Agriculture is the lifeline of Assam's economy with its remarkable strength in agriculture, including a suitable climate, water resources and soil that make it possible to grow a variety of food crops. Agriculture sector accounts for 18.22 percent of Gross State Domestic Product during 2011-12 and it continues to support more than 75 percent population of the state directly or indirectly providing employment of more than 53 percent of total workforce\(^1\). These facts underline the key role that agriculture plays in the Assam’s economy as well as in the state’s poverty reduction strategy. As the people of Assam cultivate agricultural goods extensively, growing importance of agricultural markets in Assam has led to the study of certain issues related to agricultural markets. In this context market integration of agricultural goods is a prime issue which is to be studied systematically.

The study of market integration has almost exclusively referred to events resulting in price changes since prices are the main reflectors of marketing system. There are several reasons for studying market integration. Market integration is linked with the free flow of goods and information over time and space. The degree of price transmission which is associated with market integration may have an effect on the speed of traders' response to move agricultural goods to deficit areas. Market integration ensures that a regional balance occurs among deficit and surplus regions. In the absence of spatial integration of markets, price signals will not be transmitted from food deficit to food surplus areas (Baulch, 1997). If market integration does not occur in the form of price convergence, the localized food scarcities and abundances may result in excessive stress on the population. The effectiveness of market based policies for poverty alleviation and food security will be better if markets are integrated. Finally the identification of the various structural factors responsible for the integration of markets may improve policy measures towards market development.

\(^1\)Source: Economic Survey of Assam, 2012-13
In the context of Assam, while agriculture scenario of the state has been extensively studied, no known attempts have been made to analyze the issues related to market integration. In view of this perceived gap in research, the present study is taken up wherein the prime focus is on the above issues. Again, due to some barriers that exist in interstate trade, the present analysis confines to the market integration analysis within Assam only.

The present study focuses on the level of integration of domestic food crops market in the Brahmaputra valley of Assam. Domestic food crops are those food crops which are largely produced in Assam. The cropping pattern of Assam reflects that food crops dominate in Assam’s agrarian economy. In 2011-12, about 79.72 percent of total area of the state was covered by food crops\(^2\). There are already separate marketing agencies for cash crops and the nature of market integration expected to be different crops is not likely to be uniform. Therefore the entire focus of the study is on food crops. The term food crops basically means primary food crops which directly come to the market from the farm but one semi-processed food crop is also included in the study. Assam has three physical divisions namely the Brahmaputra valley, the Barak valley and the hilly region. The Brahmaputra valley which forms northern part is the largest in size and geographical barriers are less compared to other parts of the state. Therefore the present study confines to the Brahmaputra valley only.

\textbf{1.2 Conceptual Background and Review of Literature}

This section provides a selective review of literature relating to relevant theoretical and empirical studies addressing the issues of integration of markets. This section has been organized in various sub-sections. Section 1.2.1 discusses the concept of marketing system and how prices guide the direction of economic activities in a market driven economy. Section 1.2.2 provides the concept of market integration. The economic justification of

\(^2\) Source: Economic Survey of Assam, 2012-13
market integration is presented in section 1.2.3. In section 1.2.4, the factors significantly affecting integration of markets are reviewed. Section 1.2.5 starts by reviewing methods used in testing market integration. Section 1.2.6 gives an overview of selected literature on integration of markets internationally. The review of empirical market integration studies specific to India given in section 1.2.7.

1.2.1 The Concept of Marketing System and Price Analysis

The two basic elements of an agricultural system are production and marketing. Marketing as a link between producers and consumers, plays a very important role not only in stimulating production and consumption but also in increasing the pace of economic development (A Sivarama Prasad, 1985). In a market driven economy, a marketing system transmits information which is useful in efficient decision making of market participants and encourages compromises between the goals of producers and consumers (Alemu and Schalkwyk, 2009).

Price signals play a very significant role in the manner and performance of an efficient marketing system. They provide a good explanation of market choices and guide and regulate production, consumption and marketing decisions over time, form and place (Kohls and Uhl, 1990). Given this market-price linkage, the interrelationships of prices among spatial markets become vital to economic analysis. In this regard, market integration is gaining special significance in the current economic literature.

1.2.2 The Concept of Market Integration

If the markets of commodities are closely interrelated i.e. the price formation in one market is related to the prices in other markets, this interrelation between price movements in the markets is defined as market integration. Market integration is defined as the degree of price transmission between two either vertically or spatially related markets. The operational definition of market integration is known as the Law of One Price (LOP) which means that identical products sell at uniform price across different markets. In the
domestic economy if LOP holds then domestic market integration exists (Bradford & Lawrence, 2004).

Market integration can be horizontal and vertical. Horizontal integration or spatial integration is measured by the relationship in prices prevailing in spatially separated market places. According to Goletti, Ahmed and Farid (1995), spatial market integration refers to the co-movement of prices, and more generally, to the smooth transmission of price signals and information across spatially separated markets. Horizontally two types of prices are prevailed, spatial price and seasonal price (within the year). Vertical integration is measured by the relationship of prices prevailing at different stages of marketing or at different points of time during a marketing season. Vertically three types of prices are prevailed, farm gate price, wholesale price and retail price (Acharya and Agarwal, 2004).

According to Rivera and Helfand (2001), a market with ‘n’ geographically distinct locations will be considered integrated if the following two conditions are satisfied:

a) There must be physical flow of goods connecting all ‘n’ locations either directly or indirectly.

b) ‘n’ locations must have a corresponding vector of prices \( \{p_{1t}, p_{2t}, \ldots, p_{nt}\} \) that can be decomposed as \( p_i = a_i f_t + t_{it}, i=1,2,\ldots,n \) and \( a_i \neq 0 \), where \( f_t \) is the integrating factor that characterizes the permanent (long run) component of the price and \( t_{it} \) is the transitory (short run) component for each location.

The basic elements of this definition are the existence of trade and that \( f_t \) is common to all series of prices. This definition provides an operational framework to search for the extent, or geographic boundaries, of an integrated market.

Market integration is different from competitive spatial equilibrium (Barrett, 2002). Market integration might be most usefully defined as tradability or contestability between markets. This implies the transfer of Walrasian excess demand from one market to another, manifest in the physical flow of commodity, the transmission of price shocks from one market to another, or
both. The distinct yet interrelated concepts of spatial equilibrium and market integration both rely on three variables: prices, transaction costs and trade volumes. One can use these three variables to define four distinct market conditions:

a) Perfect integration: \( R_{jit} = 0 \) and \( T_{jit} \geq 0 \)

Where \( R_{jit} \rightarrow \) Returns accrued from flow of commodities from location \( j \) to location \( i \) in time \( t \).

\( T_{jit} \rightarrow \) transaction costs of spatial arbitrage from location \( j \) to location \( i \) in time \( t \).

b) Segmented equilibrium: \( R_{jit} < 0 \) and \( T_{jit} = 0 \)

c) Imperfect integration: \( R_{jit} \neq 0 \) and \( T_{jit} > 0 \)

d) Segmented disequilibrium: \( R_{jit} > 0 \) and \( T_{jit} = 0 \)

The first two conditions, perfect integration and segmented equilibrium are consistent with spatial equilibrium, although integration holds in only the first of these. The latter two conditions, imperfect integration and segmented disequilibrium are inconsistent with spatial equilibrium, although the former condition describes integrated markets.

1.2.3 Economic Justification for Market Integration

There are several reasons for studying market integration. According to Barret (2005), spatial market integration can be treated as a guide for corporate or government policy. At the national level, macroeconomic policies commonly become ineffective without strong market transmission across space. Markets play a fundamental role in managing risk associated with demand and supply shocks in that well integrated markets facilitate adjustment in net export flows across space, thereby reducing price variability faced by the producers and consumers.

Goodwin and Schroeder (2001) indicate that if markets are not integrated, it may convey inaccurate price information which may distort marketing decisions of producers. It may also contribute to inefficient movement of goods. For the appropriate formulation of policies and food security programmes such as emergency stock and trade, it is very crucial to understand the degree of market integration.
Wu Laping (2009) states that the studies of speed of price transmission can help the governments to plan price support policy for regional markets. It also helps governments to control the supply of agricultural products so as to ensure balances in agricultural products supply across the country and to evade too much volatility in the rural economy.

Baulch (1997) indicates that without spatial integration of markets, price signals will not be transmitted from urban food deficit to rural food surplus areas, there will be more volatility of prices, agricultural producers will fail to specialize according to long term comparative advantage and the gains from trade will not be realized.

Amha (1999) states that market integration ensures Pareto optimal resource allocation across spaces. However a quite contradictory result was found by Ravallion (1986) that market integration is by no means sufficient for the Pareto optimality of a competitive equilibrium. Even when based on a sound empirical methodology, the conclusion that markets are well integrated does not, of itself, imply an efficient spatial allocation.

According to Goletti, Ahmed and Farid (1995), the study of market integration makes it possible to identify groups of integrated markets, so as to avoid duplication of intervention. If locations A, B and C are well integrated, then the government may think of withdrawing from, or at least reduce, its effort to influence the price process in those locations. Moreover knowledge of market integration is relevant to the success of market liberalization and price stabilization policies.

According to Bradford and Lawrence (2004), if two competitive markets are integrated, prices will rise in one market and fall in the other. As prices converge, production in the market experiencing price rise will increase and consumption will fall as some of the goods it produces are exported to the other market. The gains to producers outweigh the losses to consumers. On the other hand, in the other market in which price falls, the gains to consumers outweigh the losses to producers. Thus price converge necessarily improves overall welfare.
1.2.4 Factors affecting Market Integration

Goletti, Ahmed and Farid (1995) explored several issues related to rice market integration in Bangladesh. They analyzed the effects of various structural factors on spatial market integration. They categorized the factors into three broad headings viz infrastructure, production and volatility of policy. Transportation infrastructure was captured by the road distance between markets. The overall results of factor analysis indicate that distance hinders spatial integration. If the road distance between two markets is greater, it is more costly to undertake trade and hence extent of integration will be less. The degree of dissimilarity in production affects market integration positively, since the more dissimilar the markets the more the incentive to trade with each other.

Volatility of government intervention can influence market integration in both a positive and a negative way. On the one hand, price intervention smoothes seasonal and inter-year fluctuations, thus enhancing the co-movement of prices across markets (Goletti, Ahmed and Farid, 1995). Again government intervention can force the same price changes among regional markets, so that the degree of market integration seems to be higher (Wu Laping, 2009). On the other hand, this very stabilizing process may become unpredictable and therefore hinder the transmission of price signals across markets (Goletti, Ahmed and Farid, 1995). Wu Laping (2009) mentions that government intervention leads to blockage of regional markets so as to reduce the degree of market integration and sometimes it cuts the price linkage among markets completely.

Angelo and Cordano (2008) studied market integration for agricultural output markets in Peru. He observed that road and electrical energy infrastructures as well as the access to local media and telecommunication facilities are the key factors for the reduction of transport costs and the improvement of spatial integration between markets.

Wu Laping (2009) states that seasonal factors and inflation will affect market integration especially in the long run. Moreover, the characteristics of different products, the presence of monopoly power and the presence of self
sufficiency in production are also important factors which affect market integration.

The conclusion that can be drawn from the above studies is that market integration is affected by various factors, among which the most important are infrastructure, production and government intervention.

1.2.5 Testing Market Integration

Testing for market integration has been an area of research interest for a long time. The most common method of testing for market integration involves evaluating the correlation between price changes in different markets (Delgado). Simple bivariate correlation model has been used by Jasdanwalla (1966), Cummings (1967), Lele (1971), Jones (1972), Kainth (1982), Stigler and Sherwin (1985) and Neal (1987) for testing market integration. This method is widely used in early studies because of its simplicity (Goodwin and Piggott, 2001). The degree of correlation between prices in various markets is taken as an index of the extent to which the two markets are integrated. A high degree of correlation coefficient indicates a greater degree of integration, at least in terms of the pricing of the product between market centers and vice versa. However this approach has been strongly criticized. Price correlation assumes instantaneous price adjustment and it unable to capture the dynamic nature of the market system (Sexton et al. 1991). It is possible that prices tend to move together or high price correlation exists for reasons like common trends, common seasonality, monopoly price fixing, inflation etc other than market integration. Hence price correlation may suggest spurious market integration. There may be biases arising from serial correlations or omitted variables. Price correlation studies the relationship between two markets at a time. It cannot be used to evaluate the marketing system as a whole (Barret, 1996).

In the recent research studies, time series price data have been extensively used to throw light on the market integration of agricultural commodities. Cointegration analysis is the primary tool used for analyzing market integration since most of the price series tend to be non stationary. According to cointegration modeling technique, markets are said to be
integrated when prices in spatially separated markets are cointegrated. Two or more non stationary price series belonging to spatially separated markets are said to be cointegrated if there exists a long term equilibrium relationship between them. Two most common methods which are widely used by researchers for testing cointegration are Engle and Granger (1987) two step procedures and Johansen’s (1988) cointegration test.

The Engle and Granger test involves straight forward regression procedure. If two time series $X_t$ and $Y_t$ are co-integrated, a linear combination of them must be stationary. In other words $Y_t - \beta X_t = U_t$ where $U_t$ is stationary. The first step is to estimate $\beta$ by using Ordinary Least Squares (OLS) method. The second step is to run stationarity test on the estimated $U_t$ series. However this method has been criticized on the ground that it is subject to the normalization problem in setting the dependent variable as in the case with stationary data and normal statistical inference and tests for the law of one price (LOP) are not valid (Asche, Gordon and Hannesson, 2004).

Johansen (1988) offers a solution to the problems faced by the Engle and Granger test by modeling the price relationships in a Vector Auto Regressive format (VAR). It is carried out within a system format and therefore normalization on the prices is not necessary. Again in this method, likelihood ratio tests can be used to investigate hypotheses on the parameters and hence test for law of one price (Asche, Gordon and Hannesson, 2004).

Johansen cointegration method involves the following steps. The first step is to check the non stationary nature of price series with the help of unit root test. The second step is to find out the order of integration of the univariate price series with the help of same unit root test. Thirdly, if the price series are integrated of the same order, then Johansen test is done to find out the number of potential cointegrating relationships or vectors. The main advantage of this method is that when there are ‘n’ price series, there can be ‘n-1’ potential cointegrating relationships or vectors. The number of cointegrating vector is an important indicator of the extent of market integration. An increase in the number of cointegrating vector implies an increase in the strength of market integration. If there are ‘n-1’ cointegrating vectors, then the markets are said to be fully integrated and if the number of
cointegrating vectors are less than 'n-1', then the markets are not fully integrated.

However there is a possibility of short term disequilibrium which means that a price change in one market is not immediately passed on to the other market. Using the Error Correction Model (ECM) which was popularized by Engle and Granger, the speed of adjustment towards the long run equilibrium path can be ascertained.

Some other methods found in existing literature are Parity Bounds Model (PBM) proposed by Baulch (1997) which uses information on transfer costs, in addition to prices to assess the efficiency of spatial arbitrage. Threshold co-integration is another method to account for transaction costs in spatial price analysis. Thresholds are measures of transaction costs which must be exceeded by price differentials before the latter are capable of aggravating equilibrating price adjustments which lead to market integration (Goodwin and Piggott, 2001).

1.2.6 An Overview of Selected Literature on Market Integration

A lot of research has been carried out at the international level on market integration. Few of them have been discussed below.

Hossain and Verbeke (2010) evaluated integration of rice markets in Bangladesh following the liberalization of the rice market during the late 1980s and early 1990s. They used Johansen's multivariate cointegration test for testing market integration. The overall results of the market integration analysis in Bangladesh indicate that the six regional rice markets in Bangladesh are moderately linked together in the long run. Although the rice markets are found to be integrated in the long run, yet the short run results with the help of error correction mechanism reveal that these markets are weakly integrated in the short run. The speed of adjustment towards long run equilibrium appears to be inversely related with distance and directly related with simplicity of transportation system. The authors observed that poor infrastructural facilities and insufficient transportation networks which were the main causes of structural rigidities hampered the free flow of information.
between markets and hence the short run integration of markets. They suggest that in order for better integration of surplus regional markets with deficit regional markets, the government should invest more and more in infrastructure and transportation facilities.

Jaleta and Gebermedhin (2009) examined the cointegration of food crop market prices in Northern Ethiopia. Two food crops viz. wheat and teff were covered in their study. By applying Johansen cointegration test, they found that most markets under study are cointegrated in both wheat and teff retail prices. The extent of integration is found to be higher in case of wheat market than teff market. They explained the reason by saying that might be because of the fact that production of wheat is higher in the region than that of teff. Further they observed that unexpected price shocks in wheat prices in one market had a transitory effect on prices in other markets while teff price shocks in one market had a permanent effect on prices in other markets. They have given importance to market information system along with infrastructural development for better market integration.

Zahid, Qayyum and Malik (2007) in their study tested integration of wheat markets of Northern Punjab, Pakistan which are spatially separated from each other. They applied Engle and Granger test of cointegration to analyze market integration. They found that perfectly integrated market pairs had direct and better road and rail link and identical socio-economic culture. In addition flow of information within those market pairs is high as people of the regions travel daily between those market centers. The market pairs having longer distance between them and different socio-economic conditions have been found to be partially integrated. The partially integrated market pairs do not have any direct road and rail link for transporting goods. A study by Lohano, Mari and Memon (2005) is found for testing onion market integration in the context of Pakistan. The study has great significance since onion is perishable in nature and its demand is relatively inelastic in Pakistan. The empirical results reveal high spatial price linkages among onion markets indicating higher market integration.

Rivera and Helfand (2001) analyzed the extent, pattern and degree of market integration of Brazilian rice market. The extent of market integration
was analyzed with the help of identifying locations sharing identical long run information on prices and linked by trade. The conclusion from the analysis is that the states belonged to the same economic market share a single common trend in the long run. Those states engage in a considerable amount of inter-state trade and different qualities of rice of those states are substitutes for each other to some degree. The pattern of integration was captured by framing a vector error correction model. They found that the pattern of adjustment of spatially separated markets towards long run equilibrium is likely to be very complex. The degree of substitution among different qualities of rice is probably low and it only forces their prices to move together in the long run. The authors used persistence profiles of the long run relations to measure the degree of integration. They found that a high volume of trade is not sufficient to generate a high degree of integration. Physical distance and distance in physical space in terms of quality can both lead to a low degree of market integration.

Nga and Lantican (2009) analyzed the extent, pattern and degree of integration of spatially separated rice markets in Vietnam. They also studied dynamic relationship of the export prices of rice of Vietnam and Thailand as the two countries are major exporters of rice in the world rice market. They found that out of 34 rice markets in Vietnam, 9 markets are integrated into a common rice market. However price transmission is found to be very well among the integrated markets. The export prices of rice of Vietnam and Thailand are found to be cointegrated and conform to law of one price. The removal of export quota is found to be insignificant in determining price relationship between the two countries.

Tahir and Riaz (1997) studied integration of agricultural commodity markets in Southeastern Punjab, Pakistan. This region is dominated by relatively small markets called as "mandis". The study included three crops cotton, wheat and rice of which cotton and wheat are principal crops while rice is mostly grown in the area to control salinity. They found that markets are integrated only in the long run while short run integration is limited. Again integration is found to be more among larger markets while smaller markets are more likely to be isolated. The authors observe that the study of rice
market integration has environmental implications. Since rice markets are found to be not integrated even in the long run, therefore they suggest that there is potential for local demand conditions to limit farmers’ motivation for adopting rice as salinity controlling strategy.

Alemu and Schalkwyk (2009) evaluated integration of maize markets in Mozambique. They used two interrelated methods to measure the extent of market integration. Firstly, they carried out a market survey in major consumption markets in Mozambique, to investigate the operations of informal marketing system in the country. Secondly, they used econometric tools viz. Threshold Vector Error Correction Model (TVECM) to measure the extent of market integration between major maize markets. The market survey revealed that informal maize traders experience high transportation costs, lack of working capital and poor infrastructures. These are the major bottlenecks to maize trade. Grain businesses generally operate on small scale in Mozambique with little storage beyond three days to one week. The results from the TVECM indicated that the extent of integration of maize markets improve after the 1987 reforms adopted in the country. The price series for different market pairs exhibit significant dynamic relationships. The authors also found that threshold values are positively correlated with the conditions of the road which connects market.

Other than agricultural commodities, some researchers have extended market integration concept also to other things. Goodwin and Schroeder (1991) evaluated spatial price linkages among regional cattle markets using cointegration test in the United States of America. The objective of the study was to evaluate integration empirically and to determine the impacts on integration of several market characteristics. The authors conclude that overall, integration is limited in regional cattle markets. Their empirical tests indicate that during 1980s, regional cattle prices have not been fully cointegrated. It means prices across different market regions have exhibited moderate divergence between one another. However, over time, integration has increased across the markets. Although their findings did not provide conclusive signal that increased in integration over time is due to increase in concentration in cattle slaughtering, they suggest that it is a reasonable
expectation, since trade and information costs across markets would decrease.

Asche, Gordon and Hannesson (2003) tested market integration and the Law of One Price (LOP) for whitefish market in France. The authors found that prices of different species of whitefish in France do not represent separate or independent prices but a part of a system of whitefish prices. They concluded that different whitefish species in France compete in a single market.

There are other important issues also which are raised by the researchers on market integration. Faminow and Benson (1990) point out that in markets where buyers and sellers are spatially distributed, transfer costs affect the net price received or paid. In food markets, consumers generally consider only those retailers who are located nearby even though many more retail outlets may exist in the economic market. Similarly in agricultural product markets, even when large numbers of buyers are located across a geographic area, farmers typically compare the prices in several proximate locations because of intraregional transport costs. That is farmers differentiate between buyers on the basis of location. Thus spatial markets where both buyers and sellers are dispersed and transport costs are significant should not be characterized as perfectly competitive.

Fafchamps (1992) points out that market integration confronts the producer with entirely new market demand schedules for his crops and affects average price, price elasticity, price variance and the correlation between prices and revenues. For agricultural products, one expects the price elasticity of market demand to be higher in large integrated markets than in small isolated markets. The reason is that markets covering a lot of geographical and sectoral diversity offer more substitution possibilities. The variance of prices, on the other hand, is likely to decline with market integration. Indeed the major cause of yield variability is weather, and in a large geographical market, aggregate supply will mix local disturbances that are partly uncorrelated. Finally, correlation between individual weather conditions on separate farms is likely to decrease with the distance separating them.
The effects of different integration cases can be better judged if their multiple commodity, multiple unit, as well as their multiple level aspects are examined (Hirsch, 1950). In this sense integration is multi-dimensional and usually quite complex. It is by no means enough to show that the larger farms of a particular industry control a given percentage of the industry’s output, in order to know the degree of horizontal integration in the industry and thus infer its impact on public welfare. One has to inquire also into the inter-commodity and inter-level relations. They often may be just as or perhaps more important.

Delgado (1986) suggests the need to look carefully at marketing behavior that differs across seasons. There are apparent seasonal differences in food grain market integration between the harvest and post harvest periods. Research should focus on explaining the distinctive bump in prices that occurs in the middle of the harvest season in some years, since it appears likely that this is associated with the finding of lower market integration at that time. The role of discontinuous markets (those in which transactions do not occur during some time period) has been neglected in the debate over how to define a “market”. Many economic sectors include discontinuous markets. For example, markets for many agricultural commodities, such as fresh foods and vegetables are seasonal or more generally discontinuous in that transactions occur during part of the annual marketing cycle and are absent in the remainder of the cycle. Dahlgran and Blank (1992) found that continuous markets are less well integrated when the discontinuous markets are operating than when they are not operating.

1.2.7 An Overview of Selected Literature on Market Integration in India

Ghosh (2011) evaluated the impact of agricultural policy reforms on spatial integration of food grain markets in India applying Johansen (1988) maximum likelihood method of cointegration. Their results indicate that the extent of spatial integration of rice and wheat markets improve during the post-reform period as compared to the pre-reform period. The agricultural policy reforms in India since the early 1990s seem to have contributed towards improving the extent of spatial integration of rice and wheat markets.
They suggest that the government could encourage agricultural growth and ensure price stability by limiting its direct intervention in the agricultural markets.

Acharya, Chand, Birthal, Kumar and Negi (2012) assessed the integration of domestic markets for rice and wheat during and around the global food crisis of 2007-08. They analyzed both horizontal and vertical integration of rice and wheat markets. They found that in case of rice and wheat, wholesale, retail and primary markets are integrated and therefore a long run relationship exists in rice and wheat markets. The vertical transmission of rice and wheat prices from wholesale to farm gate is quite smooth. They observed that there is a long run equilibrium relationship between wholesale and farm gate prices.

Kumar and Sharma (2003) analyzed market integration among wholesale paddy markets in Haryana with the help of Johansen cointegration test and error correction mechanism (ECM). The study period was divided into pre-liberalisation period i.e. October 1978 to September 1989 and post-liberalisation period i.e. October 1989 to September 2001. The analysis of wholesale paddy prices indicates that markets are integrated in the long run although price transmission is found to be lacking in the short run. Price adjustment among the markets is taking around 2-3 weeks time period and adjustment process is found to be quicker in the post-liberalisation period compared to pre-liberalisation period.

Behura and Pradhan (1998) used bivariate correlation and Engle Granger test to analyse the market integration for Orissa marine fish markets. The bivariate correlation coefficients for six selected market pairs ranged between 0.60 to 0.85. However, of late, the price series correlation coefficient test has been discredited for testing the food market integration. This may be due to existence of common trends or seasonability in price data or due to non-stationary nature of price series. So Engle Granger test has been employed to test the integration among the marine fish markets in the state. The test statistic obtained for all the pairwise markets are found to be less than the critical values even at 10 percent level except that of one pair. Thus marine fish markets in the state are not integrated. This is mainly
attributed to poor infrastructural facilities at landing centers as well as at the terminal secondary markets. The poor market integration observed in this case reveals that marine fish markets in the state are quite uncompetitive. This necessitates strong and extensive government intervention designed to improve competitiveness to enhance market efficiency.

Transport and communications are basic and necessary infrastructure for market integration. The markets in India have continued to face problems with regards to such basic infrastructure (Mukim, K.Singh and Kanakraj, 2009). Transaction costs can be high owing to an inefficient transport system because of long distances between markets and the perishable nature of commodities. Mukim, Singh and Kanakraj examine whether wheat market is integrated across states in India and conclude that the market is integrated in the long run. This long run integration is however, does not come from the free flow of goods across states in the country, but from the sharing of similar production technologies by farmers across states. However the market for wheat is not integrated in the short run. This implies that at a given time period there exist two prices for the same commodity, since transaction costs are the main barriers to market integration. They estimate transaction costs using transport and communication infrastructure indices across states and conclude that there exist large variations in prices due to the presence of high transaction costs.

Jha, Murthy and Sharma (2005) in their paper, tested for market integration in 55 wholesale rice markets in India using monthly data over the period 1970-1999. It is discovered that market integration is far from complete in India and a major reason for this is the excessive interference in rice markets by government agencies. These interferences are found to be quantitative interventions, price distortions, heavy subsidies, tax structure etc.

However a contradictory result was found by Virmani and Mittal (2006). They tested for the level of integration of domestic markets across states and across commodity markets between 1994 & 2004. The results clearly indicate that the Indian markets are moving towards one price and getting integrated for both primary and manufactured goods. Increasing commercialization, development of transport and communication facilities...
and expansion of market network has led to increased integration of good markets in India. The manufactured goods market is much more integrated than the primary goods market. The coefficient of variation for manufactured goods is 0.06 and for primary goods is 0.13. Again it is interestingly found that in 2004, the overall Indian market is more integrated than that in 1994.

Inspite of the growing importance being given to market integration by the researchers, no known attempts have been made to analyze the market integration in the context of Assam. This research is an attempt to analyze the food crops market integration in Assam.

1.3 Objectives and Hypothesis

The specific objectives of the study have been formulated as the following:

1. To study the extent of market integration (both spatial and vertical) of food crops in the Brahmaputra valley of Assam.
2. To study the change in the level of spatial market integration over time.
3. To identify the factors significantly affecting integration of market.
4. To prescribe policy measures to facilitate market integration.

Moreover the following hypothesis will be tested during the course of the study.

- The markets in Assam are moving towards one price and getting integrated for food crops.

1.4 Sources of Data

The required data for the study has been collected from both primary and secondary sources. Basic secondary data on general background information such as demographic features, the level and type of agricultural operation, production, cropping pattern, market infrastructure has been collected from Statistical Handbook, Assam; Economic Survey, Assam; Directorate of Agriculture, Government of Assam; Directorate of Horticulture, Government of Assam; Directorate of Economics and Statistics, Government of Assam; and available published reports. Secondary data pertaining to
weekly wholesale prices of food crops were collected from the reports of Assam State Agricultural Marketing Board and the Agricultural Produce Market Committee reports of the Directorate of Marketing and Inspection, Ministry of Agriculture, Government of India. However, secondary data did not reflect the extent of vertical integration of food crops and the factors affecting it. Therefore secondary data was not sufficient to fulfill the objectives of the study. Hence primary data had to be collected to fulfill the objectives.

The detail discussions on primary data have been made in chapter IV.

1.5 Methodology

The main analytical challenge of the study lied in dealing with the first objective, i.e. extent of market integration of food crops. This objective has been divided into two sub sections i.e. extent of spatial market integration and extent of vertical market integration. For analyzing the extent of spatial market integration of food crops, secondary data has been used and Johansen’s (1988) method of cointegration has been applied in both bivariate as well as multivariate framework. Before running cointegration test, the standard Augmented Dickey Fuller (ADF) test has been applied to check the stationarity of the individual price series. The Granger causality test has been done to show the cause and effect relationships among prices in different markets. Granger causality test is associated with the null hypothesis that there is no Granger causality from one market to another market. The short run dynamic analysis of rice market integration has been done with the help of Vector Error Correction Model (VECM). For analyzing the extent of vertical market integration, primary data has been used. The prices received by the farmers have been compared to the wholesale prices and retail prices prevailing in the nearest market. Ratio of these prices has been taken to form an index called as Price Realization Index. This index gives an idea of the extent of vertical market integration. Radar diagram has been used to explain it elaborately.
With regard to the second objective, the change in the level of integration over time has been analyzed with the help of using coefficient of variation technique for which secondary data has been used.

The third objective was divided into two sub-sections i.e. factors affecting spatial market integration and factors affecting vertical market integration. To identify the factors significantly affecting spatial integration of markets, a LOGIT model has been fitted with the help of secondary data. The factors significantly affecting vertical integration of markets have been analyzed by fitting a Logistic regression model with the help of primary data.

The analytical framework has been summarized in table 1.1.

Table 1.1: Analytical Framework

<table>
<thead>
<tr>
<th>Objectives:</th>
<th>Methods:</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (a). Analysis of the extent of spatial market integration</td>
<td>Time series analysis ➢ Cointegration test ➢ Granger causality test ➢ Error Correction Model</td>
<td>Secondary</td>
</tr>
<tr>
<td>1 (b). Analysis of the extent of vertical market integration</td>
<td>Index and radar diagram</td>
<td>Primary</td>
</tr>
<tr>
<td>2. Study of the change in the level of spatial market integration</td>
<td>Coefficient of variation</td>
<td>Secondary</td>
</tr>
<tr>
<td>3 (a). Identification of the factors affecting spatial market integration</td>
<td>Binary LOGIT Model</td>
<td>Secondary</td>
</tr>
<tr>
<td>3 (b). Identification of the factors affecting vertical market integration</td>
<td>Logistic Regression Model</td>
<td>Primary</td>
</tr>
</tbody>
</table>

1.6 Layout of the Thesis

The study has been organized into six chapters. Chapter II has been designed to provide an overview of agriculture of Assam which included land
use pattern, land holding pattern, cropping pattern and food production. The various crops selected for detailed study, area, production and productivity of selected crops have been discussed in this chapter. The extent of spatial market integration of agricultural crops across different markets of Brahmaputra valley of Assam and its changes over time have been analyzed in chapter III. This chapter also elaborates the factors significantly affecting spatial integration of markets. Chapter IV is a discussion of the field study methodology and a preliminary analysis of the field study. The extent and determinants of vertical integration of markets have been discussed in chapter V. The concluding chapter summarizes the findings and inferences of the study and discusses the policy implications of the findings and inferences.