RESEARCHING REALITY INTERNSHIP| 2011

Farm to Fork Supply Chain of Potato in the state of Bihar

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CCS Working Paper No. 252
Summer Research Internship Programme 2011
Centre for Civil Society
www.ccs.in

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ACKNOWLEDGMENT

During my internship at Centre for Civil Society, I had a great opportunity to participate in a research project concerning my abilities. For a successful and a learning experience here at CCS, I'd like to acknowledge, with utmost sincerity, the efforts of all those who have made the successful completion of my research project during the period of this internship possible.

I am thankful to my research guides- Parth J Shah (President, Centre for Civil Society), Vipin P Veetil (Research Guide, Centre for Civil Society) for their constant guidance and support throughout the period of project. I'd also like to put in my words of thanks for Ms. Mehek Rastogi (Programs Associate, Centre for Civil Society) for assisting me on every possible occasion during the course of my stay at CCS. I am also highly indebted to Amit Chandra (Campaign Coordinator, Centre for Civil Society) and Rakesh (Nidan, Patna) for assisting me in my field trip to Bihar.

Last but not the least, my honest regards for all my fellow interns from different institutes and academic backgrounds who made this internship experience all the more enjoyable, the staff at CCS who were always willing to help with any matter whatsoever and the wonderful people of Bihar who were always helpful and considerate during my field trips.

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ABSTRACT

The food supply chain in India is highly fragmented. The number of intermediaries in the chain is exceedingly high. These intermediaries are important because they act as a substitute for infrastructure where none exists. But over the years a layer of intermediaries has grown most of which add little value to the produce but collectively they add significantly to the final cost.

This study carried out in the state of Bihar has found that the share of the farmer in the total margin across the value chain of potato is considerably low and the maximum part of the margin is cornered by the intermediaries. The study has also analysed the contribution of value addition in total price escalation along the value chain and the share of farmer in the final retail price. The study has also listed the current constraints in the system and ends with recommendations towards weeding out inefficiencies from the current system.

MOTIVATION

India ranks second worldwide in farm output. India is the largest producer in the world of fresh fruit, pulses, mangoes, goat milk and buffalo milk and meat to name a few. It also has the world's largest cattle population. It comes second in the production of cashews, cabbages, fresh vegetables, goat meat, onions, wheat, rice, cauliflower and potatoes amongst others. It is the third largest producer of coconuts, hen's eggs and tomatoes. India accounts for 10% of the world fruit production (Food and Agricultural Organization of the United Nations, 2008). Yet India finds it difficult to feed its poor. Consider the following:

- 5.6 million Children die of malnutrition every year in India which is more than half of the world's total child deaths due to malnutrition (Pandey, 2006).
- India was ranked 67 out of 84 countries in '2010 Global Hunger Index Report' released by International Food Policy Research Institute (IFPRI) (IFPRI, 2010).
- In 2009, 17368 Indian farmers committed suicide according to National Crime Records Bureau (The Hindu, 2010).
- India contributes only 1.5% of the international food trade (WAY2WEALTH Securities Private Limited, 2008).
- India wastes more fruits and vegetables then are consumed in the whole of United Kingdom (The McKinsey Quarterly, 1997).

Thus in spite of a high farm output, the status of agriculture in India looks bleak offering more questions than answers. The answer to a lot of these questions lies in the ineffective supply chain that leads to the transport of the produce from the farm to the end consumer. This study aims to study the supply chain in its current state and look at the constraints in the system to work towards identifying effective alternatives.

INTRODUCTION TO THE FOOD SUPPLY CHAIN AND ITS ANALYSIS

1.1 Definition of food supply chain

A food supply chain refers to a description of the systematic movement of the food from the farm to the customer. This includes various intermediate processes of production, processing, distribution and consumption. A food supply chain can be taken to be a domino-like motion where changes at any level in the chain affect the entire supply chain and these changes often manifest themselves in the form of change in prices. In a food supply chain, the resources and materials flow downstream for the production of goods and provision of services while the money paid by the consumer flows in the reverse direction to different elements involved in the chain.

1.2 Value Chain Analysis

The food supply chain is analysed through a chain map which is a graphic representation of vertical channel of enterprises that transforms raw materials and delivers them to consumers as finished goods. Considering the case of a potato supply chain, the chain map consists of graphical depiction of all the core business units involved in physical product flow from supplier to end user. These units can be broadly classified under the heads of supply, production and distribution.

The basic objective of such analysis is to describe, characterize and understand a chain to evaluate its performance and then use the analysis to identify the constraints which limit the efficiency of the chain. Thus the relationships and benefits distributions amongst different stakeholders, constraints to competing in the market, market access problems for small producers and the interventions required at different levels of the chain to improve upon its efficiency can be analysed using this chain. To go a step further, this analysis can then be used to advocate solutions to enhance the performance of the chain.

The value chain analysis can be done using a format which shows all cost, losses, margins and prices along the chain and the share of each actor as the product moves from production to local traders, wholesale market, retail market and finally up to the consumer (Full Bright Consultancy Private Limited, 2008). The analysis is based on the information provided by various stakeholders in the chain. The necessary calculations at each level of ownership can be done using the following format:

Level of Ownership 1 (Farmer say)	
PARTICULARS	COST
1. Cost of Inputs	
2. Losses	
3. Margin	
4. Price (1+2+3)	

Table 1.1: Format for value chain analysis
(Full Bright Consultancy Private Limited, 2008)

Food supply chains are directly linked to inflation, food security and rural development through the prosperity of the stakeholders in the chain.

The process of value chain analysis involves the following steps (Cromme, Prakash, Lutaladio and Ezeta, 2010):

1. Chain Delimitation: This includes defining the boundaries of the analysis in terms of the product to be tracked, activities to be included along the chain and setting a geographic boundary for the chain.
2. Chain Mapping**:** This involves listing the various activities in a chain in a sequential order.
3. Information Gathering**:** This involves collecting all the relevant information required for a thorough mapping of the chain.
4. Performance evaluation: This step includes the analysis of the information gathered in terms of cost and value addition at each level of ownership.

1.3 Structure of the Research

This study aims to examine the supply chain of potato in Bihar in its current state, to do a comprehensive value chain analysis to study the role of various intermediaries in terms of price escalation and value addition at different levels of ownership and to propose solutions towards overcoming the current constraints in the system.

The decision to analyse the supply chain for potato was made for following reasons:

a) Potato produces more edible protein per unit land and time than many other major crops such as wheat (About 85% of the potato plant is edible compared to 50% in cereals) (Food and Agricultural Organization of the United Nations, 2010). The efficient management of potato supply chain can thus be crucial in the fight against hunger.

b) Given the fact that potato generates high employment in the farm economy (about 350 million man days annually) (Singh and Rai, 2010) when compared with other major crops, an efficient potato supply chain is also important in ensuring rural prosperity and proper livelihood as it generates larger returns per unit land, time and man-hours.

c) Since a small portion (6% in 2007) (Cromme, Prakash, Lutaladio and Ezeta, 2010) of the world's potato output enters international trade, the prices of Potato and thus its supply chain can be assumed to be independent of any speculative activity.

d) On the global map, India is the second largest producer of Potato behind China (Food and Agriculture Organization of the United Nations, 2010). So an efficient potato supply chain in India will be important in the world food demand and supply scenario.

e) Out of the total fast food segment in India, potato based products like French fries, wedges, potato flakes constitute an amount of Rs. 750 million in absolute terms, which is around 30 % of the total market in this segment (Global AgriSystem Private Limited, 2010).

The study was undertaken in the state of Bihar. A study by the Oxford Poverty and Human Development Initiative used multi-dimensional poverty index to put the number of poor in Bihar at a staggering 77.4 million out of total population of 95 million (Oxford Poverty and Human Development Initiative, 2010). Even if one goes by the most conservative estimates, Bihar represents one of the most densely populated agglomerations of poor people anywhere in the world. Improving the supply chain performance is critical to the improvement of livelihoods and reduction of poverty in Bihar.

CURRENT STATE OF POTATO PRODUCTION

Potato is a temperate or cool season crop which needs a low temperature, low humidity, less wind, and bright sunny days. Humidity and rains are not conducive to potatoes as these lead to insect pests and disease attacks. Potato is rich in carbohydrates, comprising 22-24%. Moreover, it contains 2.1% to 2.7% protein, less than 0.5% of fat and the rest is water (United States Department of Agriculture, 2010). Being a short duration crop, it produces more quantity of dry matter, edible energy, and edible protein in lesser duration of time compared to cereals like rice and wheat. Also potato offers a wide flexibility in planting to the cultivator.

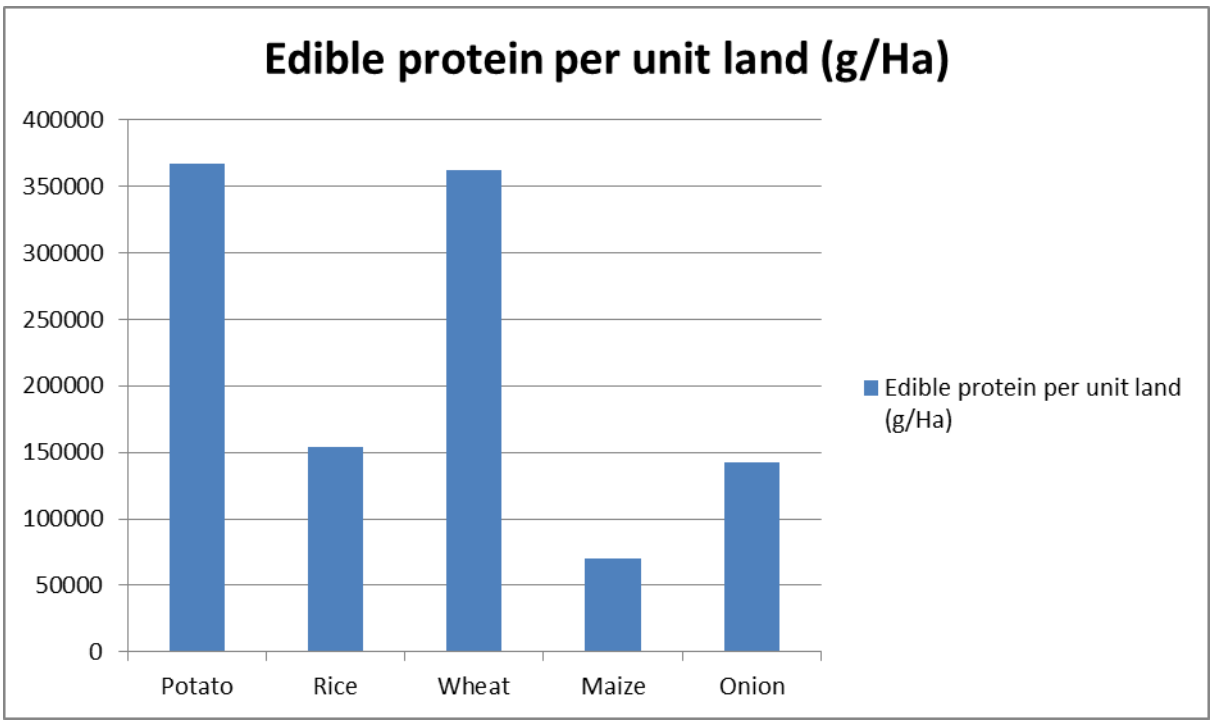

Figure 2.1: Edible protein produced per unit of land by a potato crop
(United States Department of Agriculture, 2010)

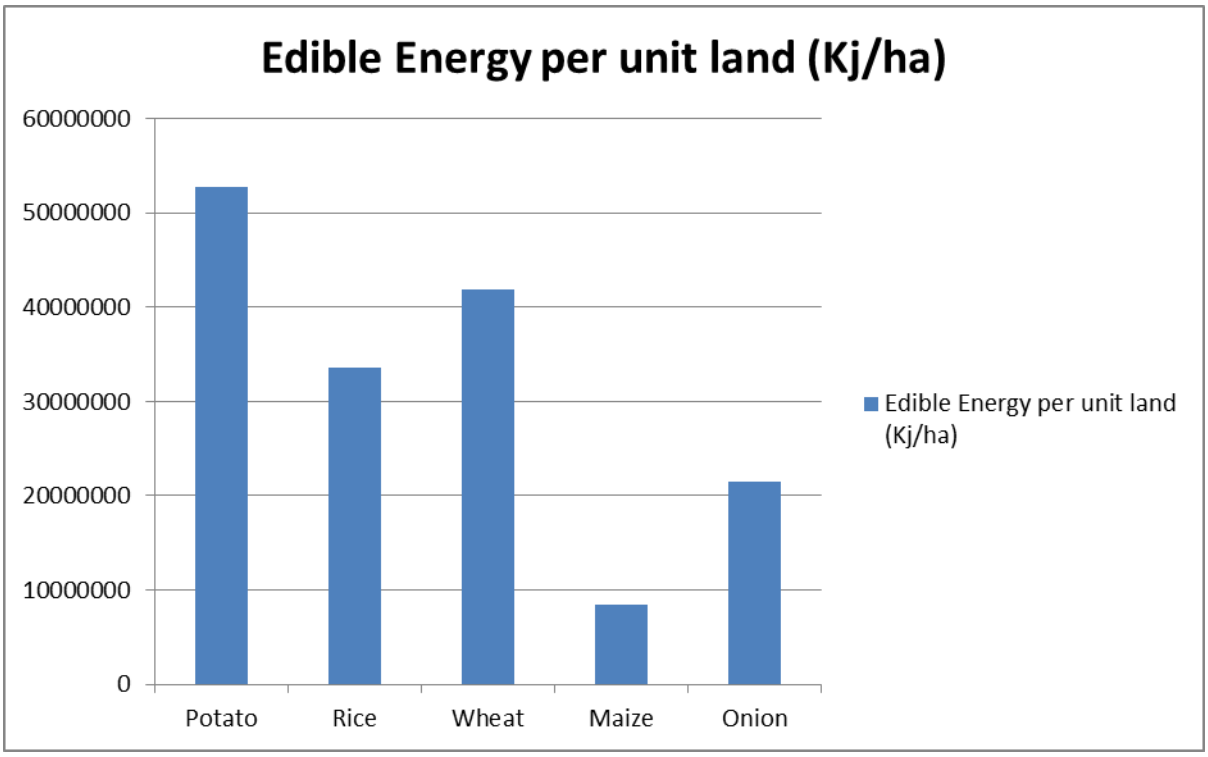

Figure 2.2: Edible energy produced per unit land by a potato crop
(United States Department of Agriculture, 2010)

Thus, given the amount of edible protein and edible energy produced per unit of the harvest area, an efficient distribution of potato will hold the key to ensuring the food security in the world.

2.1 Global Scenario of Potato Production

The world population is expected to reach around 9 billion by 2050. Thus all the activities concerning the potato production, processing, consumption, marketing and trade will play a significant role in the economic development and food security in the time to come. Currently, potatoes are grown in about 155 countries around the world and more than a billion people worldwide eat this vegetable. For the year 2010, the world potato production estimates are nearly 320 million tonnes from acreage of about 19.33 million hectares. The United Nations officially declared the year 2008 as the "International Year of Potato", calling the crop a "hidden treasure".

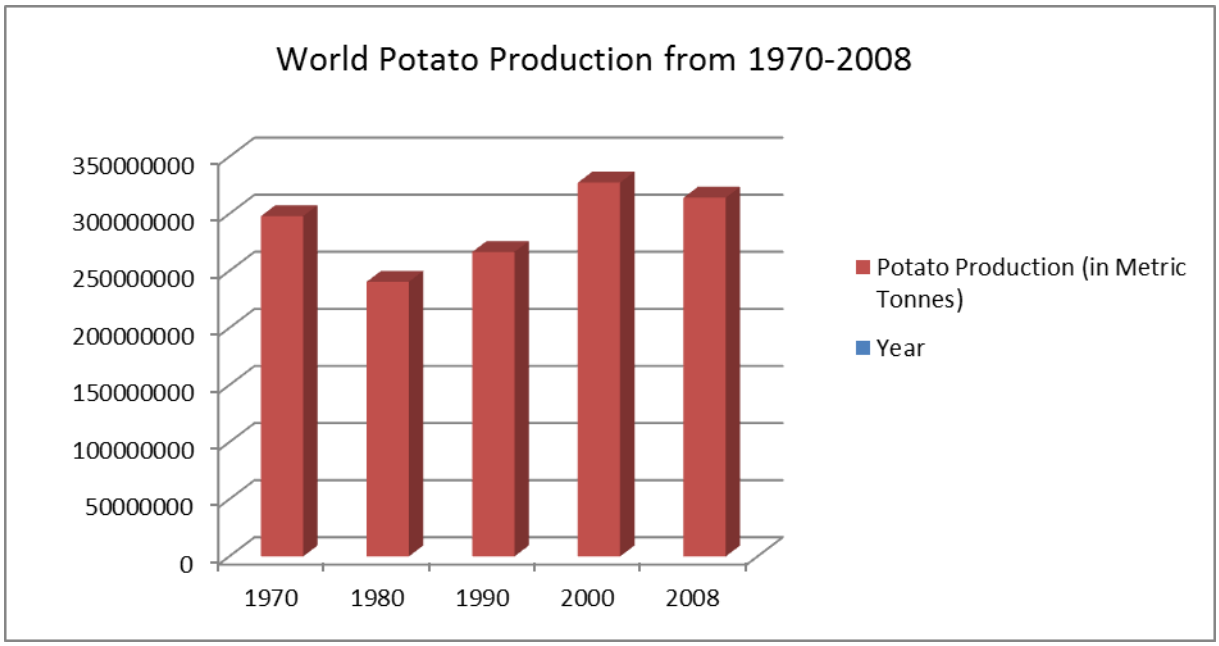

Figure 2.3: World Potato Production from 1970-2008
(Food and Agricultural Organization of United Nations, 2009)

India is the second largest potato producer in the world after China. The top ten potato producing countries in the world (according to the potato production figures in 2008) in 2008 were China, India, Russia, United States, Ukraine, Germany, Poland, Belarus, Netherlands and France. The contribution of the various countries in the global potato production can be represented pictorially as follows:

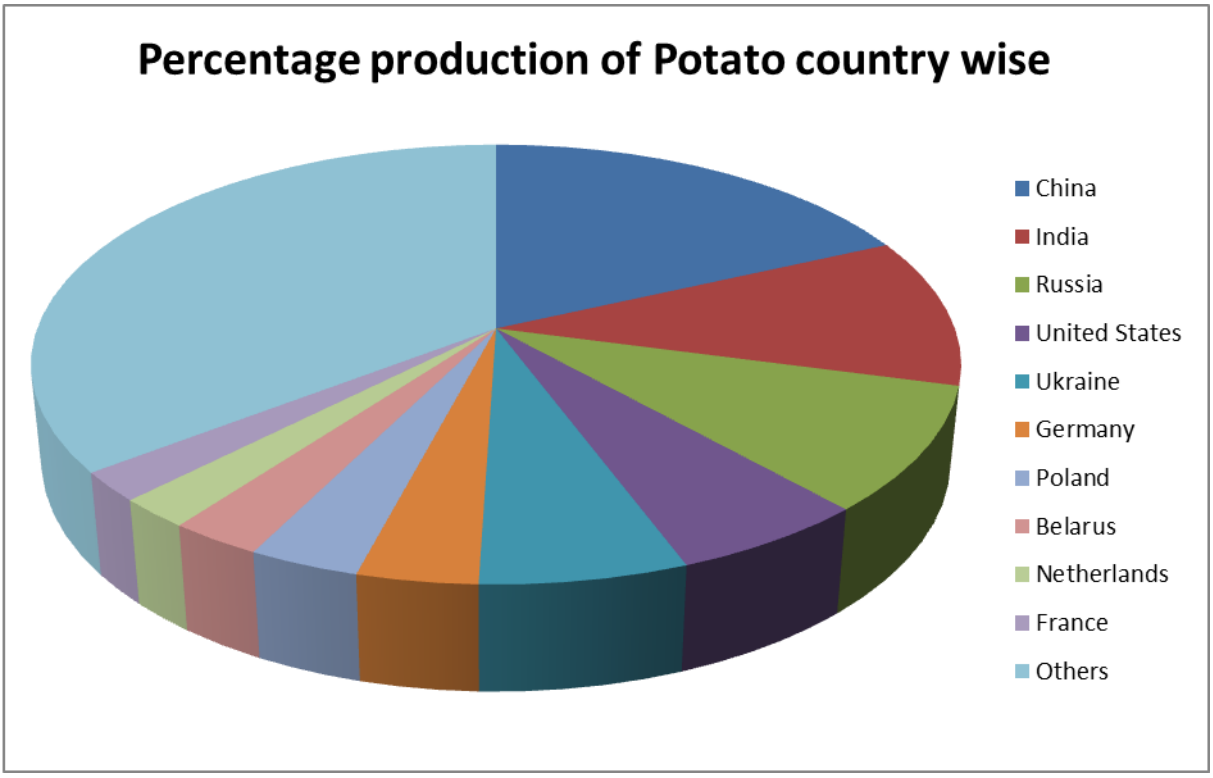

Figure 2.4: Percentage production of potato country wise in 2008
(Food and Agriculture Organization of United Nations, 2009)

2.2 Domestic Scenario of Potato Production

Potatoes were first introduced in India in the 17th century by the Portuguese who cultivated the crop in Surat for the first time. Thereafter, it spread quite rapidly across India. In India, although more than 60 percent of the gross cropped area is under food grain crops (cereals and pulses), their share of contribution to the total agricultural output is now less than 25 percent (Source: Food and Agriculture Organization). High value commodities like Horticulture, marine products are increasingly gaining dominance in the cropping pattern.

Currently, India is the second-largest producer of potatoes in the world. The production level of the country hovers around 25 million tonnes. It produces around 8% of the world's total produce. Uttar Pradesh (39-40%) produces the highest quantity of potatoes for India followed by West Bengal (35%) (Central Potato Research Institute, 2010). The annual compound growth rate of potato is higher than other major food crops in respect of area, production and productivity, resulting in its bumper yields which reflects in glut situations and unattractive prices for the farmers in almost every year. To overcome this situation, the remedial measures have been taken at different levels in regard of production, marketing, processing and export.

Regarding the consumption pattern, India has a huge population to feed and that's why there is a large demand for this crop. As a result, there is usually very little quantity left for exports, making India's share in world exports insignificant and inconsistent. India exports just around 1-0.5% of the world's total potato exports. The area under potato cultivation in India has increased from 2,34,000 hectares in 1949-50 to 18,11,000 hectares in 2008-09 while the potato production has gone up from 15,43,000 tonnes in 1949-50 to 2,85,80,000 tonnes in 2008-09 (Central Potato Research Institute, 2010). The chart drawn below depicts the decade-wise variations in the area under potato production and the total production of potato.

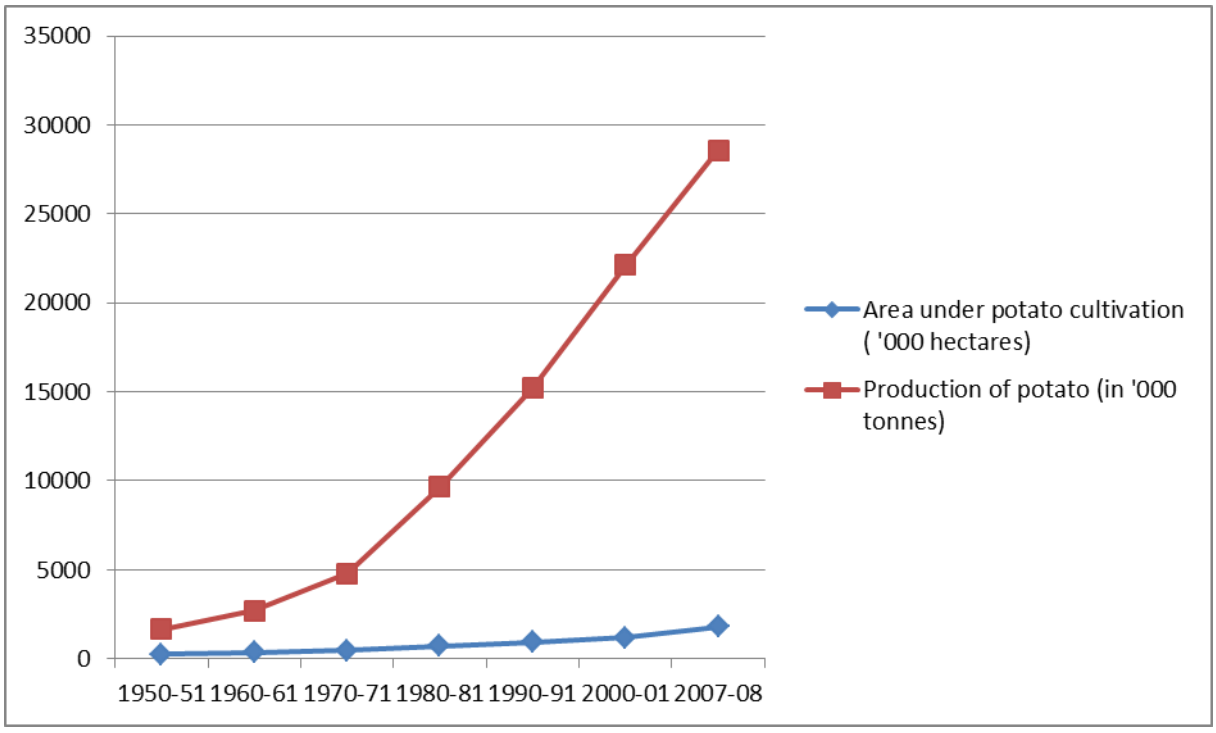

Figure 2.5: Area and production of potato in India year wise
(Central Potato Research Institute, 2010)

The yield of potato in India has shown a constant growth since independence. At 263.3 quintals/hectare, the state of Kerala had the highest yield in 2008-09 in India followed by Gujarat at 254.2 quintals/hectare and Punjab at 246.7 quintals per hectare.

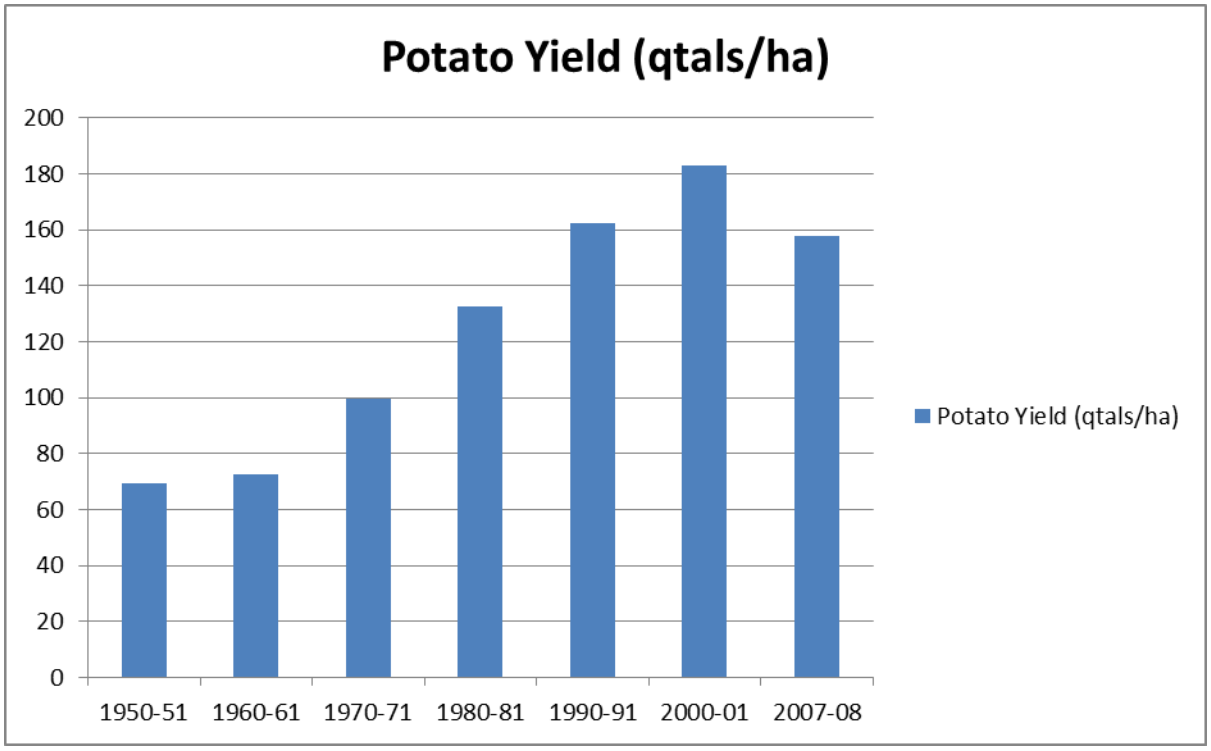

Figure 2.6: Potato yield in India
(Central Potato Research Institute, 2010)

Domestically, the top 5 potato producing states in the country were Uttar Pradesh (38%), Bihar (18%), West Bengal (14 %), Punjab (7%) and Gujarat (5%).

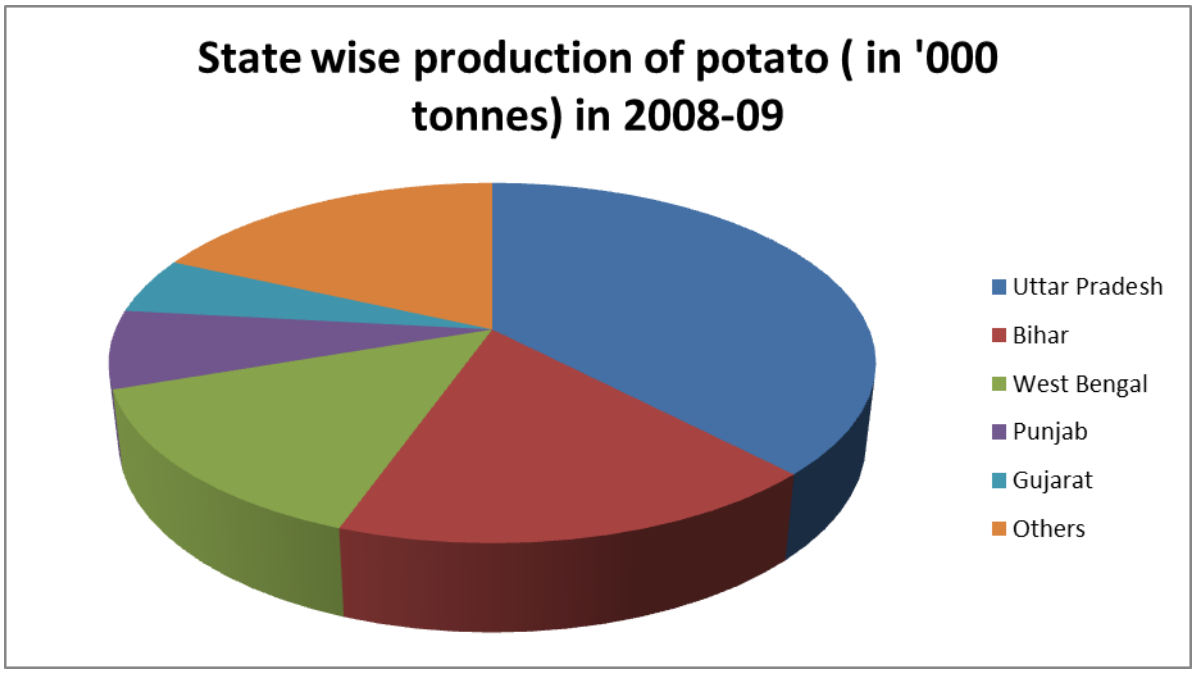

Figure 2.7: State wise production of potato in 2008-09
(Central Potato Research Institute, 2010)

2.3 Potato production in Bihar

Potato is the single largest vegetable crop in Bihar. In 2008-09, Bihar produced 18% of the total national potato production making it the second largest crop in terms of the production. Around 25 % of the total area under vegetable production in Bihar is allocated for the cultivation of potatoes. The crop is usually sown in the months of October-November and harvested in the months of February-March.

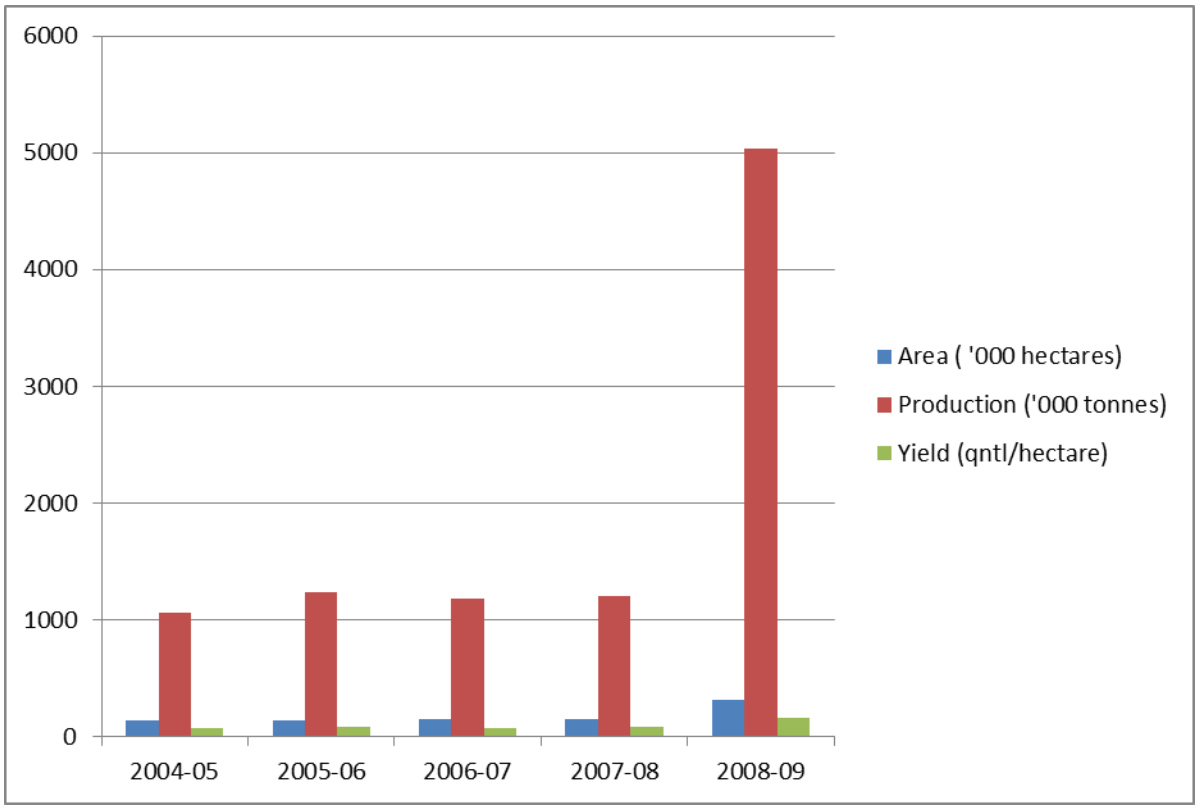

Figure 2.8: Area, Production and Yield of potato in Bihar
(Central Potato Research Institute, 2010)

The yield of potato production in Bihar has been less when compared with the major potato producing states like Uttar Pradesh, Gujarat and Punjab. Following chart depicts this fact:

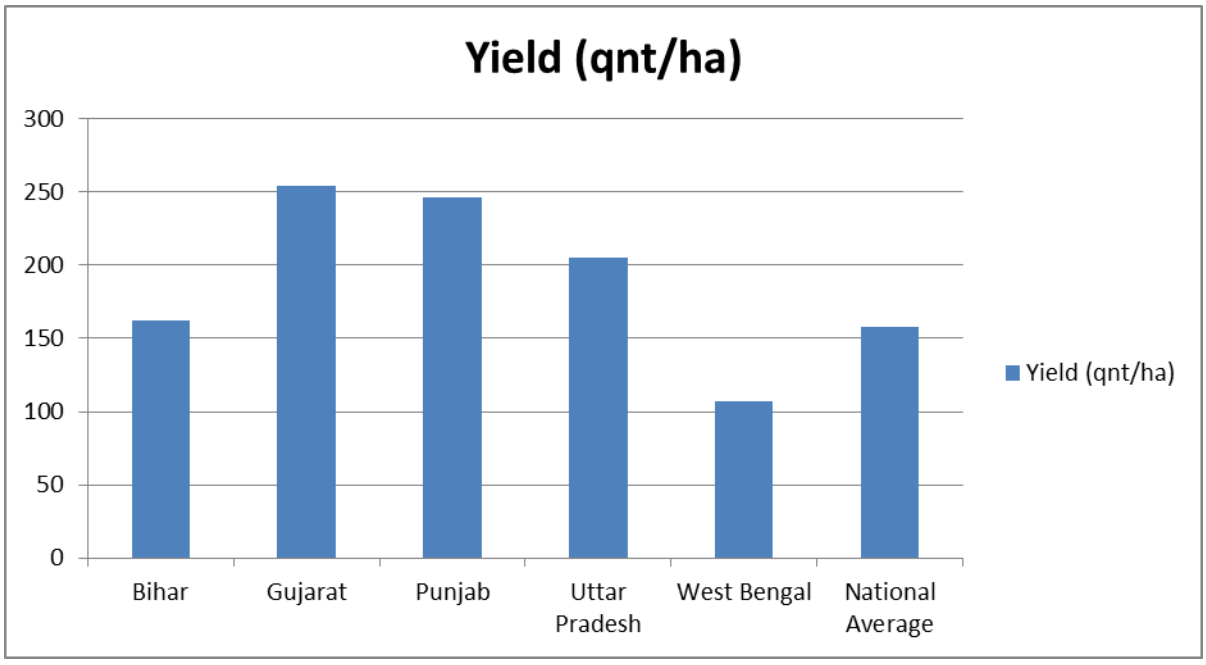

Figure 2.9: Comparison of potato yield in Bihar with other states
(Central Potato Research Institute, 2010)

2.4 Seasonality of Production in India

Potato is mainly a Rabi season crop, sown in the month of October and harvested in the month of March. However in hilly regions of Himachal Pradesh, Uttarakhand and Jammu and Kashmir, potato is grown as a Kharif crop where it is sown in the month of July and harvested in the month of October. In Bihar, potato is grown as Rabi season crop.

2.5 Arrival Season for potatoes in India

The arrival for potatoes in India is different across different states depending upon the season of sowing and farming practices. The arrival season of potatoes can be tabulated as below:

Name of State	Season
Uttar Pradesh	November-April
West Bengal	March-April, Sept-Nov (plains), Jan-March, July-Aug (hills)
Punjab	Dec-April (peak arrival), Oct-Nov (average arrival), May-Sept (lean period of arrival)
Haryana	Dec-Jan (for early variety), Jan-March (for mid variety), March-April (for late variety)
Himachal Pradesh	Sept- Oct (Seed Potato variety)
Gujarat	Dec- Jan (for early variety), March-May (for late variety)
Bihar	Feb-April
Maharashtra	Feb-March
Karnataka	Sept-Oct (Kharif Crop), March-April (Rabi crop)
Madhya Pradesh	Dec- April

Table 2.1: Arrival season of potatoes in India
(Government of India, 2010)

2.6 Usage of Potato in India

As in most other countries, potato in India finds an extensive usage in the following areas:

a) **Table Purpose Usage (As vegetables):** Potato is one of the most widely consumed vegetables in the world, used either alone or as a combination with other vegetables.
b) **Usage as Seed**: Medium sized tubers produced in Punjab and Northern and Eastern hills are used as seed potatoes.
c) **Usage in Processed Food**: Dehydrated potato products like chips, potato powder, potato biscuits, granules etc. and frozen foods like potato patties, puffs, wedges, pancakes etc. utilize potato in one way or another.

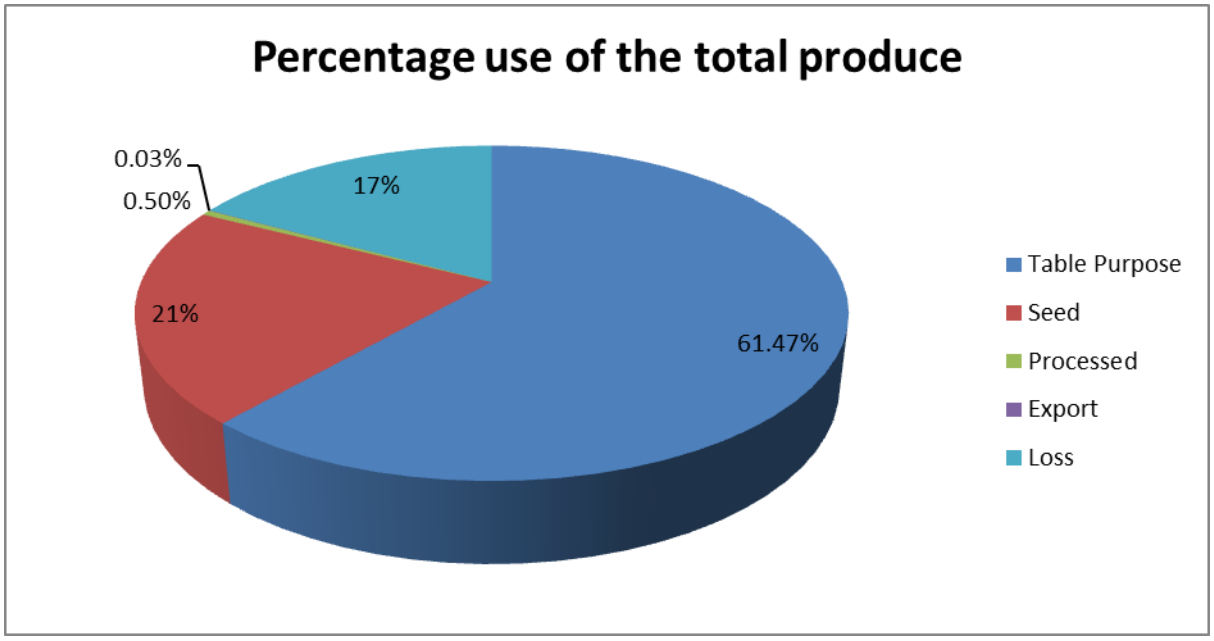

Figure 2.10: Usage of potatoes in India
(National Horticulture Research and Development Foundation, 2010)

LEGAL RULES GOVERNING THE PRODUCTION OF POTATO

Since agriculture is a state subject in India, the marketing of agricultural products is governed by respective state Agricultural Products Marketing Committee (APMC) acts.

3.1 APMC Act 1960

The APMC Act 1960 required all agricultural products to be regulated to licensed commission agents in government regulated markets commonly known as *Mundee.* Created with an intention of preventing the exploitation of farmers by city based retailers and wholesalers, the act resulted in creation of marketing monopolies with a strong hold of commission agents who charged substantial commission and fee. The act also prohibited direct agreements between farmers and buyers, thus inhibiting investment (both domestic and foreign) in the food processing sector. The inefficient structure of the law promoted multiple intermediaries in the chain who added little to the value of produce but added a lot to the final cost collectively. The farmers were divorced from the market feedback and customers had little choice but to accept the produce irrespective of the quality and cost. The different levels of taxes charged by APMC centres and different state level regulations at different locations distort trade.

Recognising the flaws in the original act, the Ministry of Agriculture formulated a Model APMC Act 2003 and advised states to implement the act.

3.2 Model APMC Act 2003

Model APMC Act was formulated in 2003 by the Ministry of Agriculture to improve the efficiency of the marketing system. Following are some of the key recommendations in the Model Act (Government of India, 2010):

1. There will be no compulsion on farmers to sell to the government regulated APMC Markets.

2. Licensing of market functionaries is dispensed with and a time bound procedure for registration is laid down.

3. Legal persons, growers and local authorities are permitted to apply for new markets for marketing of agricultural produce in the area.

4. The existing APMC markets have been made responsible for ensuring complete transparency in pricing and other transactions taking place in the market area, providing market-led extension services to the farmers, ensuring payment to the farmers on the day of selling.

5. Promoting agricultural processing including activities for value addition.

6. Promoting public-private partnerships in the management of agricultural markets.

7. Provision made for selling of farm produce to contract farming sponsor without necessarily routing it through notified markets.

8. There will be no deduction towards commission from the sale proceeds payable to agriculturist seller.

This model act is quite comprehensive and if adopted will help in improving the efficiency of marketing system. The act is intended to end the monopoly of the state in the current system resulting in benefits for both- farmers and customers.

Many states have initiated reform in lines of the model act. The following chart depicts the progress of various states in implementing the necessary changes in the existing marketing system in accordance to the Model APMC Act (Government of India, 2010).

3.2.1 Progress of Reforms in Agricultural Markets (APMC Act) as on 30.11.2009

Sl. No.	Stage of Reforms	Name of States/ Union Territories
1.	States/ UTs where reforms to APMC Act has been done for Direct Marketing; Contract Farming and Markets in Private/ Cooperative sectors	Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Rajasthan, Sikkim and Tripura.
2.	States/ UTs where reforms to APMC Act has been done partially	**Direct Marketing:** NCT of Delhi. **Contract Farming:** Haryana, Punjab, Chandigarh. **Private Markets:** Punjab, Chandigarh.
3.	States/ UTs where there is no APMC Act and hence not requiring reforms	Bihar*, Kerala, Manipur, Andaman & Nicobar Islands, Dadra & Nagar Haveli, Daman & Diu, and Lakshadweep.
4.	States/ UTs where APMC Act already provides for the reforms	Tamil Nadu.
5.	States/ UTs where administrative action is initiated for the reforms	Mizoram, Meghalaya, Haryana, J&K, Uttarakhand, West Bengal, Puducherry, NCT of Delhi, Uttar Pradesh.

Table 3.1: Progress of reforms in Agricultural Markets as on 30.11.2009
(Government of India, 2010)

3.3 Status of Agricultural Marketing in Bihar

In 2006, Government of Bihar repealed the APMC Act. This was done with an intention of checking rampant exploitation of farmers by the licensed agents in the APMC markets and to encourage more private participation in the agriculture sector for the purpose of increased returns to the farmers. However the participation of private sector has not grown to very encouraging levels. The market yards are still being used by traders. Since there is no regulation in place now, there is a complete absence of transparency in the pricing of the produce and a stronger collusion between the commission agents and the traders. The repealing of APMC Act has not been followed by rapid development of alternate marketing channels. Thus farmers are forced to take their produce to the trader dominated market leading to their exploitation.

The Bihar State Regulation of Cold Storages Act 1992 requires operators to obtain a license to operate a cold store in the state. There are no restrictions on the number of cold stores. A 2000 amendment to the act establishes that the rental charges in a cold store cannot be regulated by the state. If an owner refuses to store the produce on claims of damage to the stored produce in the facility, Licensing Officer can be approached to check the validity of such claims.

The Essential Commodities Act 1955 was intended to ensure the availability of essential commodities including basic food items. This act provides powers for the searching of premise and confiscation of products if the act is violated.

CURRENT STATE OF POTATO SUPPLY CHAIN IN BIHAR

The potato supply chain in Bihar is another example of a highly inefficient supply chain which has become a typical characteristic of Indian agriculture over time. There are numerous intermediaries involved in the journey of the produce from farm to fork. The small and marginal farmers are often exploited at the hands of big traders, commission agents, wholesalers etc. and the consumers have to buy low quality produce at higher cost.

The study was carried out by interviewing various people representing different levels in a potato supply chain. The interviews were conducted at various places in Patna and Hazipur in Bihar. Wherever possible, the data obtained from the interviews was then checked against various relevant sources of information.

4.1 Possible routes in a potato supply chain

The following chart depicts the possible modes of a potato supply chain.

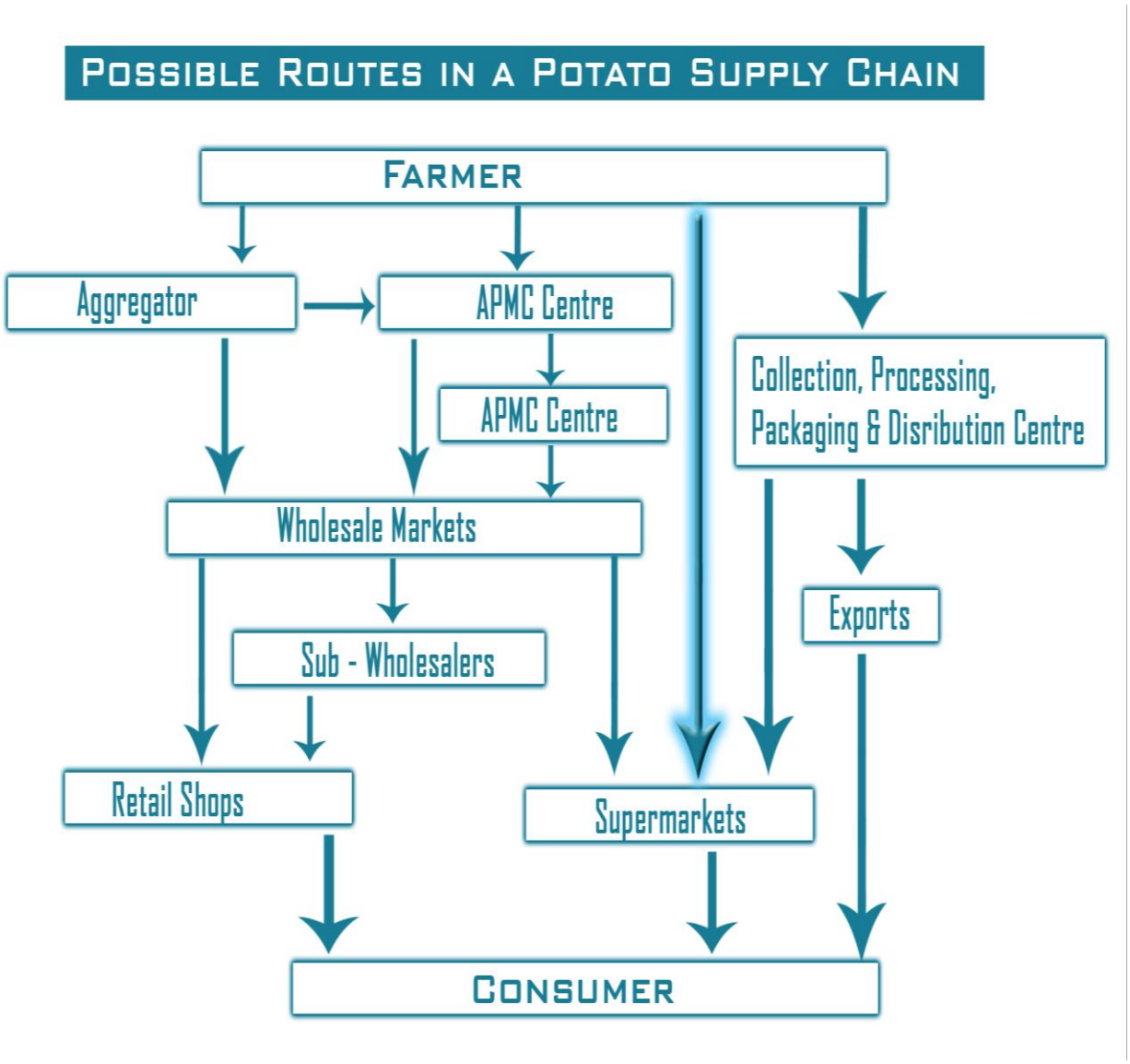

Figure 4.1: All possible modes of potato supply chain

The potato supply chain is highly complex with numerous stakeholders in the most common supply chain. The infrastructure connecting these partners is very weak leading to huge wastage along the chain. The shortest path containing the least number of intermediaries has been shown with a highlighted arrow. Here the produce collected from the farm is directly sold in the supermarkets bypassing the various intermediaries in the chain.

4.2 Functionaries in the supply chain

The potato supply chain consists of various components along the chain. This section gives the brief description of these components.

India is a land of small farms with an average size of operational land holding estimated to be 1.22 hectares in 2009.

A farmer is one of the most important components in the supply chain. A farmer undertakes substantial investment-both in time and money, in the entire cropping process. The size of operational holdings is decreasing with every successive generation thus limiting the ability of the farmers to access the markets. The average size of operational land holding was estimated to be 1.22 hectare in 2009 (Source: Government of India, 2006). As the consumption patterns of the Indian consumers shift towards fruits and vegetables, many such marginal farmers are taking to horticulture owing mainly to the increase in farm income from horticulture crops when compared with traditional crops of wheat and rice. Potato is a preferred crop for the farmers because of the low input costs and less duration of cropping among other reasons. The returns to these small holders and their ability to access markets will be critical towards ensuring an efficient supply chain.

Year	**Size of operational land holdings (hectare)**
1971	2.28
1991	1.57
1996	1.41
2009 (estimated)	1.22

Table 4.1: Decline in land holding size in India
(Source: Government of India, 2006).

An aggregator is a potato trader who in most cases is also involved in medium or large scale commercial potato farming. They generally function as a collector purchasing potato from farmers at the village level and then selling it either at the APMC markets in the peak season (Feb-March) or to the wholesalers from the cold storages in the off season (July-August). They deal in big quantities and are aware of the information pertaining to prevalent prices in various markets. In most cases, the aggregators provide credit to the farmers at the time of sowing. The farmer is thus obliged to sell his produce to the aggregator. Also, the interest rates charged on credit are found to be exceptionally high (as high as 5% per month).

An APMC market is a regulated market yard where a licensed commission agent facilitates the sale of agricultural produce brought by the farmer to the market. The produce is sold by the means of an open-

outcry auction managed by the commission agent who deducts his commission. These licensed middlemen often collude with traders leading to widespread exploitation of farmers. Given the abysmal state of infrastructure in these markets, a lot of agricultural produce brought to these markets is wasted. The functioning of these markets is regulated by respective state APMC acts.

Wholesalers are specialized potato traders dealing in big quantities of potato brought either from the APMC market (during peak season) or from the cold storage (during off season). They often sell to small unorganized retailers which includes the neighbourhood *kirana* stores or the street vendors. The wholesale markets are also an important source for the modern organized retail formats such as supermarkets.

A major innovation in the supply chain has been the establishment of the modern centres with the facilities for collection, processing, packaging and distribution of the produce. A large part of the produce at such centres is meant for exports. Also, a substantial part of the produce is taken by the modern supermarkets.

An estimated Rs 1000 billion are lost in the supply chain annually, 57% of which is due to avoidable costs of wastage and rest is due to avoidable costs of storage and commissions (Credit Rating Information Services of India Limited, 2007).

The supply chain for potato can be studied under the following two heads:

1. Supply chain during peak season (February-March)

2. Supply chain during off season (July-August)

The potato supply chain is different for the above two cases. The value chain analysis has been done separately for both cases in the following section.

The supply chain during peak season and off season has been represented in separate charts in the following section. The charts also depict the value addition at each level of ownership and the margin of the respective component of the chain. The margin for an ownership level is calculated using the values of the buying cost, selling cost, cost of value addition on the date of observation and the loss at that level. The amount of loss is assumed to be roughly 4% at each level of ownership.

4.3 Chain maps for the supply chain of potato both during peak season and off season

Potato is harvested during the months of February and March. A part of the produce is then directly sold in the markets. The most common supply chain for potato during peak season (February-March) and off season (July-August) can be represented by the following chain maps:

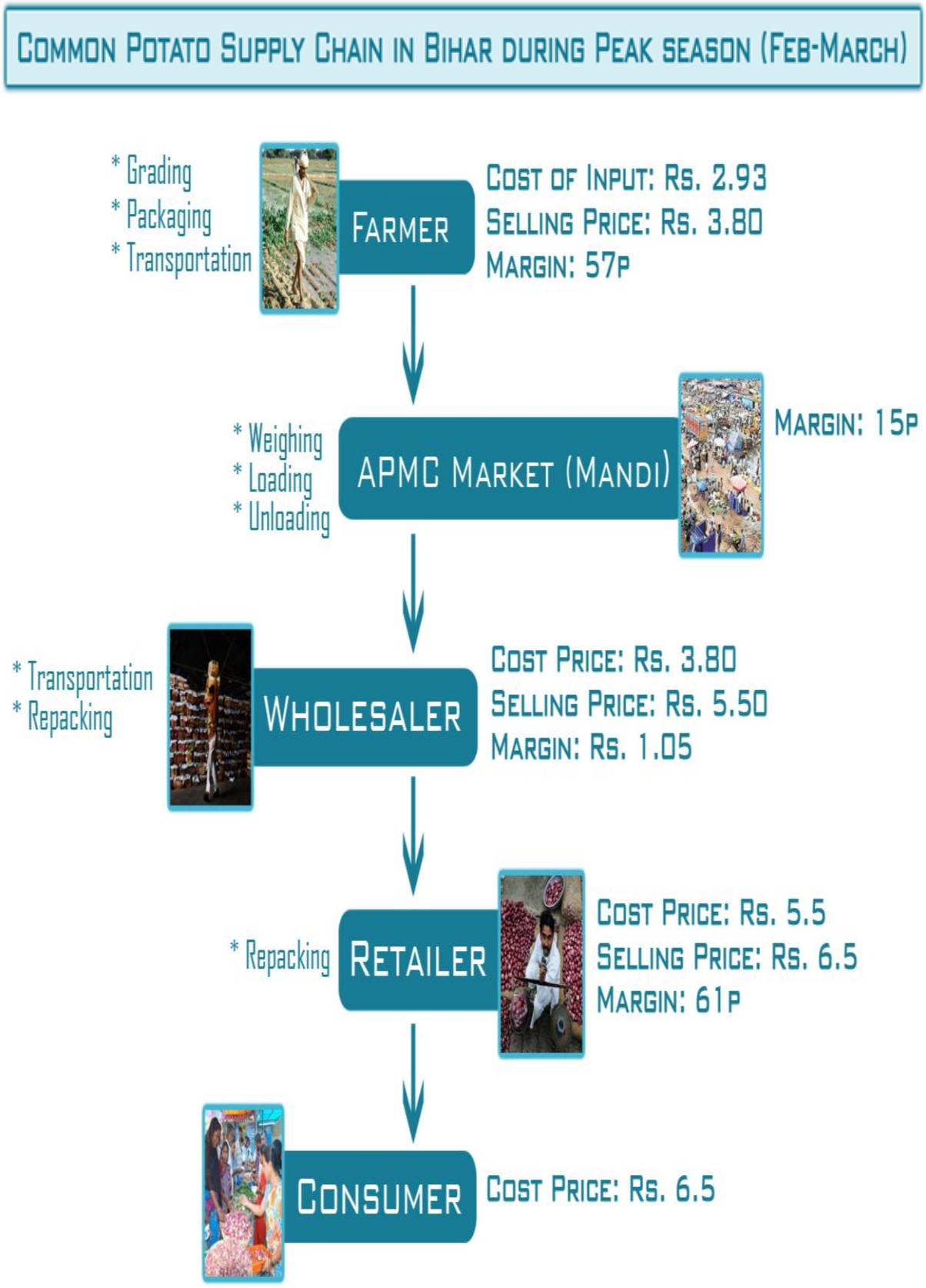

Figure 4.2: Common potato supply chain in Bihar during peak season

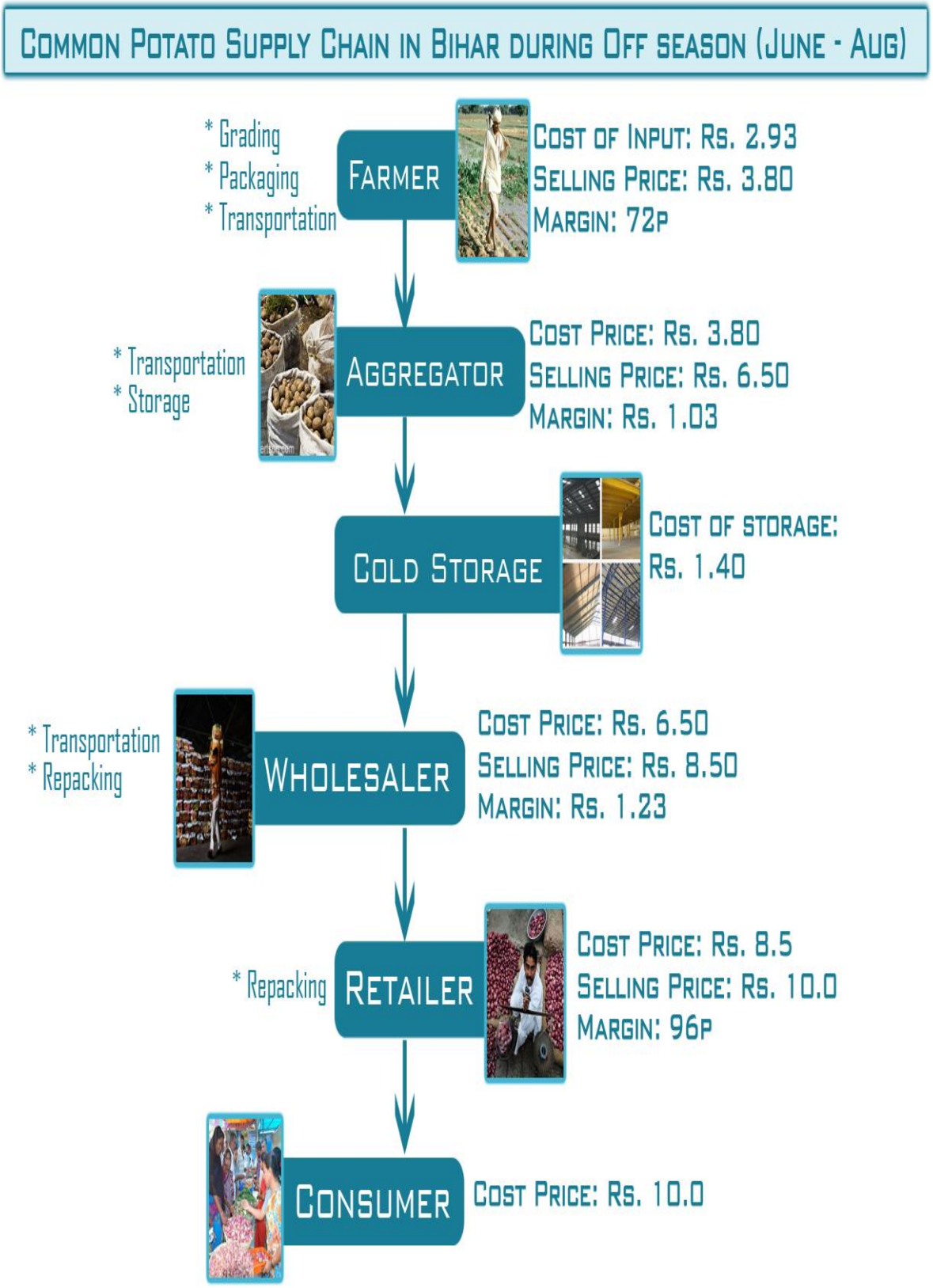

Figure 4.3: Common potato supply chain in Bihar during the off season

Following points describe in detail the chain maps during peak season and off season.

1. Before selling the produce at the market, farmer invests in grading, packaging and transportation of the produce to the market.

2. In peak season, the farmers then take their produce to the shop of the commission agent in the market area who facilitates the sale of his produce by means of an open-outcry auction. The agent deducts his commission from the transaction (In Bihar, the agent charges 4% of the selling price from the farmers as commission). The agent does not take the possession and in most cases no value is added at this level of ownership.

3. In off season, the produce from the farmers is acquired by an aggregator who takes the produce to the cold storage. The small farmers often lack the capital to spend on storing the produce and are often unwilling to take the risk of storing now and selling later. The aggregator takes advantage of the higher prices in the off season.

3. The produce from the APMC markets in the peak season and from the cold storages in the off season is acquired by the wholesalers who transport the produce from the market yard to their premises and sell the produce to the retailers.

4. The last link in the chain is the customer.

4.4 Value Chain analysis for the potato supply chain in Bihar

The value chain is analysed in terms of the margin distribution among different components in the chain, distribution of the retail price in terms of the percentage of the final retail price received by the farmer and the percentage of the price escalation accounted for by the value addition.

4.4.1 Margin Distribution among various intermediaries in the supply chain

The following pie charts represent the share of various components of the chain in the total margin along the chain. The margin has been calculated considering the input cost, cost of selling and cost of value addition at that level of ownership.

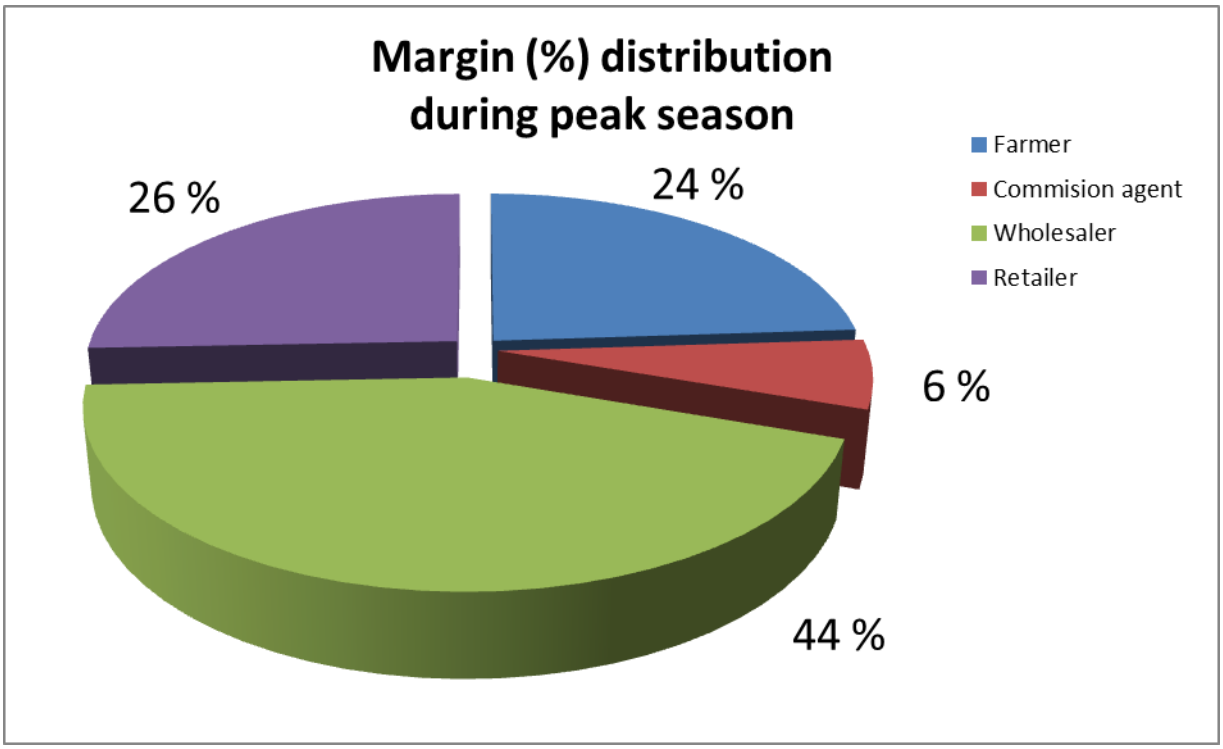

Figure 4.4: Distribution of margin amongst various intermediaries during peak season

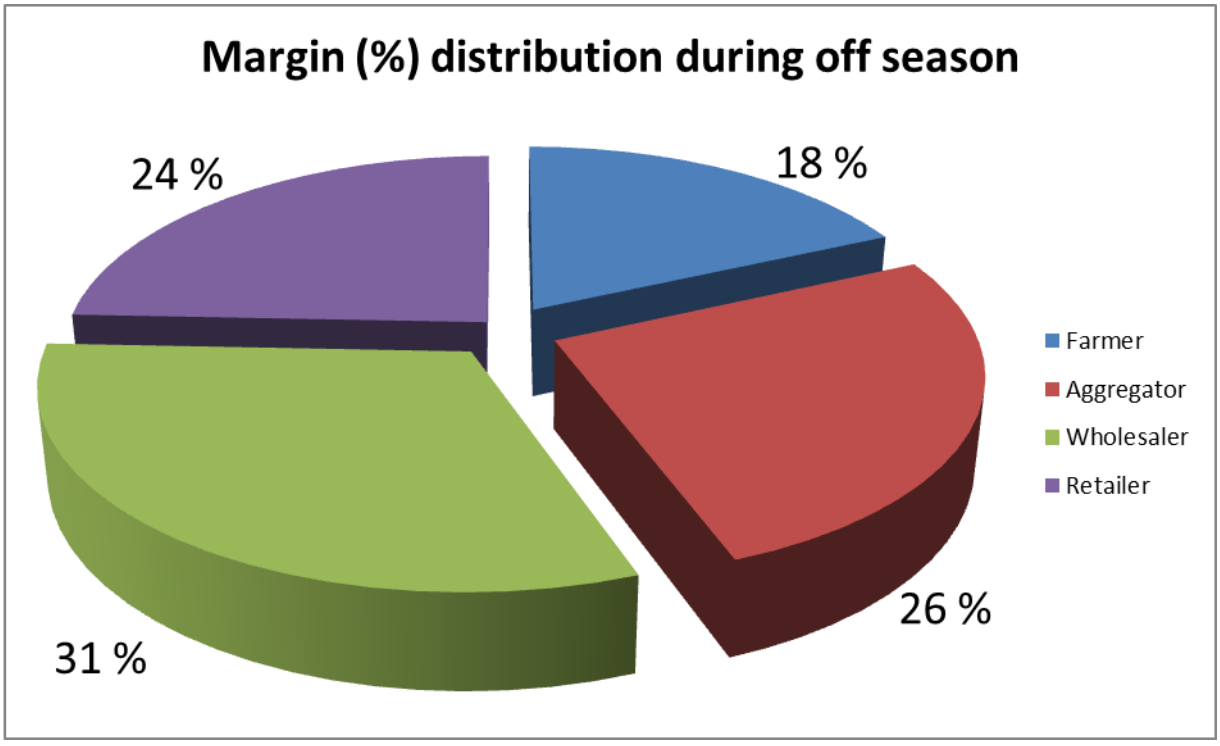

Figure 4.5: Distribution of margin amongst various intermediaries during off season

The margin distribution amongst various intermediaries in the potato supply chain both during peak and off season is explained below.

1. In the peak season supply chain, maximum share of the margin is cornered by the wholesaler while the farmer gets only a little part especially when the maximum value addition and input cost is borne by the farmer.

2. In the off season, the wholesaler still has the highest margin when compared with other components in the chain. This margin however is significantly lower than the margin in the peak season largely because in the off season a significant part of the margin is cornered by the aggregator who sells the produce from the cold storage when the prices are high.

3. The insignificant margin received by the farmer in both the cases can be attributed to their little bargaining power, high cost of credit, collusion between commission agents and wholesalers and high levels of wastage owing to poor infrastructure.

4. The wholesalers and aggregators receive a high share of the margin largely because of the superior price information available to them.

5. The retailers also receive a significant margin, more so when there is very little value added by them.

4.4.2 Share of value addition in total price escalation

Only a small part of the total price escalation in the potato supply chain is accounted for by the value addition. The remaining cost is added on account of various intermediaries present along the chain who add little value to the produce but add collectively to the price escalation along the chain.

In the peak season supply chain, only 19% of the total price escalation from farmer to the consumer is accounted for by the value addition. This is less compared to the 34% of the total price escalation that is accounted for by the value addition in the supply chain during off season.

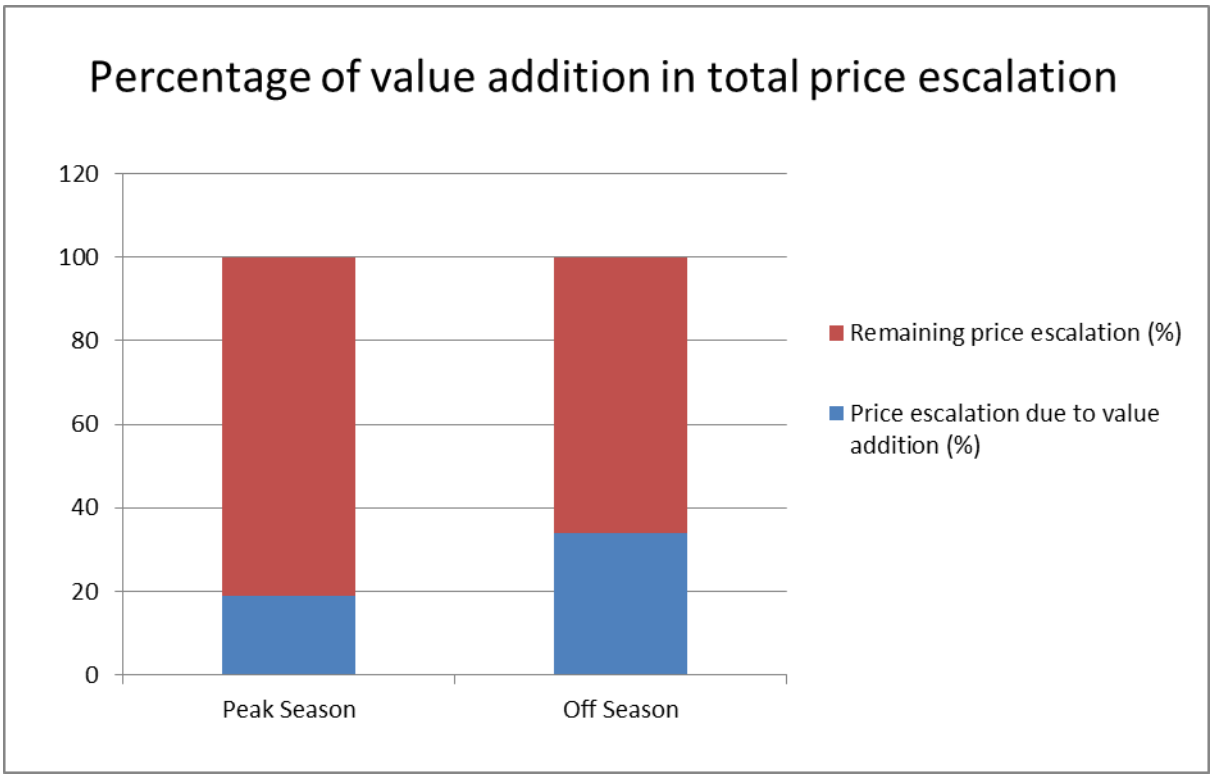

Figure 4.6: Percentage of value addition in total price escalation

As is seen in the figure, the percentage contribution of value addition in the total price escalation is more in the off season than in the peak season. This is because of the significant storage costs in the off season. In both the cases, the contribution of the value addition in the total price escalation is low especially when compared with countries like USA where the contribution of value addition in the total price escalation is as high as 80% (The McKinsey Quarterly, 1997).

4.4.3 Share of farmer in the final retail price of potato

The share of farmer in the final retail price of potato is more in peak season (58%) when compared with the off season (38%). This is because a significant part of the retail price in the off season is accounted for by the storage costs and comparably high margin of intermediaries.

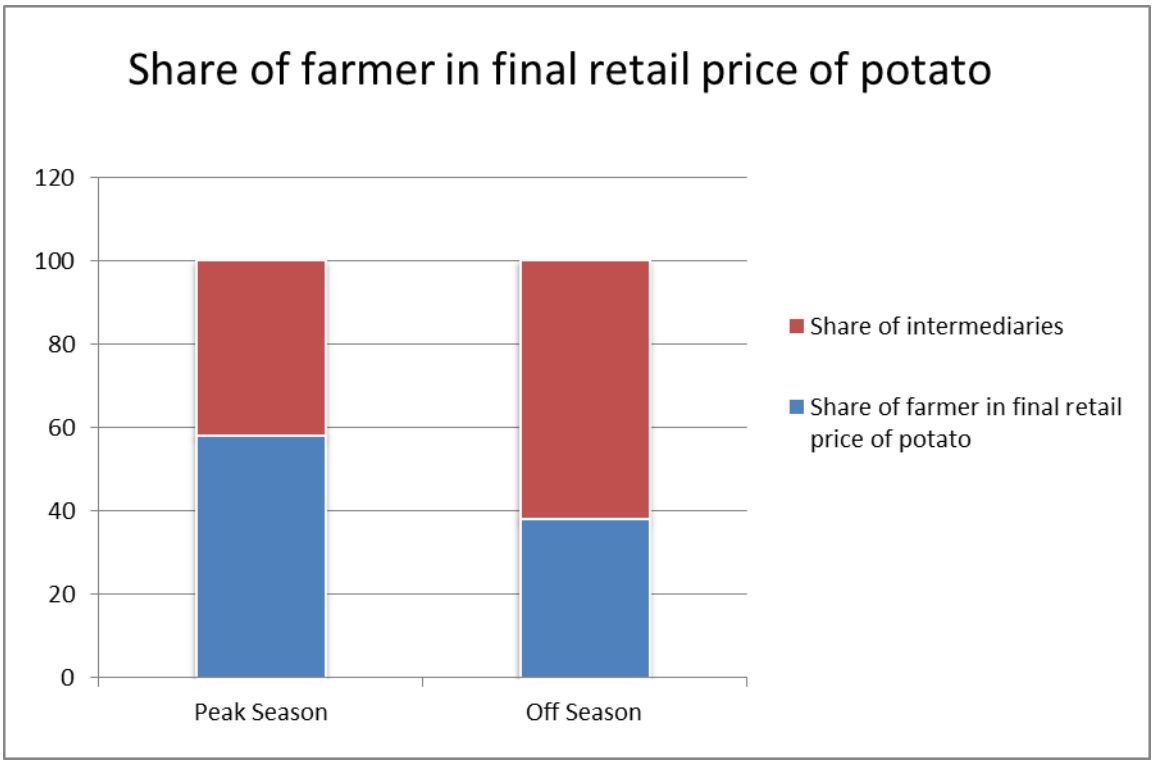

Figure 4.7: Share of farmer in final retail price of potato

The share of the farmer in the final retail price of potato is low when compared with farmers in countries like USA. A farmer bears the maximum input cost and value addition but still receives only a little part of the final retail price. The intermediaries take away a significant chunk most of which is not accounted for by the value added by the intermediaries.

CONSTRAINTS IDENTIFIED ACROSS THE SUPPLY CHAIN

From the value chain analysis it is amply clear that there are a lot of constraints present across the supply chain. This is clearly evident from the share of farmer in the margin and the final retail price and percentage of price escalation accounted for by the value addition. The constraints identified across the supply chain can be labelled under following three heads.

1. On-farm Constraints
2. Non-farm constraints
3. Logistic Constraints

5.1 On-farm constraints

The problems impacting the potato supply chain at the farm level can be clubbed under on-farm constraints. This section discusses the various major problems faced by the farmer in the production of potato.

a) **Lack of quality inputs at affordable prices:** Seed is the most important input in terms of cost and impact on the process of production. During the study it was observed that medium size tubers meant for table-purpose usage were used as seeds. The cost of certified seed available at subsidized prices in Patna was Rs. 1400/quintal. There was an additional cost of transportation to be borne by the farmer. Thus in most cases farmers store a part of their produce in the cold storage which is used as a seed. This had a considerable impact on the yield obtained. The susceptibility to diseases also goes up considerably. Similarly, inputs like fertilizers and pesticides were not accessible at reasonable prices. The consumption of fertilizers per hectare in Bihar in 2003 was half of what was consumed in Punjab. (World Bank, 2007). Also, shortage of electricity is forcing farmers to shift to diesel pumps for irrigation which increases the cost of production.

b) **Inferior farm technology:** The level of adoption of modern technology was observed to be very low in Bihar. This can partly be attributed to the small size of land holdings in Bihar. Technology transfer through public extension is at negligible levels in Bihar. In most cases farmers relied on mass media (TV/Radio/Newspaper) or other farmers for accessing information (World Bank, 2007). The agricultural research is yet to effectively find its way to the fields.

c) **Poor access to formal credit:** Bihar had one bank branch for 22,248 people in 2006 according to a Government of Bihar report. This was significantly worse than the national average of one bank for 15,000 people. This limited reach of banking institutions forced farmers to seek credit from informal sources such as private moneylenders who charged exorbitant rates of interest. At the site of study in Bihar, it was observed that rates as high as 5% per month were being charged by private moneylenders. On account of the low levels of awareness, collusion between bank officials and middlemen who charged huge commissions for assisting farmers in getting the credit and several other reasons, a significant part of the farmers contract their debt from private moneylenders. The high cost of credit contributed significantly in increasing the cost of potato production.

5.2 Non-farm Constraints

The constraints existing across the supply chain once the produce moves beyond the farm to the consumer can be classified under this head.

a) **Ineffective APMC markets:** In the current marketing setup, APMC markets occupy an important position. Even though the APMC Act has been repealed in Bihar, a significant part of the produce is routed through APMC markets owing largely to the absence of effective alternatives. Going by their mode of operation, these markets are inefficient with opaque pricing process. They are plagued by collusion of APMC agents amongst themselves and with the traders thus depriving farmers of the fair price for their produce. There is a high level of physical wastage at this level of the supply chain. Also, the licensing of the commission agents acts as an entry barrier for other entrepreneurs to be a part of the supply chain.

b) **Absence of an effective legislation to check collusion:** There is no effective legislative enforcement to check the widespread collusion between different intermediaries in the supply chain which ultimately leads to low returns to the farmer and the high prices for the consumer.

c) **Absence of effective supply chain management techniques:** In Bihar, as in other parts of India there is no master of chain who ensures the efficiency of the chain. As a result, practices like Demand-Supply matching, management of financial flows, efficient transport scheduling etc. have not yet found a place for themselves in the supply chain.

d) **Low level of processing:** An inefficient supply chain, an inferior quality of produce, high taxes and duties and very few food processing units has meant that the level of food processing remains at very low levels. This has acted as a serious impediment in the way of farmers getting more returns for the produce.

5.3 Logistic Constraints

In Bihar, there is insufficient infrastructure available for warehousing, distribution, cold storage and transport. In 2009, Bihar produced 50, 33,000 tonnes of potato while the cold storage capacity for potatoes was a meagre 13, 62,429 tonnes (Central Potato Research Institute, 2010). Thus there is a huge infrastructure gap which leads to a high level of wastage across the chain. This in turn leads to a significant escalation in the price of the commodity.

RECOMMENDATIONS

Following are some of the recommendations made to improve the efficiency of the supply chain:

6.1 Promotion of expansion of organized retail

A simplification of entry barriers can give a major boost to the expansion of the organized retail in India. In many developing countries where the share of organized retail is much higher it has been observed that the efficiency of the supply chain has improved greatly (Indian Council for Research on International Economic Relations, 2008). The biggest concern of the policymakers in enforcing such legislation has been the impact of organized retail on the unorganized sector. However it has been established through research that unorganized retail has maintained employment levels in presence of organized retail perhaps as a result of competitive response (Indian Council for Research on International Economic Relations, 2008). In addition to this, there will be a lot of new jobs added by the organized retail. Following are some of the ways in which the organized retail can help address some of the issues in the current supply chain:

a) Direct procurement of farmers will lead to increased returns to farmers on account of bypassing of numerous intermediaries in the supply chain.
b) The organized retail outlets will work directly with farmers to improve yields by enabling them to obtain quality input supplies, modern farm technology and timely credit at reasonable interest rates.
c) They will invest heavily on logistics such as cold storage, warehousing, transport and distribution either directly or through third party logistics.
d) These outlets will create employment for both skilled and unskilled workers.
e) A higher share of organized retail will boost the tax receipts of the government.

6.2 Promotion of associations of farmers and small retail outlets:

Organizing farmers into larger producer groups can benefit the entire value chain. These groups will then be better placed in terms of collective pre and post-harvest management, reduced transaction costs and higher bargaining power. The government can also encourage small retailers to come together to form cooperatives which can then undertake direct procurement from farmers.

6.3 Policy Recommendations

Following recommendations are hereby put forth in the area of policy changes required to improve the efficiency of the supply chain:

a) Ensure better credit access to small farmers from banks and micro-credit institutions.
b) To build capacity to boost agricultural research so that better farm techniques can find their way to the fields.
c) Modernize the APMC markets by providing for better infrastructure in the market place such as closed places for trading, better roads, better hygiene, better waste disposal system etc.
d) Increase incentives in terms of cheap credit, reduced entry barriers for the private players to invest in the logistics across the chain.
e) Find ways to curb collusion between market players at various levels of supply chain.

f) Reduce the entry barriers for the organized retail.
g) Promote the food processing industry through simplified tax regime and other relevant incentives in credit etc.

CONCLUSION

The margin analysis for potato supply chain for both peak season and off season loudly points towards widespread exploitation of the farmers in the current state of the supply chain. The supply chain is dominated by numerous intermediaries who do not add significant value along the chain but add a lot to the final price. The situation is further aggravated by a very little bargaining power of the farmers who in absence of a transparent pricing process are unable to receive a fair price for their produce. This is supported by the margin analysis presented in the study. For an effective overhaul of the supply chain towards a more efficient system, several measures have been recommended in the study. The private sector has to be encouraged towards an increased participation in the supply chain. The government will also have an important role to play in setting the overall strategy and ensuring its implementation, overhauling infrastructure and creating a conducive environment to attract sizeable investment in this sector in the future.

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APPENDIX

Table 1: Dry matter content in Potato compared with other food commodities

Commodity	**Potato**	**Wheat**	**Rice**	**Maize**
Dry matter content (kg/ha/day)	47.6	18.1	12.4	9.1

Table 2: Usage of Potato for different purposes

Usage	**Percentage use of the total produce**
Table Purpose	61.47%
Seed	21%
Processed	0.50%
Export	0.03%
Loss	17%

Table 3: World Potato production year wise

Year	1970	1980	1990	2000	2008
Potato Production (in Metric Tonnes)	29,80,48,017	24,04,64,105	26,66,27,589	32,73,42,594	31,41,40,107

Table 4: Country wise potato production in 2008

Name of the Country	**Potato Production in 2008 (Metric Tonnes)**	**Percentage Production**
China	57059652	18
India	34462500	11
Russia	28874230	9

United States	18721660	6
Ukraine	19545400	6
Germany	11369000	4
Poland	10462100	3
Belarus	8748630	3
Netherlands	6922700	2
France	6808210	2
Others	111166025	36

Table 5: Statistics on Potato production in India

Year	Area under Potato cultivation ('000 hectares)	Production of Potato (in '000 tonnes)	Potato Yield (qtals/ha)
1950-51	240	1660	69.2
1960-61	375	2719	72.5
1970-71	482	4807	99.7
1980-81	729	9668	132.6
1990-91	936	15206	162.5
2000-01	1200	22143	182.8
2007-08	1811	28580	157.8

Table 6: State wise potato production in 2008-09

Name of State	Uttar Pradesh	Bihar	West Bengal	Punjab	Gujarat	Others
Production of potato (in '000 tonnes)	10,809.90	5033.6	4090	2001.1	1448	5,197.60
Percentage production statewise	37.8230383	17.6121930	14.3106064	7.00170047	5.06644460	18.1860168

Table 7: Yield comparison of different staes in 2008-09

Name of State	Bihar	Gujarat	Punjab	Uttar Pradesh	West Bengal	National Average
Yield (qnt/ha)	162.2	254.2	246.7	205	106.8	157.8

Table 8: Status of potato production in Bihar

Year	2004-05	2005-06	2006-07	2007-08	2008-09
Area ('000 hectares)	138.7	142.3	151.4	152.4	310.3
Production ('000 tonnes)	1062.8	1232.7	1178.1	1203	5033.6
Yield (qntl/hectare)	76.6	86.6	77.8	78.9	162.2

Table 9: Share of organized retail in developing countries

Country	China	Brazil	Indonesia	South Korea	Thailand	India
Share of organized retail (%)	20	36	30	15	40	4

Table 10: Level of food processing in fruits and vegetables country wise

Country	USA	Australia	Germany	India	China	Phillipines
Level of Processing (%)	80	25	33	1.3	23	78

Table 11: Impact of Contract Farming on return to farmers

	Contract	Non-Contract
Price (Rs./ql)	546	316
Gross Margin (Rs./acre)	16595	10272

Table 12: Cold storage scenario in India

Cold Storage Capacity for potato in 2008-09('000 tonnes)	Potato production in 2008-09 ('000 tonnes)	Additional Capacity required ('000 tonnes)
18426.316	28580.2	10153.884