CHAPTER- 8

CONCLUSION AND POLICY IMPLICATIONS

8.1 The basic objectives of the present study were to examine the trends in area, production and productivity of potato crop in Assam, examine the trends in area under potato and production in terms of the relative price and infrastructure related factors, to understand the regional concentration of potato production within the state of Assam based on the agro-economic factors and understanding the cost and returns of potato production at the farmers’ level. Besides, the present investigation also focused on the post harvest value chains of potato produced in Assam and examining the efficiencies of marketing of potatoes in Assam compared to the state of West Bengal which is the second largest potato producing state in India. The present chapter has been designed for summarizing the principal findings of the investigation and extracting the policy implications. Accordingly, to highlight the policy implications of the study, the principal findings of the present study have been summarized. Thus, in the first section of the chapter, the principal findings are summarized and the next sections present the policy implications on the basis of the research findings.

8.2 Summary of the Findings of the Study:
The summary of the principal findings can categorically be presented under the following subsections.

(a) Trends in Area, Production and Productivity of Potato:
The trends in the area harvested, production and productivity of potato in Assam have been estimated from 1951-52 to 2011-12. The compound annual growth rates (CAGR)
of area, production and productivity of potato have been estimated and the acceleration/deceleration in the growth of area harvested, production and productivity of potato have been calculated. Moreover, structural break of the growth in area harvested under potatoes in Assam has been examined and its significance has been tested. The compound annual growth rates of area harvested before and after the structural break have been estimated.

The trends in area harvested, production and productivity of potato have estimated for the country as a whole from 1961 to 2011. The compound annual growth rates in area harvested, production and average yield of potato in India have been calculated and acceleration and deceleration in the growth of the variables have also been tested. The main results emerging from the study of trends are summarized below-

**(b) Trends in the Growth of Area Harvested Production and Productivity of Potato in Assam:**

The area harvested under potato in Assam has the increasing trend from 1951-52 to 2011-12. But, the actual trend line is highly fluctuating in nature. The production of potato has recorded an increasing trend over the period under study. The potato output has shown higher rising trend during the later part of the study in comparison the first part. As has been found in the study, the average yield of potato in Assam has also maintained an increasing trend from 1951-52 to 2011-12.

The compound annual growth rate in the area harvested in Assam is 3 percent from 1951-52 to 2011-12 and it is as a highly significant growth rate. The compound annual growth rate in the production of potato in Assam is 4.3 percent per annum during the same period and it is also a statistically high significant growth rate. The average yield
or productivity has recorded 1.30 percent compound annual growth rate from 1951-52 to 2011-12 in the state and this is also a highly significant growth rate. There has not been any significant acceleration or deceleration in the growth of area harvested, production and productivity of potato in Assam over the period under study.

The area harvested under potato production in the state of Assam has a structural break in the year 1974. Area harvested has shown a significant step-up in its growth rate since 1974. The compound annual growth rate in the area under potato cultivation in the state of Assam during 1951-52 to 1973-74 period was 1.80 percent per annum, which has increased to 3.10 percent per annum in the post 1974 period.

(c) Trends in the Growth of Area Harvested Production and Productivity of Potato in India:

The area harvested under potato in India has a rising trend over the 51 years of period of study from 1961 to 2011. The growth in the production of potato output in India has also recorded an increasing trend during the period under study. The productivity of potato in India has maintained a rising trend during the same. The growth of potato productivity in the country has the higher rate in the recent years.

The area harvested under potato production in India has the compound annual growth rate of 3.20 percent per annum from 1961 to 2011. This is a highly significant rate of growth as found in the study. The compound annual growth rate of production of potato is 5.40 percent per annum during the 51 years of study in the country. It is also a statistically a high significant rate of growth. In case of productivity of potato, compound annual growth rate is 2.20 percent per annum in India during the same period under study and this growth rate is also a highly significant at 1 percent level. The
growth of area harvested under potato cultivation in India during the study period has no acceleration or deceleration. But, the growth of production and productivity of potato have accelerated over the 51 years period of study from 1961 to 2011.

**(d) Comparison of CAGRs and Acceleration/Deceleration in Area, Production and Productivity of Potato between Assam and India:**

The comparative study of compound annual growth rates (CAGR) of area harvested, production and productivity of potato between Assam and India during the period from 1961 to 2011 has found that the growth rate in the area harvested under potato in Assam is the equal to the growth rate in area harvested of India as a whole. But, the annual growth rates in production and productivity of potato in Assam are lacking behind the annual growth rates in production and productivity of potato of India. There is no any acceleration or deceleration in area harvested, production and productivity of potato in Assam. But, in case of India as a whole, there are significant accelerations both in case of the growth in production and productivity of potato during the period under the study.

*Thus, the first objective of the study that is to examine the trends in area, production and productivity of potato in Assam since the early 1950s has been fulfilled successfully.*

**(e) Trend in the Relative Yield Gap of Potato in Assam Compared to All India and its CAGR:**

The relative yield gap of potato in Assam compared to the All India yield has the increasing trend during the period under study that is from 1961 to 2011. It is significant to note that the relative yield gap has recorded more fluctuations around the fitted
regression line particularly in the early period of the study. The compound annual growth rate of the Relative Yield Gap of Potato in Assam compared to All India is 0.40 Percent per annum from 1961 to 2011. This growth rate is statistically significant at 5 percent level.

(f) Trend in Area Shared by Potato out of Gross Cropped Area in Assam:

The area shared by potato crop out of the gross cropped area in the state of Assam has been found as an increasing trend during 1991-92 to 2007-08. The compound annual growth rate in the trend of the area shared by potato out of the gross cropped area in Assam is 1.10 percent during the study period and this growth rate is statistically significant at 5 percent level.

(g) District-Wise Area Harvested and Potato Production in Assam:

In the year of 2011-12, Lakhimpur, Sonitpur and Barpeta districts have shared first highest, second highest and third highest percentage shares of area harvested under potato cultivation in the state of Assam. Lakhimpur district has shared 14.39 percent, Sonitpur district has shared 9.13 percent and Barpeta district has shared 8.23 percentage of area harvested under the potato crop. In case of percentage shares of production of potato, Lakhimpur, Sonitpur and Barpeta districts have occupied the first three positions among all the districts of Assam in the year of 2011-12. Lakhimpur district contributed 12.82 percent, Sonitpur district contributed 10.14 percent and the Barpeta district contributed 9.32 percentage shares of total potato output in the state in 2011-12.
It is noted that with this finding, the third objective of the study, that is to understand the regional concentration of potato production within the state of Assam in terms of agro-climatic and socio-economic factors has been fulfilled adequately.

(h) Potato Acreage, Relative Price Movements and Infrastructure Development

The farmers’ allocation of area to potato crop is influenced by expected returns from its cultivation compared to the expected returns of its competing crops. The relative price movement among the competing crops is a main influencing factor of acreage allocating decision of the farmers. The other two factors which are infrastructure improvement, in terms of improved road connectivity, market development, cold storage facilities and irrigation development which have significant impact on area acreage of potato.

(i) Price Movements and their Coefficients of Variations:

As was found in Howly, Uparhali (Guwahati) and in Cachar markets in Assam, the prices of potato, cabbage and green chilli have the increasing trends during January 2005 to March 2014. The price of potato has the minimum fluctuations in its trend in comparison to the other two crops. During the months of harvesting, prices of both potato and cabbage remained very low, but, price of cabbage was lower than the price potato. Again, during the non-harvesting season particularly in the months of September to October, prices of both potato and cabbage became high, but the price of cabbage remains higher than the price of potato. According to a comparative study of the relative prices of potato and its competing crops among the markets under study, it has revealed
that prices of all the three crops remained higher in Golaghat market in comparison to Howly, Uparhali (Guwahati) and Cachar markets in January 2014.

Prices of potatoes both in the months of February-March (harvesting season) and November-December (seedling season) in Howly, Uparhali (Guwahati) and in Cacher markets have maintained increasing trends during 2005 to 2014. It is remarkable that prices in the months of November have higher rates of increasing trends in comparison to the trends in the prices in February months during the same period. It has been found that among all the markets under study, both in the months of February-March (harvesting season) and in the months of November-December (seedling season), the coefficient of variations in the trends in the prices of potato are highest in Howly market during 2005 to 2014.

The mean price of potato in the month of February (harvesting season) has the increasing trend in Assam from the year of 2005 to 2014. The mean price of potato in the month of November (seedling season) in Assam has also maintained an increasing trend during 2005 to 2014. Remarkably, it has been found that the coefficient of variations in the mean prices of potato in the month of February (harvesting season) as well in the month of November (seedling season) have the decreasing trends from 2005 to 2014. It is to be noted that according to the findings, there is an increasing trend in the relative gap in the mean prices of potato in the month February (harvesting season) compared to November (seedling season) during 2005 to 2014 in the state of Assam.
(j) **Trends in the Relative Prices of Potato in Relation to its Competing Crops:**

Trends in the Relative prices of potato in relation to its competing crops such as cabbage and green chilli have been investigated for the major potato markets in the state of Assam. The trend analysis of the relative prices of potato in relation to its competing crops in the major potato markets such as Howly, Kharupetia and Guwahati markets from the months of January/2005 to December/2016 have shown that the relative prices of potato both in relation to cabbage and green chilli have been increasing during the period under study. But, it is remarkable that the relative price of potato in relation to cabbage has been found to be increasing at the faster rate in comparison to the trend in the relative price of potato in relation to green chilli in case of all the potato markets under the study.

(k) **Infrastructure Development:**

According to the findings of the study, total number of cold storage for preserving potatoes and some other horticultural crops were 30 in Assam in 2009 which has increased to 51 in 2013. During 2009 to 2013, number of cold storage has been increased by 70 percent and total storage capacity in the cold storages in Assam has increased by 73 percent. It is remarkable that the public sector is lacking behind the private sector in the development of cold storage in the state of Assam as found in the study.

It has been found that till 2013, there were altogether 405 wholesale markets and 735 rural primary markets and the government has arranged 24 regulated market committees
in the state. Moreover, there were 143 traders’ shops and 532 auction platforms which help in marketing of crops including potatoes in an efficient manner.

According to findings, till January 2013, the government of Assam has either installed or distributed around 4 lakhs shallow tube wells and 38,522 numbers of low lift pumps sets to in Assam. Moreover, 44 numbers of deep tube wells and 2,244 numbers of sprinkler or drip irrigation sets have installed or distributed to the farmers and the flow irrigation has increased to 5,250 hectares and micro watershed drainage has been increased to 15915 hectares. It has been found that the compound annual growth rate (CAGR) in the gross area irrigated in Assam is 5.5 percent during 2001 to 2013 and it is significant at 5 percent level.

(I) Impact of the Relative Prices of Potato in Relation to its Competing Crops on Area Acreage of Potato:

The impacts of the relative prices of potato in relation to its competing crops such as cabbage and green chilli on the area acreage of potato have been investigated for the period of 2005 to 2013 across the different districts of Assam. According to the findings, the variation in the relative price of potato in relation to green chilli has the positive and significant impact on the area acreage of potato in the area under the investigation.

"Therefore, it is remarkable that the second objective of the study that is to examine trend in area and production of potato in terms of economic (e.g. relative price movement) and infrastructure (development of irrigation, storage and marketing facilities) related factors has been successfully fulfilled."
(m) Post Harvest Value Chains and Market Efficiency of Potato in Assam Compared to West Bengal:

The price spread determines the producer’s share in consumer’s rupee that is the level of market efficiency. Higher price spread leads lesser efficiency of potato marketing. Again, lower price spread leads more competitiveness and hence more efficiency in potato markets. In case of all the three districts in Assam under the study, potato marketing value chains- III are more competitive and efficient in comparison to the other two value chains available during the potato harvesting season (February – March). The potato growers sell potato through the marketing value chain- II only in the non-harvesting season (in the month of September – October) as found in the study. It is revealed that marketing of potato crop through value chain- II in Lakhimpur district is the most efficient in comparison to the marketing of potatoes through value chain- II in Barpeta and Sonitpur districts in the non-harvesting season.

From the case study conducted in Hooghly district of West Bengal in the month of September 2014, it has been found that the potato marketing value chain- III, which is “Producer – Retailer – Consumer”, is most efficient during the potato harvesting season. Marketing of potatoes during the harvesting season (February – March) is more efficient in comparison to the marketing of the crop during the non-harvesting season (September – October) in the state of West Bengal in the area under the study.

During the harvesting season (February – March), markets of potatoes in the state of West Bengal are more efficient in comparison to the potato markets in the state of Assam. In the non-harvesting season, particularly during the pre-seedling season
[September – October], markets of potato in the state of Assam are more efficient in comparison to the markets of potatoes in the state of West Bengal.

**Significance of Cold Storages in the Post Harvest Management of Potato:**
As has been found in the study, cold storages play a very important role in the post harvest managements of potato which is a semi-perishable crop. It helps in preserving and supplying potatoes whole the year at the stable prices both for the consumers and the potato processing industries. The number of cold storage in West Bengal was 390 in the year 2013 which are 7.6 times more in comparison to number of cold storage in Assam in the same year. Similarly, in 2013, capacity of cold storage in West Bengal was 27 times more than the capacity of cold storage in Assam. It is important to note that the ratio of cold storage capacity to the total potato production in the state of West Bengal is comparatively higher in comparison to the state of Assam in 2013. From this finding, it is clear that there is a considerable shortage of cold storage facility in the state of Assam in comparison to the neighbouring state of West Bengal.

As reported by the potato growers and the potato dealers, shortage of cold storage and cold chain facilities is one of the main reasons of low level production and inefficient post harvest management of potato crop in Assam particularly in the area under study. The cold storages in Assam have been suffering from some common problems such as irregular power supply, high electricity charge etc. which cause the rise in the rental rates of potato storage in the cold storages in the state. It has been found that the potato storage costs/rents in the cold storages are far higher in the state of Assam in comparison to the potato storage costs/rents in the cold storages in the neighbouring state of West Bengal.
Therefore from the above findings, the fifth objective of the study that is to understand the post harvest value chains of potatoes produced in Assam, a comparative study with the value chains in neighbouring West Bengal and the sixth objective that is to examine the market efficiency of potato produced in Assam, have been fulfilled successfully.

It is remarkable that with the fulfillment of fifth and sixth objectives, the hypothesis of the study that is the farm-gate realization of price by potato farmers in Assam has remained low because of non-development of post harvest value chain management has also been fulfilled.

(o) Analysis of Cost and Returns of Potato Production:

In all the selected villages in the major potato producing districts under the study, the seed cost composites the highest percentage share in the total cost of potato cultivation per hectare. Rent and labour costs also share the considerable percentage of total cost of potato cultivation as found in the study. Returns or profits from potato production are comparatively higher in case of early harvesting in comparison to the late harvesting in case of all the villages under the present study. In case of early harvesting the average return or profit from potato production is highest in Shogorpur village under Naubaisa ADO circle in Lakhimpur district and in case late harvesting, the Podumoni village under Laluk ADO circle has the highest average return or profit per hectare of potato production. As has been found in the study; in case of late harvesting the villages under Mandia ADO circle in Barpeta district have the negative returns from potato production.

It has been found that among all the variables of cost of potato cultivation, cost of human labour, Seeds, manure, fertilizer, rent of land and interest costs are statically high
significant in leading variation in the cost of potato cultivation per hectare in the villages under the present investigation. It is revealed in the study that majority of the potato growers take farm loans from the village money lenders for potato cultivation and pay very high rate of interest. According to the findings, the returns or profits from potato cultivation are higher under the institutional source of farm credit in comparison to the non-institutional source of farm credit.

**(p) Determinants of Income and Returns from Potato Production:**

It has been found that the average values of gross value added, incomes accruing to the farm households and profits from potato cultivation per hectare are higher in case Lakhimpur district in comparison Barpeta and Sonitpur district.

According to the findings of the study, among all the determinants of gross value added from potato cultivation such as operational land holding, potato acreage, labour intensity, fertilizer intensity, irrigation, area under certified seeds, government extension service, marketing system, location of farms etc., the potato acreage, labour intensity and location of potato farms are the significant determinants of gross value added. It has been found that the labour intensity, area under certified seeds and irrigation have the significant and positive effects on the incomes accruing to the farm households from potato production across the sample farm households. Similarly, the operational land holdings, irrigation and credit source significantly and positively determine the profits from potato cultivation. The agro-climatic and socio-economic conditions of the different locations significantly affect the gross value added, income accruing to the farm households and profits from potato production.
The returns from potato production or farm business incomes from potato cultivation are comparatively higher in comparison to the farm business incomes from the cultivation of winter paddy across the land-size classes particularly in the plains area of Assam.

*Therefore, from the above findings the fourth objective of the study that is to examine cost and returns from potato production at the farmers level under different farming conditions distinguished by purpose of production, availability of irrigation and agrarian conditions of farm size and tenure status has been fulfilled.*

**8.3 Conclusion with Policy Implications of the Findings of the Study:**

Given the above findings of the study, some policy measures can be suggested as summed up below-

The production and average yield of potato in Assam have been increasing since the early 1950s, still the continuous increase in the relative yield gap in comparison to all India yield implies that policy measures should ensure to increase productivity of potato in the state by adopting intensive scientific farming techniques so as to cope up with the productivity of potato of the country as a whole.

The variation in the mean price of potato across the markets in Assam has been decreasing over times. Farmers’ losses due drastic price falls particularly in case of the perishable winter vegetable crops can be controlled by increasing the area acreage of potato. This induces the policy measures to make a transition in the patterns of cultivation of winter vegetable crops. Price of potato remains comparatively stable across the seasons in comparison to the perishable vegetable crops.
Potato is a semi-perishable crop which needs scientific storage facilities to make it available round the year at the reasonable prices and to induce the potato growers to increase production of the crop. Given the findings that cold storage facilities in the state of West Bengal are far better in comparison to the state of Assam, which cause transportation of huge size of potatoes in the markets of Assam every year particularly during the non-harvesting season when price rises to high. This implies the policy measures to increase in the number as well as the capacity of cold storage in Assam with farmers’ easy accessibility in the commercial centers as well as in and around the production centers.

The high seed price (certified seeds) and fertilizers prices result considerable increase in the cost of potato production. The arrangements of subsidized certified seeds and fertilizers by adopting appropriate policy measures by the government authorities for the potato growers considerably reduce the cost of potato production per unit of produce and land.

The cold storages in Assam have been suffering the common problems like high electricity charges and irregular power supply. As a result the cold storage authorities impose high rental rates of potato storages. Moreover, the incidents of large scale potato damages in the cold storages have been occurring frequently due to irregular power supply as found in the study. All these are the disincentives for the potato growers to store their potato output in the cold storages. Thus, the appropriate policy measures for subsidized and regular electricity supplies for the cold storages in Assam will be able reduce the rental rates of storage, control the incidents of large scale damages of potatoes in the cold storages and encourage the potato growers to increase potato production.
The returns from potato production are comparatively higher in case of the institutional farm credit in comparison to the non-institutional farm credit. This suggests that institutional farm credits for the potato growers should be increased by implementing appropriate farm credit policies by the concern agricultural department and the agricultural financing authorities in the state.

Policy measures should ensure the development of irrigation facilities which have the important role in production and productivity of potato crop in Assam that is mainly produced in the dry winter season. Increase in the potato area under irrigation significantly increases the profits from potato production as given in the findings. State supply of irrigation facilities across the potato farms will reduce the unit cost of irrigation and encourage the potato growers to avail the facilities. This will increase potato production and productivity and hence the returns from potato cultivation will rise.

The returns from potato production or farm business incomes from potato cultivation are comparatively higher in comparison to the farm business incomes from the cultivation of winter paddy across the land-size classes particularly in the plains area of Assam. This fact induces the policy measures to change the patterns of cultivation particularly the winter crops. The increase in potato acreage in comparison to winter paddy results increase in returns or farm business incomes across the farm households in the state.