in Haryana has expanded during last two and a half decades. Small area under vegetables in early 1990s has been mainly concentrated in eastern region. During the next decade, area under vegetables has increased significantly in the same region and expanded

Table 1
Haryana: District-wise Share of Area under Vegetable Crops (Per cent)

Districts	1990-91	2002-03	2016-17
Ambala	9.00	5.54	6.81
Panchkula	DNA	4.13	2.61
Yamunanagar	2.36	8.51	8.79
Kurukshetra	9.14	6.19	4.87
Kaithal	3.22	3.20	1.74
Karnal	8.95	7.79	9.62
Panipat	9.63	7.67	10.09
Sonipat	20.70	14.13	11.38
Rohtak	6.48	3.01	3.82
Jhajjar	DNA	6.06	2.68
Mahendergarh	1.10	2.02	1.81
Rewari	1.24	1.21	1.41
Faridabad	4.10	3.57	2.54
Palwal	DNA	DNA	2.24
Gurugram	7.74	10.21	6.00
Nuh	DNA	DNA	7.57
Bhiwani	3.08	4.40	2.61
Hisar	8.17	3.56	2.94
Fatehabad	DNA	2.85	3.85
Sirsa	2.47	2.76	2.65
Jind	2.63	3.17	3.95
Haryana	**100.00**	**100.00**	**100.00**

Source: Compiled by Authors. DNA – Districts not available.

to central and western parts. The next one and a half decades have witnessed intensification of cultivation of vegetables in the eastern region and its expansion in the western and southern regions.

Concentration of Area under Vegetable Crops

Cultivation of vegetables has been taken up by farmers in many areas to improve their income. It has turned out to be an effective mechanism for overall diversification of cropping pattern. Though it has pockets of concentration in certain areas, yet cultivation of vegetables has become quite widespread in Haryana. Potato cultivation is largely confined to north-eastern part extended between Panchkula and Sonipat districts. Onion and tomato growing areas spread from Nuh in the south to Panchkula in the north.

During 1990-91, the highest concentration of area under vegetable crops has been found in Sonipat district (7.66 location quotient). Panipat, Ambala and Kurukshetra are other districts having high (location quotient above 2.0) concentration of vegetables cultivation (Fig. 3). Karnal and Gurugram districts have witnessed moderate (location quotient 1.5-2.0) concentration of area under vegetables. Cultivation of vegetables has been a minor economic pursuit for farmers in 10 out

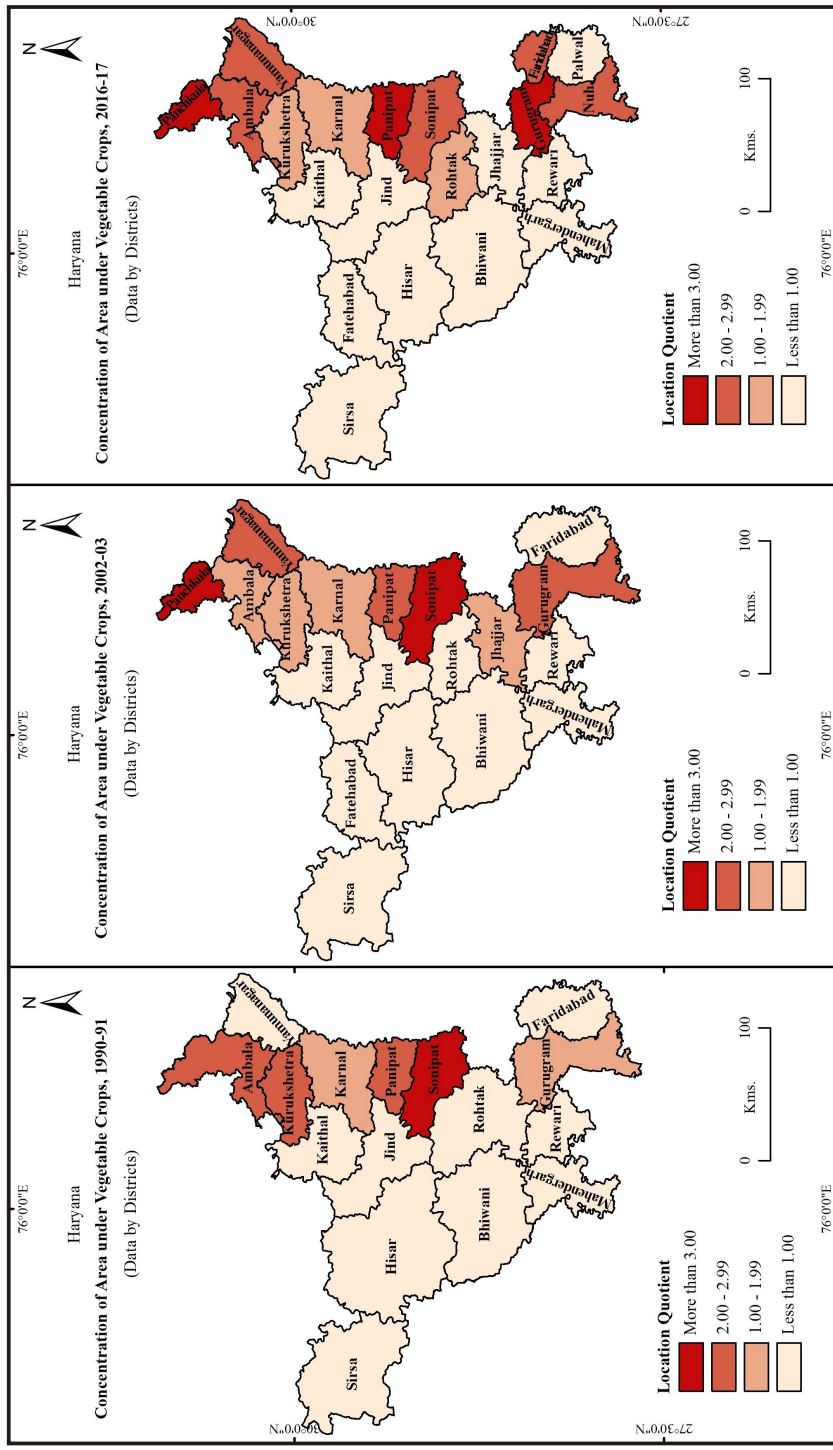
Haryana
Concentration of Area under Vegetable Crops, 1990-91
(Data by Districts)
Concentration of Area under Vegetable Crops, 2002-03
(Data by Districts)
Concentration of Area under Vegetable Crops, 2016-17
(Data by Districts)
76°00'E
30°00'N
27°30'N
N
0 Kms. 100
Location Quotient
More than 3.00
2.00 - 2.99
1.00 - 1.99
Less than 1.00
Yamunanagar
Ambala
Kurukshetra
Kaithal
Karnal
Panipat
Sonipat
Jind
Rohtak
Jhajjar
Faridabad
Gurugram
Rewari
Mahendergarh
Bhiwani
Hisar
Fatehabad
Sirsa
Palwal

Fig. 3

of 16 districts recording location quotient below 1.0 in 1990-91. The study reveals that cultivation of vegetables in early 1990s has been mostly concentrated along the Grand Trunk Road belt in eastern Haryana.

Areas having high concentration of vegetables cultivation didn't change much in 2002-03 with respect to early 1990s. At district level, Panchkula and Sonipat districts have respectively recorded highest (location quotient 5.8) and second highest (location quotient 3.27) positions in concentration of cultivation of vegetables. Yamunanagar district has taken a big leap forward in cultivation of vegetables between 1990-91 and 2002-03 followed by Gurugram district. There has been a moderate concentration of vegetables in Ambala, Jhajjar, Kurukshetra and Karnal distr-icts in 2002-03.

In 2016-17, Panchkula, Gurugram and Panipat districts recorded very high level (location quotient above 3) of concentration of vegetables cultivation (Fig. 3). Other districts with high concentration (location quotient varying between 2 and 3) of cultivation of vegetables have been Faridabad, Yamunanagar, Sonipat, Ambala and Nuh. While, Karnal, Kurukshetra and Rohtak districts have registered moderate (location quotient 1.0-1.5) concentration of vegetable crops.

It has been found that although inter-district variations in area under vegetables have been minimized, yet during the study period, cultivation of vegetables has largely remained concentrated in eastern parts of the state. The spatial variations in this regard have been caused by availability of irrigation facilities and proximity to the markets.

Diversification in Cultivation of Vegetable Crops

The crop diversification index has been quite high (0.90 in 1990-91 and 0.91 in 2016-17), suggesting that Haryana does not specialize in cultivation of vegetables rather it grows a variety of vegetables. Jind district has been found to be the most diversified in cultivation of vegetables in 1990-91. Besides, there are twelve districts spreading all over the state, except north-eastern region that have quite diversified (index 0.86-0.90) cultivation of vegetables. The least diversified cultivation of vegetables (index less than 0.80) has been found in north-eastern Haryana i.e., Kurukshetra and Ambala districts. Yamunanagar, district of this region, has witnessed moderate diversification index of cultivation of vegetables (Fig. 4).

There are many districts that have experienced further diversification in cultivation of vegetables during the period 1990-91 to 2016-17. The diversification has particularly been intensified in central and north-eastern parts of the state. In 2016-17, the most diversified cultivation of vegetables has been found in seven districts namely Jind, Kaithal, Panipat, Karnal, Ambala, Sirsa and Rewari. The moderate level of diversification of vegetables has been found in twelve districts namely Sonipat, Yamunanagar, Panchkula, Rohtak, Jhajjar, Gurugram, Faridabad, Palwal, Hisar, Fatehabad, Bhiwani and Mahendergarh (Fig. 4). Cultivation of vegetables has low diversification in Nuh district which mainly produces onion and tomato crops. Kurukshetra district which mainly cultivates potatoes has least diversified cultivation of vegetables. Overall, north-eastern and north-central parts of Haryana are heading towards more diversification in cultivation of vegetables.

Table 2 depicts that over the period 1990-91 to 2016-17 Ambala, Panchkula and Kurukshetra districts falling in north-eastern

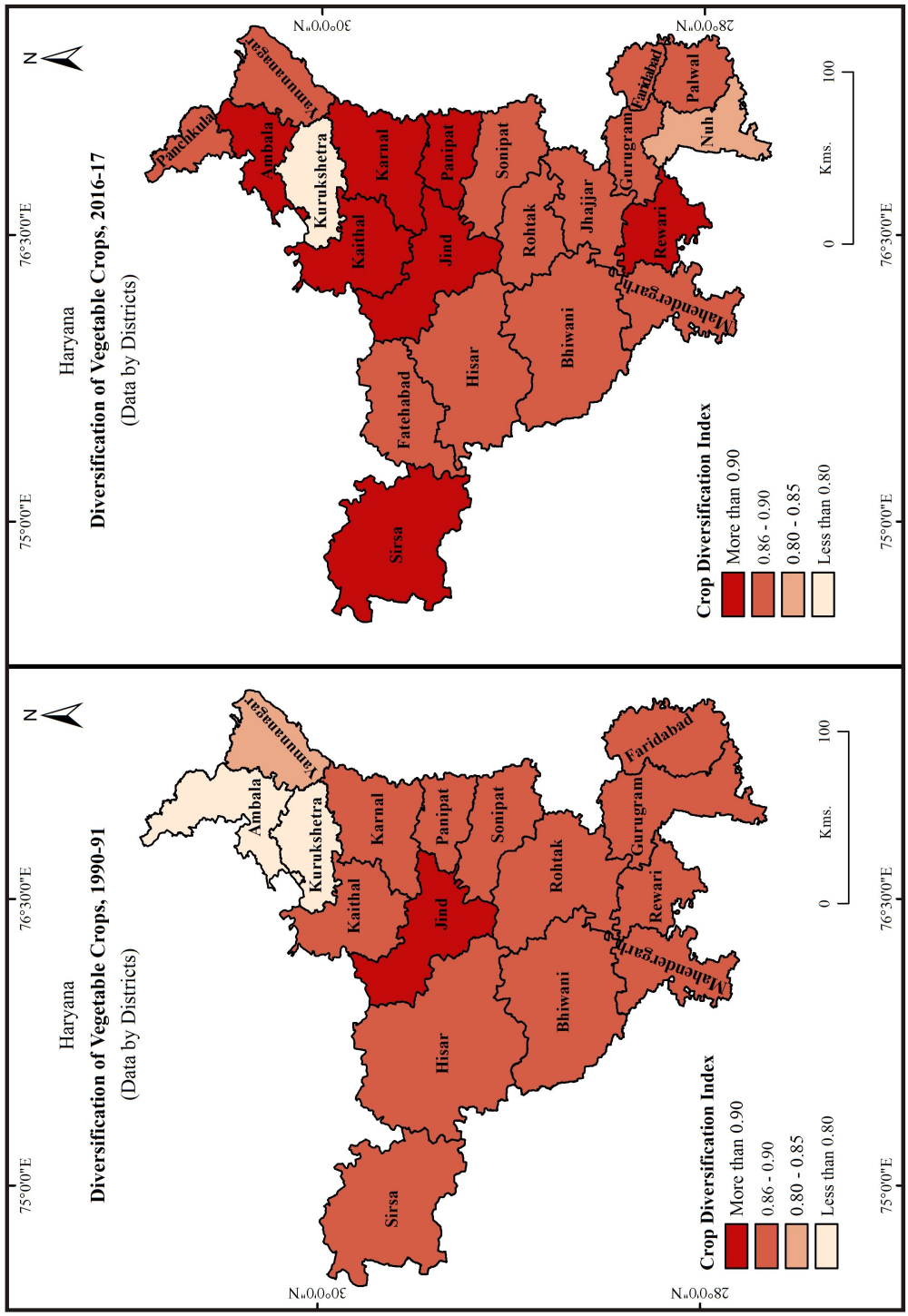
Haryana
Diversification of Vegetable Crops, 1990-91
(Data by Districts)
Haryana
Diversification of Vegetable Crops, 2016-17
(Data by Districts)
N
75°0'0"E
76°30'0"E
30°0'0"N
28°0'0"N
Crop Diversification Index
More than 0.90
0.86 - 0.90
0.80 - 0.85
Less than 0.80
0
Kms.
100
Yamunanagar
Panchkula
Ambala
Kurukshetra
Karnal
Kaithal
Panipat
Jind
Sonipat
Rohtak
Jhajjar
Gurugram
Faridabad
Palwal
Nuh
Rewari
Mahendergarh
Bhiwani
Hisar
Fatehabad
Sirsa

Fig. 4

region have been fast in diversification in cultivation of vegetables. Yamunanagar, Kaithal, Karnal, Panipat, Rewari, Bhiwani, Sirsa and Mahendragarh have been other districts moving towards vegetable diversification but at a low pace. The districts of Nuh, Palwal, Faridabad, and Fatehabad have moved toward specialization of vegetables. There is no significant change in this regard in Sonipat, Rohtak, Jhajjar, Jind, Gurugram and Hisar districts. All these districts already have quite diversified cultivation of vegetables.

Regions of Vegetable Crops

Cultivation of vegetables is quite diversified in Haryana as these crops are being grown in many combinations. Twelve vegetables namely, cucurbits, cauliflower, potato, leafy vegetables, tomato, radish, onion, carrot, okra, brinjal, peas and chilies have been taken into account for crop combination analysis. Fig. 5 shows that there are seven vegetable crops regions identified on the basis of combination of vegetables grown at district level. The common factor among all these vegetable regions is that all of them have a diversified cultivation of vegetables.

The north-eastern region comprising of Panchkula, Ambala, Kurukshetra and Yamunanagar districts lies in the piedmont plains of Shivalik hills. The main vegetables being cultivated in the region are potato, onion, tomato, radish, leafy vegetables and cauliflower, which account for about 65 per cent of the total area under vegetables. The eastern region (Karnal, Panipat and Sonipat districts) has been dominated by cultivation of cauliflower, potato, leafy vegetables, radish, cabbage, carrot, peas and tomato. On the other hand, carrot, leafy vegetables, tomato, radish, cabbage, cauliflower and chillies are main vegetables being cultivated in the central region confined to Jind, Kaithal and Rohtak districts. Cauliflower, radish, chillies, carrot, cabbage, leafy vegetables and bottle gourd are dominant vegetables cultivated in the western region including Sirsa, Hisar and Fatehabad districts. Together these crops account for more than half of the total area under vegetables of these districts. The south-western region comprising Mahendergarh, Bhiwani and Rewari districts mostly produce tomato, leafy vegetables, radish, carrot, cauliflower, chilly and onion. The south-central region (Nuh, Gurugram and Jhajjar districts) mostly produce onion, bottle gourd, tomato, okra,

Table 2
Haryana: Districts by Changes in Diversification Index of Vegetable Crops (1990-91 to 2016-17)

Category of Diversification	Index Value	Districts
Towards fast diversification	Index value decline 0.10 and more	Ambala, Panchkula, Kurukshetra
Towards slow diversification	Index value decline 0.02 to 0.09	Yamuna Nagar, Kaithal, Karnal, Panipat, Rewari, Bhiwani, Sirsa, Mahendragarh
No significant change	Index value change within ± 0.01	Sonipat, Rohtak, Jhajjar, Jind, Gurugram, Hisar
Towards slow specialization	Index value increase 0.02 to 0.09	Nuh, Palwal, Faridabad, Fatehabad

Source: Compiled by Authors.

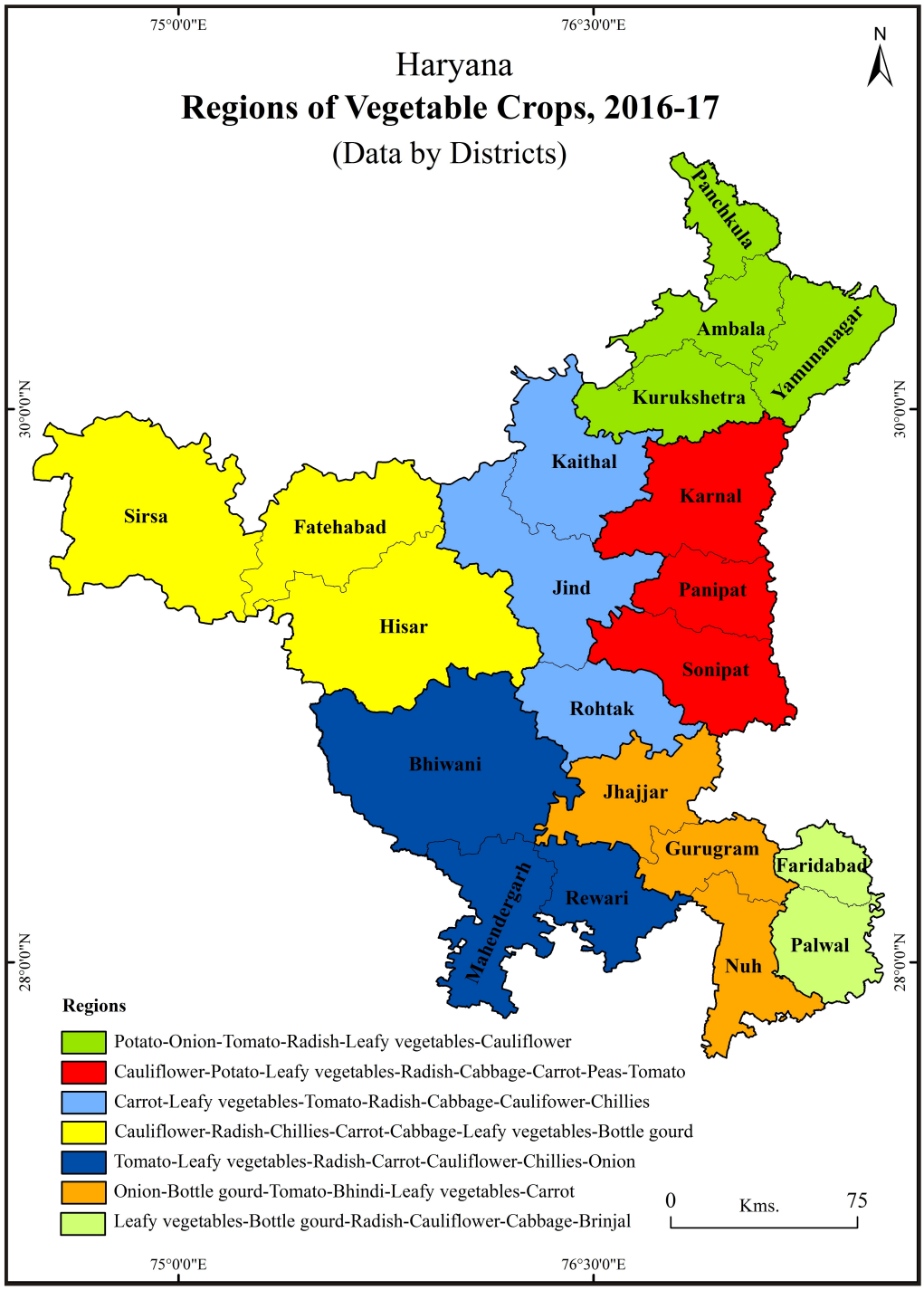
75°0'0"E
76°30'0"E
N
Haryana
Regions of Vegetable Crops, 2016-17
(Data by Districts)
30°0'0"N
28°0'0"N
Panchkula
Ambala
Yamunanagar
Kurukshetra
Kaithal
Karnal
Sirsa
Fatehabad
Jind
Panipat
Hisar
Sonipat
Rohtak
Bhiwani
Jhajjar
Gurugram
Faridabad
Rewari
Mahendergarh
Palwal
Nuh
Regions
Potato-Onion-Tomato-Radish-Leafy vegetables-Cauliflower
Cauliflower-Potato-Leafy vegetables-Radish-Cabbage-Carrot-Peas-Tomato
Carrot-Leafy vegetables-Tomato-Radish-Cabbage-Caulifower-Chillies
Cauliflower-Radish-Chillies-Carrot-Cabbage-Leafy vegetables-Bottle gourd
Tomato-Leafy vegetables-Radish-Carrot-Cauliflower-Chillies-Onion
Onion-Bottle gourd-Tomato-Bhindi-Leafy vegetables-Carrot
Leafy vegetables-Bottle gourd-Radish-Cauliflower-Cabbage-Brinjal
0
Kms.
75

Fig. 5

leafy vegetables and carrot. While the south-eastern region comprising of Faridabad and Palwal districts has a quite different pattern of cultivation of vegetables which include leafy vegetables, bottle gourd, radish, cauliflower, cabbage and brinjal.

The regions of vegetable crops in Haryana have been found mostly different from each other on the basis of ranking of vegetable crops based on their proportion of acreage. There hardly seems a regional specialization of cultivation of vegetables although the intensity of cultivation of vegetables (in terms of acreage) has been comparatively high in the eastern parts and quite low in the extreme north-western and south-western parts of the state.

Prospects and Challenges of Vegetables Farming

Cultivation of vegetables has emerged as a fast-growing sub-sector of agricultural economy in Haryana. Area under vegetables has increased from merely 1 per cent of total cropped area in 1990-91 to 3.5 per cent in 2002-03 and to 7.5 per cent in 2015-16 (Singh and Jaglan, 2019). Much of the growth in area and production of vegetable crops has been registered after the initiation of National Horticultural Mission, 2005. The prospects of cultivation of vegetables seem bright as the Horticulture Department of the state is currently contemplating on introduction of latest technologies in a joint venture with Israel. It has established a Centre of Excellence for vegetables under Indo-Israel Agriculture Project at Karnal (Kumar et al., 2020).

Despite the bright prospects, the vegetables growing farmers are facing problems such as lack of marketing and storage facilities, price volatility, high input costs etc. The marketing of the vegetables, being perishable, remains a big problem. The government must arrange for an efficient marketing mechanism and price information system. Price fluctuations must be minimized by fixing of minimum support prices. There is a need for provision of cold storage facilities at village level and adequate refrigerated transport facilities. The scarcity of irrigation water is the main hindrance in expansion of cultivation of vegetables in the southern and western parts. The cultivation of vegetables can be instrumental towards intensification of agriculture and crop diversification to keep farmers away from wheat and rice crops, provided there is a favorable price regime and marketing mechanism, technology for raising the vegetables productivity, financial support and rural infrastructural facilities.

Conclusions

The present study explores the acreage trend, spatial pattern of cultivation and diversification of vegetable crops in Haryana since the initiation of economic reforms in 1990s. It brings out that cultivation of vegetables has expanded remarkably over the period of two and a half decades (1990-91 to 2016-17). Area under vegetables has increased at an impressive compound growth rate of 7.69 per cent during this period. Area under vegetables has shown a slow and steady rise till early 2000s but increased quite sharply thereafter. It may be attributed to the initiation of National Horticultural Mission in 2005-06 that provided impetus to the cultivation of vegetables. The growth rate of area under vegetables has been very high in case of leafy vegetables followed by radish, cauliflower, carrot, cucurbits and onion.

In the first phase of 1990-91 and 2002-

03 area under vegetable crops has mostly expanded in the eastern parts and also stretched to the central and western parts. The second phase (2002-03 to 2016-17) has witnessed intensification of cultivation of vegetables in the eastern region and its expansion continued in the western and southern areas. Overall, cultivation of vegetables in the state continues to be concentrated in eastern parts with spatial variations caused by level of irrigation development and proximity to the markets.

Haryana has not specialized in cultivation of specific vegetables. It has quite diversified pattern of cultivation of vegetables without much change in diversification level during the last two and a half decades. At regional level, north-eastern districts of Kurukshetra, Ambala and Panchkula are having dominance of potato and tomato cultivation and has witnessed least diversified pattern in 1990s. However, in the due course of two and a half decades, these districts have also moved towards fast diversification of vegetables.

Seven regions of vegetable crops have been identified on the basis of different combinations of vegetables. However, these regions have been different from each other mostly in terms of acreage based ranking order of vegetable crops rather than crop exclusivity. There hardly seems a regional specialization of vegetables although intensity of cultivation of vegetables (in terms of acreage) has been comparatively high in the eastern parts and quite low in the extreme north-western and south-western parts. The experience of last two and a half decades reveals that expansion of cultivation of vegetables can provide much needed impetus towards crop diversification and enhance the farm income provided that the farmers get required institutional support from the government.

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