CHAPTER- 1

INTRODUCTION

1.1 Statement of the Problem:

Traditionally agriculture in Assam has been virtually mono-cropped with overwhelming dominance of winter rice in the total area under cultivation. However, over the last couple of decades there has been a tendency towards diversification of cropping patterns in the state (Dhar, 2007). There has been change in the cropping patterns in Assam particularly since the early 1980s. The diversification of cropping patterns mainly occurred due to increase in the prices of cash crops and also with the enhancement of agricultural infrastructures. The HYV seeds of the crops including potatoes have been used in Assam. The Planning Commission has also emphasized on the diversification of Indian agriculture through the Fifth Five Year Plan (1974 – 1979).

Development of tube well based irrigation under Assam Rural Infrastructure and Agricultural Services Project (ARIASP) and Rural Infrastructure Development Fund (RIDF) facilitated not only increase in the cropping intensity but also cultivation of crops like summer rice and winter vegetables in a more significant scale. Potato has emerged as a significant crop in parts of Assam with impressive growth. Even though potatoes have been used mainly as vegetable crop in Assam, but in the recent years, the crop is also used to prepare snack foods and other forms of processed products in the state. Potato contains different dietary components such as minerals and vitamins (Pandey, 2007).

Post harvest management including marketing practices and storage methods are significant aspects for the sustainability of potato sector in the country (Ilangantileke,
Along with the increase in the production of potato, efficient management of the different phases of post harvest processes determinant the economic conditions of the potato growers in the rural areas. Marketing of agricultural crops is a process through which the crops move from the actual producers to the ultimate consumers. This process includes the different marketing operations such as grading, packaging, storing, transporting and selling of the crops. In this context, an investigation in the potato production and marketing in Assam is important to understand the production trends and marketing status of potato. Moreover, attaining marketing efficiency of potatoes in the state is significant so as to compete with the major potato producing states of the country.

As a crop, potato has its peculiarities and special significance. While it is not as perishable as the other horticultural crops of fruits and vegetables, it is also not as storable as cereals and pulses. Unlike in some courtiers of Europe, potato in India and even in Assam is not considered mainly as a staple food. Yet potato forms a regular component of diet of the average Indian. During the last couple of decades, potato has become a food supplement as the potato processing industries have been developing across the different states of India. These peculiarities and specialties of potato have induced this study to investigate into the production trends of the crop and post harvest management of the potato output.

1.2 Potato as a Crop and its Cultivation:

Potato (Solanum Tuberosum L) is the third most important food crop in the world, after rice and wheat (Singh, 2011). Potato has been found as the largest crop in the group of tuber and root crops in the world. Moreover, potato is the fifth largest produced
agricultural crop. In most of the countries of the world, potato crop has been increasingly cultivated and widely consumed. Potatoes have been cultivated in about 150 countries over the world (CIP, 2008). During the long duration of time from the birth place of potato in Andes, a lot of varieties with different characteristics including different colour, sizes, processing qualities, contents of dry matter etc., have been developed across the different countries in the world.

Agriculture is the dominant sector in the state economy of Assam. Agriculture provides food needed the state along with vegetables and other horticultural crops. Moreover, the sector provides raw materials for many agro-based food processing and other industries in the state of Assam. But, in the later part of the last century, particularly from the early 1980s, agricultural crops diversification has taken place in the cropping patterns of the state. This is mainly due to the expansion of the irrigation facilities, availability of HYV seeds, fertilizers, pesticides and insecticides, training and demonstration to the farmers on production of different crops etc. As a result, along with the cereal crops, the horticultural crops including vegetable production got a momentum growth in the state of Assam. Potato is such an important item in the vegetable basket and also in some extent in table food item, which has some peculiar characteristics (Das, 2012). Potato is known as the king of vegetable as it is the most important type of vegetable and it is consumed in large quantities in the whole year in a diversified ways. Potato is a semi perishable crop (Khan, 2012). This is because, the potato is perishable but not as perishable as many other vegetables. Again, the crop is storable but not as storable as many cereal crops like rice, wheat etc.

Unlike the hilly states of northeast India, potatoes in Assam are cultivated mainly as winter crop. In the state, potato seeds are sown in the month of November – December
and harvested in the month of January – February. Production of potato crop requires comparatively short time period from planting to harvesting compared to the cereal crops. In the plains area of Assam, potatoes are being produced in the winter season. Sometimes the practices of intercropping or double cropping patterns of potato with other crops have also been applied. On the other hand, in the hilly areas in the different northeastern states, potatoes are being grown in the summer season as rain fed crop.

Even though potato is an important vegetable crop and recently also a food item, but production of the crop is regionally concentrated in Assam. Due to some agro-climatic and agro-economic conditions, production of potato is mainly concentrated in some particular districts of the state. Barpeta, Sonitpur, Lakhimpur and Dhubri are the important potato growing centers in the state of Assam. Accordingly, price of potato varies among the different markets located in the different production areas and the markets where production of potato is very low or not at all within the state.

Post harvest managements including marketing patterns of potatoes are very important aspects for sustainable production of the crop. Since, potato is a short duration crop compared to the cereal crops and pulses, as a result when the potato is harvested in the main harvesting period that creates gluts in the markets at the production centre. Due to the lack of cold storage facilities or due to the immediate requirements of cash money, the farmers try to sale their potato output just after harvesting. As a result, price of potato comes down so low that even some of the farmers cannot recover the cost of production (Sundaram, 2011). Due to the inadequate development of marketing infrastructures including cold storage and cold chain facilities in the state of Assam, the small and marginal farmers sell their potato at whatever prices are available in the
market. In some of the cases, the farmers sell the potatoes immediately after harvest as because of their inability of book in cold storage as the storage owners charge high rates rent for storage, conditions given by the cold storage owners and transportation problems.

The producers sell their potato products at the low prices, but it has also been observed that consumers pay comparatively high price for potato in the big city markets like Guwahati even during the time of harvesting of potato crop. High price spread and price variations are some major problems which cause inefficient nature in potato marketing in Assam. Existence of large number of middlemen in the post harvest value chains of potato crop also contribute in aggravating price spread and hence inefficiency in marketing of potato. The producer receives comparatively a lesser portion of the rupee paid by the ultimate consumers of potato.

The inter-state potato marketing is an important area of interest of the present research investigation. The major potato producing states of India like Uttar Pradesh, West Bengal, Bihar etc. transport huge size of potato both for table purposes and seed purposes in the markets of Assam (Mahanta, 2008, Gupta, 2011) and also in the other northeast states of the country (Sah et a., 2011). This again reduces the price level of potato in the state markets as also claimed by some of the farmers. The large scale production of the crop in the neighbouring state like West Bengal attains the economies of scale and hence low cost of production of potato enables to capture the markets of Assam and other northeast states. Similarly, contract potato farming in the major potato growing states like Uttar Pradesh, West Bengal etc. result direct selling and buying of the crop (Roy, 2012). In case of contract farming and selling, the potato growers
directly sell the potato to the companies concerned. In this process price spread is comparatively lower and returns from potato production and marketing remains more stable.

Modernization of agricultural sector in Assam has been taking place but at a slow pace in comparison to the many other states of India. From production to marketing, the state agriculture faces a lot of problems. The production and marketing of potato in Assam has many bottlenecks. Mahanta (2008) observes that the potato sector in Assam has been suffering from lots of problems. The farmers apply low productive seeds due to their inability to purchase high value hybrid seeds. The potato growers in the state do not know the uses of dozes of N, P and K and manure in their potato fields. Moreover, lack of irrigation facilities also responsible for low production. The post harvest processes of potato crop also have lots of problems such as no grading of crops, high transportation cost from production centre to market yards, inadequate cold storage and malpractices of middlemen and asymmetric information etc.

Barpeta, Lakhimpur and Sonitpur are the major potato producing districts in Assam. Still the potato sector of the districts has been suffering from lack of irrigations and cold storage facilities. It has been found that farmers do not use quality seeds and balanced doses of fertilizers. The potato producers in the districts are also lacking the knowledge of scientific production practices. The government extension services to the potato growers regarding land preparations, utilization of fertilizers and plant protection measures are not adequate.

When the high price of potato shows high demand of the crop in the market, on the other hand, producers get a low price of their produce due to inefficient nature of potato
market in the state of Assam. The present study has emphasized the production trends and issues of marketing of potatoes in Assam. The study is expected to focus on the marketing practices of the crop and investigate the causes of inefficient nature of potato marketing in the state economy of Assam in comparison to the potato markets of the major potato growing state like West Bengal.

1.3 **Historical Perspective of Potato:**

Initially, it was believed that potato has been domesticated in the different places independently. But, in the later stages, different varieties of potato have been genetically tested and it has been proved that there is a single origin of potatoes in the areas of present day Southern Peru and in northwestern Bolivia between the 8000 and 5000 BCE (CIP, 2008). It has been assumed that the mainland people forced the ancient Andeans to migrate to the highlands in that time period and there they domesticated the potato crop. The potato crop continued as main food items for the poor and mass people for long time. To the Andeans and later to the Incas, it was known as papa. For millennia, it was the source of food for survival of great Andean civilization, but it was remained unknown to the rest of the World. As the historical proof, it can be mentioned that the ancient Andeans today also includes the name of potato in their myths and rituals. Moray Raymi potato festival still celebrated in the potato’s birth place, the Andes (CIP, 2001).

After the discovery of the different countries in the rest of the world, the potato crop was newly introduced in European countries along with some other crops such as maize and tobacco. But the European societies denied in accepting the potato crop as vegetable or food item for many centuries. This was mainly because of the fact that the European
societies had some misunderstanding regarding the consumption of potatoes. They regarded potato as unhealthy crop which should not be consumed. But, during the changes in the consumption behaviours among the European people during the long period of time, the potato crop has been gradually accepted among the European societies. Once the potato crop has been accepted as vegetable or as food crop, there was a great change in the consumption patterns based on potato crop. Production as well as consumption of potato has increased tremendously.

According to some historians, development of potato sector contributed in the industrial revolution in Europe. There was a famine in Ireland known as potato famine which occurred due to drastic fall in potato production. This proves that the Europeans largely depended on potato crop for their survival from the early to the mid of 19th century. Even the Bavarian war in 19th century was termed as a ‘Potato War’ because it continued till the potato stocks exhausted (CPRI, 2004). It is also noted that during the Inca periods in South America a fierce battle between the different tribal groups occurred and the war was postponed in order to cultivate the potato fields as it is the source of their survival.

According to some other historians, acceptance and development of potato sector also partially responsible for the considerable growth of the world population. Potato also contributed in the expansion in urbanization across the different countries during 17th to 19th century. After the conquest of the Inca Empire, the Spanish mariners introduced potato in Europe in the second half of the 16th century (Wikipedia). In the later time periods, the European mariners spread the potato crop throughout the different countries of the world. Even though, the spread of potato crop among the European countries was slow during the initial stages, but gradually the potato became very popular crop among
the European societies. The demand of potato became very high as staple food crop and production of potatoes increased significantly. As stated by the historians, the development of potato sector contributed importantly in the 19th century European population boom.

In the initial stages, there was limited genetic diversity and the number of potato varieties was very few. As a result, potato production sometimes became vulnerable as because of many diseases appeared in potato cultivation. One of the major potato diseases namely late blight was found in 1845 in Ireland. The late blight disease reduced potato production considerably and sometimes production of potato failed in the country. As a result of potato crop failure, the Great Irish Famine occurred according to the historians. With the discoveries of different countries in the rest of the world, potato crop has spread in about 150 countries over the world.

According to the sources, in the South Asian countries potato was initially introduced in the late sixteenth century or in the early seventeenth century by the Portuguese mariners (CIP, 2008). During that time period, European people considered potato crop as a botanical crop as well as potential food crop. Thus, the Portuguese mariners introduced potato crop in India in the 17th century. Initially, the crop was cultivated in the Surat area in the state of Gujarat.

The British colonial governor Warren Hastings tried to expand potato cultivation in India during his tenure from 1772 to 1785. Thus, during the late of eighteenth century and early of nineteenth century, the cultivation of potato has been spread across the different hills and plains area in India. Even the people of different locations called the potato by different local names such as Phulwa, Gola and Satha (Panday, et al., 2003). It
is noted that the varieties of seed potatoes imported from the European countries were
not appropriate to cultivate in the countries of Asia. Thus, in the initial stages, potato
cultivation in Asian countries including India was not up to the mark. Production fell
down considerably, problems of potato damages and problems of viral infections
occurred. A few number of potato varieties such as Magnum, Bonum, Royal Kidney,
Great Scot etc. sustained in production in the higher altitudes (CIP, 2007).

In India, the Central Potato Research Institute (CPRI) was established in 1949, two
years after Indian Independence to develop potato varieties and technologies appropriate
to the Indian agro-climatic conditions. Over the last few decades, potato crop has
become the fastest growing vegetable and also staple food crop in India. In Assam,
potatoes were introduced by Mr. David Scott in the early part of the nineteenth century,
soon after the conquest of Assam by the Britishers (Gossami, 2003). Initially, efforts
were made to cultivate potatoes in the Khasi Hills, presently located in the state of
Meghalaya where the production was very successful. Production and productivity was
comparatively higher. But the potato cultivation has spread to the plains area at a slow
pace as the variety grown in Khasi Hills was not suitable in the plains of Assam. The
variety which was suitable in summer rain fed conditions in Khasi Hills was not suitable
in the plains of Assam where potatoes were produced as winter crop. After the
introduction of seeds from the states of Bengal and Bihar, it has been cultivated
extensively in the plains districts also. According to Gossami (2003), the yields of
potato per acre were comparatively higher in the Khasi Hills and quality of the product
was good.
1.4 Potato and its Nutritious Value:

Potato is one of the important high value agricultural products in the state economy of Assam. Potato in the state of Assam along with the country as a whole is mainly used as vegetable item. But still, the crop forms a regular component in the human diet of the average consumers in the country. Particularly during last couple of decades, the potato becomes a food supplement with the development of potato processing industries in India.

According to the United Nations FAO (2011) about 70 percent of the total potato production of the world was directly consumed by the humans and the remaining 30 percent was used to feed animals or used to produce starch. According to this estimates, in the present century, the annual diet of an average global citizen includes 33 kg of potato product. The consumption of potato crop is still the dominant among the European people where per capita consumption of potato is the highest in world.

Potato is one of the four major food crops in the World. The other three crops beings rice, wheat and maize. Potato is one of the important food crops as because of the reason that potato contains higher dry matter food and it produces proteins and vitamins. Moreover, potato crop produces more calories per unit of area harvested and comparatively within short duration of time compared to the major cereal crops. The problems of food shortage and under nutrition are the major problems particularly in the developing countries of Asia. These problems of under nutrition and food shortage can be removed considerably with the expansion of potato production and diversification of consumption behaviours.
Potato crop is very nutritious as it contains most of the dietary components of foods. Carbohydrate is the major constituent of potatoes similar to the major cereal crops. The nutritious contents of potato of 100 gram edible portion have been summerised. According to National Horticultural Board, Government of India (2010) a 100 gm edible portion of potato normally contains 85 percent edible portion. It contains Protein 1.6 gm, Minerals 0.6 gm, Carbohydrates 22.6 gm, energy 97 kcal and Calcium 10 mg. Moreover, the 100 gm edible portion of potato also contains Calcium 10 mg, Phosphorus 40 mg, Iron 0.7 mg, Carbonate 24 mg and Vitamin C 17 mg. This indicates that potato contains all the important nutritious components.

Potatoes have been considered as high food value crop. The role of potato crop in the food supply base has been recognized internationally. According to the United Nations Food and Agricultural Organization, potato can be considered as the food crop for the future generations throughout the world. The FAO also recognizes that potato crop can play a significant role in removing the problems of poverty and hungry across the different countries (CPRI, 2011).

Presently, potato, after rice and wheat, is the third most important food crop in the World as well as in India from the human consumption point of view. According to the Central Potato Research Institute (CPRI), Shimla, even though presently, potato has been mainly utilized as vegetable crop in India, but in future, potato will be used as food item in the country. Potato will greatly help in achieving the food security mission in the country. Of course, the potato sector in the country has to face some challenges such as shrinking cultivable land, low quality soils, increased abiotic and biotic problems on account of climatic changes etc. The Central Potato Research Institute has supposed that the country will be able to produce about 70 million tonne of potato by the year 2030 in
response to the ever increasing demand of potato by the growing population in the country.

The United Nations named 2008 as the International Year of the potato to highlight its significance in removing the problems of poverty and hungry from the world (Sundaram, 2011). The Food and Agricultural Organization (FAO) of the United Nations has identified and considered the potato crop as the next best staple food item for the common people, particularly for the poor people in the countries of Asia and Africa. Comparatively, within the less sizes of land, more nutritions can be produced in case of potato cultivation in comparison to the cereals crops and pulses. About 85% of the potato plant can be consumed whereas in case of cereal crops only about 50% of the plants can be consumed by human beings (CIP, 2010).

Potato ensures food supplies and nutrition to the ever growing population in the country. Generally, the people of the country largely depend on a few number of cereal crops such as rice, wheat and maize for food and nutrition supplies. As remarked by Azimuddin et al., (2009), the vulnerability of the national food supply is subject to the vagaries of changing weather conditions and too much dependence on a few numbers of crops for the food requirements. To achieve the food security mission in the country, the food supply base should be expanded by including potato crop.

1.5 Economic Significance of Potato:

Potato crop has high economic value in terms of generating incomes and employment along with its contributions in food supply base. The United Nations Organization (UNO) has highlighted economic significance of potato towards development and in the achievement of food securities across the different countries particularly the countries of
Asia, Africa and Latin America. In these countries, potato crop has been widely used either as vegetable or as staple food items. The most important development goal of United Nations is the removing of the extreme poverty and hungry form the world. To achieve this goal, the United Nations has undertaken the measures for rapid development and increase agricultural production. In this case, potato production can play an important role in removing extreme poverty and hungry from the countries of Asia, Africa and Latin America (FAO, 2008).

The United Nations Food and Agricultural Organization (FAO) also recognized the economic significance of potato crop and hence undertook the policy measures to modernize the potato sector and promote the technological development for increase production and productivity of potato. The FAO also suggested for developing linkages among the policy makers, actual producers and the potato processing units so as to achieve best economic benefits.

According to Sundaram (2010), with the development of potato sector by increasing production and productivity and diversifying the potato utilization behaviours, the problems of malnutrition and under nutrition can be reduced significantly in the developing countries of the world. Generally, the developing countries are characterized by over population and hence limited land resources. The most important economically beneficial aspect of potato crop is that potato produces more food items with short duration of time and per unit of land which is very essential for the developing countries. Moreover, by nature in case of potato production, the methods of intercropping and double cropping of potato with some other crops are frequently done which is more economical in comparison to the major cereal crops. Potato crop cultivation is labour intensive in nature. About 145 man days are required to cultivate
one hectare of land. Accordingly, about 260 million man-days of employment opportunities have been generated in India during the year 2008 (CPRI, 2011).

Another important economically beneficial aspect of potato is that majority of unskilled and semi skilled labourers engaged in potato cultivation and in the different stages of its post harvest managements. The rural unskilled and semi-skilled labourers have been employed in potato harvesting, grading, packaging, transportation, storage, processing, marketing etc. Therefore, potato sector significantly contributes employment and income generations in the rural economy. One important aspect of potato cultivation is that women labourers are mostly engaged in the processes of potato cultivation and post harvest managements. Thus, potato production encourages gender equity in the agricultural labour market in the country.

The economic contribution of potato crop can be understood in two aspects. For some people and in some regions, potato contributes in human development by providing food and nutritional requirements. People directly eat potato or consume the processed potato products and thus potato helps in removing the hunger problems. In another aspect, in some regions and basically for some people, generally for poor people, potato provides source of employment and incomes. Since potato is high value crop, its production helps in earning more income and hence improves the standard of living particularly of the rural poor people (Thiele et al., 2010).

Potato is the input intensive agricultural crop. The potato production contributes in economic development of a country by supporting the other sectors of the economy. The cultivation of potato crop requires more of industrial outputs such as chemical fertilizers, pesticides, machineries for cultivation, harvesting and processing, the
transportation facilities, cold storage instruments, packaging materials etc. Thus, the potato sector helps in industrial development by demanding more of the industrial products (Singh et al., 2011).

Similarly, the capital intensive nature of potato production also induces for financial and the service sectors development in the economy. In the patterns of potato marketing, financial activities such as expansion of credit markets have been developed. Another economic contribution of potato is that the byproducts and waste portions of potato products have been used as the fodder for animals which help in the development of animal husbandry. It is remarkable that many food processing and potato processing industries have been developing across the different countries including India. This results high value crop and widely used in hotels, restaurant, canteen etc. At the same time, potato based industries generate huge employment opportunities and hence contribute in removing the problem of poverty and unemployment (Thiele et al., 2010).

The prices of food commodities have been increasing gradually all over the world. This problem of inflation is mainly caused by the comparatively shortage of supplies in relation to demands of the food crops across the different countries. The diversification of food commodity sources can be adopted as a policy measure to partially remove the problem of food price rise in the developing countries which suffer the most. In such situations, the increased in potato crop and acceptance as staple food item can help in reducing food price inflation in the international markets (FAO, 2008). The potato is a perishable crop and hence comparatively lesser quantities of potato output are marketed internationally compared to the cereal crops such as rice, wheat and maize. Therefore, the potato prices are not much affected by the vagaries of international food price
fluctuations. According to the report of a survey conducted by United Nations Food and Agricultural Organization (FAO), in about 70 developing countries, the rate of inflation was comparatively lower in case of potato crop in comparison to the major cereal crops. Thus, potato can play an important role in stabilization in the food prices across the different countries which are much more vulnerable in terms of international food price inflations.

Achieving gender equality in the rural labour markets is a challenge in the Indian economy. But, in the agricultural sector including potato production and harvesting, most of the labour force is provided by the unskilled women labourers. Thus, the potato sector has gender implications in employment of labourers particularly in unorganized rural sector. In the different stages of potato production and harvesting, such as nurturing potato plants, harvesting, sorting and packaging operations are mainly performed by the unskilled and semi skilled woman labourers in the rural areas in the developing countries (FAO, 2010). As many times, the male workers have to migrate in urban areas and hence women labourers bear more responsibility in case of potato cultivation particularly in the developing countries including India.

An observation by the author (2013) on potato production in Chirang district of lower Assam, revealed that women labourers are mainly engaged from planting to harvesting, grading and packaging of the crop. For planting women labourers were paid Rs. 120 as wage per day. But, for harvesting Rs. 100 is paid as wage in cash along with a small bag full of potatoes for family consumption of the women labourers. In this way, potato sector signifies in ensuring family incomes and food security and removal of poverty in rural the areas of Assam.
1.6 Justification of the Study:

Production of potato and its marketing practices are increasing all over the country due to its higher economic value and nutritional contents. Various institutes in India and worldwide have been carrying research and development studies on potato production and post harvest management both of economically and technologically. The international potato organizations consider the crop as the poor men’s friend. This research work also undertakes to examine the trends of production and marketing of potato in this part of the country. Thus, the present study can be justified on the following grounds.

1. This investigation helps to understand the trends in area production and productivity of potato in Assam.

2. The study is justified in understanding the development of economic infrastructures such as irrigation, storage and marketing facilities of potato in the state of Assam.

3. The regional concentration of potato production in Assam and agro-climatic factors behind it can also be understood through this research study.

4. The study helps to know the comparative post harvest value chains of potatoes produced in Assam and the major potato producing state of the country like West Bengal.

5. The study also justified in understanding the marketing competitiveness of the crop produced in Assam in comparison to West Bengal which supplies potato in Assam and other northeastern states of the country.
1.7 Objectives and Hypothesis:

The specific objectives of the study are-

1. To examine the trends in area, production and productivity of potato in Assam since the early 1950s.

2. To examine trends 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.

3. To understand the regional concentration of potato production within the state of Assam in terms of agro-climatic and socio-economic factors.

4. To examine cost and returns from potato production at the farmers level under different farming conditions distinguished by purpose of production (self consumption or commercial), availability of irrigation and agrarian conditions of farm size and tenure status.

5. To understand the post harvest value chains of potatoes produced in Assam. A comparative study with the value chains in neighbouring West Bengal, which has established itself as a major potato producer in the country, has been taken up.

6. To examine the market efficiency of potato produced in Assam (Assam is far from self sufficient in potato production. Supply to Assam markets comes not only from the neighbouring states of West Bengal and Meghalaya but also from the distant states of Punjab and Uttarakhand).

Hypothesis:

Further the study verifies the hypothesis that Farm-gate realization of price by potato farmers in Assam has remained low because of non-development of post harvest value chain management.
1.8 Methodology:

Regarding research methodology, the present study is based on both primary and secondary data.

1.8.1 Sources of Data:

**Secondary Data:**

Secondary have been collected from the published as well as unpublished sources. Secondary data have been collected from the office of the Directorate of Agriculture, Government of Assam, office of the Directorate of Economics and Statistics, Government of Assam, Directorate of Marketing and Inspection, Government of India, National Horticultural Board, Government of India. Moreover, secondary data have also been collected from United Nations Food and Agriculture Organization (FAO), Central Potato Research Institute (CPRI), books, Potato Journals of the Potato Association of India, news papers etc.

**Primary Data:**

To fulfill the objectives of this research study, primary data have been collected. Primary data have been collected from the potato farmers regarding production of potato and costs and returns of potato cultivation. Primary data have been collected from the dealers of potato such as wholesalers, retailers and commission agents, cold storages, regarding prices, storage rents and quantities of the crop by using pre-tested questionnaires.

1.8.2 Selection of the Districts:

For conducting the field study and collecting primary data, Lakhimpur, Sonitpur and Barpeta districts have been selected from the state of Assam. Hooghly district has been selected from the state of West Bengal for carry out field study.
Rationale for Selecting the Districts:

Out of the 27 districts of Assam, Lakhimpur, Sonitpur and Barpeta districts have been selected for conducting field study and collecting primary data because of the following reasons.

1. 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.

2. 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.

3. Hooghly district has been selected from the state of West Bengal for conducting field study because Hooghly district is the highest potato producing district among all the districts of West Bengal.

1.8.3 Sample Design and Data Collection:

For primary data collection, two types of pre-tested questionnaires have been used. The first type questionnaire has been used to collect village level data. The second type of questionnaire has been used for the collection of data from the potato growers regarding production, costs and returns from potato cultivation under different farming conditions. Keeping in view the objectives of the study, primary data have been collected by following four stages multiple sampling design in each of the selected districts. From
each of the selected districts of Assam, two subdivisions have been selected purposively in the first stage. In the second stage, from each of the selected subdivisions, one ADO (Agricultural Development Officers) circle has been selected purposively. And in the third stage, from the selected ADO circle, two villages have been selected purposively. In the fourth stage, from each of the selected villages 10 percent of potato growers have been selected randomly to collect the required data.

Case studies were conducted in the major potato markets in Assam such as Howly market from Barpeta District, North Lakhimpur market from Lakhimpur district and Tezpur market from Sonitpur district. Data have been collected from dealers of potato like wholesalers, retailers, commission agents, cold stores owners regarding prices and value chains of the product. For this purpose, in the first stage, from each of the selected subdivisions in the districts of Assam, one potato market has been selected purposively. And in the second stage, 10 percent of potato sellers have been selected from the selected market for collecting data about prices and quantities.

From the state of West Bengal, two major potato markets have been selected purposively from Hooghly district to carry out the case study. In the next stage, from each of the selected markets, about 10 percent of potato sellers have been selected randomly for collecting data.

1.8.4 Line of Analysis:

The present study is based on primary as well as secondary data. Both quantitative and qualitative methods of research have been used in this study. To fulfil the objectives of the study, data have been analysed by following different statistical and econometric
methods along with the case studies. The table no. 1.1 represents the analytical framework of the present study.

**Table No. 1.1: Analytical Framework**

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Data Source</th>
<th>Line of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Trend analysis of area, production and productivity.</td>
<td>Secondary data</td>
<td>Fitting of semi log linear trend equation, semi log quadratic trend equation and trend with time dummy.</td>
</tr>
<tr>
<td>2. To examine trends in area and production of potato in terms of economic (e.g. relative price movement) and infrastructure related factors.</td>
<td>Secondary data</td>
<td>Multiple regression equations with access to irrigation etc. as explanatory variable and acreage under potato as dependent variable.</td>
</tr>
<tr>
<td>3. To understand the regional concentration of potato production within the state of Assam.</td>
<td>Secondary data</td>
<td>Percentage, graphs.</td>
</tr>
<tr>
<td>4. To examine costs and returns from potato production at the farmers level under different farming conditions.</td>
<td>Primary data</td>
<td>Ratio, percentage and graphs.</td>
</tr>
<tr>
<td>5. To understand the post harvest value chains of potato produced in Assam. A comparative study with the value chains in West Bengal.</td>
<td>Primary data</td>
<td>Case studies of the post harvest value chains.</td>
</tr>
<tr>
<td>6. To examine the market efficiency of potato produced in Assam.</td>
<td>Primary data</td>
<td>Percentages, ratios and graphs.</td>
</tr>
</tbody>
</table>

Source: Author’s Self Preparation

For estimating the **Compound Annual Growth Rates (CAGR)** of the area harvested under potato cultivation, Production and productivity or average yield of potato in the state of Assam and India as a whole, following semi log linear trend equation has been used.
\[ \ln Y = \beta_0 + \beta_1 t + U \]  \hspace{1cm} (1.1)

Where, \( \ln Y \) is the logarithmic value of the variable under consideration, \( \beta_0 \) is the constant term; \( \beta_1 \) is the coefficient to be estimated and \( U \) is the error term.

Ordinary least square technique is used to determine the value of the respective coefficients. The compound annual growth rate \( (r) \) has been calculated as follows-

\[ r = (e^{\beta_1} - 1) \times 100 \]  \hspace{1cm} (1.2)

Where, \( e^{\beta_1} \) is the exponential value of the regression coefficient \( \beta_1 \)

In order to test whether there has been any acceleration or deceleration in the growth rate, the following semi log quadratic equation has been used.

\[ \ln Y = \beta_0 + \beta_1 t + \beta_2 t^2 + U \]  \hspace{1cm} (1.3)

Differentiating equation (1.3) with respect to time \( (t) \), we have

\[ \frac{\partial \ln Y}{\partial t} = \beta_1 + 2\beta_2 t + U \]  \hspace{1cm} (1.4)

Equation (1.4) can accommodate acceleration / deceleration in the trend of growth rate on the basis of the estimated coefficient \( \beta_2 \) and its signs. A positive and significant value of \( \beta_2 \) represents acceleration whereas a negative and significant value of \( \beta_2 \) represents deceleration in the trends of growth rates. \( \beta_2 \) being positive or negative but insignificant implies neither acceleration nor deceleration in the growth rates.

We have estimated the structural break in the growth of area harvested under potato cultivation in Assam during 1951-52 to 2011-12. To examine whether the apparent structural break is statically significant or not, the following growth equation has been estimated.

\[ \ln Y = \alpha + \beta T + \gamma DT + U \]  \hspace{1cm} (1.5)
Where, $\ln Y$ is the logarithmic value of the area harvested under potato cultivation in Assam. $\alpha$ is the constant term, $\beta$ and $\gamma$ are the coefficients to be estimated. $D$ is the dummy variable which takes value 0 for the period 1951 to 1974 and 1 for the subsequent period and $U$ is the error term.

Whether the growth rate during the two concerned periods is same or not is tested by the statistical significance of the coefficient $DT$. If the coefficient of $DT$ that is $\gamma$ is insignificant, then there is no structural break and if it is significant with positive sign, then there is structural break in the growth trend of area harvested under potato production in the state of Assam.

While estimating the cost of potato cultivation per hectare across the sample farm households, the following cost $C_2$ has been used.

$Cost\ C_2 = Cost\ B_2 + \text{imputed value of family labour}.$

Where, $Cost\ B_2 = Cost\ B_1 + \text{rental value of own land (net of land revenue) and rent paid for leased-in land.}$

Where, $Cost\ B_1 = Cost\ A_1 + \text{interest on value of owned capital assets (excluding land).}$

Where, $Cost\ A_1 = \text{All actual expenses in cash and kind incurred in production by potato grower.}$

In other words, the cost $C_2$ includes all the actual expenses in cash and kind incurred in production of potato by farmer, interest on the value of owned capital assets (excluding land), rental value of own land (net of land revenue) and rent paid for leased-in land and the imputed value of the family labour.
1.9 Layout of the Thesis:

The present study has been organized into a total of eight chapters. The studies on the relevant empirical literatures which have the interest with this study have been included in Chapter 2. Chapter 3 of the thesis includes the analysis on the trends in area harvested, production and productivity of potato in Assam. This chapter also includes the comparative studies of the potato sector of Assam with the country as a whole in terms of trends in area, production and yield. Chapter 4 includes the analysis on area acreage under potato, relative price movements of potato with its competing crops and agricultural infrastructures. Chapter 5 includes the analysis on the post harvest management of potato including marketing value chains and marketing efficiency in Assam and a comparison with the state of West Bengal. Costs and returns from potato production at the farmers’ level have been analysed based on the inputs of the field studies which have been included in Chapter 6 of the thesis. Chapter 7 includes the analyses on the determinants of returns and farm business incomes from potato production across the sample farm households. The concluding Chapter 8 includes the summery of the findings and the policy implications of the findings of the study.