Chapter 7

Summary and Conclusion
Agriculture in India accounts for nearly 65% of the country's employment, 18% of the total GDP and about 18% of total export earning and a major supplier of raw material to industries. Agriculture is not only the backbone of Indian economy and food security but also a way of life, a tradition and anchor of overall livelihood opportunity for about 700 million of over one billion populations. Agriculture, therefore, is and will continue to be central to all strategies for planned socio-economic development of the country. Vegetables being a vital source of mineral, vitamins and dietary fibers, play an important role in human nutrition in supplying certain constituents in which other food materials are deficient.

Agricultural productivity is demanded at a faster pace than ever before to meet the demands of increasing population, besides other compelling factors including global climatic changes, global market competition and consumer choices. India is the second largest producer of vegetables in the world, next to China. These are grown on 7.8 million hectares forming about 4% of the total cropped area. The limited cultivable area can be best utilized for growing vegetables, which are known to give higher yields per unit area and time. In recent years, keen interest has developed in vegetable cultivation on larger farms that are distantly placed from consuming centres. Based on the climatic condition prevailing in different parts of the country, 8 agro-climatic zones for vegetable crops have been formed, viz. I. Humid western Himalayan region (J&K, Himachal Pradesh and Uttaranchal), II. Humid Bengal –Assam basin (West Bengal and Assam), III. Humid eastern Himalayan and bay islands (Sikkim, Meghalaya, Manipur, Nagaland, Mizoram, Tripura, Arunanchal Pradesh and Andaman &
Nicobar Islands), IV. Sub-humid Sutlej Ganga Alluvial plains (Punjab, Uttar Pradesh and Bihar), V. Sub-humid eastern and south eastern uplands (Chhattisgarh, Orissa and Andhra Pradesh), VI. Arid western plain (Rajasthan, Gujarat, Haryana and Delhi), VII. Semi arid plateau and central highlands (Madhya Pradesh and Maharashtra) and VIII. Humid to semi arid western ghats and Karnataka plateau (Karnataka, Tamil Nadu and Kerala).

In India, solanaceous vegetables constitute a major share of the total vegetable production. During 2007-08, tomato accounted for 8.9% (10.26 million tons) of the total vegetable production of 125.88 million tons with productivity of 17.9 t/ha. The major tomato producing states within India are Andhra Pradesh, Orissa, Karnataka, West Bengal, Bihar, Uttar Pradesh, Gujarat, Maharashtra and Chhattisgarh. Similarly, 9.59 million tons of brinjal was produced in India from an area of 566 thousand ha with average productivity of 17 t/ha during 2007-08. In India, the important brinjal producing states are- West Bengal, Orissa, Bihar, Gujarat, Maharashtra, Andhra Pradesh, Jharkhand, Karnataka, Chhattisgarh, Madhya Pradesh, Uttar Pradesh and North-eastern states. India is the largest producer and consumer of chilli in the world and is at the top in terms of international trade, exporting 20% of its total production. The production of chilli in India is dominated by Andhra Pradesh with 53% of the total production, followed by Karnataka (9%), Orissa (6%), West Bengal (6%), Maharashtra (5%), Madhya Pradesh (4%) and others (17%).

Vegetable export has more than tripled by volume in the decade from 1995 to 2005, and now represents about 2.5% of production. The agriculture sector is changing throughout the world. Cereal farmers are adding vegetables to their crop rotations in response to increased consumer
demands. Assuming a 3.5 and 5.5 percent GDP growth rate in India, the projected demand for vegetables in the year 2030 for India alone is 151 and 193 million tons, respectively. However, there are certain issues that hinder a smooth adaptation of the technologies and also in realizing the full potential of the vegetable sector of India, e.g., lack of education and awareness about opportunities, lack of market knowledge and marketing skills, lack of professionalism and small holding, falling water levels and lack of irrigation facilities, expensive credits, many intermediaries who increase cost but do not add much value, controlled prices and poor infrastructures are important impediments hindering full exploitation of the potential.

Thus, in view the above situation and the need of a planned appraisal of the current economic scenario, particularly in solanaceous vegetables, the present study entitled 'Economic Appraisal of Production and Marketing of Solanaceous Vegetables in Different Agro-climatic Zones of India' was formulated with the following objectives:

1. To study the resource-use pattern and its efficiency in production of solanaceous vegetables on sample farmers.

2. To estimate the comparative profitability of solanaceous vegetables in different agro-climatic zones of the country.

3. To study the marketing and temporal price behaviour and supply-price relationship in solanaceous vegetables.

4. To study the export performance of solanaceous vegetables.
5. To identify the constraint faced by vegetable growers in the field of production and its marketing and to suggest suitable measures to overcome them.

For the present study, primary and secondary data were collected from various sources under public and private sectors. The study comprised two-stage stratified random sampling for collecting primary data, i.e. State, district and villages were selected in first stage and growers and other stakeholders were selected in second stage of sampling. A total 320 farmers were selected from 16 states (two from each agro-climatic zone), 32 districts (2 from each selected states) and 64 villages (2 from each selected district). The data were collected through a pre-tested questionnaire developed for the purpose. The collected data from primary and secondary sources were further analyzed by using appropriate statistics tools for drawing desired interpretations.

The pattern on the use of various resources for the cultivation of solanaceous vegetables varied from one places to another depending upon the varied agro-climatic condition. In case of tomato, it was observed that in all the zones of the country, farmers are spending maximum budget on human labour. In Humid western Himalayan region (J&K, Himachal Pradesh and Uttaranchal) farmers are spending least amount on manures-fertilizers (11.02 per cent of total cost of cultivation) and plant protection measures (5.21 per cent of total cost of cultivation), however, it was maximum in sub-humid eastern and south eastern uplands (Chhattisgarh, Orissa and Andhra Pradesh) and sub-humid Sutlej Ganga alluvial plains (Punjab, Uttar Pradesh and Bihar), respectively. In almost all the zones using of machinery/bullock power in tomato production was less which indicated the
efforts required for mechanization of tomato farming so that the average productivity can be enhanced.

Similar to tomato, in brinjal production also the farmers are using more human labour compared to machinery/bullock labour. The disease and insect-pest in brinjal was a severe problem and farmers were using number of pesticides for their control. It was observed that farmers of all the zones were spending 13-14 per cent of total brinjal production cost in plant protection measures only except in humid western Himalayan region (J&K, Himachal Pradesh and Uttaranchal) where it is 5.57 percent.

The data pertaining to input use pattern in chilli production revealed that once again like tomato and brinjal, in chilli farmers are using more manpower as labours are used from field preparation to nursery raising and different agronomic practices till harvesting. The fertilizers use pattern in chilli production shows a common trend in all the zones varying from 12.86 in zone I to 16.71 in zone VI. However, in case of use of pesticides, farmers of humid western Himalayan region (J&K, Himachal Pradesh and Uttaranchal) used least with an average of 4.0 per cent. Use of pesticides in this zone was also least in case of tomato and brinjal. Seed use pattern data showed that despite of availability of quality seeds/hybrids in the market still, a numbers of farmers are practicing the traditional/local varieties which ultimately hampers the average productivity of vegetable crops.

An overview of the results revealed that there is an urgent need of changing farmers’ attitude from traditional to improved production practices through training, field visit, demonstrations and other means of transfer of technologies for enhancing total production of the country. It was observed that some of the crucial inputs were either under-utilized or over utilized in
the crop production. Further, with much pressure on the land holdings, limited resources availability with farmers and increased cost of agricultural inputs, it has become imperative for farmers to make optimum use of resources for realizing maximum farm returns. Therefore, it is desirable to make some adjustments in the allocation of their resources to induce an upward trend in production function which may further result into the higher profitability on the farms.

Different types of production functions such as linear, quadratic, square-root, semi-log and Cobb-Douglas functions attempted to exhibit the relationship between inputs and output for tomato, brinjal and chilli on sample farms fitted tomato, brinjal and chilli grown in different zones in order to derive marginal value products of resources. The production functions were estimated on per hectare basis in order to overcome the problem of multi-collinearity which was encountered in case of input-output relationship on per farm basis. This was performed at a cost of reduction in the magnitudes of coefficient of multiple determination (R²) nonetheless, the fitted functions were “good fit” as evidenced by their respective R² values. In most of the cases it was more than 50 per cent implying thereby, that the included explanatory variables explained more than 50 per cent variation in yields.

An analysis of production response for tomato production revealed that human labour was the significant factors which influenced the crop yield positively. The magnitude of elasticity of human labour was found to be 0.908 for sub-humid Sutlej Ganga alluvial plains which indicated that one percent increase in the use of this input would increase the yield by 0.908 per cent. The elasticities of all the other inputs indicating a positive
influence on the yield although in some cases coefficients were statistically non-significant. In case of all the zones, $R^2$ value was found to be high i.e., 0.64-0.89 indicating the other variables which were not included in the function were influencing the variation of tomato yield less than the variables included in the function.

Similarly, analysis of production response for brinjal production also revealed that human labour was the significant factors and influenced the crop yield positively, indicating the employment opportunities in the production of solanaceous crops. The elasticity of seeds was found to be 0.046 in humid Bengal-Assam basin (West Bengal and Assam) to as high as 0.648 in humid to semi arid western ghats and Karnataka plateau indicating that one percent increase in the use of this input would increase the yield by 0.046 and 0.648 percent, respectively. The elasticities of all the other inputs indicating a positive influence on the yield although in some cases coefficients were statistically non-significant.

In case of chilli production also the elasticities of all the inputs indicated a positive influence on the yield although in some cases coefficients were statistically non-significant. Like brinjal and tomato, in case of chilli also $R^2$ value for all the zones was found to be high i.e., 0.59-0.81 indicating the other variables which were not included in the function were less influencing the variation of chilli yield compare to the variables included in the function.

The results also indicated that human labour and machinery/bullock labour were under-utilized in almost all the zones except in humid to semi arid western ghats and Karnataka plateau, where machinery/bullock labour were over-utilized as evidenced by their MVP/price ratio. The highest MVP/price ratio for human labour (4.570) was observed in sub-humid Sutlej Ganga
alluvial plains (Punjab, Uttar Pradesh and Bihar) and lowest in Arid western plain (Rajasthan, Gujarat, Haryana and Delhi). In case of tomato production, quality seeds are a major constraint and except in zone III and zone VII, everywhere it was over utilized. Similarly in brinjal also human labour was under utilized indicating a greater scope of labour employment in the cultivation. However, there was a mixed response of machinery/bullock labour as it is under utilized in zone III, VII and VIII and over utilized in zone I, II, IV, V and VI. Similar trends are also seen in case of seeds and manure-fertilizers, where in some zone it was under-utilized and in some zone over-utilized. Except in humid western Himalayan region, all over the country pesticides was over-utilized which not only increased the total cost of brinjal production but, also are hazardous for human health and environment. Interestingly, in chilli production, seed rate used for nursery is over utilized in all the zones, showing the urgent need of awareness of recommended dose to the growers. Plant protection measures are other important input which is over utilized all over the country except humid western Himalayan region.

The analysis for resource use efficiency depicted the low efficiency of the farmers in using their existing resources in the cultivation of tomato, brinjal and chilli. The resources were either under-utilized or over-utilized across the country. The reallocation of existing funds for judicious use of farm resources is, therefore, strongly recommended i.e., the resources which are over-used can be put to use in such a way that income or savings generated from them can be utilized for the judicious use of inputs being currently used sub-optimally.
Commercialization of horticulture crops largely depends upon the use of appropriate technology and market oriented cultivation. In the recent years, the country has witnessed tremendous changes in both the production and productivity of vegetable crops especially in tomato, brinjal and chilli, which has increased manifold and India have boast itself as a leading vegetable producer of the world with a total annual production of vegetable crops ie. 125.89 million ton during 2007-08.

According to the conducted survey, the highest production of tomato was recorded in Zone I with 325 q/ha and lowest in Zone-III and Zone VIII with 250 q/ha. The variation in yield is not only due to heavy post harvest losses and varied agro-climatic conditions but also due to the poor adoption of improved tomato production technologies by the growers. The maximum yield and cost benefit ratio of 1:4.21 was recorded for Zone I but due to lesser area under tomato, its total production is less however there is greater scope of increasing production here. The cost benefit ratio varied from 1:2.45 in Zone VII to 1:4.21 in Zone I. The farmers of Zone II (Humid Bengal-Assam basin) were fetching maximum net income of Rs. 210650.00 from tomato where as it is minimum in Zone VII (semi arid lava plateau and central high land) i.e., Rs. 126950.00.

In Indian conditions, growers are spending lots of money on plant protection measures in case of brinjal. Heavy use of manures and fertilizers was also observed in almost all the zones, varying from Rs. 4800.00 to Rs. 7000.00 per ha. Cultivation of brinjal is labour intensive with an average grower spending Rs. 18000.00 and Rs. 18500.00 for one ha in Zone I and Zone VIII, respectively. It was further observed that in brinjal cultivation,
the cost benefit ratio was highest in Zone I and II (1:3.90) and lowest in Zone VII (1:2.86).

In case of chilli, farmers were using mostly local seeds instead of high yielding varieties/hybrids which can be witnessed by the expenditure farmers are spending on seeds i.e. Rs. 1250 in Zone II to Rs. 1100 in Zone IV and V. Further, management of diseases and insect pest is a severe problem for the chilli growers where they are spending up to Rs. 4500.00 in Zone III, IV, V and VIII. The cost of human labour is more (up to Rs. 15500.00) compare to bullock/machinery power (up to Rs. 5000.00) that reflects the dependency of farmers on human labour. The cost benefit ratio was calculated for seeing the profitability of chilli cultivation showed that in Zone IV, VI and VII, farmers are getting less profit (less than 1:2) compare to other zones.

The marketing system in India by and large, operates under the normal forms of supply and demand. The trade of vegetable is still mainly in the hands of private enterprises. Absence of infrastructure and improper management coupled with lack of market intelligence, credit etc. has made the system unfavourable to the growers. Various marketing channels for vegetables were observed. Among them, the marketing channel of producer → commission agent → retailer → consumer was considered most important one as most of the transaction took place between producer and commission agent in early morning and producer has to pay a commission of up to 8 per cent.

Rapid price fluctuation in vegetables shows how vegetable growers are suffering in getting the desirable price of their produce. A marketing network of vegetables markets in the country will certainly help the growers in
getting/transporting their produce in other part of the country for better price.

In case of chilli, it has been observed that highest price was fetched during October-December 2008 in zone III. However, in zone II price of chilli decreased below Rs.2000.00 per quintal during the month of July-September. In our country tomato, brinjal and chilli are grown in all tropical, sub-tropical and temperate region, but still it fails to meet the basic requirements of ever increasing population because of low productivity and huge post harvest losses from farmers field to market and finally to consumers’ hand. This can be witnessed in case of tomato where the average maximum price gone upto Rs. 1985.83 during October-December 2008 in zone II i.e., Humid Bengal –Assam basin (West Bengal and Assam) and lowest ranges from Rs. 500-1000 per quintal in other zones. The fluctuation in prices was continued in case of brinjal also where the average prices in 2008 varies from Rs. 603.04 per quintal during January-March in zone IV to a maximum of Rs. 1580.50 per quintal during July-September in Zone II.

The export of tomato, brinjal and chilli and their products in terms of their quantity and value in different decade since 1960s have been studied. The Indian export of tomato and its products during 1970s was of the value US $ 900 per annum, which was of fresh tomatoes only. During 1980s the export basket of tomato products expanded and the share of tomatoes in their total export value became 42.7 per cent, followed by tomato juice (39.8%), tomato paste (14.62%) and peeled tomato (2.89%). During the early 2000s, India exported tomato and tomato products worth US$1.6 million per annum, in which tomato constituted about 85.6 per cent,
followed by tomato paste (5.9%), peeled tomato (5.6%) and tomato juice (2.9%). Thus, tomato has been the major contributor in the export basket of tomato and its products and the shares of tomato products like peeled tomato, tomato paste and juice of tomato have remained very small, which needs to be increased to reap the benefit of value-addition in the country.

Export Performance Ratio/Revealed Comparative Advantage (RCAs) in both tomatoes and tomato products were far less than unity and the Revealed Symmetric Comparative Advantage (RSCAs) were negative, almost -1. This indicates that India was not competitive in tomato export for almost 3 decades; however, an increasing trend in RCAs and RSCA was observed during recent years with a reversal in some years. An increasing trend in RCAs in recent years indicated improvement in the export competitiveness of India in tomato and its products with the passage of time. Therefore, it is required to give a support to improve India’s competitiveness by adopting some appropriate measures like improvement in infrastructural facilities like cold chain, faster transportation at cheaper rates, better port facilities and socialization of improved and efficient technology in production and processing of tomato with quality improvement as per demand in the international market.

Export of tomato and its products from India has registered a very high growth during both the pre- and post-WTO periods than the world. Among the tomato and its products, peeled tomato has registered the highest growth rate of 146 per cent, followed by tomatoes (96.86%), tomato paste (89.27%) and tomato juice (54.69%).

The values of coefficient of variation in export of all tomato and its products, except tomato juice, have come down during the post-WTO than...
pre-WTO period, which indicate that export of tomato and tomato products (except tomato juice) from India has become more stable during post- than pre-WTO period.

Bangladesh, Pakistan, Nepal, USA, UAE and Maldives have been the major importers of tomato and tomato products from India and their share was about 93 per cent in total export of tomato and its products from India in value terms in TE2005. Bangladesh was the largest importer (45.2%) in terms of total value of export of tomato and its products from India, followed by Pakistan (26.7%), Nepal (10.7%), USA (5.6%), UAE (3.1%) and Maldives (1.8%). A perusal of the study revealed that tomato is being exported mainly to the neighbouring countries like Bangladesh, Pakistan, Nepal and Sri Lanka, while ‘tomato products’ are being exported to distant markets like, USA, France, UK, Israel, and New Zealand. It is due to the perishable nature of tomato. To identify the factors affecting demand for export of tomato, regression analysis was carried out using time series data for the period 1985-2004 which revealed that four factors, viz. volume of international trade in tomato, domestic production of tomato, ratio of Indian and non-Indian international export price and exchange rate could explain about 98 per cent of the total variations in the export of tomato from India.

The major countries where brinjal is exported are UK, France, Saudi Arabia, Germany, Hong Kong, Portugal, UAE and Belgium. United Kingdom has been the leading importer of brinjal from India since years; during 2005-06, India exported 83752 kg to UK, which increased to 258843 kg during 2007-08 with the respective values of 44.12 lakhs and 1347.85 lakhs. According to the APEDA report, a total of 71.9 % of brinjal was exported to UK followed by France (10.9 %), Saudi Arabia (4.3 %) and Germany (2.9 %).
During 2007-08, a total of 338103 kg of brinjal was exported to different countries worth Rs. 1.91 crores which was a quantum jump in brinjal export as compared to the export during 2005-06, when only worth Rs. 1.01 crores brinjal was exported to different countries.

India is the largest producer, consumer and exporter of chilli in the world and is at the top in terms of international trade, exporting 20% of its total production. In India, dry chilli production rose by nearly 43% from 8.7 lakh tons in 1997-98 to 12.5 lakh tons in 2007-08. The fundamental factors driving this significant increase in production are the use of high yielding varieties/hybrids, increase in average yield from 1035 kg/ha to 1736 kg/ha, favourable weather conditions and changing consumption pattern. India has immense potential to export different types of chillies required by various markets around the world. It is the leader in export, with 25% share in the world trade, followed by China with 24% share in the global exports. In 2007-08, India exported 16.4% of its total chilli production. The export of chilli accounts for 48% in terms of quantity and 28% in terms of value of the total export of spices from India. Currently, India is the main source of red chilli in the international market. It exports in different forms like chilli powder, dried chilli, pickled chillies and chilli oleoresins.

In the present study, it was observed that need of adequate seeds of varieties (hybrid and open pollinated) responding to specific area is not always available in every part of the country. Seasonality of vegetable production is a general problem in India. During the winter season, abundant solanaceous vegetables are available often leading to market price fluctuations and a low profitability for the growers during that season. During the off-season (summer), critical weather conditions prevent
solanaceous vegetable cultivation and these results in a scarcity of these vegetables and very high prices.

Some of the major constraints related with production of solanaceous vegetables at producer level in all zones are lack of information on production technologies regarding solanaceous varieties and package of practices, lack of labour force for timely production operations, non availability of credit support for solanaceous vegetable growers, non availability of quality inputs like seeds, agrochemicals and fertilizers, low production at the farm level, incidence of pests and diseases, lack of awareness on global production standards, lack of proper irrigation facilities in many areas of the country, poor and marginal farmers of the country cannot afford to grow vegetable because of the high initial investment (cost of hybrid seed, input, and high risk crop), improper marketing channels of fresh vegetables, lack of infrastructure, and strong hold of middlemen in the marketing chain.