CHAPTER II

of Literature
The related literature was reviewed to gain perception of and clarity about the status of cotton production and marketing in the historical and contemporary contexts and expected changes in an environment that will be characterised by free trade regime from the year 2005. A review of various research studies in the related field also helped in understanding appropriate tools and techniques that can be used for analysis, appreciating various evidences generated and policy prescriptions suggested. The literature reviewed included books, reports, articles and theses. Some important ones are presented in this chapter under the following subject groupings for purpose of clarity.

2.1 Growth performance of crops

2.2 Instability in crop production

2.3 Crop dynamics – Structural changes in inter-crop area allocation

2.4 Seasonal price behaviour analysis

2.5 Market integration studies

2.1 GROWTH PERFORMANCE OF CROPS

Minhas and Vaidyanathan (1965) studied the growth of crop output in India for the period 1951-54 to 1958-61. The growth rates were worked
out using exponential growth functions. During the period, the total crop output in India was estimated to have increased by 27.8 per cent, that was, a compound annual growth rate of 3.57 per cent. In seven of the fourteen states for which indices were calculated, the rates of growth were higher than the national average.

Sidhu and Sankhayan (1973) studied green revolution and the change in the cropping pattern in Punjab over the period 1950-51 to 1970-71. The growth rates were worked out using exponential growth functions. The study showed that the growth rates of area during Period I (1950-51 to 1964-65) were higher as compared to the corresponding growth rates during Period II (1965-66 to 1970-71) in case of maize, wheat, total cereals, total foodgrains, groundnut, sugarcane and oil seeds. The maximum difference in the growth rates of two periods was observed in the case of groundnut. In case of remaining crops, the growth rates of area were lower during Period I compared to Period II.

Bhatia and Singh (1975) studied the growth rates and relative contribution of different components towards total foodgrain production in Uttar Pradesh over the period 1950-51 to 1970-71. The results of the analysis revealed that amongst all the food grains, wheat showed the highest growth rate of production (4.3%) followed by maize (3.51%) and rice (2.60%). The rates of growth of productivity showed a significant increase in the case of rice, maize, wheat, barley and chickpea, whereas the productivity of sorghum showed a significant decline during the period under study.
Pereira (1976) analysed growth rates of crop output in Karnataka during the period 1955-56 to 1972-73. Three types of growth functions were used, namely, linear, geometric and quadratic for each of the three sub periods. The analysis concluded that over the aggregate period, with the exception of sorghum, castor, cotton and tobacco, the rest of the crops recorded positive growth rates in their acreage. In case of productivity, it was observed that the green revolution period was more favourable for most of the crops in the state. However, the study revealed that the growth rate of area under groundnut during the green revolution period was marginally decelerating at 0.61 per cent but productivity was increasing at the rate of 1.81 per cent.

The growth rates of area, production and productivity of castor and linseed were examined by Verma (1982) over the period 1950-51 to 1977-78 using the exponential growth function at all India level. The results highlighted that the growth rate of area under castor at all India level was negative but productivity and production showed highly significant positive growth rates (2.3 and 3.03%, respectively). In most of the states the area showed a negative rate due to an increase in proportion of irrigation and consequent substitution of castor by other cereals. On the other hand, the productivity of linseed was negative at all India level but production and area showed positive growth rates of 1.25 and 1.63 per cents, respectively.

Gupta (1989) made a spatio-temporal analysis of non-traditional edible oilseeds in India for the period 1970-71 to 1985-86. The results
revealed that the growth rates of area, production and productivity were the highest in Karnataka (20.95, 12.29 and 3.59 per cents, respectively) followed by Maharashtra. On the other hand, the minor producing states showed negative growth in all the aspects. The study concluded that area was the dominant causal factor in increasing the production of non-traditional edible oilseeds of India in all the growing regions of the country.

The growth performance of banana was studied in Kerala for the period 1970 to 1987 using time series data on area, production and productivity pertaining to the study period (Devi et al., 1990). The yield showed a declining trend during the period 1970-80 while there was an increasing trend during 1980-87. At aggregate level its trend was found to be slightly decreasing mainly on account of the effect of the first period. An increasing trend was noticed in the second period in the case of production. The area under this crop during 1970s showed a rising trend whereas sharp decline was noticed during 1980s. Though the area showed an increasing trend in the first period the decline in production was noticed due to decline in yield. The investigators further deduced that banana production in the state showed a better performance in the 1980s mainly because of the increase in productivity.

Mander and Sharma (1992) examined the growth performance of crop output in India for the period 1966-67 to 1988-89. It was evident from the result that cotton production registered a significant growth rate
of 2.39 per cent per annum during the period of Green Revolution. They also showed that the entire increase in production of cotton occurred as a result of increase in yield (2.74%) despite the area under this crop decreasing significantly.

Investigation of growth rates in production of oilseeds in India (Rao et al., 1993) confirmed lack of uniformity across crops over years. The aggregate oilseed production was stagnant during the 1970s and recorded a growth rate of 5.25 per cent in the 1980s resulting in an overall growth rate of 3.04 per cent for the period 1970-71 to 1989-90. The authors concluded from the study that acceleration in production was due to significant growth in both area and productivity during the 1980s.

Mundinamani and Mahajanashetti (1993) employed the orthogonal polynomial regression analysis technique to reveal trends and growth performance of oilseed in Karnataka during the period 1955-56 to 1989-90. The results of the study indicated that, in Bijapur district, there was a continuous decline in groundnut area till 1979-80 and a mild increase thereafter. But in case of Dharwad district, a continuously significant increase was noticed till 1964-65 and it stabilized thereafter. In Raichur district and at state level, an increase in area was noticed in recent years. However, the area under safflower and sesame showed stable trend over the years. Moreover, an impressive growth in area was observed under sunflower since its introduction. The yield trend showed mixed results but at state level an increasing trend in yield was observed and the production trend was more or less similar to the area trend.
Singh et al. (1993) in their study, “Cotton development and export potential in India”, reported that cotton area and production increased by 49 and 315 per cents, respectively during the previous four decades. They also suggested that this increase in cotton production was more on account of increased yield rather than an increase in cotton acreage.

Jha (1994) analysed growth rates in agriculture associated with new technology for the period 1972-73 to 1990-91. The investigator reported that the compound growth rate in agriculture was about 16.7 per cent in Period I (1972-73 to 1980-81) while in the second period (1981-82 to 1990-91), a reduction was observed.

Patel and Agarwal (1994) analysed growth performance of groundnut production in Saurashtra region of Gujarat using compound growth rates by fitting exponential function to the time series data on area, production and productivity for the period 1960-61 to 1988-89, where in the years 1960-61 to 1969-70 are referred to as Period I and the year 1970-71 to 1988-89 as Period II. The area, production and productivity of groundnut in the state of Gujarat had shown a negative growth during both the study periods. However, the rates of decline in area and production were more pronounced and statistically significant during the first period -2.23 and -3.42 per cent per annum respectively. In sum, while the results of compound growth rates of area, production and productivity of groundnut for the Gujarat state generally revealed a negative trend in both the periods it was more pronounced in the first period.
A study on growth rates in potato production in India (Singh and Mathur, 1994) showed that the annual compound growth rates of area, production and productivity of potato during the period 1970-71 to 1989-90 were 3.6, 6.7 and 2.99 per cents, respectively. Among the states, it was found that the compound growth rate of production was the highest (8.87%) in West Bengal followed by Assam and Uttar Pradesh.

Singh et al. (1997) studied “Regional variation in agricultural performance in India” using secondary data for the period from 1960-61 to 1992-93. The data was analyzed by compound growth rate after fitting log-linear function. The result revealed that the national growth rate in cotton increased to 3.20 per cent in Period II (1969-81) from 0.02 per cent in Period I (1966-68) and finally slid down to 2.47 per cent in Period III (1982-93) due to decrease in acreage growth.

In his study of the “Performance of Indian Agriculture”, Sawant (1997) used time series data for the period 1967-68 to 1995-96. The data was analyzed by compound growth rate after fitting log-linear function. It was found that, of the two cash crops, namely, cotton and sugarcane, the former moved to high growth range with its compound growth rate of output exceeding 4 per cent during 1981-82 to 1994-95. This was mainly due to significant advances in its seed technology and resultant high growth in yield per hectare.

Gaddi et al. (1998) studied growth rates in area, production and productivity of cotton for the major cotton producing countries for the
period 1982-83 to 1996-97 and for the state of Karnataka for the period 1970-71 to 1996-97 using exponential function. The results showed that world cotton area declined at a rate of 0.33 per cent per annum due to improved productivity. Similar results were reported for the case of India, Karnataka state and some of the traditional cotton growing districts. Production of cotton registered significant growth in all the cases mainly due to substantial growth in productivity.

Dashora et al. (2000) studied the growth in production of important pulse crops in Rajasthan for a period of 26 years viz., 1967-68 to 1992-93. This period was subdivided into two groups i.e., group I (1967-68 to 1979-80) and group II (1980-81 to 1992-93) for the study. The compound growth rates were worked out using the exponential equations. The study revealed that there was no significant increase in the aggregate pulse crop output in the overall period.

Singh and Chandra (2001) studied the growth trends in area, productivity and production of foodgrains in Madhya Pradesh during three phases viz., pre-green revolution era (1951-52 to 1965-66); green revolution era (1966-67 to 1975-76) and post green revolution era (1976-77 to 1998-99). Various types of growth function like linear, quadratic, exponential, compound growth and logarithmic functions were tried and the one with high coefficient of determination was used for various variables and different phases. The results showed increased growth in foodgrain production and productivity but decline in area. The growth
rate for production did not differ significantly between and pre and post-green revolution period but, it declined significantly in area from 1.2 per cent to 0.009 per cent and growth rate of yield increased significantly between the pre and post green revolution period from 1.1 per cent to 3.09 per cent, indicating thus that further increase in foodgrain production would be possible by increasing mainly productivity.

2.2 INSTABILITY IN CROP PRODUCTION

Sastri and Sharma (1959) while examining the contribution of area and productivity to the increased rice output in the states of Andhra Pradesh, Madras (now Tamil Nadu) and West Bengal over the period 1949-50 to 1956-57, reported that the increase in rice production in the selected districts of these three states was attributable to increases in productivity rather than area, while in a few other districts the reverse was true.

Sastri (1960) studied the relative contribution of area and productivity of the increased production of wheat during (1949-52 to 1954-57) in the districts of Uttar Pradesh and Punjab. The results revealed that, in the first plan period, the increase in wheat production in these two states occurred more through extension of area than through higher per acre yields.

Minhas and Vaidyanathan (1965) studied the components of growth of crop output in India for the period 1951-54 to 1958-61. Using additive
decomposition scheme, they found that, of the 3.57 per cent compound rate of growth of aggregate crop output in India, approximately 45 per cent could be attributed to area growth, 46 per cent to yield increases, a little over 8 per cent to crop pattern changes and less than 1 per cent to interaction between yield and change in cropping pattern. In other words, for the country as a whole, about nine-tenths of addition to output was the result of increases in crop area extension and per acre yields.

Sardana et al. (1966) while examining the relative contribution of area and average yield to increase in production of potato during the second five year plan period (1954-57 to 1959-62), reported that potato production in India went up by about 50 per cent. West Bengal, Bihar and Uttar Pradesh accounted for largest share in the increased potato production with 32.6, 26.1 and 14.0 per cent shares, respectively. The contribution of area and average yield, to the increase in the production of potato, varied between states. In West Bengal average productivity contributed to the tune of 44.6 per cent as compared to 25.6 per cent in case of area while in Bihar the reverse was the case.

Sharma (1977) studied the effect of area, yield and price on increase of value of crop output in India for the period 1960-61 to 1970-71. The author used his own decomposition scheme in measuring the effects of productivity, area and prices and their interactions in the increase of value of production of wheat, rice, pulses, foodgrains, oilseeds, sugarcane, jute, tobacco, cotton, tea and chilies. In case of cash crops like sugarcane,
jute, tobacco and chilies, area effect was higher than yield effect by 0.74 per cent, 40.09 per cent, 10.08 per cent and 3.72 per cent, respectively. The price effect was in the range of 49.22 per cent to 74.37 per cent in respect of these crops. The price effect in case of cotton was found to be 142.95 per cent, which offset the negative effect of yield, area and interaction and thus resulted in a net increase in income by Rs.1,538 million.

Nandkarni and Ghosh (1978) while studying the instability in agriculture yield in relation to variability in rainfall combined the traditional technique of measuring instability through coefficient of variation (CV) value. The variability in yield was measured in terms of coefficient of variation, probability of crop failure and crop loss ratio. It was found that the yield variability was quite high (CV ranged from 1.6% to 46%). Instability was found to have no relationship with irrigated area and growth rate of yield. It was also emphasized that rainfall factor was not sufficient to explain total yield variability implying that there were other factors affecting the variability in yield.

Sain (1980) attempted to test the contribution of technological innovations in farming for the accelerated progress of Indian agriculture during the post-independence period. Correlation coefficient in case of foodgrain production on the one hand and some of the new technological farm inputs on the other were estimated. Linear and compound rates of growth of foodgrain production and of a few such technological inputs
were also estimated along with their respective standard errors. The estimates of both correlation coefficient and growth rate were put to test for significance. The result revealed that technological progress in farming had played a key role in the preceding three decades. But, compared to the developed countries the extent of adoption of new technology was reported to be very poor in India.

Mehra (1981) measured instability around the trend and carried out analysis by dividing the time period into pre and post green revolution periods. The results showed that out of 18 crops examined, the standard deviation of detrended production figures rose in 15 crops and the coefficient of variation rose in 12 crops. Comparatively higher yield variability showed that it was the dominant source of production variability. The standard deviation for non-foodgrain (aggregated) crops showed decrease. Further, it was brought out that, comparatively larger area under wheat, rice, potato and sugarcane being irrigated, these crops showed less increase in yield variability in the second time period. Similarly, the states having larger area under irrigation showed smaller increase in yield variability and concomitant decrease in variability of production.

Verma (1982) while examining the sources of change in agricultural growth of major edible oilseeds in India over the period from 1950-51 to 1977-78, reported that the increase in groundnut production was dominated by area effect to an extent of 963.44 per cent. It was observed
that most of the states showed high growth rates in production mainly due to rapid increase in acreage rather than in yield. The case was similar for rapeseed-mustard and sesamum.

Hazell (1984) applied variance decomposition analysis to Indian states on crop output to analyze the sources of increased instability. The study revealed that production had become significantly more covariant between states and crops, largely because of increased yield variability and loss in offsetting patterns of variation between crop yields in different states. The investigator opined that these changes might be associated with more variable prices, higher yielding technologies and the narrowing of the genetic base.

Narang et al. (1989) studied the performance and prospects of major oilseed crops in India over the period 1965-85. The variability estimated by using coefficient of variation pointed out that instability observed in most of the states was mainly attributable to weather aberrations leading to high degree of variability in almost all the states for the three crops, mainly, groundnut, rapeseed-mustard and sesamum.

Pal (1989) analyzed production instability of oilseeds in India over the period from 1950-1966 to 1967-1984. The results indicated that the coefficient of variation of production for the country as a whole increased from 11.38 per cent to 13.98 per cent in groundnut, from 12.78 per cent to 13.80 per cent in rapeseed-mustard and it declined from 19.08 per cent
to 16.33 per cent in sesameum between the above two periods. Similar
results were observed in the case of yield variability for all the three crops.
Further, the coefficient of variation of production and yield in majority of
the states were substantially higher than that for the country as a whole.

Singh (1989) studied instability of crop yield in 16 states of the
country for a period of 15 years (1971-86) and observed that some states
had comparatively low level of instability in one crop while others had the
same advantage in respect of other crops. This analysis showed that there
is scope to achieve higher and stable production of various crops at the
national level. He used the traditional method of coefficient of variation for
estimation of instability.

Devi et al. (1990) examined the determinants of banana production
in Kerala using a simple decomposition model. It was brought out that
production of banana was mainly a function of area during 1970s and of
yield during 1980s. It meant that the main determinant of banana
production was area variance in the 1970s and yield variance in the
1980s.

Investigation of instability in production of oilseeds in India by Rao
et al. (1993) using coefficient of variation showed an increasing trend from
10.44 per cent in 1970s to 21.89 per cent in 1980s. Similar increase in
instability was observed in area and yield levels. They concluded that,
higher the growth rates, higher the instability, which was not a desired
phenomenon. Finally the sources of instability in oilseed production were reported to have area component, productivity component and area-yield interaction component.

Instability in agriculture associated with new technologies was studied (Jha, 1994) and the results revealed that instability in gross return of crops was highest in Rabi oilseeds (153 per cent) followed by gram, coarse cereals, cotton, wheat and paddy in the first period (1972-73 to 1980-81). Instability in gross return of paddy was, however, small in Period II (1981-82 to 1990-91) may be because of fluctuation in area under basmati paddy during the 1980s. Maize and cotton showed decline in instability of gross return in Period II while instability in yield increased thereby emphasizing the role of price instability in explaining the instability in gross return.

The coefficient of variation estimated from the de-trended time series data on production, area and yield of potato for major growing states during 1970-71 to 1989-90 revealed that potato production was unstable in nature in all the states, but the extent of instability varied form state to state (Singh and Mathur, 1994). The values of coefficient of variation were high for Uttar Pradesh (33.1%) and Punjab (29.2%) where the growth rates in production were high. The investigators further explained that instability in production increased with the rapid growth of potato production. In other words, high growth in production was
accompanied by high variability in production indicating greater yield risk associated with the cultivation of potato.

The variance of production of groundnut was decomposed to area variance, productivity variance and area-yield covariance for the 1960s (Period I) and 1970-80s (Period II) using decomposition model (Patel and Agarwal, 1994). The decomposition of the production variance of groundnut into its components for the state level showed that yield variance accounted for more than 80 per cent of production variance in both the periods. Both productivity and area variance declined over the periods, the decline being 100.43 to 81.81 per cent in productivity variance and 16.96 to 7.92 per cent in area variance. Area productivity variance was negative (-17.39%) in Period I and positive (10.27%) in the period II. The investigator explained further that the stabilizing effect on instability in groundnut production was brought out mainly by reduction in yield instability.

Singh and Pandey (1996) studied the growth and instability of rice production in the Plateau region of Bihar over the period 1959-60 to 1990-91. They worked out the extent of instability using coefficient of variation between the two sub-periods (pre and post green revolution). The study revealed that the magnitude of variability of area, production and yield increased during the post-green revolution period as compared to the pre-green revolution period.
Upender and Venkateswarlu (1996) made a comparative analysis of growth and instability of groundnut in Andhra Pradesh and for the country as a whole with respect to area, production and productivity during the period from 1949-50 to 1990-91. The results of the normalized coefficient of variation around the trend line indicated that the extent of fluctuations in area and productivity were relatively high during the post-green revolution period (1966-67 to 1990-91) in the state as compared to the pre-green revolution (1949-50 to 1965-66). Similar trend of instability was observed at the all India level.

Borthakur and Krishnamoorthy (1997) studied sources of production instability in rapeseed and mustard in Assam. The results revealed that change in mean area alone contributed 89.75 per cent to the increased production while the contribution of mean yield was 5.77 per cent. Therefore, the most important sources of change in production variance of rapeseed and mustard were change in area variance and change in mean area which contributed about 83.61 per cent and 57.03 per cents respectively to the total increase in variance of production.

Tripathy and Mishra (1997) based on the investigation made on growth and instability of ragi production in Orissa, reported that 63 per cent of the increase in production of ragi was due to increase in mean area, 26.56 per cent from increase in mean yield and 9.84 per cent from increase in area-yield covariance. They concluded that mean area, mean
yield and area-yield covariance were the most important sources of production instability of ragi in Orissa.

The extent of instability in area, production and productivity of sugarcane in India was examined by Chinnapa and Reddy (1999) using coefficient of variation. The results revealed that there was a variation in area to the tune of 22.36 per cent and 42.14 per cent in production during the previous six decades. The study remarked that the variation in area and production was due to shift in acreage from sugarcane to more remunerative crops besides unfavourable weather conditions, incidence of disease and pests.

Vatta and Agarwal (2000) estimated the growth and trends in the area, production and yield of the major agricultural crops of the Punjab state during the post-green revolution period, that is, 1970-71 to 1997-98. The compound growth rates were calculated for the three periods viz., Period I (1970-71 to 1983-84), Period II (1984-85 to 1997-98) and over all (1970-71 to 1997-98). The results showed that the total production of the major agricultural crops in the state increased during the period 1970-71 to 1997-98. On the contrary, the total production of coarse cereals and pulses declined over the same period at the rate of -3.91 to -6.57 per cent, respectively. The change was attributed to all the three effects i.e., area effect (31.91% for coarse cereal and 4.90% for pulses), yield effect (44.90% for coarse cereals and 91.36% for pulses) and interaction effect (23.19% for coarse cereal and pulses 3.74%).
2.3 CROP DYNAMICS – STRUCTURAL CHANGES IN INTER-CROP AREA ALLOCATION

Padberg (1962) adopted the Markov chain model to analyse the structural development in the California Wholesale Fluid Milk Industry during 1950-55 period which tended towards very high concentration. The equilibrium size distribution based on the observation of that period gave the largest firm more than 80 per cent of the market share. It may be noted that 95 per cent of the industry output was produced by six firms.

Konandreas and Aurtado (1978) analysed the trade flows in the international market for the period from 1951-66 to 1969-74. They explained the export performance of major wheat exports and the evolution of trade pattern over time. They concluded that exporters who failed to consolidate their marketing efforts in fast growing markets performed poorly, whereas others who enjoyed preferential treatments on major markets and/or managed to overcome trade barriers in fast-growing markets performed quite well.

Buckwell et al. (1983) analysed changes in the size structure of dairy industry in the Scottish Milk Marketing Board (SMMB) area. The projected six distributions of dairy herds were combined with simple projections of average herd size and yield, which indicated the outlook for milk production during 1980s. This suggested that secular increases in SMMB milk production might be slowing down and could even come to an end during the following few years.
Mellor (1984) introduced the Markov chain model as a mechanistic model of behaviour in an agricultural setting. The concept of time-varying transition probabilities was introduced as a feasible alternative to the standard stationary assumptions. The results supported the view that the basic model was simple and it benefits from the introduction of explanatory variables influencing the transition probabilities. It was suggested that neglect of important variables could lead to undesirable consequences when the model was used for forecasting purpose.

Durham et al. (1987) analysed the changes in exporter market shares in the Kuwaiti poultry import market over the period 1971-81 by using three modeling procedures. The two traditional approaches, a first order constant transition probability Markov model and a set of market share equations were found to be of only limited use. As an alternative, a multinomial logic model of market share behaviour was estimated. The empirical results indicated that in addition to relative price changes, domestic policy inducement for Britain and European Community exports were important in determining market share changes.

Wilson et al. (1990) studied importer loyalty in the international wheat market. The results indicated that in general the United States had relatively strong importer loyalty compared to other exporters such as Canada and the European Community.

Gemtessa (1991) analysed the direction of trade using Markov chain model. The share of Ethiopian coffee exports to USA had drastically
declined during 1979 to 1989. The loss in the export shares of Ethiopian coffee to USA, France, USSR and other countries was directed to erstwhile West Germany. The study revealed that the Ethiopian coffee exports to Japan, France and Italy had moderately increased. But the share of Saudi Arabia remained stagnant. It was predicted that the market share of Ethiopian coffee exports to West Germany would increase to 32 per cent by 2000 AD, mainly because of Germans' preference for Ethiopian mild coffee.

Veena (1992) analysed the changing direction of Indian coffee exports in terms of importing country shares over the period 1965-90 using Markov chain analysis. The projections indicated a declining trend in Indian coffee exports to the USA, Yugoslavia, Netherlands and other importing countries. The increased market share of the USSR in the 1970s and 1980s was then threatened by economic and political upheaval in the region.

Jeromi and Ramanathan (1993) noticed significant changes in the direction of pepper exports from India for the period 1975-90. It was observed that nearly 44 per cent of India's pepper exports were directed to former USSR which constituted about 82 per cent of the total pepper imports of that country. On the other hand, India not only failed to increase its exports to USA in tandem with increased consumption in that country but also could not sustain the quantity exported in the preceding years. Instability in exports was low in case of former USSR, Italy and Canada and higher for Poland, USA and Czechoslovakia.
Jalajakshi (1994) highlighted the changing pattern of Indian shrimp exports between two periods: Period I covering 1970-80 and Period II covering 1980-90. It was indicated that during Period I, India could not retain its previous market share in the EEC countries. Nearly, 90 per cent of India's share was diverted to Japan and seven per cent to the United Kingdom (UK). However, in Period II, India could retain its previous market share in the EEC countries due to gradual acceptance of tropical shrimps in these countries.

Diana (1997) used non-stationary Markov chain analysis to explore the linkages between sector-specific policy and sector employment in Oregon, USA. Application of the technique to Oregon's forestry sector and national forest policy demonstrated that macroeconomic forces had statistically significant effects on employment while national forest policy, measured as timber sold or timber cut, did not. This result raised questions about forest policy impact analysis and assumptions inherent in national forest policy implementation.

Ajjan et al. (1998) analysed the direction of trade of senna and periwinkle in India using Markov chain analysis. The probability of Germany and USA retaining their import shares of senna in the years to come were estimated to be 0.8258 and 0.8188 which clearly indicated that these two countries would retain their import share in the same position as in 1997. For periwinkle, France had a high retention of the export share (probability of 0.8826) while Germany and others had as low
as 0.2644 and 0.0543, respectively which clearly indicated that chances of maintaining the import share of France was 88.26 per cent and in two other cases there existed practically low or nil chance for the year 1996.

Murthy and Subramanyam (1999) measured the dynamics of changes in the exports of onion from India to different countries with the help of a Markov chain model. From one step transitional probabilities the model was extended to n-step for future forecasting. The results revealed that Malaysia, UAE and Singapore were having high probability of retention and would continue to be the major importers in future also. As revealed by the low values of probability of retention, Saudi Arabia and others were concluded to be unstable importers of Indian onion. It was also summed up that in the next decade, Srilanka and Bangladesh are likely to increase their imports from India though it may come at the cost of United Arab Emirates.

2.4 SEASONAL PRICE BEHAVIOUR ANALYSIS

Price analysis explains how and why prices behave in a particular manner. It also explains whether there is any consistency in the price behaviour of commodities over a period of time and space. It involves use of a large number of quantitative and econometric techniques. From the stand point policy formulation, price behaviour analysis is a continuous and never ending process because the objectives, instruments and consequences of price changes constantly move in seemingly unpredictable patterns.
While studying the behaviour of potato prices in Punjab, Chatha and Kaul (1982) found that potato prices did have a definite cycle of three years period that was statistically significant in all the markets under study. In addition to the periodogram analysis of wholesale prices, the correlogram of price series showed oscillations in a remarkable way in all the markets, which kept the price away from reaching an equilibrium. The results implied that instability in prices and resultant income of growers needed an immediate check.

An attempt was made to figure out the cyclical changes in the production and prices of potato crop in Nilgiris district by Puhazhendhi and Ramasamy (1984). Four year analysis was used to compute the square of amplitude for each specified period by assuming several periods and correlogram helped to distinguish between different types of oscillatory series. The harmonic analysis revealed that cycles of four years in production and six years in prices were not discernable and production and price cycle did not persist in uniform manner. They concluded that the variations in production and price of potato in recent years were less due to improvement in production and market system and further that the stability in price could bring about increases in farm investment and stabilization of population.

Sabur and Gangwar (1984) noticed that the 'b' values of the fitted linear and quadratic forms of regression equations were highly significant in all the selected markets in Bangladesh during the period 1963 to 1982,
revealing significant increase in prices of potato over the years. The seasonal variation computed from multiplicative models indicated that a wide seasonal fluctuation in potato prices occurred and were similar in nature in all the markets. Furthermore, the results of periodogram analysis showed that there was no cycle of uniform period in potato price implying that there was a continuous fluctuation every year in Bangladesh. From the analysis, it was concluded that instability of potato price led to income instability of the growers and price stabilizing policy was therefore needed.

In his study on the supply, price and trade of Indian tea, Achoth (1985) fitted ARIMA models to price and production data. The results revealed that the moving average models were found to be more appropriate for the study. Among the price series a particular month’s price was not related to the price of the same month during previous years. However, the production in a particular month was related to both the production of the previous month as well as production of the same month in previous years. The forecast provided reasonably better results as judged from the test of their efficiency. The forecasts of prices were superior when compared to the forecasts of quantities, which was attributed to the highly structured pattern of price behaviour.

Diwakar (1987) while studying the seasonality of prices and arrivals of potato during the period 1968-1976 in Farrukhabad district of Uttar Pradesh used the regression equation \( Y_t = B_0 + B_1D_1 + B_2D_2 + ... + B_{11}D_{11} + U_t \)
corresponding to the twelve months, where, the 12\textsuperscript{th} month is excluded from the model and D\textsubscript{i} is a dummy variable that takes the value 1 when the price data or arrival data (Y) corresponding to the \textit{i}\textsuperscript{th} month is available. Otherwise it is deleted from the corresponding \textit{i}\textsuperscript{th} month from sequence of arrangement. Among the selected markets for the study, seasonal price fluctuations were very high in Chhibramau market as it ruled lowest throughout the peak period of the market arrivals in comparison to other markets. On the other hand, the price in Kannuj was found to be highest throughout the peak season of potato arrivals in comparison to other markets owing to its nearness and connection by a fine road to a very big consumption market for potato. Besides, the results of all potato markets indicated that mostly changes in arrivals of potato had corresponding effect on prices in opposite direction.

Sangwan (1989) examined the extent of seasonal variation in wholesale prices of potato over different periods in five important markets of India, namely, Farrukhabad, Meerut, Kanpur, Delhi and Patna. The analysis presented that the level of seasonal variation in prices of potato was considerably lesser in Delhi market than in Farrukhabad, Meerut, Kanpur and Patna markets due to lowest harvest season prices in producing areas than consumption centers like Delhi. However, all the five markets did not show similar trend over the entire period and the direction of their changes was largely in keeping with respective trends in the production of potato and establishment of cold storage capacity.
Agrawal and Sharma (1990) analysed the inter and intra-year price behaviour of pulses using linear and exponential functions in annual wholesale and farm harvest price index and twelve months moving averages accordingly for the period 1972 to 1987 in Rajasthan. The market-wise comparison revealed that wholesale price of all the pulse crops except arhar increased at a higher rate in Jaipur market than in the main production district markets. The comparison of linear and compound rate of increase in two types of prices indicated that farm harvest price showed higher rate of linear as well as compound increase than wholesale price in consumption as well as in production markets. In addition, price indices were lowest during peak arrival months (April-May for gram and October-November for moth, moong and urad pulse crops) and highest during sowing season months of the crop (October-November for gram and June-July for moth, moong and urad). They concluded that the inter and intra-year price variations in pulse crops revealed that during the preceding one and half decade, prices increased at alarming rates for all the pulse crops.

Sharma et al. (1992) made price analysis of potato vis-à-vis vegetables and pulses for eighteen years (1969 to 1987) in five important markets of India: Amritsar (Punjab), Delhi, Kanpur (UP), Jamshedpur (Bihar) and Calcutta (West Bengal). The analysis conclusively showed strong sympathetic price movements between potatoes and vegetables, and to a lesser extent between potatoes and pulses. This led to an
inevitable conclusion that the prices of vegetables should be considered as important variable while analysing the behaviour of potato prices and for devising policy measures aimed at dealing with the fluctuations and thereby protect the interests of both the producers and consumers.

Singh et al. (1993) studied the behaviour of market arrivals and prices of potato in Punjab by making use of multiplicative model and harmonic analysis. It was concluded that, in spite of a rising trend in arrivals, prices of potato increased significantly. During post-harvest period (December-February) owing to excessive supply of potato in the market, prices ruled very low, whereas during the lean period (July-November) the indices of prices remained high and ranged widely. The study further revealed that cycles of three years and five years were found to be significant in the case of prices and production arrivals of potato respectively.

Min (1995) applied ARIMA models to forecast the changes in the number of pigs and farms in Korea by total and herd size. The ARIMA model for pig production was identified and estimated using quarterly data for 1985(1) to 1994(4). The forecasting period was 3-year horizon, from 1995(1) to 1997(4). The number of pig farms in the fourth quarter of 1997 was predicted to decrease by 39.81 per cent to 32,642 households, while the number of pigs were predicted to increase by 7.44 per cent.

Alebrahiem (1996) employed time series data of retail prices of eggs in Saudi Arabia between January 1990 and December 1994 and
constructed a model, which could be used to forecast future prices. Two methods were used; namely ARIMA model and multiple regression technique to account for trend and seasonality followed by analysis of components of the regression error. Findings of the study indicated that the seasonality adjusted prices resulted from the first method could be modelled as an ARIMA (0,1,0), while the residuals of the regression could be represented as an AR(1) process. The results also showed that egg prices start to significantly decrease in April and continue to fall until August, then start to improve in September reaching the highest level in February. The regression model was used to forecast prices of the first nine months of 1995. The forecasted prices were very accurate since percentage deviation from real values did not exceed 3 per cent. The study recommended erection of factories and manufacture of egg powder by utilizing the excess supply of eggs during the period April-August and resort to exports.

An examination was made of the level of and variation in monthly wholesale prices of three main vegetables *viz.*, potato, onion and tomato in the four metropolitan cities of India [Delhi, Bombay (now Mumbai), Calcutta and Madras (now Chennai)], over a period of five years (1989-93) by Sharma and Sharma (1996). Among these three vegetables, tomato was found to be the most expensive one followed by onion and potato, in that order. Potato prices were less variable in relation to onion and tomato. There was no significant positive correlation between levels of exports and domestic prices of vegetables.
Upender and Manohara Chary (1996) while analyzing market arrivals and prices of paddy in regulated agricultural markets pointed out that, in the three markets selected for the study, the maximum quantity of market arrivals of paddy were observed during the peak market period probably due to distress sale by farmers having no post-harvest withholding capacity. The trend values of arrivals of paddy exhibited significant increase over the years in the three agricultural markets i.e., Karimnagar, Jammikunta and Vemulawada in Andhra Pradesh over time as a result of increase in productivity and production of paddy. The extent of variability in the market arrivals was found to be higher than in the prices of paddy in all markets selected for the study. In Jammikunta and Vemulawada agricultural markets, in particular, the price elasticities of market arrivals of paddy were not only positive but also more than unity indicating that price response was very high. On the contrary, in Karimnagar market the price elasticity of market arrivals was positive but less than unity showing that price response was poor. The positive price elasticity of market arrivals reflected the price consciousness of farmers. With a rise in the prices of agricultural products, farmers were tempted to dispose off more and retain less, resulting in higher quantity of arrivals in regulated markets over a period of time.

Mitrannavar and Gummagolmath (1998) analysed the seasonal indices of arrivals and prices of potato in regulated markets of north Karnataka. The long run trends in arrivals and prices of potato in
Belgaum and Hubli markets were analysed using three years moving average method. The study concluded that arrivals were highest in the months of November in both the markets indicating glut during harvesting season. However, prices did not decrease during glut season as the majority of the traders purchased potato at that time in Belgaum market while there was a negative relationship between arrivals and prices in Hubli market.

Srivastava et al. (1998) used ARIMA for forecasting sugarcane productivity based on the time series data of fifty years (1940-41 to 1989-90) in Bihar. The major phases involved in model building are identification of the order of model, estimation of the parameters, and diagnostic checking for adequacy of the model. ARIMA models are characterized by the order \((p, d, q)\) where 'd' denotes the degree of differencing and it is assumed that \(d^\text{th}\) of original data \(Z_t\) is stationary. The constant 'p' and 'q' denote the orders of the autoregressive and moving average operators, respectively of appropriately differenced series. Their findings, therefore, ascertained that the time series data on sugarcane productivity for the state of Bihar was described by an ARIMA \((0,1,1)\) model. Forecasts of sugarcane at origin 't' for the state of Bihar were computed with the help of equation \(Z_t(1)=Z_t -0.85a_t\) (1 step ahead forecast) and \(Z_t=Z_t(L-1), L\) step ahead forecast \((L>1)\).

During the study on trends and seasonality in market arrivals and prices of groundnut for three districts of Karnataka over the period 1965-
66 to 1990-91, Mundinamani et al. (1999), contended that as far as trend and monthly seasonal indices were concerned, a continuous upward movement and a higher monthly seasonal indices immediately after harvest for arrivals were observed in all markets under the study. It was concluded that in the hinterlands of some markets, the crop was raised mainly under rainfed condition, which resulted in wide fluctuations in arrivals and prices. In this study orthogonal regression analysis and seasonal indices were employed to examine the trends as well as seasonal movements of arrivals and prices.

In forecasting the agricultural scenario in Tamil Nadu, ARIMA models were built by Balanagammal et al. (2000) for the data related to the cultivable area, production and productivity of chosen crops over the period 1956-57 to 1994-95 and to forecast over the next five years, i.e., 1995-96 to 1999-2000 considering 1994-95 as the base year. With regard to production, finger millet and groundnut showed decreasing level of production with a decrease in the area of cultivation whereas for sorghum, greengram and redgram the cultivable area decreased though production level increased. With regard to productivity of the crops, maize, blackgram, greengram and cotton showed a decreasing trend during the forecasting period while other crops such as rice, sorghum, pearl millet, finger millet, redgram, sugarcane and groundnut showed a mildly increasing trend. It was revealed that nearly all the crops covered by the study did not show higher increasing trends in the area of
cultivation and production. From their study it was inferred that the impact of green revolution could be revitalized.

Molla and Atteri (2000) analyzed the price behaviour of potato and onion in Delhi wholesale market for the years 1998-99 using multiplicative scheme. They concluded that trend and seasonality components were significant in both time series of arrivals and prices of both the commodities. Also, arrival fluctuation played an important role in causing high fluctuation in prices of potato and onion.

Ansari and Ahmed (2000) applied ARIMA modeling for time series analysis of world tea prices and industrialized countries' export prices. The results of the estimated ARIMA equations implied that the information on the current period's tea price was sufficient to forecast the next period's and the industrialized countries' export prices could be forecast from information on the prices of the previous two periods. They concluded, from the fitted ARIMA model that auto-regressive processes generate both price series and there is no influence of external factors.

Sadequl Islam (2001) made a time series analysis of jute prices in Bangladesh for the period 1966-90. To compare and compute relative prices of raw jute he used not only prices of jute but also prices of agricultural raw materials and prices of exports of industrialized countries. In order to examine whether the absolute or relative prices of jute were stationary or non-stationary, unit root tests suggested by Dickey
and Fuller were adopted. Also, a non-parametric test provided by Cochran to measure the persistence of fluctuations in jute prices, prices of agricultural raw materials and prices of exports of industrialized countries were employed. The empirical evidence of the study showed that jute prices were more volatile than those of agricultural raw materials during the study period. However, the volatility of jute prices relative to prices of export of industrialized countries was lower than that of prices of agricultural raw materials relative to prices of industrialized countries’ exports which suggested that movements in the case of the former were relatively more synchronous. The study further suggested that the degree of persistence was lower for jute prices compared to that for the prices of agricultural raw materials and prices of industrialized countries’ exports. In a nutshell, the study suggested that for a country like Bangladesh, there was need for long-term shifts in the allocation of resources away from jute production.

2.5 MARKET INTEGRATION STUDIES

Dinakar (1990) assessed the extent of price integration between the markets by using coefficient of variation technique. He noticed that there was poor integration between the village markets and secondary markets as demonstrated by significant differences in the coefficient of variation of prices.

Arya (1991) analysed the spatial integration of four markets in Gujarat using zero order price series correlation analysis. She noticed
significant and high correlations in the price movements between the markets and concluded that the markets under consideration were integrated in terms of price movements.

Mali et al. (1999) analysed the trend in arrivals and prices of vegetables (tomato and lady’s finger) in Pune regulated market during the period from 1978-79 to 1996-97. The coefficients of variations of arrivals (56% to 80%) and prices (40% to 80%) of tomato were higher than the variations in arrivals (27% to 60%) and prices (49% to 75%) of lady’s finger. The compound growth rate of arrivals (2.11%) and prices (1.02%) of both vegetables were significant during the same period and prices of both vegetables showed increasing trend indicating good integration of Pune regulated market for vegetables.

Nawadkar et al. (1999) reported that coefficients of variation of arrivals (22% to 79%) and prices (30% to 55%) of cabbage in Pune regulated market from 1978-79 to 1996-97 were found to be higher. Similar trend in arrivals (31% to 69%) and prices (24% to 54%) was observed in cauliflower. The compound growth rates of arrivals and prices (2.20%) of the cole crops were significant in the same period. The seasonal indices of prices and arrivals of both these vegetables were inversely related and prices of both showed an increasing trend indicating good market integration for these vegetables.