PRODUCTION, MARKETING AND EXPORT PERFORMANCE OF TURMERIC IN KARNATAKA-AN ECONOMIC ANALYSIS

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INTRODUCTION

India is popularly known as the “Spice Bowl of the World” as a wide variety of spices with premium quality are grown in the country since ancient times. In Vedas, as early as 6000 BC, scruples evidences are available regarding various spices, their properties and utility. Among the commodities that were traded during that period, spices occupied a major portion due to their superior quality and diversity which attracted foreigners to India. India has been well known for the trade since the period of exploration of sea routes, because of its various spices and superior quality. This was the key reason because of which India has invaded by the European countries and was imperialized.

According to the International Organization for Standardization (ISO), 65 spices are grown in India. The spices are grown throughout the country from tropical to temperate climate. India has the highest number of spice varieties in the world. As per the definition of International Spice Group “Spices are any of the flavoured or aromatic substances of vegetable origin obtained from the tropical or other plants, commonly used as condiments or employed for the other purposes on account of their fragrance preservation or medicinal qualities” (Angels, 2001).

Turmeric — the Golden Spice — is widely cultivated in different countries such as India, China, Myanmar, Nigeria, Bangladesh, Pakistan, Sri Lanka, Taiwan, Burma, Indonesia, *etc.* Among these countries, India occupies the first position in area, with 195.10 thousand hectares and also in production, with 992.90 thousand tonnes during 2010-11. In India, turmeric is grown in 18 states and Andhra Pradesh, Tamil Nadu, Karnataka, Orissa and West Bengal are the major turmeric-producing states.

A yellow spice with a warm and mellow flavor, turmeric is related to ginger. Turmeric is used in preparation of mustard and curry powder and it's a popular ingredient in Middle Eastern cooking. Turmeric is a spice derived from a rhizome (a type of root) native to India and South East Asia. Turmeric was prized as a dye for centuries, thanks to its power to tint fabric--or food--a brilliant yellow-gold. The dried, powdered rhizome is used in curry powder, some types of pickles and also as a natural food coloring agent. Turmeric is sometimes substituted for saffron (which is far more expensive); but aside from their colour, the two spices have little in common. Turmeric's flavor has been described as peppery and somewhat bitter, so it's important to be judicious when adding this spice to foods.

History/Region of origin

Turmeric, with its brilliant yellow colour, has been used as a dye, medicine, and flavoring since 600 BC. In 1280, Marco Polo described Turmeric as "a vegetable with the properties of saffron, yet it is not really saffron." Indonesians used Turmeric to dye their bodies as part of their wedding ritual. Turmeric has been used medicinally throughout Asia to treat stomach and liver ailments. It also was used externally, to heal sores and as a cosmetic.

Turmeric has been used for many centuries. Due to its ancient origin, its actual place of origin cannot be ascertained, but however it has been grown in many parts of South Asia and South East Asia. In South Asia, India is a major producer, consumer and exporter of turmeric whereas Java, Sumatra are the major producers in Indonesia. Apart from this turmeric is also now grown in Philippines, Japan, Korea, China, Sri Lanka, Nepal, East & West Africa, Caribbean Islands and Central America.

Botanical description of turmeric

Indian Name	: Haldi
Botanical Name	: *Curcuma longa*
Family Name	: Zingiberaceae
Parts Used	: Rhizomes
Habitat	: Southern Asia

Varieties

A number of cultivars are available in India and are known mostly by the name of region where they are cultivated. The important varieties in India are: Alleppey Finger (Kerala), Erode and Salem turmeric (Tamil Nadu), Rajapuri and Sangli turmeric (Maharashtra) and Nizamabad Bulb (Andhra Pradesh). In Tamil Nadu, the important varieties cultivated are Erode local, BSR-1, PTS-10, Roma, Suguna, Sudarsana and Salem local. Among these varieties, 70 to 75 per cent was occupied by the local varieties. In domestic and international markets, Salem turmeric has established itself as the best quality turmeric and it fetches the higher price compared to the price of Erode turmeric. The superior quality of Salem turmeric is due to good soil conditions and less cross contamination.

Economic use

Turmeric is one of the multi-use products which has many valuable properties and uses. It is extensively used in food, textile, medicine and cosmetic industries. The curry powder is one of the indispensable ingredient in the Indian foods, which contains 5 to 30 per cent of the turmeric powder in its total content. Turmeric has colouring property because of the curcumin content and hence it is used as a natural colouring agent for food stuffs, jellies and fruit drinks. The dye made out of turmeric is used in cosmetic industries for its unique properties such as skin clearing property. It checks growth of hair and adds beauty to the face. Turmeric plays a prominent role in the medicinal industries, serving as an ingredient for the preparation of valuable drugs for many of the disorders in human beings.

Global scenario of turmeric

In the world, India is the leader in terms of production, consumption and export. India accounts for 78 per cent of the total world production followed by China (8%), Myanmar (4%), Bangladesh and Nigeria (3%). After India, China is the major exporter followed by Vietnam and Myanmar. United Arab Emirates (UAE) is the major importer accounting for 24.06 per cent of the total exports followed by United States of America (12.93%), Japan, Sri Lanka, Iran, United Kingdom and Middle Eastern countries. These importing countries represent 75 per cent of the turmeric world trade and are mostly supplied by the Asian producing countries. Europe and North America represent the remaining 15 per cent, and are supplied by India and Central and Latin American countries. Taiwan exports mostly to Japan. India contributes 70.41 per cent of world exports followed by Vietnam (6.1%), Netherlands (3.09%), Indonesia (2.32%), Myanmar (2.16%) and China (2.02%) during 2010-11 (*UCX, 2012*). The United States imports turmeric from India to the extent of 97 per cent its domestic requirements and the rest is supplied by the islands of the Pacific and Thailand. The total yearly consumption of Turmeric all around the globe is approximately 38 lakh bags to 40 lakh bags depending on the rates. The price of turmeric in New York market declined from 5.29 US$/kg in April 2011 to 3.53 US$/kg during March 2012.

On an average India exports about 40,000 to 45,000 tons of turmeric per annum. It is shipped in the form of dry turmeric after polishing, fresh turmeric, turmeric powder, dehydrated turmeric powder, oils and oleoresins. In terms of volume, turmeric oleoresin account for about 200 tons per annum and turmeric powder constitutes very small portion. During the year 2011-12, the share of turmeric in the export of total spices was 14 per cent with an quantity of 79500 metric tonnes whereas, value wise 8 per cent of total spices with an value of ₹ 73,434.40 lakhs (*Spice Board, 2012*).

India exports about 10 per cent of its turmeric per annum. The key export destination for Indian turmeric are UAE – 17 per cent, USA - 10 per cent, Bangladesh - 9 per cent, Sri Lanka - 7 per cent, Japan - 7 per cent, Malaysia - 6 per cent and UK - 6 per cent. All these countries together account for 65 per cent of the India's total exports. Remaining 35 per cent is being shipped to Europe, North America, Central and Latin American Countries during 2010-11.

Indian scenario

India has 195.10 thousand hectares under turmeric cultivation with a total production of 992.90 thousand tones (2010-11). The area and production of turmeric in India is growing at the rate of 2.60 and 5.60 per cent per annum during the period from 1974-75 to 2010-11. Andhra Pradesh is called the "turmeric bowl of India" as it topped both in area and production with 59475 hectares and 364044 tonnes respectively. Tamil Nadu follows with respect to area under turmeric of about 33368 hectares with production of 169311 tonnes during 2009-10 (*Spices Board*). Tamil Nadu has witnessed sharp decline in total production due to shifting of area towards other crops such as sugarcane on account of poor price realization. Andhra Pradesh, Tamil Nadu and Karnataka constitute major share in India's total production. Meanwhile, area under turmeric in the state of Orissa (13%) is also significant although level of yield is lower.

Turmeric is a seasonal product which is available in the market mainly in two seasons, the first season commenc in mid February to May and second season in mid August to October. Out of the total production, over 90 per cent is consumed domestically and 10 per cent is exported to other countries.

Karnataka scenario

Karnataka is also one of the major producer of turmeric in India with an area of 24912 ha and with production of 250829 tonnes in 2010-11 with a share of 25.20 per cent to the India's total production. In Karnataka, the area and production of turmeric is growing at the rate of 5 and 6 per cent per annum. The major districts which are producing turmeric in the state are Chamarajanagar, Mysore, Bagalkot, Belgaum and Bidar. Chamarajanagar is the leading producer with an area of about 9708 ha and a production of 50808 tonnes followed by Mysore (6389 ha and 100310 tonnes), Bagalkot (4161 ha and 62898 tonnes) and Belgaum (1695 ha and 10352 tonnes). These districts together contribute 89 per cent of the total area and 88 per cent of the total production of the state. Rest of the production was contributed by Gulbarga and Bidar.

Vision 2030

The Indian Institute of Spice Research has estimated the production of turmeric for the year 2030. The total demand for turmeric by 2030 is 11, 50,003 tonnes, to achieve this target extra quantity to be produced over the present is 1, 57,103 tonnes with a productivity of 6450 kg/ha. These estimates were made taking into account the present level of production, export, import, per capita consumption, expected level of increase in export and population growth *etc.* There is an urgent need to take stock of the present level of production and export and prospects of increasing the production with available technologies to meet the future demand. Under the above said background, the targeted production need to be achieved without increasing the area under the crops potentially utilizing the scientific, technological and traditional strengths for sustainable production. India can withstand competition only by increasing productivity and reducing cost of cultivation leading to low cost per unit of production.

Price behavior of turmeric in India

The price of turmeric in India had witnessed a sharp increase for the past few seasons. From the year 2008-09 there was an upward movement in the price trend. On 18 October 2008 the futures price of turmeric was Rs.3528 and in 19 October 2010 it hovered to Rs.15498. The spot price also witnessed a sharp increase. In November 2008 the price was at a range of Rs.3750-3850 and in November 2010 it touched around Rs.16000.Turmeric prices were seen headed southwards. After having touched ₹ 17,000 per quintal mark in 2010-11, bears have slowly but steadily been tightening their grip on the golden spice. At the Erode market in Tamil Nadu, for instance, it was estimated that stocks in the hands of farmers and traders has risen year on year by as much as 30 per cent to 40 per cent. Farmers have been holding back stocks in the belief that prices would rise higher enabling them to make additional profits.

Exporters and traders believed that the additional stocks would come into the market ahead of the beginning of the month of Aadi or Ashad (the inauspicious month in the Hindu calendar) leading to a glut in supplies and a further fall in prices. Most of the exporters and traders were seen staying on the sidelines and resorting to just-in-time purchases for meeting export requirement. Some export orders were booked in the price range of ₹ 158-160 per kg. Typically, there was a price differential of ₹ 10-12 per kg in the prices between Erode and Nizamabad with the former being more expensive.

Indian turmeric production could reach 30-35 lakh bags in the Kharif 2012-13 against last year's 12-14 lakh bags, because of this the price of the turmeric has steadily fall down to around ₹ 5565 per quintal in 2012-13. Higher prices have encouraged farmers to bring additional land under turmeric cultivation in 2011-12. Increased acreage under turmeric was reported in Gobichettypalayam, Kodumudi and Bannari regions of Tamil Nadu state. Exporters believed that only an increased offtake due to demand in Middle-East can see a rise in prices and demand for Indian turmeric is robust in markets like Dubai and Japan.

Due to all these reasons Government of India announced the minimum support price for turmeric during May 2012. Central government announced ₹ 4, 092 per quintal for polished turmeric and to safeguard the interest of the Karnataka farmers, the state government announced the additional amount of ₹ 908 per quintal. Thus the government purchased turmeric at the price of ₹ 5000 per quintal. Total quantity procured under this scheme in Karnataka and costs involved in the procurement is given in Appendix-I.

Turmeric patent issue

The turmeric patent shows the impact of World Trade Organisation (WTO) on the Indian Biological Heritage. The patent on turmeric had been granted in March 1995 to two non-resident

Indians associated with the University of Mississipi Medicinal Centre, Jackson, USA. Totally six patents were granted for the wound healing properties of turmeric powder.

The patent was challenged by the Council of Scientific and Industrial Research (CSIR) on October 28, 1998. CSIR challenged the patent on the ground that it lacked novelty, the patent are supposed to satisfy three criteria *viz.,* novelty, non-obviousness and utility. Novelty implies that the innovation must be new and it cannot be part of 'prior art' or existing knowledge. Non-obviousness implies that some one familiar in the art should not be able to achieve the same step.

India had evidence both from *Hindi* and *Sanskrit* works and the research work by its own laboratories. Based on these evidences after a complex legal battle, the US patents and trademark was ruled out on August 14, 1997. The patent on the use of turmeric as a healing agent was invalid because it was not a novel innovation.

Government policies and outlays for spice improvement`

Recognising the importance of turmeric as well as other spice crops, the Government of India has taken up several steps to promote the production of spices in India. Some of the major policy decisions were Indian spice logo and brand promotion, spice subsidies, reduction in cess, monitoring and coordinating body at the level of planning commission *etc.* Quality planting materials of improved varieties are produced and distributed by Indian Institute of Spices Research (IISR), Calicut. Financial assistance for production of planting material is made available under ICAR Mega Seed Project, Revolving Fund Project of ICAR, National Horticulture Mission, KVKs and ATIC programmes. Besides, SAUs, Govt. Seed Farms, NGOs, and private entrepreneurs are also involved in the development and distribution of planting material. Spices Board is also supporting some seed multiplication farms. The plant materials are supplied to developmental agencies and progressive farmers.

On the quality front, the major consuming countries like Europe and USA are demanding higher quality compliance by the producing countries. It is pertinent to note that India was able to cope with the new stringent quality stipulations set up by these consuming countries and sustain and increase its export share in these markets with various quality improvement programmes initiated by the Spices Board. But the recent trends among these countries in quality stipulations will definitely go further and only those suppliers who can meet the aspirations of the consumers would be able to survive in future. To meet this challenge, the Spices Board has set up Spice Park, which is an industrial park for processing and value addition of Spices and Spice products. It offers the processing facilities at par with the international standards. The Regional crop specific Spices Park is a well-conceived approach to have an integrated operation for cultivation, post harvesting, processing for value addition, packaging, storage and exports of spices and spice products by meeting the quality specifications of the consuming countries. The Board is in the process of establishing Spices Parks across the major producing/market centers. The mission is to establish at least one Spice park in each State of the Country by the end of the XII plan period. For overall development of spices in India, the government of India sanctioned about ₹ 1500 crore during eleventh Five Year Plan to spice board, in that major share was kept for Export Oriented Production (₹ 1000 crore).

Importance of the study

Turmeric is a widely grown and consumed spice that has got good international market. A large group of market participants are engaged in different activities in the entire value chain of turmeric right from production to its consumption. Prices show considerable volatility that could pose profit risk to different stakeholders. Due to high marketing cost involved in the marketing of turmeric, it reinforces the need for risk management tool.

India is the major exporter of turmeric in the world, yet there are few studies throwing light on various facets of turmeric. These studies lack a holistic approach encompassing production, marketing, price behavior, production and post harvest constraints and export of turmeric. In the era of globalization, a reassessment of supply potential, domestic and international demand scenarios and export potential becomes most essential. Keeping in view the above points, the present study is an attempt to analyse production, marketing, export potential of turmeric in Karnataka since it is also one of the major producer of turmeric in the country. The study will also help planners and policy makers to frame appropriate policies related to turmeric production, marketing and exports.

Objectives

1. To estimate growth and instability in area, production and productivity of turmeric in Karnataka
2. To work out the allocative and technical efficiency in the production of turmeric

3. To work out the cost and returns in the production of turmeric
4. To identify and evaluate marketing channels for turmeric in Karnataka
5. To analyse the trends in arrivals and prices of turmeric and predict the future prices
6. To analyse the export performance of turmeric from India
7. To study the integration of important markets for turmeric
8. To enumerate production and post harvest constraints in turmeric

Hypotheses

1. There is an increasing trend in the area, production and productivity of turmeric in the study area
2. The resources are optimally utilized in the production of turmeric
3. Cultivation of turmeric is profitable
4. There are few channels in the marketing of turmeric
5. There is a positive growth in export and the direction of trade is visible
6. The markets are better integrated for turmeric

Presentation of study

The entire study has been presented in seven chapters. The first chapter deals with the importance and the specific objectives of the study as well as limitations of the study have been indicated.

Chapter II deals with the reviews of the relevant research studies connected with the objectives.

Chapter III provides the main features of the study area and the study outline. The nature and sources from which relevant data have been collected and the various statistical tools and techniques employed in the study for evaluating the objectives have been discussed.

Chapter IV is devoted to results of the analysis of the data through a variety of tables into which relevant details have been compressed and summarized under appropriate heads and presented in the tables.

Chapter V provides a discussion on casual relationship between certain variables and the outcome which they produced.

Chapter VI briefs the summary of the main findings along with the policy implications that emerged from the findings of the study.

Chapter VII, the final chapter, lists the references cited while undertaking the research.

Limitations of the study

Due to the limitation of the time and other resources, the present investigation has been restricted to the selection of sample size and variables. Hence, the findings have to be viewed in the specific context of the conditions prevailing in the study area and cannot be generalized for wider geographical area. However, careful and rigorous procedures have been adopted in carrying out the research as objectively as possible. In order to study export performance of turmeric, the data were collected with respect to India, as state wise export data were not available. In spite of the individual bias the respondent farmers in eliciting the necessary responses, it is believed that the findings and conclusions drawn in the present study would form the basis for future research studies.

REVIEW OF LITERATURE

With a view to evaluate the objectives of the study, it was considered desirable to have an idea of the findings of some earlier researches and the methods adopted for arriving at the same. Such a review of literature connected with the main objective of the study, it is hoped, would provide a basis either for confirming the earlier findings or for contradicting the same and thereby to suggest points of departure for further studies.

Consistent with the objectives of the study, the review of literature is presented in this chapter under the following heads:

2.1 Growth and instability analysis

2.2 Allocative and technical efficiency

2.3 Cost and returns

2.4 Marketing channels

2.5 Trend analysis

2.6 ARIMA technique

2.7 Export performance

2.8 Market integration

2.9 Production and post harvest constraints

2.1 Growth and instability analysis

Hazell (1984) assessed the sources of increased instability in cereal production in India and USA. The results revealed that the recent growth of cereal production in India and US was being accompanied by more than proportionate increase in the standard deviation of production. This study applied variance decomposition procedure using state wise data on crop production to analyse the sources of increased instability. It was found that the covariance in production between states and crops was high in view of increased yield variability and a loss in off-setting patterns of variability between crop yields in different states. These changes were associated with variable prices, high yield technologies and narrowing genetic base.

Pal and Sirohi (1989) identified the sources of instability in crop production and yield in different states in India between two periods, 1960-1965 and 1966-1984. The results revealed that yield variation contributed largely to the variance in production of pulses and oilseeds and the same increased over time. After adoption of HYV, the absolute variance increased on account of increased sensitivity of HYV to inputs and weather, especially rainfall. The intensive use of irrigation led to comparatively stable production of foodgrains.

Jeromi and Ramanathan (1993) examined the growth of world pepper market for the period from 1975 to 1990. Among the exporting countries, Sri Lanka recorded the highest annual compound growth rate of 24.59 per cent. This was mainly due to its low base in the initial years. Positive and statistically significant growth rate was recorded in the case of India. In contrast, the growth rate in total exports from the other producing countries was statistically non-significant. The growth rates of pepper imports ranged from a negative level of 2.56 per cent for Argentina to a high and positive level of 11.64 per cent for Saudi Arabia.

Patel and Agarwal (1994) analysed the sources of instability in the production of groundnut in Gujarat by decomposing the variance of production into its sources *viz.*, area variance, productivity variance and area productivity covariance. The study period was divided into two periods *i.e.,* period I (1960-61 to 1969-70) and period II (1970-71 to 1988-89). The results of the study revealed that, yield variance accounted for more than 80 per cent of production variance in the study period.

Mamatha (1995) estimated the growth rates of production and export of selected spices for the period from 1970-71 to 1991-92. The spices considered were pepper, chillies, turmeric and ginger. She found that positive growth rate in respect of production and export of the selected spices was due to the increased domestic production and demand for these in the international market. The increased domestic production and exports were attributed to the several measures taken by the spice board such as improved methods of production, assistance for the export of spices by setting up facilities for upgrading quality and technical advice on scientific post-harvest operation and processing.

Kumar and Sankaran (1998) analysed the instability in turmeric production in India. The factors responsible for the instability in turmeric production in India during the period from 1970-71 to 1989-90 were investigated. The decrease in the area instability more than compensated for the marginal increase in the yield instability during the 1980's. The resulting reduction in production instability indicated that the yield instability was the dominated factor affecting production instability.

Angles (2001) studied the production and export of turmeric in south India. He found that all the states registered significant growth in area, production and productivity, except in the case of area in Tamil Nadu and Kerala, production in Tamil Nadu and productivity in Karnataka. The analysis of price trend in important markets of south India revealed that there was an increasing trend in all the markets.

Jayesh (2001) studied the production and export performance of pepper and cardamom in south India. He found that all the south Indian states except Karnataka (-0.47%) and Tamil Nadu (-1.62%) recorded significant growth in area and production of pepper and in case of cardamom, all the states recorded a negative growth in area, while the productivity and production showed significant growth. A positive growth was found in the export quantity, value and unit value of pepper. But a negative growth was recorded in the export of cardamom.

Angels and Hosamani (2005) examined the instability in area, production and productivity of turmeric in selected South Indian states *viz.* Andhra Pradesh, Tamil Nadu, Karnataka and Kerala considering the period from 1979-80 to 1998-99. Hazell's decomposition model was used for the analysis. The instability in area and productivity of turmeric indicated that the area in the case of Andhra Pradesh and Tamil Nadu showed instability, while Kerala showed stability. But, in the case of yield, except Karnataka all other states showed instability. Decomposition analysis showed that yield instability was the dominant factor affecting production. The future development programmes should envisage stabilization of yield, which would stabilize production. Evolving location specific varieties, adoption of modern cultural practices and intensive cultivation were some of the suggestions for stabilizing productivity of turmeric.

Kumawat and Meena (2005) studied growth and instability in area, production and yield of spice crops such as coriander, cumin, fenugreek, fennel, garlic and chilli in Rajasthan *vis-à-vis* India from 1986-87 to 2000-01, indicated that almost all the spices registered significant growth rates in their production in Rajasthan as well as in India during the entire study period mainly due to significant increases in the same during post-Technology Mission on Oilseeds (TMO) period (1986-87 to 2000-01). In majority of the spice crops the instability in production increased during the post-TMO period over the pre-TMO period (1967-68 to 1985-86) in Rajasthan and India as well. However, the magnitudes of coefficients of variations were more pronounced at the state level than at the national level. The instability in area in the state was higher in the post-TMO period than in the pre-TMO period. The same was true for India except that the magnitudes of coefficients of variations were less at the national level. In general, yield instability, on the other hand, decreased during the post-TMO period over the pre-TMO period in both Rajasthan and India. As regards sources of variance of production, area variance played a dominant role in case of coriander, cumin, fennel and garlic. Yield variance predominantly destabilized the production of chilli in Rajasthan and of fenugreek in India. In majority of the spices, area yield covariance helped to stabilize the production in Rajasthan as well as in India.

Gyan Prakash *et al.* (2006) analysed the growth rates and decomposition analysis of foodgrains production in India from 1955-56 to 1998-99 and found that, there is, in fact, some deceleration from Pre-green Revolution Period to the Green Revolution Period, coming substantially from a decline in the growth rate of area in the Post-green Revolution Period/Pre-economic Reform Period and Post-economic Reform Period. The major contribution of output is through yield increase. The first order interaction of yield and cropping pattern was a major factor for the growth of foodgrain output. Therefore, the future effort should be made to stabilize and expand the area of food grains along with increasing yield level. For this, modern technology of agriculture should be promoted, which consists of pest and disease resistant varieties.

Thumar *et al.* (2006) analysed the growth and instability in the production of garlic in Gujarat for the period of 1985-86 to 2001-02 and the data were analysed by using exponential production function and instability index. The results of the study revealed that, area and production has increased in the state but with high instability. The productivity registered lower but relatively more stable growth compared to area and production which indicates that the area is the main source of increasing the garlic production in the state.

Ghosh and Kuri (2007) conducted study on decomposition analysis of agricultural growth in West Bengal from 1970-71 to 2003-04. The study revealed that the agricultural growth in West Bengal declined significantly in the mid-1990s from an impressive growth rate of the 1980s. The decomposition of output growth across the districts, as well as on the whole, showed that yield growth plays the most important role in output growth. The contribution of extension of area was next. A sharp fall in yield growth during the 1990s was mainly responsible for the slowdown in output growth. Analyzing the sources of agricultural growth and the causes of recent decelerating trend in agriculture in the state, the paper finally recommended appropriate extension programs suitably adjusted with the dynamics of crop diversification to exploit the advantages of globalization and to achieve a higher growth path in agriculture in the state.

Jose and Jayasekhar (2008) studied the growth trends in area, production and productivity of Arecanut in India during the period from 1971 to 2004. It revealed that the area and the production of Arecanut in India increased tremendously at the rate of 2.2 per cent and 3.2 per cent respectively. The rate of increase in both area and production is mainly due to favourable price prevailed during the period.

Madan (2008) studied changing scenario of turmeric production in India from the period 1980-81 to 2002-03. The resultant estimates of the growth rate analysis indicated that, turmeric production in the country has registered an average annual growth rate of 5.81 per cent with productivity increase of 2.6 per cent in the same period.

Sharma and Kalita (2008) studied the variation and instability in area, production and productivity of major fruit crops in Jammu and Kashmir for the period from 1974-75 to 1999-2000. It revealed that growing of pear, cherry and almond were more risky compared to other fruit crops in the state as revealed by higher coefficient of variation. The coefficients for area, production and productivity for these crops were more than 78 per cent. The raising of apple in the state was less risky, which had a coefficient of variation of less than 35 per cent.

Taher and Shadmehri (2008) examined the growth rate and decomposition analysis of agricultural production in Iran for the period of 1970-71 to 2000-01. The results of the study revealed that, the performance of agricultural sector was slightly better during pre-revolutionary period than that of post-revolutionary period. Production, yield of food grains grew during 1970-71 to 1978-79 at a higher rate than that recorded during the years 1979-80 to 2000-01. The main sources of growth of agricultural production during the period 1970-71 to 2000-01 were the growth in yield and expansion in irrigated area.

Bhowmick *et al.* (2009) analysed the growth performance of ginger in Assam for the period of 1992-93 to 2002-03 by using Linear Growth Model of the form $Y=a+b_{t,}$ the results of the study revealed that the area under ginger was found to be negative (-0.56%) where as production (11.29%) and productivity (11.85%) showed significant positive growth rates. The negative growth rate in area was mainly due to shift in cropping area to tea and rubber.

Dhakre and Sharma (2009) analysed the growth and instability analysis of ginger production in North-East region for the period of 1992-93 to 2004-05. The results of the study showed that, during the period North-East has showed the significant growth rates in production (26.72%) and productivity of ginger (6.77%). In case of area, growth rate was positive (11.91%) but not significant. During the period the region recorded instability in area, production and productivity of 204.20, 10.46, 29.43 per cent respectively and decomposition analysis showed that area instability was the dominant factor affecting production.

Hemant *et al.* (2009) studied the decomposition analysis of lentil in India. The total study period was divided in to three decades namely, 1970-71 to 1979-80, 1980-81 to 1989-90 and 1990-91 to 2000-01, to examine the contribution of area, yield and the interaction of area and yield towards increase in the lentil production in the country. The results of the study revealed that, during the eighties, contribution of yield (53%) was more than that of area (37%) and interaction (10%). However during seventies, lentil production was declined mainly due to negative area effect (-86%). During the overall period, area effect (66%) was higher than the yield and interaction effect (17%). Hence it was concluded that the total change in the production of lentil in the country was due to the area effect.

Krishndas (2010) studied production and export performance of major Indian spices. The variance decomposition analysis developed by Hazell (1982) was used to examine the sources of instability by decomposing the changes in average production between the two sub periods that is between the post WTO period (1995-96 to 2006-07) and the pre WTO period (1983-84 to 1994-95).The results revealed that in case of chilli all the components except interaction between changes in mean area and mean yield contributed for the stability in average production. Whereas the change in average production of black pepper was mainly contributed by the change in mean yield. In case of turmeric the change in mean yield was the main source of variability in turmeric production, in case of coriander all the components *viz.* change in mean yield, mean area, interaction between mean yield and area and change in covariance between area and yield contributed for the instability in average production. In case of cumin all the components except change in mean area led to the stability of average production.

Gyati Riku *et al.* (2011) estimated the growth rate in area, production and productivity of ginger in Meghalaya during 1998-99 to 2007-08, the results of the study revealed that the area under ginger (2.35%) and production (1.58%) showed a positive growth rate while the productivity of ginger showed a declining trend over the year (-0.78%).

Veeranagouda *et al.* (2011) studied the growth rate scenario of chilli in northern Karnataka. The study revealed that northern Karnataka as a whole registered positive compound growth rate for area (13.76%), production (13.88%) and productivity (12.20%). These registered values were non-significant at both ten and five per cent level of significance.

The above reviews revealed that most of the researchers had investigated various aspects of the growth of area, production, export and related aspects in various crops by computing the compound growth rate. Exponential growth function of the form $Y = ab^t$ was used and found different results based on the time series data which they had used for the specific crop and crop groups. Alternatively different modules were also tried to workout growth rate.

2.2 Allocative and technical efficiency

Dyammannavar (2000) in his study on economics of gherkin production and trade in Haveri district employed Cobb-Douglas production function. The regression co-efficient of bullock labour (0.2338) and FYM (0.4805) were found to be statistically significant indicating their crucial role in gherkin production. The MVP to MFC ratio was more than unity in the case of bullock labour, FYM, staking material and seeds. This indicated that there is an opportunity to maximize returns by using more of these resources.

Dodke *et al.* (2002b) analysed the resource use efficiency of turmeric in Chandrapur district of Maharashtra by selecting 60 farmers from ten villages in the year 1994-95 and the collected data were analysed as per Cobb-Douglas production function. The ratio of marginal value product of inputs to its price in respect of land, seed and bullock labour were positive and greater than unity indicating that there is scope to increase the use of these inputs, while in case of manures, fertilizers and irrigation the ratio was less than one indicating the over use of these inputs, which need to be reduced for their efficient use. The human labour showed negative value indicating excess use of this input and should be curtailed for the optimum use.

Elsamma and George (2002) studied the technical efficiency in rice production in Kerala through stochastic frontier production function approach. The farm specific technical efficiencies revealed wide variation in the level of technical efficiencies across the sample. The farm specific technical efficiency varied between 58 per cent to 99 per cent with a mean efficiency of 85.01 per cent during *puncha* season and 84 per cent during *virippu* season. The analysis revealed that about 31 per cent of the sample farmers were operating closer to the frontier with a technical efficiency of more than 90 per cent during the season and more than 12 per cent of the farmers were operating above 95 per cent efficiency.

Saikumar (2005) studied the resource use efficiency in different farming systems of three districts of north eastern Karnataka employing the Cobb-Douglas production function. The adjusted R^2 was 0.76, 0.58 and 0.54 for Bidar, Bellary and Raichur districts, respectively, indicating that 76, 58 and 54 per cent of variation in yield was explained by the estimated production functions. The coefficient of cost of seeds and feeds plus concentrates in Bidar, fertilizer plus FYM cost in Bellary and fertilizer plus FYM cost and labour cost in Raichur district were positive and significant at 5 per cent probability level.

Dodamani (2006) worked out the resource use and technical efficiency in naturally coloured cotton production under contract farming in Dharwad district of Northern Karnataka through Frontier

Production Function approach, the profitability ratio indicated that the land, seeds, farmyard manures, human labour, bio-pesticides and trichocards were under-utilized. The average technical efficiency of sample farmers was 75.65 per cent and majority of farmers were operating at technical efficiency between 70 to 80 per cent. The actual and frontier use of different resources indicated that farmers could produce 11.27 quintals of coloured cotton output per hectare. The allocative efficiency of sample farmers was 58.50 per cent and economic efficiency was 44.28 per cent.

Sivanagaraju (2006) examined the technical and allocative efficiency of both traditional and SRI method of paddy production in Prakasam and Guntur districts of Andhra Pradesh. The results of the study revealed that, MVP-MFC ratios in traditional paddy (>1) indicated that there was scope for increased use of seeds, fertilizers and FYM. MVP-MFC ratios in SRI paddy indicated that there was scope for increased use of all the inputs except land. The average technical efficiency was slightly high in SRI method (79.80%) than in traditional method (73.40%). However, SRI paddy farmers were found to operate at high economic efficiency level (50%) when compared to traditional paddy farmers (41.90%).

Thomas *et al.* (2006) studied the technical efficiency of vegetable production in Kerala; study is confined to the Nemmara block of Palakkad district in Kerala. The stochastic production function of the Cobb-Douglas form was used to determine the technical efficiency. The Mean Technical Efficiency (MTE) was worked out as the ratio of the production of i^{th} farm to the frontier production of the same farm. For bitter-gourd, snake-gourd and ivy-gourd, the mean technical efficiencies were 0.85, 0.91 and 0.58, respectively. Technical efficiency of the individual farms varied widely between 30 per cent and 100 per cent.

Radam *et al.* (2007) analysed the technical efficiency of Chinese Cabbage Farm in Cameron Highland Malaysia, the results showed that on an average, the Chinese cabbage farms in Cameron Highland Malaysia could have increased their output by as much as 51.7%, if operating with overall technical efficiency. Pure efficiency component was found to be the primary source of technical inefficiency in farm operation followed by scale efficiency and congestion efficiency. Output could have increased by 37.5 per cent and 12.0 per cent respectively if the farms had been operating with pure technical efficiency and at constant returns to scale. This study concludes that cabbage output could have increased significantly if the inputs had been used at optimal levels.

Singh (2007) investigated the farm-specific technical efficiency of paddy farms in Haryana using stochastic frontier production function; the study revealed that the mean technical efficiency was 87 per cent. Thus, yield of paddy in Haryana can be increased by 13 per cent without increasing the level of inputs, if the inefficiency is reduced. Medium-size paddy farms were found to be more technically efficient as compared to their large and small-size counterparts. This study suggested that the need to promote young farmers as decision-makers along with raising the education level of farming community and also those efforts should be made to further strengthen the extension contacts, access to institutional credit for farmers and to control the fragmentation of farm holdings.

Kulkarni (2008) studied allocative and technical efficiency of paddy production in degraded as well as normal soil conditions in Upper Krishna Project command area where the results showed that the MVP and MFC ratios implied that, majority of the resources used in affected soils was constrained by land degradation. The Timmer measure of technical efficiency in paddy revealed that, the proportion of farmers in the high technical efficiency level was more in normal soils whereas, majority of those in degraded soils were operating in low technical efficiency levels. The Kopp measure of technical efficiency showed that, extent of excess resources used by farmers on all degraded soils were higher than that in normal soils.

Sharma *et al.* (2008) studied the technical efficiency in North-Western Himalayan region agriculture using the frontier production function. The mean technical efficiencies revealed that a considerable portion of frontier output is left untapped; it was 35-42 per cent in maize, 44-50 per cent in paddy and 61-67 per cent in wheat. The ratio of marginal value productivity and marginal factor cost was found to be more than one in case of 50 per cent inputs for all the crops. However, female labour for most of the crops has values less than one and with negative signs as most of the work in hills is being performed by women. The analysis has also revealed that a majority of the farmers operate at low level of efficiency due to practicing of traditional cultivation methods.

Ghulghule *et al.* (2009b) analysed the resource use efficiency in fig production in Maharashtra. The study was conducted in Pune district, analysis of Cobb-Douglas production function for Pune district reflected that the ratio of marginal value product of inputs to its price in respect of area under fig, human labour, manures, nitrogen, and phosphorous were positive and greater than unity indicating that there is scope to increase the use of these inputs, while in case of potash and plant protection chemicals was less than one indicating the over use of these inputs, which need to be reduced for their efficient use.

Mohan (2009) examined that the production function estimates of IPM farmers indicated that output elasticities of seed (0.138), human labour (0.148) and IPM component (0.279) had significant influence on the cotton yield in IPM farmers. Whereas in non-IPM farmers chemical fertilizer (0.087) and plant protection chemicals (-0.047) found to have significant influence positively and negatively on cotton production in non-IPM farmers.

Huq and Arshad (2010) studied the technical efficiency of chili production in the administrative district of Jamalpur and also analyzed the status of resource allocation for its production. The study revealed that all the farmers were not very close to the maximum frontier outputs (efficiency levels varying from 11-96 per cent and their mean efficiency was 77%). On an average, 23 per cent technical inefficiency appears which implies that the output per farm can be increased on an average by 23 per cent through chilli production using the prevailing technology and without incurring any additional production cost. Advanced technology (high yielding variety, disease and pest management) could simultaneously adapted to increase production of this particular spice.

Jyoti *et al.* (2010) analysed the technical efficiency of dryland and irrigated wheat in Jammu district of Jammu & Kashmir state by using the stochastic frontier production function analysis. Technical efficiency has been found different under both the conditions. The estimated mean technical efficiency of the wheat farmers under dry conditions has been found to be 0.84, indicating 84 per cent efficiency in their use of inputs, and for irrigated condition it has been found to be 88 per cent, that means the average output of wheat could be increased by 12 per cent by adopting technology properly. The variance ratio has showed that the farm-specific variability contributed more to the variation in yield, which means that variation in output from frontier is attributed to technical inefficiency.

Anuradha and Zala (2010) estimated the technical efficiency of rice under irrigated conditions in central Gujarath by using the stochastic frontier production function analysis. The study revealed that, the farm specific technical efficiencies range from 71.39 per cent to 99.82 per cent, with the mean of 72.78 per cent, which indicated that on average, the realized output can be raised by 27 per cent in the region with the available technology and resources, without any additional resources.

Sekhon *et al.* (2010) conducted study on region wise technical efficiency in crop production in different regions as well as in the state of Punjab to show how different regions have adopted the latest technology. Technical efficiency of individual farms has been estimated through stochastic frontier production function analysis. The technical efficiency has showed a wide variation across the regions. The average technical efficiency has been found to be maximum in the central region (90%), followed by south-western and sub mountainous regions and they conclude that, the state would benefit more if policy interventions are developed at the local level.

Anand (2011) analysed the resource use efficiency of cotton in traditional paddy fields of Uttara Kannada district of Karnataka and the results found that the ratio of MVP to MFC was positive and more than unity for chemical fertilizer, FYM and bullock labour in case of paddy and it was also more than unity for FYM and seed in case of cotton revealing that these resources were underutilized and there was further scope for maximizing returns by increasing the use of seeds and FYM.

Govindarajan and Karunakaran (2011) estimated the farm specific technical efficiency in paddy production under different irrigation systems in Tamil Nadu. The farm specific technical efficiency of paddy farms under different irrigation systems was estimated through Stochastic Frontier Production Function Model. The frontier co-efficient had indicated the negative response of nitrogenous and potassic fertilizer in paddy production due to the excessive use of these fertilizers. The Stochastic frontier production function analysis further revealed that the mean technical efficiency (MTE) of paddy production in Tamil Nadu was 73.50 per cent. There lies scope for increasing the productivity further. The conjunctive system of irrigation had the highest MTE as compared to other irrigation systems, since farmers had more flexibility over their irrigation management than surface irrigation system. Hence the canal irrigated farms of the state should be targeted for technological excellence and motivating the farmers in adoption of modern technologies like System of Rice Intensification so as to achieve frontier yields.

Mary and John (2011) identified and analyzed the sources of technical inefficiency in turmeric crop farming system in north western region of Tamil Nadu from a sample of 180 turmeric growing farmers. A non-parametric approach, Data Envelopment Analysis (DEA) has been used to estimate Technical Efficiency Scores (TES). Results indicated the presence of technical inefficiency in turmeric farming system. The average technical efficiency score is 79 per cent with the maximum score of 95 per cent and minimum score of 59 per cent. The potential to increase the technical efficiency score of turmeric growing farms is found to be 17 per cent.

The above researchers had studied the resource use efficiency and technical efficiency in the production related aspects in various crops by using Cobb-Douglas, Timmers and Kopps measure of technical efficiency models and found different result based on the data.

2.3 Cost and returns

Mittal (1995) estimated the cost and returns of ginger production in Himachal Pradesh, the results of the study revealed that the average per quintal cost of production of ginger was ₹ 796 and the study also revealed that in order to break even the ginger grower must produce a minimum of 85 quintals per ha and the net returns obtained were ₹ 12,797 per ha.

Mishra *et al.* (1999) worked out the cost of cultivation and cost of production of chillies in Azamgarh district of Uttar Pradesh, the results of the study revealed that the overall per hectare cost A was ₹ 17, 802.77, cost B was ₹ 20,802.77 and cost C was ₹ 22, 439.02. The average gross income per hectare came to ₹ 50, 957.45. On an average, net income came to ₹ 28,518.43. Similarly on an average family income was ₹ 30, 154.68.

Kerutagi *et al.* (2000) worked out the costs and returns of turmeric production in Belgaum district of Karnataka. The total cost of cultivation of turmeric was ₹ 75, 579.94 per hectare in that, cost of seed material accounted for 33.54 per cent of the total cost followed by marketing cost (14.3%). The gross returns were ₹ 2, 08, 428 per hectare and the net returns were ₹ 1, 32, 848.06 per hectare. Benefit: Cost ratio was 2.76 which showed the profitability of investment in the turmeric production.

Korikantimath *et al.* (2000) analysed the economics of mixed cropping of Byadagi chilli and cotton in Dharwad district of Karnataka, the results of the study revealed that the cost of raising chilli seedlings worked out to ₹ 1695 and the cost of cultivation of the mixed cropping system was ₹ 11, 585.40 per hectare. Average yield realization of chilli and cotton were 550 kg and 440 kg per hectare respectively. Gross and net returns of the system worked out at ₹ 24640.00 and ₹ 13054.60 per hectare respectively. The B:C ratio of 2.13 indicated the profitability of the mixed cropping system.

Patil (2000) investigated the economics of production and marketing of turmeric in Sangli district (Maharashtra). The sample constituted 60 turmeric growers from Sangli district. The study revealed that the total cost of cultivation was ₹ 235224.84 per hectare with yield of 134.84 quintals. While, per hectare net profit was ₹ 87723.63. The Output- input ratio at cost 'C' was 1: 1.30. The per hectare use of inputs *viz.* human labour was 457.76 mandays and bullock labour was at 27.57 pairdays. The use of other inputs required were seed 1521.98 kg per hectare, Farm-yard manure 35.51 cartloads and of chemical fertilizers *i.e.* Nitrogen, Phosphorus and Potash 130.21, 61.35 and 21.56 kg/ha, respectively. Average marketing cost was observed to be ₹ 395.27 per quintal. On the whole the items *viz.* Hamali, market fees and commission charges were observed to be major items of marketing cost.

Pol (2001) analysed the economics of production and marketing of ginger in Satara district. The findings of the study showed that average per hectare total cost of production (Cost C) was ₹ 119534.73. The major items of cost of cultivation were seed rhizome, manures and fertilizer, machine labour and Grant total value of land. The average per hectare gross returns and net profit was worked out as ₹ 174755.43 and ₹ 41295.13, respectively. The output-input ratio at total cost was 1.31 *i.e.* greater than one indicating a profitable crop enterprise.

Dodke *et al.* (2002a) studied the economics of production of turmeric in Chandrapur district of Maharashtra. The average per hectare cost of cultivation of turmeric was ₹ 54, 249.00 in that seed cost was the major component accounted for about 32.61 per cent of the total cost. The average price per quintal received by the selected farmers was ₹ 3405.31. Per hectare gross and net returns were ₹ 65, 177.21 and ₹ 10, 928.71 respectively. The input to output ratio at cost 'C' was 1:1.20 thus the turmeric production in Chandrapur district was a profitable crop enterprise.

Lokesh and Chandrakanth (2004) conducted study on economics of production and marketing of turmeric in Karnataka, the results of the study revealed that total cost 'A' of local variety and improved variety of turmeric cultivation were ₹ 21, 791 and ₹ 31, 959 respectively. The net benefit cost ratio is 1.06 and 1.29 at a price of ₹ 2200 and ₹ 2360 per quintal of local and improved varieties of turmeric rhizomes.

Patil *et al.* (2004) conducted study on economics of production of turmeric in Sangli district of Maharashtra, the results of the study showed that the per hectare cost A, cost B, and cost C were ₹ 1,63, 824.31, ₹ 2, 29, 098.67 and ₹ 2, 36,298.67 respectively. Per hectare gross income from turmeric was ₹ 3, 72, 520.98. The input to output ratio was 1: 1.48 and indicated that turmeric is a profitable enterprise in Sangli district.

Birari *et al.* (2006) conducted a study on farm level production, processing and marketing of turmeric in Western Maharashtra. The study revealed that per hectare returns from the cultivation of turmeric were ₹ 27272.25. On account of processing turmeric, the value addition resulted in additional benefits. The producers share in the price paid by the consumer was quite satisfactory and can be increased due to the non-perishable product of processed turmeric.

Rajesh (2006) worked out the economics of vanilla cultivation in Uttara Kannada district of Karnataka, the net present value of the cash inflow per ha was ₹ 1856659.40 on small farm and ₹ 2448524.8 on large farm. B:C ratio was 10.71 on small farm and 13.71 on large farm. The internal rate of return was 58 per cent on small and 65 per cent on large farm. The break-even point for small farm was 145.52 and 127.98 kg for the large farm. In vanilla grown as pure crop, the net present value per ha was ₹ 4942593.61 on small farm and ₹ 5373993.35 on large farm.

Bala *et al.* (2007) analysed the economics of garlic cultivation in Kullu Valley of Himachal Pradesh and the results of the study indicated that the total cost of cultivation was ₹ 53,753 with an yield of 108.75 quintal per ha, in that seed was the major constituent of the total variable cost accounting for 64 per cent of it. The net returns over cost A1, A2 were ₹ 1, 17,258 while those over cost B1 and B2 were ₹ 1, 16,848 and ₹ 1, 07,775 respectively.

Basavaraj (2007) analysed the cost of cultivation of chilli in Karnataka, the total cost of cultivation per hectare was higher in Bijapur district (₹ 45109.80) followed by Gulbarga (₹ 44902.70) and Raichur (₹ 41686.60) districts. The overall cost of cultivation per hectare of chilli was ₹ 43899.71. The total return obtained per hectare of chilli was more (₹ 78778.10) in Gulbarga district followed by Raichur (₹ 76642.10) and Bijapur (₹ 73945.87) district.

Varghese (2007) studied the economics of cardamom cultivation in Kerala; the results showed that cost per acre was highest in case of large size groups (₹ 38, 668.44) followed by medium (₹ 37,371.28) and small size groups (₹ 27, 685.67). But the yield per acre under small size groups was far below than the other two counterparts. Since every small and marginal farmer was having cows and buffaloes at home, they were applying more manure and cow dung.

Ajjan *et al.* (2009) estimated the economics of cultivation of tulsi in Tamil Nadu; it was evident from the results that the total cost of cultivation was ₹ 32, 458 per acre, in that labour cost was accounted for about 34.28 per cent of the total cost. The yield of tulsi was 11, 250 kg/ha. The gross returns obtained from the tulsi were about ₹ 1, 50,000 per hectare and net returns observed was ₹ 1, 17, 542.

Gupta and Sharma (2009) estimated the cost of cultivation of ginger in Himachal Pradesh, they found that the per hectare total cost of cultivation of ginger was ₹ 1,62, 761, in that seed was the major cost component accounted for about 45 per cent of the total cost. Average productivity of ginger was 97.5 qt/ha and gross returns were ₹ 1, 94, 805 per hectare. Net returns over the cost A, B and C in ginger were ₹ 82,687, ₹ 75,362 and ₹ 32, 044 per hectare respectively. This showed that under normal conditions, ginger crop generated highly lucrative returns to the farmers.

Patil *et al.* (2009) conducted study on economic aspects of production, processing and marketing of turmeric in Western Maharashtra, indicated that the mean cost of cultivation of turmeric was ₹ 84,420.56 per hectare. The 112.39 q of output *i.e.* the wet rhizomes gave the returns of ₹ 1, 08,692.91 with the per quintal cost of production of ₹ 724.91 and the benefit cost ratio of 1.33. Per quintal cost of processing of wet rhizomes was ₹ 156.25. The human labour was the major item and shared 44.10 per cent of the total cost of processing. This was followed by machine labour 27.73, utensil charges 21.34 and fuel 6.82 per cent. Even though processing loss of produce was about 67 per cent still the returns were raised to ₹ 1,49,760 as the processed produced fetched manifold higher price. The ratio of additional returns (₹ 41,067.09) with additional cost (₹ 17,549.98) was 2.34 indicated the value addition have resulted in more added benefits.

Puran *et al.* (2009) worked out the economics of cultivation of safed musli in Haryana, the results of the study showed that the total cost of cultivation was ₹ 1, 82, 152.30 in that planting materials accounted for about 55.55 per cent of total cost, the gross returns worked out was ₹ 2, 47, 052.60. Returns over the variable costs worked out were ₹ 1, 06, 259.10 and the benefit to cost ratio was 1.36.

Tripathi *et al.* (2009) investigated the impact of training on production and marketing of ginger in Ri-Bhoi district of Meghalaya. The study was based on the data collected from the 60 participants who attended the training programme on production and marketing of ginger at KVK, Umiam. The study revealed that there was substantial increase in the income of the farmers after attending the training. Before the training programme, the yield of ginger was recorded in the range of 8650 to 8925 kg/ha whereas after application of knowledge gained in the training progarmme the yield was recorded as high in the range of 18920 to 22500 kg/ha. The per kg production cost was reduced from ₹ 6.83 to ₹ 2.89. There was increase in net income in the range of 118-156 per cent as compared to net income of the farmers before the start of the programme.

Sridhara (2010) studied the economics of chilli production under contract farming in Bagalkot district of Karnataka, the results of the study revealed that per acre cost of chilli cultivation estimated to be ₹ 38721.36, ₹ 41238.37 and ₹ 39882.74 in Bilagi, Mudhol and overall study area respectively. The per acre yield of chilli obtained were 1122.98, 1088.67 and 1096.49 Kgs in Bilagi, Mudhol and overall study area respectively by the chilli farmers. The marginal productivity analysis indicated that there is a scope for reorganizing the resources like seeds, bullock labour and plant protection chemicals.

Mane *et al.* (2011) investigated the economics of turmeric production in Sangli district of Maharashtra; the results revealed that use of hired human labour was more than family human labour in turmeric production. The use of hired human labour, bullock labour and machine labour, increased with an increase in farm size. Whereas, the use of seed, FYM, nitrogen, phosphorus, potash, family human labour decreased with an increase in farm size. Per hectare net profit was ₹ 352053.97 in small farm followed by ₹ 344388.94 and ₹ 333662.36 on medium and large farm, respectively. The output-input ratio was 2.23 on small farm followed by that of 2.21 and 2.18 on medium and large farm, respectively. Per quintal cost of production in turmeric was ₹ 1475.75 on small farm followed by ₹ 1485.46 and ₹ 1501.09 on medium and large farm, respectively.

Shivaraja (2012) studied the cost of cultivation of chilli in Haveri district of Karnataka; the results revealed that area under chilli in Haveri district was showing a decreasing trend over the years. The total cost of cultivation of chilli per hectare was worked out to be ₹ 39343.92. The net return per hectare obtained by farmers was ₹ 19589.86.

2.4 Marketing channels

Singh *et al.* (1999) studied the marketing of tomato in Hoshiarpur district of Punjab and observed that the net price received by the farmers was higher (₹ I72.50) when sold in local market as compared to the processing units. Similarly, per acre net returns obtained by farmers was also higher when the produce was sold through local market (₹ 24, 150/acre) than those sold to Pepsi foods (₹ 20, 808/acre) and Nijjar Agro Foods, even though the marketing costs were higher in local markets.

Vasudev and Chowdry (1999) identified two marketing channels which were predominant in marketing of tomato in all the three regions of Andhra Pradesh, *viz.*,

Channel- I: Producer → Commission Agent → Secondary Wholesaler → Retailer → Consumer,

Channel-II: Producer → Commission Agent → Primary Wholesaler → Retailer → Consumer.

Agarwal and Singh (2003) identified the marketing channels for cumin in Nagaur district, Rajasthan, India, as well as determined the marketable surplus and the marketing patterns and margins for cumin seed in the area. The marketable surplus for cumin seed was 98 per cent of the total production. Two marketing channels were identified: one is through village traders then to wholesalers, and the other one is direct to wholesalers. The producer's share in the consumer's rupee was 61.36 per cent in village-level sales and 69.87 per cent in sales at regulated markets.

Subal *et al.* (2003) carried out a study to identify the marketing channels for important medicinal and aromatic plants in Assam, India, to assess the present marketing system of medicinal and aromatic plants. Five marketing channels for medicinal and aromatic plants were identified including forest (producing area)-collector-local market-agent-trader-consumer (industry); forest (producing area)-collector-agent-trader-consumer (industry); forest (producing area)-collector-local market-outside collector-trader-consumer (industry); forest (producing area)-collector-agent-outside collector-trader-consumer (industry); and forest (producing area)-collector-local market-agent-outside collector-trader-consumer (industry).

Lakshmanachar and Velappan (2004) studied the marketing of chilli, ginger and turmeric in India, they found that the patterns of marketing system for these crops follow almost the same marketing channels from farmers to wholesalers. The functionaries involved in marketing of these crops are in general village merchants/itinerant merchants/regulated markets and co-operative marketing societies/commission agents and wholesale merchants. On the whole regulated markets and co-operative marketing societies transact a negligible percentage of available marketable surpluses.

Madan (2004) conducted study on identification of marketing channels for vanilla in India. They identified four marketing channels for vanilla marketing.

i. Farmer → Local agents→ Company → Export
ii. Farmer → Village development trust → Local agent→ Company → Export
iii. Farmer → Village development trust → Company → Export
iv. Farmer → Spice board →Company →Export

Navadkar *et al.* (2005b) conducted study on marketing of vegetables grown around Pune city and revealed that, per quintal cost of marketing of selected vegetables was more in terminal market (₹ 112.67 per quintal) than in primary market (₹ 57.84 per quintal). The proportionate share of transportation and commission charges to total marketing cost were significantly more in terminal market. The producers' share in consumes' rupee was observed to be the least in terminal market for cabbage and the highest in bhendi in the same market.

Tripathi *et al.* (2006) evaluated the marketing channels in the marketing of ginger in Ri-Bhoi district of Meghalaya. The results of the study found that in the marketing of ginger in the study area Producer → Commission agents → Retailers → Consumers was found to be the most efficient channel from the point of producers view as it gave about 60.59 per cent of producer's share in the consumer rupee than the remaining channels namely Producers → Commission agents →Wholesaler → Retailers → Consumers, Producers → Village traders/Commission agents → Retailers → Consumers and Producers →Small traders → Commission agents → Retailers → Consumers.

Basavaraj (2007) identified marketing channels in the marketing of chillies in Karnataka. In the study area, two important marketing channels were identified in different markets.

i. Producer → Village merchant → Wholesaler →Retailer → Consumer
ii. Producer → Commission agents →Wholesaler →Retailer → Consumer

Among these channels the channel-I was the efficient one as the producer's share in the consumers rupee was around 83.92 per cent in that channel and it yielded highest returns to producers.

Anchal and Sharma (2009) conducted a study in the sub mountainous region of Gurdaspur district of Punjab and identified the following three channels for marketing of litchi.

i. Producer → Pre-harvest contractor → Retailer → Consumer (Local market)
ii. Producer → Pre-harvest contractor → Retailer (through commission agent) → Consumer (Amritsar market)
iii. Producer → Pre-harvest contractor (wholesaler) → Retailer (through commission agent) → Consumer (Delhi market)

Of the three channels, the first one was found to be the most efficient as the producer could get as high as 72.08 per cent of the consumer's rupee. The price spread was ₹ 540.98 for local market, ₹ 1,126 for Amritsar market and ₹ 1664 for Delhi market.

Ghulghule *et al.* (2009a) identified the following channels in the marketing of fig in Aurangabad and Gultekadi market yard from Pune district of Maharashtra.

i. Producers → Consumers

ii. Producers → Retailers → Consumers

iii. Producers → Commission agents → Retailers → Consumers

Among these channels the channel-I was the efficient one as the producer's share in the consumer rupee was around 84.33 per cent in channel-I and it yielded highest returns to producers.

Kerutagi *et al.* (2009) conducted a study on sapota marketing in Belgaum and Dharwad districts of Northern Karnataka. He identified the following two channels of sapota marketing.

i. Producer → Commission agents → Retailers → Consumers

ii. Producer → Pre-harvest contractor cum wholesaler → Retailers → Consumers

The producer's share in consumer's rupee in channel-I was higher (59.58%) than in channel-II (48.14%). Similarly, the price spread in channel-I was ₹ 2500 (26.32%), in channel-II it was ₹ 4,000 (42.11%) indicating higher efficiency of channel-I.

Gupta and Sharma (2010) evaluated the following marketing channels in marketing of ginger in Himachal Pradesh.

i. Producers → Retailers → Consumers

ii. Producers → Village traders/Commission agents →Wholesalers→ Retailers→ Consumers

iii. Producers → Wholesalers → Retailers → Consumers

Among these three channels Channel-I was the most efficient one from the point of view of the producers as well as the consumers as the producers got as high as 73.02 per cent of consumer's rupee in ginger. From the producers point of view, channel-I was found to be most profitable as it yielded highest returns to producers.

Kumar and Singh (2010) estimated the price spread in following four channels of mango marketing in Lucknow district of U.P.

i. Producer (local) → Pre-harvest contractor (local) → Commission agent (Lucknow) → Wholesaler (New Delhi) → Retailer (New Delhi) → Consumer (New Delhi)

ii. Producer (local) → Pre-harvest contractor (local) → Commission agent (Lucknow) → Retailer (Lucknow) → Consumer (Lucknow)

iii. Producer (local) → Pre-harvest contractor (local) → Wholesaler (Lucknow) → Retailer (Lucknow) → Consumer (Lucknow)

iv. Producer (local) → Pre-harvest contractor (local)) → Retailer (Lucknow) → Consumer (Lucknow)

Among the four channels, channel-IV was the most efficient one from the point of view of the producers as well as the consumers as the producers got as high as 46.09 per cent of the consumer's rupee and remaining 54 per cent was incurred on different marketing costs or the margin by the pre-harvest contractor/ retailer. Thus, the price spread was found to be minimum in local markets and maximum in distant markets.

Shumeta (2010) identified the marketing channels for avocado in Southwestern Ethiopia, they found that avocado is channeled from producers to wholesalers, retailers, local collectors and cafeterians from all these market participants, wholesalers get the largest gross margin (35.41%) from the final consumer's price.

Singh *et al.* (2012) identified the marketing channels for turmeric in Punjab, they found that Producer–Processor–Consumer (channel I) was the major marketing channel by which nearly 72 per cent of the turmeric is sold. In this channel, the relative share of net price received by producer in the consumer rupee has been found as 15.46 per cent, while net margin of processor has been noted as 34.10 per cent. The other channels included were: Primary Agricultural Cooperative Society (PACS), self-help groups (SHGs) and local unemployed rural youth as intermediaries. The share of processor in consumer rupee has been found to be much less in these channels.

The above mentioned researchers found the different channels in the marketing of different commodities and they observed that the channels which were involved less number of intermediaries, found more efficient.

2.5 Trend analysis

Prasad *et al.* (1998) analysed the seasonal indices of arrivals and prices of turmeric in Guntur market for the period 1980-81 to 1995-96, indicated that the indices of arrivals were higher while the price indices were on lower side for both bulbs and fingers during the post-harvest month of March, April, May and June. They opined that due to the shortage of proper storage facilities at the farmer level in that area, the growers were forced to dispose of their produce immediately after harvest which results in a lower price.

Shiyani *et al.* (1999) in their study on time series analysis of arrivals and prices of garlic in regulated markets of Saurashtra region of Gujarat for a period of 1988 to 1998, revealed that the prices of garlic was found relatively higher in mid and lean marketing period than in the peak period.

Patel (2000) in his study used time series data on prices for a period of 1975-76 to 1992-93 on rapeseed-musturd obtained from six "khet bazaar utpan samitis", Directorate of Economics and Statistics, Gujarat Agricultural Produce Marketing Board and Directorate of Agriculture. The study revealed that all markets have around 40 to 75 per cent of the total market arrivals of rapeseed-mustard in peak marketing season. Whereas prices were lower by ₹ 20 to 60 per quintal over mid and lean marketing season in Mehasana district of Gujarat.

Mehta and Srivastava (2000) analyzed the seasonality in prices of groundnut and maize. The results showed linear trend in maize prices. The oscillatory movements affecting the prices were found to be regular in period and amplitude. There existed a crop production periodicity of 12 months seasonality. Seasonality index ranged between 5.0-5.9 implying that its supply and consumption were nearly equi-spread throughout the year. Steep price fall after September synchronized with crop attaining maturity in three months after sowing. In case of groundnut, the results showed moderately increasing trend, the periodic variations were of non-uniform cycle and amplitude. The long-term price behaviour was approximately linear and the cyclical trend was less pronounced.

Birukal (2001) collected data on monthly arrivals and prices of cotton for the period from 1984-85 to 1999-2000 from the Agricultural Produce Marketing Committees and indicated a continuous decreasing trend in both price and arrivals of Laxmi cotton due to the introduction of DCH-32 around the area. Whereas, the trend values of market arrivals and prices of Varalaxmi cotton in Dharwad market showed an increasing trend.

Ravikumar *et al.* (2001) analysed the arrivals and prices of selected agricultural commodities in Anakapalle regulated market of Andhra Pradesh for the period from 1981-82 to 1995-96. The study concluded that, in general, arrivals showed mixed trend, whereas, prices showed an increasing trend for the selected commodities in the market. There existed an inverse relationship between seasonal indices of arrivals and prices of selected commodities. Therefore, the policy implication lies in encouraging the farmers to dispose off their produce at the opportune time to get good remunerative prices.

Sanjay Kumar (2003) studied relationship between arrivals and prices of onion in selected markets of India from 1994-2000. The results revealed that the arrivals fluctuated to a great extent and prices had a tendency to rise in all the markets during the study period. The correlation coefficients between yearly arrivals and prices of onion were found to be negative and significant over the years in most of the markets. This indicated inverse relationship between market arrivals and prices.

Wadhwani and Bhogal (2003) observed price behaviour of cauliflower and cabbage in Western Uttar Pradesh (1988-1997). The results showed that, the prices of those two vegetables were found to be higher in September and started declining from October onwards. The prices were again found increasing from May. The lowest prices were found to be in March and also that the prices of cauliflower / cabbage responded negatively to the arrivals.

Hiremath (2004) collected the data on monthly prices and arrivals of cotton for a period of 1985-86 to 2002-03 in Hubli market (Karnataka). He revealed that for DCH-32 cotton kapas, the seasonal indices were the lowest in the month of September and highest in the month of December. The seasonal index was below 100 during the months from April to August.

Sangeeta (2004) analyzed the arrivals and prices of onion in Lasalgaon and Pune markets (Maharashtra) from 1999-2002. She observed that in Lasalgaon market the arrivals were more in January and February, where as in Pune market the arrivals began increasing in February and March.

The prices showed an upward trend from the month of June and continued to rise up to November, after which price decline was observed.

Pawar and Misal (2004) studied the behaviour of prices and arrivals of pomegranate in Solapur (Maharashtra) market from 1991 to 2000 and found that the arrivals were maximum during July to September and December and the lowest arrivals in the month of April. The correlation coefficient between arrivals and prices exhibited negative relationship. Trends in arrivals showed increase at 9.80 per cent per annum while prices increased at 8.20 per cent annually during the study period.

Lavleen *et al.* (2005) analyzed the cyclical variation of arrivals and prices of tomato in Punjab from 1981-2001 by employing Fourier analysis followed by periodogram analysis to estimate the hidden periodicity along with amplitude in the cycles. The periodogram analysis of time series of supply and prices of tomato showed that it followed regular cycles, seasonal within 12 months and cycles of longer duration *viz.*, Kitchin cycles for arrivals with periodicity of 3 years and Jugar cycles for prices with a periodicity of 5 years.

Navadkar *et al.* (2005a) in their study on seasonal indices of monthly arrivals and prices of vegetables in Pune (1990-2000) observed lowest coefficient of variation of arrivals for tomato and it was more than 50 per cent during remaining months. On the other hand, the price was highest during March and below 50 per cent during April to June. In case of bhendi, the coefficient of variation of arrivals was far below 50 per cent for the period from April to October, while it was more than 50 per cent in all the months except in November and May. It was noticed that the coefficient of variation ranged from 22-79 per cent for arrivals and for prices these were in the range of 31-69 per cent for cabbage. While for cauliflower the same were 31 to 69 per cent and 24 to 54 per cent, respectively. Furthermore, it was indicated that when the arrivals of vegetables were higher, the prices are at the lower side.

Virender Kumar *et al.* (2005) studied the behavior of market arrivals and prices of major vegetable crops in four metropolitan markets of Delhi, Mumbai, Bangalore and Kolkata from 1990-2001. The results showed that in cabbage, the extent of variability in arrivals was lower in Bangalore and higher in Mumbai. Prices were relatively stable in Mumbai but were volatile in Bangalore. There was broadly a similar pattern in the price across different months in Kolkata and Delhi markets. The authors also found inverse relationship between market arrivals and prices over the years in all the four metropolitan markets. Across different months, there have been several instances of positive relationship between arrivals and prices in all the four markets.

Khunt *et al.* (2006) made a study on the price behaviour of major vegetables in Gujarat state. The major vegetables considered for the study were onion, brinjal, potato, chillies, tomato and clusterbean. The number of regulated markets was selected by considering the major vegetable growing areas and data availability about the prices and arrivals of vegetables. The study revealed that there is seasonality in arrivals and prices of all the major vegetables produced in the state which indicated the need for storage facilities. The inverse relationship was observed between prices and arrivals of most of the vegetables. Arrivals and prices of major vegetables have increased over the period in most of the regulated markets, showing the scope for expansion of vegetable cultivation.

Yogisha *et al.* (2007) in their study concluded that, there was a mixed trend in arrivals and prices of potato in all the selected markets. The data pertaining to the study was collected for a period from 1994-95 to 2004-05. The monthly seasonal indices for arrivals of potato, onion, ragi and groundnut were found to be higher immediately after the harvest in all the markets and the price indices were found to be maximum during lean period and minimum during harvesting period. Hence, the dissemination of information on market arrivals, prices prevailing in the market, crops to be grown to the season, *etc.*, will result in maintaining uniformity in supply and demand of the produce.

Madan (2008) analysed the cyclical behavior of turmeric prices in India to identify the long-term business cycle behavior, indicated the existence of both long and short term cycles in turmeric prices. Analysis of price data for Alleppey turmeric in Cochin market revealed the existence of six years cycle. The results of the seasonal index showed that, the price in Cochin market alone was ruling high during the harvesting season. This was because of the strong storage/holding behavior of the farmer.

Manasa (2009) analysed the long term and short term variations in prices and arrivals of pigeonpea in Bidar, Bellary, Gulbarga and Sedam markets in Karnataka. Monthly data on arrivals and prices were collected for the period of 1987-88 to 2007-08. All markets had shown fluctuations from year to year and showed an increasing trend for both arrivals and prices.

Rajur *et al.* (2009) analysed the trends in annual market arrivals and prices of chilli in Karnataka. A critical analysis of trend in arrivals and prices of chilli by orthogonal polynomial regression analysis showed that there was a marginal increasing trend in arrivals and prices over the years with mild ups and downs in the selected markets of Karnataka.

Singh *et al.* (2010) conducted a study on behavior of arrivals and prices of green chillies in Amritsar and Patiala districts of Punjab. The data collected were analysed by using trend analysis. The arrival and prices of major green chillies have increased over the period in most of the regulated markets, showing the scope for expansion of green chillies cultivation.

Jayasree *et al.* (2011) studied the price behavior of pepper in Kochi market. It revealed that pepper prices were subjected to high random variations. The random variations are minor fluctuations not attributable to specific events and were too small to merit individual consideration. These were due to random effects such as supply shocks on account of climate deviations, or market shocks on account of demand aberrations or high speculative factors.

Satheesh Babu *et al.* (2012) analysed the trend in prices of small cardamom in India from 1995 to 2012. The co-efficient of variation worked out for the period indicated that cardamom prices were subjected to instability as high as 49.17 per cent. The period from January 1995 to November 2009 was marked by frequent ups and downs. However, the period from December 2009 was characterized by a buoyant phase in cardamom prices.

The trend analysis carried out by the different researchers which are cited above revealed that there exist an inverse relationship between seasonal indices of arrivals and prices of selected commodities. The results also highlighted increasing trend in the arrivals and prices of different commodities, the periodic variations were of non-uniform cycle and amplitude

2.6 ARIMA technique

Yin and Min (1999) studied the timber price forecasts with univariate Autoregressive Integrated Moving Average model, employing standard Box-Jenkins modeling strategy using quarterly price series from timber Mart-South. The results showed that most of the selected pine pulpwood and saw timber markets in six southern US states can be evaluated using ARIMA model and that short term forecasts, especially those of one-lead forecasts, were fairly accurate. It was suggested that forecasting of future prices could aid timber producers and consumers alike in timing harvests, reducing uncertainty and enhancing efficiency.

Balanagamma *et al.* (2000) built Autoregressive integrated moving average models for the agricultural data related to area, production and productivity of the crops *viz.*, Rice, Sorghum, Pearl millet, Maize, Finger millet, Black gram, Red gram, Green gram, Sugarcane, Cotton, Groundnut and Chilli of Tamil Nadu.

Ansari and Ahmed (2001) applied ARIMA modeling for time series analysis of world tea prices and export prices in industrialized countries. The results of the estimated ARIMA equation implied that the information on the current period's tea price is sufficient to forecast the next periods and the industrialized countries' export prices can be forecasted from information on the prices of the previous two periods. The authors concluded from the fitted ARIMA models that, the autoregressive process generated both price series and there was no influence of external factors.

Almemaychu Amera (2002) applied ARIMA modeling for price data of potato in Belgaum and Hassan markets. A stochastic seasonal ARIMA was found to be appropriate model for Belgaum and Hassan markets, as well as for the state. The forecasted values of potato prices using ARIMA model showed an increasing trend up to year 2003 in the selected districts and state in general.

Selvakumar (2003) forecasted the future demand for agriculture manpower in Government and Private sectors using ARIMA models. He revealed that the supply of agricultural graduates exceeds the demand and could lead to unemployment for agriculture manpower. Creating new jobs in agriculture by Government sector and investment in agriculture business by the private sector would be beneficial to boost the Indian agriculture sector.

Indira and Arindam (2003) forecasted the agriculture production of five states of India namely Punjab, Rajasthan, Karnataka, Andhra Pradesh and Uttar Pradesh using ARIMA models. They have used Index of Agricultural Production (IAP) rather than Gross State Domestic Product (GSDP) of the states. Models were fitted for the data for the period from 1950-51 to 2000-2001 and forecasted for next three years. The forecast for the year 2002-2003 showed negative growth for Rajasthan (-1.7%) and Andhra Pradesh (-3.5%). The forecast for Punjab and Karnataka were positive at 1.8 and 5.0 per cent, respectively.

Cheluvarangappa (2007) applied ARIMA model in his study to forecast the monthly prices of copra in Tiptur market of Karnataka. He considered monthly time series data of copra prices for the period from 1975 to 2005. The post period forecasted values depicted the same pattern of actual prices of copra. The fitted model for these monthly prices of copra was (4, 1, 5).

Dilip Reddy (2008) forecasted the prices of soybean and soyaoil in major markets of India. He concluded that there was narrow variation between actual and forecasted prices of soybean but soyaoil spot market has wide variation between actual and forecasted prices.

Nikhil (2008) in his study on "Arecanut marketing and prices under economic liberalization in Karnataka" fitted an interactive Auto Regressive Integrated Moving Average (ARIMA) process to monthly average prices of two varieties of arecanut. The ACF and PACF showed autoregressive and moving average process with seasonality component in the selected markets. The auto correlation coefficients were significant in both the varieties, which implied that there was a strong seasonality component in the error terms. Using the model, the prices of both types of arecanut were ex-post forecasted. Accordingly, prices of both varieties reached a peak in the month of August and declined thereafter.

Manasa (2009) forecasted the prices of pigeonpea in Bidar, Bellary, Gulbarga and Sedam markets in Karnataka. She concluded that there was narrow variation between actual and forecasted prices of pigeonpea in the selected markets.

They had used the ARIMA (p, d, q) model written in the form

$$\Psi (B) Z_t = \varphi (B) (1 - B)^d Z_t = \alpha + \theta (B) a_t$$

Where,

$\{Z_t\}$; t = 1 …n is given set of observations

$\varphi (B) = 1 - \varphi_1 B^1 - \varphi_2 B^2 - \ldots - \varphi_p B^p$ and

$\theta (B) = 1 - \theta_1 B^1 - \theta_2 B^2 - \ldots - \theta_q B^q$

The Autoregressive (AR) operator φ (B) is assumed to be stationary and the Moving Average operator θ (B) is assumed to be invertible, $\{a_t\}$ is a sequence of independent and identically distributed random variables (iid) with mean zero and variance σ^2, B is the back shift operator such that $B^i Z_t = Z_t - 1$ for any integer i, d is the differencing, necessary to induce stationary in the data and a is a constant. The data pertaining to the years 1956-57 to 1994-1995 were used for the modeling and forecasting was done for 1995-96 to 1999-2000 for all crops chosen. They found that the crops taken for study showed less increasing trend.

Kuldeep (2010) forecasted the prices of mustard seed in Jaipur market using the ARIMA technique up to June 2010 and the forecasted values showed an increasing trend in the future years. In the Jaipur market, it was observed that there was a sudden increase in the prices during the year 2007 and 2008 after that decrease in the prices was noticed during the year 2009. The year-wise alternate increase in production and inadequate storage facilities might be the reasons for such sudden decrease in the price.

Anil (2011) used the ARIMA for forecasting of prices of wheat in the selected markets of Karnataka. It revealed that in all the selected markets, the non-seasonal MA and AR (autoregressive terms) process were present. Thus, it was concluded that all the price series under the study were linearly related to both the previous year's error term and previous year values. Seasonal moving averages (MA) were found to be significant at one per cent probability level in all the selected markets except in Dharwad and Bagalkot, while, seasonal term AR in Dharwad and Bagalkot markets was significant at one per cent. None of the AR terms were significant in the selected markets, implying that the present prices were not linearly related to the previous year's prices.

Auto Regressive Integrated Moving Average (ARIMA) technique was employed by the different researchers for monthly average prices of different commodities to forecast the future prices. The ACF and PACF showed autoregressive and moving average process with seasonality component in the selected markets. The significant of auto correlation coefficients implied that there was a strong seasonality component in the error terms.

2.7 Export performance

Angles (2001) studied the production and export of turmeric in South India, he found that growth in export of turmeric was significant in total quantity, total value and unit value of turmeric, because of the high demand coupled with inflation. The results of the Markov chain analysis showed that previous export share retention for Indian turmeric was high in UK (42.99%) and countries pooled under the others category (58.77%). The countries such as USA, Iran, Japan and UAE were not stable importers of Indian turmeric.

Rajesh (2003) studied the export performance of major spices in India. The study has indicated that all major spices, except turmeric and chillies, have registered a higher growth in value terms during the post-liberalization period (1991–92 to 2000–01). This was mainly because of increase in unit value realization whereas, the quantity exported for pepper and ginger has shown a declining trend during the post-liberalization period. In case of cardamom, turmeric and chilli, fluctuations in value, quantity and unit value have declined in the post-liberalization period (1981–82 to 1990–91).

Kaur *et al.* (2004) analysed the export performance of Indian turmeric from the year 1970-71 to 2001-02, the exports of turmeric were 11, 109 tonnes in 1970-71, which were valued at ₹ 3.83 crores. There was a steady increase in the quantity exported to a peak of 38, 149 tonnes in 2000-01 valued at ₹ 94.58 crores at the rate of 7.32 per cent and 14.40 per cent per annum both quantity wise and value wise, respectively.

Rajesh (2004) contemplated to address some of the export issues in Indian spices based on the performance during the two time periods, *viz.* pre-liberalization (1981–82 to 1990– 91) and post-liberalization (1991–92 to 2000–01). The study had indicated that all major spices, except turmeric and chillies, have registered a higher growth in value terms during the post-liberalization period. This was mainly because of the increase in unit value realization whereas, the quantity exported for pepper and ginger has shown a declining trend during the post-liberalization period. In the case of cardamom, turmeric and chilli, fluctuations in value, quantity and unit value have declined in the post-liberalization period. The analysis of the dynamics in direction of exports using the Markov chain model has revealed that the erstwhile USSR and the USA have been the stable markets for Indian pepper during the pre-liberalization period. In the post-liberalization period, the USA has emerged as a stable export market mainly due to the disintegration of the erstwhile USSR.

Thumar *et al.* (2006) studied the decade wise growth and instability in the export of garlic in India from 1961-62 to 2001-02. The study revealed that, in first (1961-62 to 1970-71), second (1971-72 to 1980-81) and fourth (1991-92 to 2000-01) decade, exports have shown positive growth whereas in third (1981-82 to 1990-91), negative growth rates of export quantity as well as for the value were observed. It was mainly due to reduction in domestic supply due to consecutive three drought years (1986, 1987 and 1988) in major garlic growing states. The co-efficient of variation of garlic export in quantity was found to be the highest during the period from 1991-92 to 2000-01 (86.29%) and lowest during the period 1981-82 to 1990-91 (60.33%).

Arulanandu (2007) conducted study on international trade performance of spices for the period from 1970-71 to 2005-06. The Compound growth rates worked for both pre and post-liberalization periods revealed that growth rates for export quantity of cardamom-small, chilli, turmeric, spice oil and oleoresins, coriander and cumin were high during post-liberalization than pre-liberalization period. The results of instability in export had indicated that the spice trade was more stable during post-liberalization than pre-liberalization period and Nominal protection coefficient for all the selected spices has been found less than one, which indicated that these spices are competitive in the international market.

Hema and Kumar (2007) studied the export performance of turmeric grown in Western Ghat region of India during Pre-liberalization (1970-1990) and Post-liberalization period (1990-2002). The study revealed that, during the Pre-liberalization the growth in the export of turmeric was lower (1.82%) than that of in Post-liberalization period (6.53%) whereas co-efficient of variation was found to be more during pre-liberalization than post-liberalization period.

Sadeesh *et al.* (2007) studied the export performance of Indian spices during pre-WTO (1980-81 to 1994-95) and post-WTO (1994-95 to 2003-04) periods. The export exhibited a higher growth in the pre-WTO era and magnitude of growth had come down for quantity and value in the post-WTO era. There is remarkably significant reduction in the instability in the export of spices in post-WTO era. The maximum decline in instability was found in the case of quantum of exports.

Murugananthi *et al.* (2008) analyzed the export performance of turmeric from India. The export performance is measured in terms of growth rate, instability index and Markov chain analysis. The data on export quantity and export value from 1996-2006 was taken for the purpose of the study. Both exported quantity and value recorded a positive and significant growth of 6.2 per cent and 9.61 per cent per annum respectively. There was high instability in export value when compared to the export quantity, which was due to the export unit value fluctuation. The results of Markov chain analysis confirmed that UAE and Bangladesh remained as the stable markets for Indian turmeric compared to other markets. The study suggested that appropriate positioning and pricing strategies should be used to strengthen India's position in the unstable global market.

Sujatha and Eswara Prasad (2008) studied the performance of Indian pepper exports during the two time periods *viz.,* pre-WTO (1981-82 to 1994-95) and post-WTO (1995-96 to 2003-04). The study concluded that the US and the USSR were found to be stable export markets for Indian pepper during pre-WTO period as reflected by the high retention probabilities, but Canada had a moderate probability of retention. On the contrary, Italy and Germany had a probability of zero retention indicating that they were unstable importers of pepper during pre-WTO period as well as post-WTO period. But, during post-WTO period, Canada and the US remained comparatively stable markets for Indian pepper. The disintegration of USSR and the consequent reduction in the purchasing power of these countries led to a very low probability of retention by the erstwhile USSR countries. Finally, the study suggested that there were a number of approaches to remove impediments from day-to-day export business apart from quality improvement and value addition.

Siddaya and Atteri (2010) examined the export competitiveness under the cost compliance horticultural commodities. The NPC, Effective Protection Coefficient (EPC), DRC and Effective Subsidy Co-efficient (ESC) were computed under cost compliance as well as without cost compliance. Except for grapes, NPC, ESC and ORCs were found to be less than unity for fresh and processed fruits and vegetables, implying that the Indian horticultural sector has a comparative advantage in the selected fruits and vegetables. The EPC was more than unity for various fresh and processed fruits and vegetables because the relation between domestic and international input and output prices were not uniform.

Angles *et al.* (2011) studied the impact of globalization on export of turmeric in India. The export performance of turmeric in India was examined using secondary data for the period from 1974-75 to 2007-08 and exponential form of growth function has been used for the analysis. The growth in export of turmeric was reported as significant, because of the high demand coupled with inflation. For the assessment of direction of trade, the Markov chain model was used. The data regarding country-wise export of turmeric had shown that the previous export share retention for Indian turmeric was high in minor importing countries (pooled under others category) (87%), followed by UAE (49%), Iran (41%) and UK (35%). The countries such as USA and Japan were unstable importers of Indian turmeric. Thus the author concluded that the plans for export may be oriented towards these two countries and also plans should be formulated for stabilizing the export of turmeric to other countries. The farmers should be provided training on production of a quality product.

Hosamani *et al.* (2011) conducted a study on export performance of Indian pomegranate in the Pre-WTO (1987-88 to 1995-96) and Post-WTO (1996-97 to 2006-07) periods, the compound growth rate and Markov Chain analysis were used to meet the objectives of the study. The growth rate analysis showed that the growth in the export of pomegranate during the Pre-WTO period than Post-WTO period both in terms of quantity and value. The results of the Markov Chain analysis revealed that, UAE was one of the stable importers of Indian pomegranate in both periods.

Krishnadas and Mundinamani (2011) studied the changing direction of major spices exports from India from the year 1994-95 to 2006-07 using Markov chain approach. The analysis of changing direction of exports of major spices revealed that the markets which gained share in export of major spices were Malaysia for chilli and cumin, United States of America for black pepper, Bangladesh for turmeric and Singapore for coriander. The most unstable markets were Bangladesh and USA for chilli, United Kingdom and Australia for black pepper, Japan for turmeric, Saudi Arabia and South Africa for coriander and USA and UK for cumin.

Mahajan and Nanda (2011) examined the structural changes in agricultural and allied products' exports and direction of agricultural exports of India during post- WTO period (*i.e.*, 1995-96 to 2005-06). The study reveals that though India's agricultural exports share in world's agricultural exports witnessed a fluctuating and declining phenomena after 1996, the share of India's agricultural exports in world total agricultural exports is greater than the share of India's total exports in world's total exports. Within agricultural and allied products, if we consider the share of India's agricultural exports to world exports, there has been a sharp turnaround, contributed mainly by the enhanced share of exports of rice, tea and mate and spices.

Chhabi De *et al.* (2012) studied the export performance of major Indian vegetables during pre and post-WTO periods. The impressive growth rate of vegetable export from India at 9.8 per cent per annum was recorded in last decade. In global market export of onion stands tall as compared to trade share for potato and tomato is negligible. In domestic market trade share and consumers preference follows potato, onion and tomato sequence. The very low export performance ratio or RCA (<1) and negative value of revealed symmetric comparative advantage (RSCA) indicated that both potato and tomato were not export competitive. The high coefficient of variation was used as an index of instability in tomato as well as potato export from India.

Jyothi and Thomas (2012) studied the global competitiveness of Indian turmeric during Pre-WTO (1980-81 to 1994-95) and Post-WTO (1995-96 to 2009-10) periods. The findings of the study revealed that, the domestic prices of turmeric have been consistently lower than the international prices, indicating that, India enjoys more export competitiveness for turmeric in the international market. During both pre and post-WTO regimes, turmeric enjoyed more export competitiveness in the international market. Further, NPCs were declined during post-WTO regimes compared to pre-WTO regimes.

Mokashi (2012) studied the direction of trade and export competitiveness of Indian grapes, the results of the study revealed that the other countries, Bangladesh, UK and Netherlands were the most stable markets as indicated by 80.37, 68.44, 50.06 and 45.50 per cent of market share retention by Transitional Probability Matrix and Germany was the most unstable market tending to lose its entire share to other countries. NPC for grapes exports during study period from India were less than unity indicated that Indian grapes are highly competitive in the Global market.

Markov chain analysis and Nominal protection coefficient are the most commonly used technique to find out the trade direction and competitiveness of export of a commodity. In this study, the same techniques were made use of to find out the trade directions of turmeric exports and trade competitiveness.

2.8 Market integration

Baharumshah and Habibullah (1994) employed the co-integration method developed by Engle-Granger to analyse the long-run relationship between pepper prices in different markets in Malaysia. The results suggested that these markets were highly co-integrated, which implied that commodity arbitrage was working. The results also showed that the prices of pepper moved uniformly across spatial markets. Importantly, the distance between markets was not an impediment to efficient adjustment of price to new information. Thus, the price changes were fully and immediately passed on to the other markets.

Dittok and Breth (1994) used the Ravallion type model to test the market integration of dry season vegetables in Nigeria. The weekly price data were examined and results indicated that there was little and a low degree of integration of markets in the study area. Some market integration, however, existed between major producing and consuming areas. The results also indicated that good access to roads were more important for markets to be integrated than the distance between the markets.

Sinharoy and Nair (1994) analysed the international trade of pepper and price variations using co-integration analysis. India along with Indonesia, Malaysia and Brazil enjoyed the oligopoly power in the world pepper market. The study attempted to examine whether the Indian pepper price reflects the international market conditions. The monthly spot price series for India, Indonesia and Brazil were checked for stationarity in terms of Dickey Fuller (OF) and Augmented Dickey Fuller (ADF) methods. The results showed that prices of pepper for the different countries have moved synchronously indicating integration of world pepper market and revealed a kind of tacit collusion among exporters on market sharing and price parity.

Mendoza and Rosegrant (1995) examined the dynamics and efficiency of Philippines maize markets through the application of Auto Regressive Conditional Heteroscedaticity model (ARCH) to time series data. The findings of the study revealed that there existed imperfect market integration for Phillippine maize markets and indicated that there may be substantial benefits (i) in developing better infrastructural facilities to effectively link production and market centres and (ii) in improving market knowledge by providing more relevant, accurate and timely public market information.

A study was taken up by Vani and Krishnaiah (1998) in Guntur district of Andhra Pradesh to assess the price integration existing between two regulated markets, Guntur and Tadikonda as central and local markets, respectively. The index of market connection was 0.82, indicating a high degree of short-run market integration. The influence of change in central market price over local market price was 0.30, which implied that one rupee change in Guntur market prices between the current and the last years price brought about ₹ 0.30 increase in Tadikonda market price during the same time period. Guntur market prices influenced Tadikonda market price with an increase of 0.63 during the same period, while it would increase the difference by 0.63 in Tadikonda market price during last year. Dynamic marketing is necessary for maintaining proper price structure in chillies so as to provide remunerative prices to chillli growers.

Ashalatha (2000) employed the co-integration technique to analyze the theoretical long-run equilibrium relation between economic time series. She used the model to examine whether the domestic market was integrated with the international market for cashew kernel. The results proved that there was a long-run equilibrium of the prices of cashew kernel. This explained the tendency of domestic cashew prices to move in unison with the international market prices in the long-run, confirming the law of one price (LOP).

Balappa (2000) made an attempt to examine the extent of price integration of onion and potato in the selected markets of North Karnataka, comprising Belgaum, Bijapur, Dharwad, Gulbarga, Raichur and Hubli. The zero order correlation and coefficient of variation techniques were used. The correlation matrix of prices of different markets was worked out to know their integration. The results for onion clearly indicated the integration among the selected markets, except Bijapur with other markets. However, the magnitude of integration was found to be higher between Belgaum and Raichur (0.9447) between Hubli and Raichur (0.9439), between Belgaum and Hubli (0.9253), Raichur and Gulbarga (0.8669) and Belgaum and Gulbarga (0.8393).

Angel (2001) studied the extent of market integration among the important turmeric markets in South India *viz.*, Erode, Cochin, Sangli and Duggrala; he revealed that the wholesale prices were correlated for four markets from South Indian states. In case of Erode market almost all the markets were having same co-efficient of correlation which was ranging between 0.87 to 0.88. In case of Cochin, Sangli had high correlation co-efficient which was 0.97 followed by Duggrala (0.94) and Erode (0.87). In case of Duggrala market Sangli had the highest correlation co-efficient of 0.99 followed by Cochin (0.94) and Erode (0.87). Thus Sangli market was concerned which has the highest correlation co-efficient of 0.99 with Duggrala, followed by Cochin (0.97) and Erode (0.88).

Basu and Dinda (2003) studied the spatial integration of three potato markets of Hooghly district (*viz.*, Champandanga, Sheoraphully and Tarakeswar) of West Bengal using the wholesale and retail prices during January 1998 to December 2000. They found that all three market pairs such as Champandanga - Sheoraphully, Champandanga - Tarakeswar and Sheoraphully-Tarakeswar in terms of both wholesale and retail prices were cointegrated. They also found that within one market the wholesale and retail prices were co-integrated and concluded that there was a close proximity between markets and good communication and infrastructure facilities were available in Hooghly District.

Kumar and Sharma (2003) studied the market integration of wholesale paddy markets using co integration and error-correction mechanism. They used Johansen procedure to test for price integration among four paddy markets in Haryana based on the error correction representation. Monthly data on four paddy wholesale markets of Haryana *viz.*, Ambala, Kamal, Kaithal and Sirsa were collected from October 1978 to September 2001. The period was divided into two *viz.*, pre liberalization and post liberalization. The co integration results showed a long new association between the four markets and revealed a weak association in the short run.

Dalawai (2004) analyzed the relationship between the prices in major six domestic cotton markets and also at international market (New York) using the co-integration technique. The results clearly indicated that, all the price series in major four DCH cotton markets and two Jayadhar cotton markets in the state were assumed to be stationary at order of integration one. The Dickey Fuller test statistic obtained for all the markets, including international market, were found to be more than the asymptotic critical value even at 10 per cent level. Thus, the major cotton markets in the state were found to be integrated and hence quite competitive pricing behaviour was observed.

Kumawat and Kumar (2006) studied market integrated of rapeseed-mustard among nine selected markets of Rajasthan namely; Alwar, Bharatpur, Baran, Dholpur, Hanumanagarg, Nagaur, Sriganganagar, Sawaimadhopur and Tonk. Market integration was examined by computing price correlation between monthly wholesale prices. Price correlation was estimated at four points 1990-91, 1995-96, 2000-01 and 2003-04. The results revealed that, almost all the selected markets were mutually integrated. However, the degree of integration varied from one market pair to another within and across the years. In majority of the markets the degree of correlation was more than 0.90.

Rajur (2007) evaluated the spatial integration of the selected chilli markets in Karnataka by employing co-integration technique and assessed the market integration. Dickey-Fuller test for stationary of the price series of chilli in selected markets indicated that the price series of chilli in all the selected markets attain stationary at same orders, differencing except in Byadagi market, which was found to be negative and significant at first order of integration. The Dickey-Fuller values for the differenced series in all the markets found to be negative and significant at same levels of differencing. This indicated that the price series of all the selected markets attains its stationary at zero order of integration. But, in Byadagi market, the price series attains stationary at first order of integration, even though, different markets have attained stationarity at different orders of integration.

In the research papers of Yogisha *et al.* (2007), market integration for major agricultural commodities was studied by employing distributed lag model, which was superior over correlation analysis. Distributed lag model of potato prices revealed that, Chickballapur market took less than a day to transfer the prices signals from Bangalore followed by Srinivaspur (3.48 days), Chintamani (13.03 days) and Kolar (16.18 days). In case of onion, Chickballpur took 1.38 days followed by Chintamani (4.38 days), Kolar (7.45 days) and Srinivaspur (7.93 days) to reflect Bangalore onion prices. Kolar took 8.34 days to reflect Bangalore ragi prices. In case of groundnut prices, Kolar took less than 6 days and it was highest (16.01 days) for Srinivaspur market.

Dilip Reddy (2008) analysed the market integration of the price series of soybean and soy oil by using Dickey-Fuller test of co-integration. He concluded that the critical value and ADF value was found to be -5.0054 and -4.993 for soybean spot and soybean futures respectively. Hence markets were integrated.

Manasa (2009) analysed the spatial movement of prices and arrivals of Pigeonpea in major five markets in Karnataka by using Co-integration technique. The results clearly showed, prices in Bidar market were influenced by the price in Gulbarga market to a very high degree. Bidar market price influenced prices in Raichur and Bellary markets almost to the same degree. A low degree of association was found between Bellary and Sedam markets. The zero order correlation between average monthly prices of pigeonpea in all the selected markets revealed a strong integration among all the markets.

Jayasree *et al.* (2010) studied the integration of domestic markets (Kochi) and international market (New York) for pepper by using the co-integration method. The results showed that the co-integration equation was found significant at one per cent level, indicating that two series were highly integrated, which was indicative of mutual influence exerted by the markets on each other. This was understandable because Kochi has been a reference market for spices in general and pepper in particular, while New York is the largest commercial center in the world.

Kuldeep (2010) studied the market integration of price series of mustard oil and mustard oilcake on both domestic and future markets by using Dickey-Fuller test of co-integration. The study revealed that the Dicky–Fuller value is higher than ACV value so there is high integration among the selected markets. The highest integration between spot and futures market may be because of good communication and transportation facilities available and short distance between the markets.

Vishal (2010) analysed the market integration of maize in the selected districts of Karnataka. The results of the study revealed that the prices of Chitradurga market and Davanagere market follow each other to the extent of 98 per cent. Davanagere is the major market for maize in Karnataka. It can be considered as price leader for the crop in the state. Chitradurga is very nearby market to Davanagere. Hence, price signal of Davanagere market easily travels to Chitradurga market. Hence, there was high degree of co-integration between these markets. The other major markets for maize in the state *viz.*, Shimoga, Hassan and Mysore markets are also highly cointegrated with Davanagere as the leader market.

Jaleta and Gebremedhin (2011) analysed the price co-integration of food crop markets in Northern Ethiopia. The co-integration test revealed that most markets are co-integrated in wheat and *teff* retail prices. However, there was an indication that retail prices at Abi-Adi, a town located relatively farther away from the main asphalt road is less integrated to other markets. This implies that, in addition to market price information dissemination, other infrastructural developments like road networks are crucial for spatial market integration through the physical transfer of goods from one market to another.

Sekhar (2012) analysed the market integration of selected agricultural commodities in India by employing co-integration technique, the results of the study indicated that the commodity markets that do not face inter-state or inter-regional movement restrictions, like gram and edible oils, appear well-integrated. On the contrary, rice market, subject to the maximum inter-state movement restrictions, does not show integration at the national level. The broad implication of the study was that the markets can play a more effective role if supplemented with more open policy initiatives.

The results of the literature proved that there was a long-run equilibrium of the prices of different commodities. This explained the tendency of domestic prices to move in unison with the international market prices in the long-run, confirming the law of one price.

2.9 Production and post harvest constraints

Saini and Bhati (1995) identified the major storage and transportation problems of ginger in Himachal Pradesh. The results of the study revealed that, absence of store house in ginger producing area (100.00%), wastage of ginger due to traditional method of storage (95.00%) and absence of the improved methods of storage structures were the major problems with respect to storage and with regard to transportation problems, lack of approach/link roads (100.00%), non-availability of vehicles (98.00%) and high charges of transportation were the major problems in the study area.

Karpagam (2000) conducted a study on turmeric growers of Tamil Nadu state and reported the problems such as price fluctuation; high cost of inputs and scarcity of labour. A very few respondents expressed the problem of non-availability of credit.

Pol (2001) studied the major constraints faced by the ginger growers in production were non-availability of quality seeds at cheap rates, high cost of fertilizer and wage rates, non-availability of loan facility in time. In case of marketing, major difficulties expressed by farmers were price variation, high commission rates, high transport cost, *etc.* The study therefore suggested that the ginger growers should be given adequate and timely supply of inputs like quality seed, fertilizers, *etc.*, at reasonable rates, also supply credit in time to purchase above inputs. Cold storage facilities should be provided at low cost by the government. Steps should be taken to reduce the transport charges. Government should fix the support prices in the interest of both producers as well as consumers. Market information should also be provided to ginger growers.

Madan *et al.* (2002) assessed the major production and post harvest problems in turmeric and chilli cultivation in Andhra Pradesh. The results of the study showed that, absence of scientific system of post harvest handling, wide fluctuations of prices and lack of warehousing facilities were the major problems in case of chilli and in case of turmeric, incidence of rhizome rot and absence of processing industries in the study area were the major hurdles for the farmers.

Sawant (2002) studied the production problems of turmeric in Satara district. The important constraints reported by considerable number of turmeric growers were with respect to cultivation and marketing of turmeric, namely non availability of quality seed, high cost of seed, attack of rhizome fly, higher charges of commission agents and low market price. The important suggestions made by turmeric growers were assured and reasonable selling price, dimidiation on control of rhizome fly attack, timely availability of quality seeds and credit. Majority of the respondents also suggested for timely guidance by village extension work and organization of farmers' rallies, exhibitions on turmeric crop and elimination of middle men in marketing, providing fertilizers and pesticides at subsidized rates and starting separate Turmeric Research Station in Satara district.

Tamil Selvan and Manojkumar (2003) studied major problems in the spices production in India. Major constraints in the spices sector were weak marketing infrastructure, lack of export oriented production strategies, high cost of production, quality aspects like high pesticide residue and poor trading strategies had led to decline in the India’s share in the global spice trade.

Vadival and Madhusoodanan (2003) reported that pest and disease problems, fluctuating climate, post harvest management, inadequate market support were the major limiting factors for the production of garlic in India. Thus efforts should be made to compile the information and technologies with different universities and institutions on different aspects and they must be popularized among the growers.

Rajesh (2006) examined the main problems in production and marketing of vanilla in Uttar Kannada district. The results of the study revealed that incidence of pest and diseases as well as non-availability of skilled labour were the major problems with respect to production, problems in processing were low price to poorly processed bean and non-availability of skilled labour for processing. Lack of assured market facility and drastic price fluctuations are the major constraints observed in the marketing of vanilla.

Ganga and Saran (2007) investigated the problems in the production of henna in Pali district of Rajasthan. The results of the opinion survey showed that lack of irrigation facilities, poor quality of water, problems of intercultural operations, prevailing adverse weather conditions and lack of skilled and unskilled labour were the important problems faced by the farmers. Whereas the major problems faced by the market functionaries were problem of storage, drying, spoilage, high fluctuation in prices and high cost of labour.

Rajur (2007) reported that 55 per cent of farmers faced the problem of getting technical assistance; about 81 per cent of the farmers expressed that the problem of pest and disease were the major problem in chilli production. Non-availability of sophisticated grading facilities in the regulated market was the major problem faced by the farmers. They felt that establishment of grading laboratories for grading agricultural produce mainly for chilli is necessary to obtain maximum possible price for their produce. According to them, that could also avoid most of the malpractices taking place in the markets.

Shivashankar (2007) reported that the rain uncertainty, lack of labour availability, lack of input availability and high incidence of pests and diseases and low quality seeds were the major problem in production and wide price fluctuations, high transportation and high cost on packing and transportation are the major marketing problems in the production and marketing of chilli in Karnataka respectively.

Singh (2007) conducted a study on constraints in adoption of production technologies in cumin in four districts of Rajasthan, viz, Jodhpur, Pali, Bikaner and Jaisalmer. The study revealed that non-availability of seeds of high yielding varieties at proper time (93.40%), lack of knowledge and interest (73.30%), high cost of seeds (61.70%), fertilizers and pesticides (57.50%), lack of technical guidance (35.00%) and lack of finance (34.20%) were perceived by farmers as main constraints in adoption of improved technologies.

Moktan and Dhiman (2008) studied trade and marketing strategy for spice crops in Darjeeling district, spices produced in Darjeeling sub-division mainly comprise ginger, cardamom and turmeric, the study revealed that production per unit area is low. The major constraints of such low production are poor crop management and post-harvest management practices. Farmers are getting low value of their produce due to poor marketing strategy. There is no proper marketing and trade policy for spices. The marketing system is primitive and dominated by middleman, resulting into market imperfection, inefficiencies, exploitation and high post-harvest losses.

Sarada and Kalidasu (2008) reported that the major threats in the production of coriander in Andhra Pradesh were vagaries in climate, non-availability of quality seed, terminal moisture stress and fluctuations in market prices. The study also focused on achievements of the state in crossing the average national productivity of the crop through strong research by AICRP on Spices and efforts of Department of Horticulture in extension programmes.

Kshirsagar (2008) analysed the problems in production and marketing of Kokum in Maharashtra, iteration of labour shortage, late harvesting, wastage of fruits, non availability and high degree of mortality of kokum graft, laborious home processing were the crux of the cultivation problems of grower. Regarding the problems relating to fruit marketing, the sample farmers expressed lower price and no demand to fruits, no standard grade to their produce and malpractices in the market place as their problems. The farmers expressed dissatisfaction with the current set up of *kokum* marketing and those reflected the grower's awareness and desire to expand his *kokum* cultivation.

Anavrat (2010) studied on marketing constraints and technology needs of Nagpur Mandarin growers. The study revealed that lack of remunerative prices was the major constraint as expressed by 82.28 per cent respondents, financial constraints compel 68.57 per cent orchardists for preferential selling to the pre-harvest contractors. The lack of refrigerated storage facility in the market for the storage of Nagapur Mandarin fruits was also a major constraints expressed by 62.85 per cent farmers.

Adelani *et al.* (2011) analysed the production constraints facing Fadama vegetable farmers in Oyo state, Nigeria. The unavailability of credit sources, high cost of inputs (52.1%), irregular fuel supply (24.7%), frequent pump break down (24.7%), irregularities in water pump operation (16.7%) and maintenance of the pump (9.6%) were constraints against capital use in the study area. The major constraint against labour use was the inability to hire labour. It was recommended that there should be provision of credit facilities and initial take off capital for both male and female for the production of vegetable during the dry season. This will enable them to benefit from the high profit usually realized in vegetable production during the period.

Rao *et al.* (2011) studied the major problems faced by the farmers of saffron in Jammu & Kashmir. The small size corm, improper nutrient management, conventional method of drying which leads to loss of colour and other characteristics of saffron, absence of stringent quality standards in practice and involvement of chain of middlemen in the market practice which lead to menace of adulteration as it was a low volume and high export value export oriented crop.

Gichangi *et al.* (2012) assessed the problems in the production of climbing beans in Kenya. The selected districts were facing high population density and over- exploitation of land. Scarcity of cultivable land therefore, was one of the challenges to the production of climbing beans; hence the population was experiencing acute food and deficits and low incomes. Despite the better yields of climbing bean varieties, farmers continue to grow poorly performing mixed bush type bean varieties due to lack of seeds and staking materials for climbing beans. Besides, most farmers lack sufficient knowledge on the best staking methods. This implies that although staking has been noted to lead to better yields, lack of appropriate staking materials is a key challenge to the adoption of the technology.

Srivastava *et al.* (2012) studied the production and post-harvest constraints of Saffron in Jammu and Kashmir. They reported that inadequate availability of large sized seed corms, proper crop management, incidence of corm rot disease, inadequate post harvest handling, processing and marketing, lack of quality standards, inadequate R&D support and non-availability of standard high yielding varieties were the major constraints in the study area.

Tabular analysis and Garrett ranking are the common tools to to analyse the opinion of farmers regarding the problems in production, marketing and export. In this study, the Garrett ranking technique was made use of to find out the status and extent of constraints in production and marketing of turmeric.

METHODOLOGY

This chapter deals with the characteristics of the area selected for the study, the methods adopted in the selection of the samples, the nature and sources of data and the various statistical tools and techniques employed in analyzing the data. The methodology is presented under the following headings:

3.1 Description of the study area

3.2 Sampling procedure

3.3 Nature and source of data

3.4 Study period

3.4 Analytical techniques employed

3.5 Definition of terms and concepts used

3.1 Description of the study area

3.1.1 India

Peninsular India has a land mass of 32, 00,483 sq km with 15,200 km land frontier. India lies to the north of equator between 8.5^0 to 37.6^0 north latitude and 68.7 to 97.25 east longitudes. India has a varied temperature ranging between 15.7^0 C and 35.5^0 C. It receives rainfall ranging from 20 to 80 inches. India gets rainfall from both southwest and northeast monsoon. India's huge agricultural potential is embodied in its size and in its abundance and diverse nature resources, unlike most part of the World which have a cold and hostile winter and a relatively small proportion of arable land, India is blessed with bounteous nature across vast fertile river plains. Indian cereal and horticultural crops provide another demonstration of her abundance, diversity and opportunity.

One among the World's largest spices producer, India is already making its presence in World markets with its typically diverse portfolio of spices. India is the largest producer, consumer and exporter of turmeric. India has 195.10 thousand hectares under turmeric cultivation with a total production of 992.90 thousand tones (2010-11).

3.1.2 Karnataka

Karnataka is purposively selected for the study as it is one of the major turmeric producing states in the country.

The state of Karnataka lies between $11^0$30' and $19^0$25' N latitudes and between $74^0$10' and $78^0$35' E longitudes. It is the eighth largest state in India in both area and population with an area of 1,91,800 km^2 and a population of about 6,11,30,704 according to 2011 census. The state is bounded by Maharashtra, Goa, Andhra Pradesh, Tamil Nadu and Kerala in the north, east, southeast and southwest, respectively. The total cultivated area is about 123.68 lakh ha constituting 64.60 per cent of the geographical area for the year 2010-11. Out of the total cultivable area, 18.99 lakh hectares are covered under horticulture. Horticultural area in the State, accounts about 15.07 per cent of the total cultivable area. Out of 18.99 lakh ha, of the total horticultural cropped area, 8.05 lakh ha. (42.39%) come under Plantation Crops; 4.37 lakh ha (23.01%) under Vegetables; 3.60 lakh ha (18.96%) under Fruits; 2.66 lakh ha (14.01%) under Spices and 0.31 lakh ha (1.64%) under Commercial Flowers, including the area under the Medicinal & Aromatic plants.

Karnataka is situated in tropical zone and enjoys warm climate throughout the year. The mean temperature ranges from 21.5^0 C to 31.7^0 C, the maximum and minimum temperature being 42^0 and 14^0C respectively. The normal rainfall of the state ranges from as low as 569 mm to as high as 4,029 mm. Average annual rainfall of the state is 1,354 mm. The major part of the rainfall of the state is received from the southwest monsoon, which commences in the first week of June and continues till the end of September. Major part of the state has red soils. Laterite soils are found in the hilly and coastal regions of the western parts. The northern part of the state has black soils with high moisture holding capacity.

According National Horticultural Board, commercially turmeric is cultivated in five states of the country such as Andhra Pradesh, Tamil Nadu, Karnataka, Assam, West Bengal and Maharashtra.

Among these states Karnataka stands third with respect to area under turmeric (24912 ha) after Andhra Pradesh (74000 ha) and Tamil Nadu (26000 ha).

3.1.3 Chamarajnagar

The district is located in the southern tip of Karnataka state and lies between the North latitude 11^{O} 40'58'' and 12^{O} 06'32'' and East longitude 76^{O} 24'14'' and 77^{O} 46'55''. According to the 2011 census Chamarajanagar district has a population of 1,020,962. The district has a population density of 200 inhabitants per square km. Its population growth rate over the decade 2001-2011 was 5.75 per cent. Chamarajanagar has a sex ratio of 989 females for every 1000 males, and a literacy rate of 61.12 per cent (Table 3.1). With regards to Sex Ratio in Chamarajanagar, it stood at 989 per 1000 male compared to 2001 census figure of 971.

The total geographical area of the district is 569901 hectares with the net cultivable area of 186616 hectares. The area not available for cultivation was 46040 hectares, fallow land was 26507 hectares and 275610 hectares of land was under forests area (Table 3.2). The net irrigated area in the district was 67671 hectares, in that bore wells were the major source of irrigation followed by canals (Table 3.3). In the district the major crops grown were total cereals and millets (92834 ha) followed by total pulses (38568 ha), total oilseeds and commercial crops (Table 3.4)

It consists of four taluks namely Chamarajanagar, Kollegal, Gundlupet and Yelandur. It falls in the southern dry zone. Topography is undulating and mountainous with north south trending hill ranges of Eastern Ghats. Salem and Coimbatore districts of Tamil Nadu in the east, Mandya and Bangalore districts in the north, parts of Mysore district in the west and Nilgiris district of Tamil Nadu in the south, bound the Chamarajanagar district. The major soil types of the district are Reddish brown forest soil, Yellowish grey to greyish sandy loam soils and mixed soils. The climate of the district is quite moderate throughout the year with fairly hot summer and cold winter. The district may be classified as partly maidan and general tableland with plain, undulating and mountainous. The district receives rainfall from southwest monsoon from June to September and northeast monsoon from October to December. The average rainfall is 698 mm.

3.1.4 Mysore

Mysore district falls in the survey of India degree sheet Nos. 48P, 57D, 57H vand 58A. The district is bounded by north latitudes 11^{0}45' - 12^{0}40' and east longitudes 75^{0}59' -77^{0}05' covering an area of 6269 Sq. km. The district is one of the southern most districts of the state and is bordered by Kodagu district in the west, Cannanore district of Kerala state in the south west, Chamarajanagar district in the south and south east, Mandya district in the north and Hassan district in the North West. The average minimum and maximum temperatures vary from 34 to 21.4^{o} C in April to 16.4 to 28.5^{o} C in January. Relative humidity ranges from 21 to 84%. The soil type of district is grouped three categories *viz.*, the red sandy soils, red loamy soils and deep black soils. Almost entire district is covered by red sandy soil except a small parts of T. Narasipur taluk. The average annual rainfall is 782 mm.

According to 2011 census, Mysore had population of 2,994,744 of which male and female were 1,511,206 and 1,483,538 respectively. There was change of 13.39 per cent in the population compared to population as per 2001. The initial provisional data released by census India 2011, shows that density of Mysore district for 2011 is 437 people per sq. km. Average literacy rate of Mysore in 2011 were 72.56 compared to 2001 census figure of 63.48. With regards to Sex Ratio in Mysore, it stood at 982 per 1000 male compared to 2001 census figure of 964 (Table 3.1).

The total geographical area of the district is 676382 hectares with the net cultivable area of 351818 hectares. The area not available for cultivation was 120521 hectares, fallow land was 66803 hectares and 62851 hectares of land was under forests area (Table 3.2). The net irrigated area in the district was 171067 hectares, in that canals were the major source of irrigation followed by bore wells (Table 3.3). In the district the major crops grown were total cereals and millets (231192 ha) followed by total pulses (128719 ha), commercial crops (56697 ha) and total oilseeds (23990 ha) (Table 3.4).

3.1.5 Bagalkot

Bagalkot district is located in the Northern part of Karnataka which is the part of larger Deccan plateau. It lies between North latitude 16.12° and East longitude of 75.45°. The district is bounded by Bijapur district towards North, Gadag district towards South, Raichur district towards East, Koppal district towards South-East and Belgaum district towards West. Bagalkot is the second largest district in Belgaum division and occupies an area of 6,588 Sq.km. The district comprises of 6 taluks and 627 villages. The average annual rainfall across the district was 516 mm. Rivers like Malaprabha, Ghataprabha and Krishna flows in the district.

In 2011, Bagalkot had population of 1,890,826 of which male and female were 952,902 and 937,924 respectively. There was change of 14.46 per cent in the population compared to population as per 2001. The initial provisional data released by census India 2011, showed that density of Bagalkot district for 2011 is 288 people per sq. km. In 2001, Bagalkot district density was at 251 people per sq. km. Average literacy rate of Bagalkot in 2011 was 69.39 compared to 57.30 of 2001. With regards to Sex Ratio in Bagalkot, it stood at 984 per 1000 male compared to 2001 census figure of 980 (Table 3.1).

The land utilization pattern of the district is depicted in Table 3.2. The net cultivable area was 466476 hectares. The area not available for cultivation was 53642 hectares, fallow land was 51895 hectares and 81126 hectares of land was under forests. The net irrigated area in the district was 261902 hectares, in that bore wells were the major source of irrigation followed by canals (Table 3.3). In the district the major crops grown were total cereals and millets (267743 ha) followed by total pulses (112222 ha), total oilseeds (95356 ha) and commercial crops (91619 ha) (Table 3.4).

3.1.6 Belgaum

Belgaum district comes under northern transitional zone of Karnataka and consists of ten taluks namely Athani, Bailhongal, Belgaum, Chikkodi, Gokak, Hukkeri, Khanapur, Raibag, Ramdurg and Savadatti. Belgaum district is located at North –West region of Karnataka state between 15-23° to 16-58° N' latitude and 74.05° to 75.28°E longitude. It is surrounded by Bijapur, Bagalkot, Dharwad and Karwar Districts of Karnataka and Sangli, Kolhapur, Ratnagiri Districts of Maharashtra state. The average rainfall is 808 mm. The major rivers flowing in the district are Krishna, Malaprabha and Ghataprabha. The main irrigation sources for the district are canals, followed by wells, bore-wells and lift irrigation. The climate is generally dry and healthy, except during the monsoon season. The hot season begins by March with the maximum temperature of 38º C and minimum temperature of 14°C during December, which is generally the coldest month.

In 2011, Belgaum had population of 4,778,439 of which male and female were 2,427,104 and 2,351,335 respectively. There was change of 13.38 per cent in the population compared to population as per 2001. In the previous census of India 2001, Belgaum District recorded increase of 17.61 per cent to its population compared to 1991. The initial provisional data released by census India 2011, shows that density of Belgaum district for 2011 is 356 people per sq. km. Average literacy rate of Belgaum in 2011 were 73.94 compared to 64.21 of 2001. While gender wise, male and female literacy were 82.90 and 64.74 respectively. With regards to Sex Ratio in Belgaum, it stood at 969 per 1000 male compared to 2001 census figure of 960 (Table 3.1).

The total geographical area of the district is 13, 44,382 ha of which 847260 ha is net cultivable area, fallow land was 153369 hectares and 190424 hectares of land was under forests area (Table 3.2). The net irrigated area in the district was 463289 hectares, in that bore wells were the major source of irrigation followed by wells (Table 3.3). In the district the major crops grown were total cereals and millets (489238 ha) followed by commercial crops (229461 ha), total oilseeds (190418 ha) and total pulses (128901ha) (Table 3.4).

3.2 Sampling procedure

Multistage sampling technique was adopted in the selection of the districts, taluks and villages and purposive sampling was undertaken for selection of market and market intermediaries.

3.2.1 Selection of the sample districts

Multi stage sampling technique was employed for selection of districts, taluks and villages. Karnataka state was selected as it is one of the major turmeric producing state in the country. In the first stage four districts were selected based on the highest area under turmeric cultivation *i.e.,* Chamarajanagar, Mysore, Bagalkot and Belgaum districts (Table 3.5).

3.2.2 Selection of the sample taluks

In the second stage two taluks from each district were selected based on the highest area. Turmeric was grown in all the taluks of these districts. All the taluks of these districts were listed in the ascending order of magnitude based on the area under turmeric in each district for the year 2011-12. Thus Chamarajanagar and Gundlupet in Chamarajanagar district, H. D. Kote and Hunsur in Mysore district (Fig. 1a), Jamakhandi and Mudhol in Bagalkot district and Gokak and Raibag in Belagum district (Fig. 1b) were topped the list and were selected for the study (Table 3.6).

Table 3.1: Demographic features of the study area (2010-11)

Sl No.	Particulars	Units	Chamarajanagar	Mysore	Bagalkot	Belgaum	Karnataka
1	Total geographical area	ha	569901	676382	658877	1344382	19049836
2	Total population (2011 census)	no	1020962	2994744	1890826	4778439	61130704
i	Rural		845669	1756412	1292036	3567739	37552529
ii	Urban		175293	1238332	598790	1210700	23578175
iii	Male		513359	1511206	952902	2427104	31057742
iv	Female		507603	1483538	937924	2351335	30072962
3	Population density		200	437	288	356	319
4	Literacy rate	Per cent	61.12	72.56	69.39	73.94	75.61
i	Male		67.88	78.44	80.16	82.9	82.84
ii	Female		54.32	66.59	58.55	64.74	68.15
5	Actual rainfall	mm	698	782	516	1153	1375
6	Number of rainy days	no	43	47	40	53	103
7	Agricultural holdings	no	211658	360824	503534	1008305	12384721
i	Marginal holdings		53426	104372	35572	107692	1651491
ii	Small holding		72337	117879	103262	212307	2875807
iii	Semi medium holdings		54541	85925	154754	283661	3468133
iv	Medium holdings		26121	43507	158496	296713	3206228
v	Larger holdings		5233	9141	51124	107437	1183062
8	Dry land	ha	162873	352448	305355	549394	8977967
9	Irrigated land	ha	67671	171067	261902	459903	3390476
10	Total cultivated area	ha	230544	523515	567257	1009297	12368443

Source: Directorate of Economics and Statistics, Gov. of Karnataka

Table 3.2: Land utilization pattern in the selected districts and state (2010-11)

(ha)

Sl No.	Particulars	Chamarajanagar	Mysore	Bagalkot	Belgaum	Karnataka
1	Area under forest	275610	62851	81126	190424	3071833
2	Land not available for cultivation	46040	120521	53642	113959	2173931
i	Non-agricultural uses	24606	74709	28832	69617	1386419
ii	Barren	21434	45812	24810	44342	787512
3	Other uncultivable land	35128	74389	5738	39370	1614677
i	Cultivable waste	7637	21425	2035	11465	412831
ii	Permanent pasture	22750	47093	3429	24807	913551
iii	Trees and grooves	4741	5871	274	3098	288295
4	Fallow land	26507	66803	51895	153369	1785288
i	Current fallow	10708	31958	41924	146375	1301361
ii	Other fallow	15799	34845	9971	6994	483927
5	Net sown area	186616	351818	466476	847260	10404107
6	Area sown more than once	38672	204901	133855	261940	2469201
7	Gross cropped area	225288	556719	600331	1109200	12873308
8	Total geographical area	569901	676382	658877	1344382	19049836

Source: Directorate of Economics and Statistics, Gov. of Karnataka

Table 3.3: Source of irrigation in the study area (2010-11)

(ha)

Source	Chamarajanagar	Mysore	Bagalkot	Belgaum	Karnataka
Canals	12726	112783	54752	101340	1105038
Tank	5260	17000	1080	1662	195698
Wells	4951	19573	12177	119729	424836
Bore well	44302	21298	87632	137214	1251643
Lift irrigation	432	413	2920	37101	106081
Other sources	0	0	103341	66243	307180
Net irrigated area	67671	171067	261902	463289	3390476

Source: Directorate of Economics and Statistics, Gov. of Karnataka

Table 3.4: Area under major crops in the study area (2010-11)

(ha)

Sl No	Crops	Chamarajanagar	Mysore	Bagalkot	Belgaum	Karnataka
I	**Cereals**					
1	Paddy	17114	123650	133	71888	1486478
2	Jowar	19269	13503	115557	169314	1369410
3	Bajra	543	0	43613	24305	305107
4	Ragi	17802	64648	0	1610	764374
5	Wheat	0	0	26356	57138	283427
6	Maize	37899	29391	82030	162344	1240477
7	Total small millets	207	0	54	2639	26682
8	Total cereals and millets	92834	231192	267743	489238	5475955
II	**Pulses**					
1	Bengal gram	4111	1158	66858	85064	972374
2	Red gram	1949	3368	4811	4671	604305
3	Other pulses	32508	124193	40553	39166	902824
4	Total pulses	38568	128719	112222	128901	2479503
III	**Oilseeds**					
1	Groundnut	16887	5855	23808	51663	817550
2	Sunflower	16181	2482	60584	31673	794165
3	Others	3601	15653	10964	107082	389673
4	Total oilseeds	36669	23990	95356	190418	2001388
IV	**Commercial crops**					
1	Sugarcane	11914	13393	88497	198917	496742
2	Cotton	754	41255	2824	30046	456802
3	Mulberry cultivation	4651	2049	298	498	82098
4	Total	17319	56697	91619	229461	1035642
V	**Horticultural crops**					
1	Fruits	15370	6019	22526	35795	436866
2	Vegetables	10645	8984	6852	12716	360245
3	Turmeric	9708	6389	4161	1695	24912

Source: Directorate of Economics and Statistics, Gov. of Karnataka

Table 3.5: District wise area, production and yield of turmeric in Karnataka (2010-2011)

Districts	Area (Ha)	Production (tonnes)	Yield (kg/ha)
Chamarajanagar	**9708**	**50808**	**5.23**
Mysore	**6389**	**100310**	**15.7**
Bagalkot	**4161**	**62898**	**15.12**
Belgaum	**1695**	**10352**	**6.11**
Gulbarga	955	8610	9.02
Bidar	530	4240	8
Mandya	340	4095	12.04
Haveri	174	870	5
Chikkamagalur	160	1841	11.51
Bijapur	151	1510	10
Raichur	124	1240	10
Ramanagar	104	1025	9.86
Udupi	85	1020	12
Hassan	81	652	8.05
Dakshina Kannada	64	293	4.58
Davanagere	62	29	0.47
Kolar	43	467	10.86
Bangalore Urban	31	124	4
Chitradurga	19	76	4
Bangalore rural	14	79	5.64
Shimoga	13	195	15
Chickballapur	6	53	8.83
Uttara Kannada	3	42	14
Bellary	0	0	0
Dharwad	0	0	0
Gadag	0	0	0
Kodagu	0	0	0
Koppal	0	0	0
Tumkur	0	0	0
Karnataka	24912	250829	10.07

Source: Directorate of Economics and Statistics, Gov. of Karnataka

3.2.3 Selection of the sample villages

In the third stage two villages from each taluk were selected again based on the area under turmeric. This information was collected from the Assistant Horticultural Office of the selected taluks. The detail list of the selected villages is presented in Table 3.7.

3.2.4 Selection of the Producers

For the selection of producers, the convience sampling method was adopted and from each village twelve farmers were selected randomly thus the total sample size of the respondents was 192.

3.2.5 Selection of the Market and Market Intermediaries

For the selection of markets and market intermediaries' purposive sampling technique was adopted *i.e.,* Sangli, Chamarajanagar, Gundlupet and Kollegal Markets were selected as the majority of the turmeric growers of the state used to sell their produce in these markets.

For studying the marketing aspects of turmeric all these markets were chosen. The market functionaries were listed under three heads namely commission agents, wholesale traders and retailers. Thus from each market five retailers, five wholesalers and five commission agents were selected randomly from each market and the total sample size was 60.

To evaluate the market integration among the selected markets for turmeric in India with international market Kochi, Erode and New York markets were considered for the study.

3.3 Nature and sources of the data

The study utilized both primary and secondary data. The primary data relating to cost of production, price obtained by the farmers, channels followed in marketing of their produce, cost of marketing the produce were obtained from the producers to study the cost of production, cost of marketing *etc*. Similarly, the data on costs incurred by the market functionaries in the marketing of the produce, price at which the commodity was purchased and sold *etc.* were collected in order to work out the margins obtained by each of them. This primary data were collected from the sample farmers and market functionaries with the help of pre-tested and well structured schedule. The relevant information on other aspects like fixed assets, land use, cropping pattern, yields and returns, quantity sold, price received, the time of sale and the channel through which the sales were done, the marketing costs incurred, profit margin recorded. The problems faced by farmers in the production and marketing of turmeric were identified mainly based on the opinion survey of with the farmers while pre-testing of the schedule and the same were discussed and clarified with the scientists who have worked on spices especially on turmeric. The farmers and various market intermediaries were personally interviewed to ensure that the data made available by them were clear, comprehensive and reasonably correct. The time series data on area, production, productivity, arrivals, prices, exports *etc.* were elicited from secondary sources. The sources for the secondary data are presented in Table 3.8.

3.4 Study period

The study period was divided into two periods based on the policy of the government on liberalization of trade at different periods. However, for better understanding of growth in area, production and yield of turmeric, the overall study period (1974-75 to 2010-11) was further divided into two sub periods.

Period-I: Pre-WTO period (1974-75 to 1994-95), Period-II: Post-WTO period (1995-96 to 2010-11) and Overall Period: 1974-75 to 2010-11.

The same period was taken into account to estimate growth rates in exports of turmeric from India. Whereas, for Karnataka the period was divided as 1979-80 to 1994-95 (Pre-WTO), 1995-96 to 2010-11 (Post-WTO) and 1979-80 to 2010-11 (Overall period). Finally to estimate the growth and instability in area, production and productivity of turmeric in the selected districts 1998-99 to 2010-11 data were considered.

The data on prices of both domestic and international market pertaining to the period from 1983-84 to 2012-13 were considered to compute export competitiveness and from 1983-84 to 1994-95 (Pre-WTO) and 1995-96 to 2012-13 (Post-WTO) were considered to trade direction.

To examine the marketing performance of turmeric and to predict the monthly future prices, data on monthly arrivals and prices for the selected markets for the period from 2003-04 to 2012-13 in the case of Sangli market, from 2005-06 to 2012-13 in the case of Chamarajanagar market, from 2006-07 to 2012-13 in the case of Gundlupet and Kollegal markets were considered based on the availability of data.

Monthly wholesale prices for the period from 2002-03 to 2012-13 in the case of Erode market and for the period from 2001-02 to 2012-13 in the case of New York and Kochi markets were considered to analyse the seasonal indices and to predict the monthly future prices based on the availability of data. The annual wholesale prices of turmeric for Sangli, Erode, Kochi and New York markets were collected for the period of 23 years (1990-91 to 2012-13) to analyse the trends and cyclical variations in the prices of turmeric.

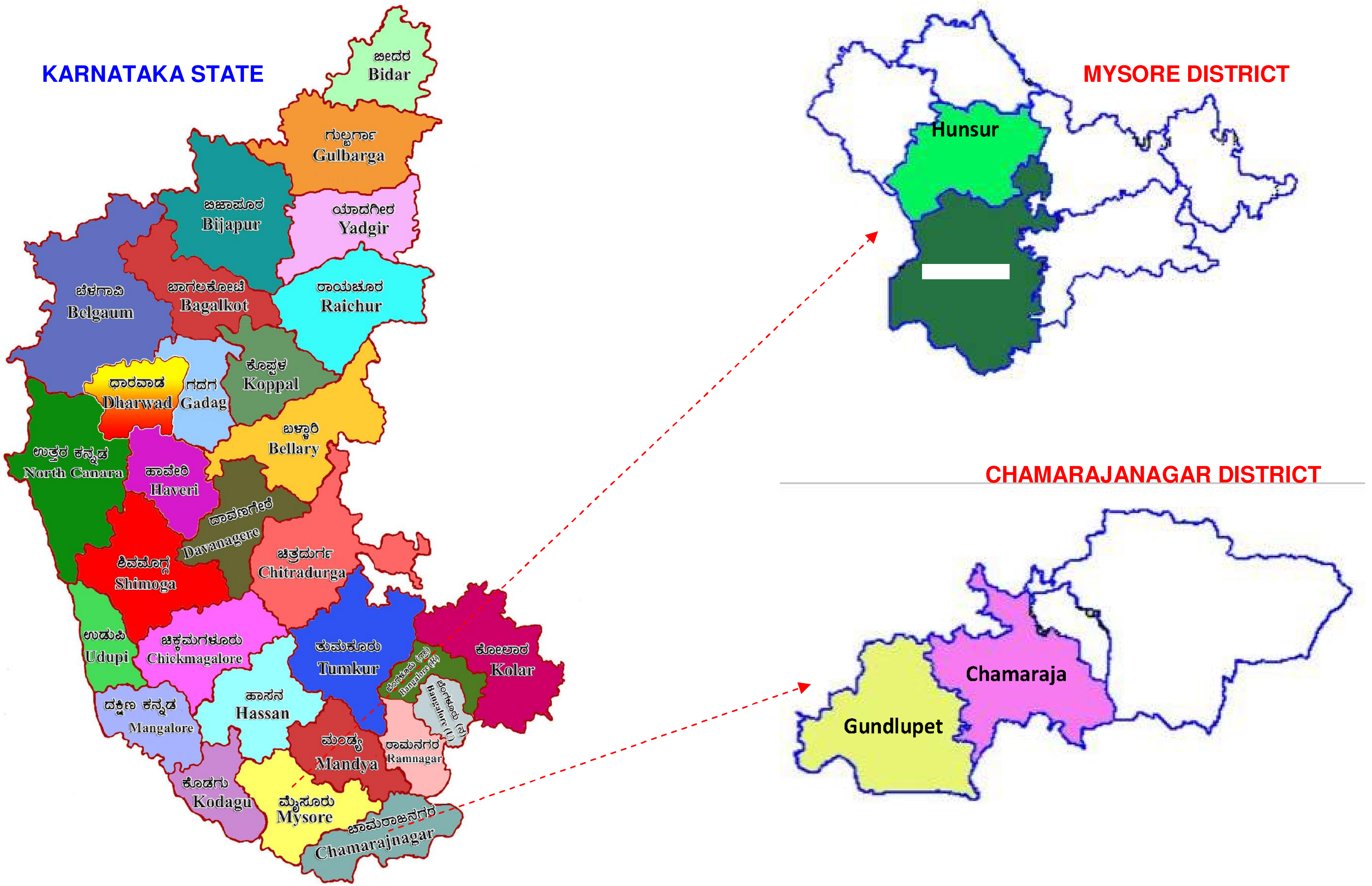

Fig. 1a: Maps of Mysore and Chamarajanagar districts showing the study area

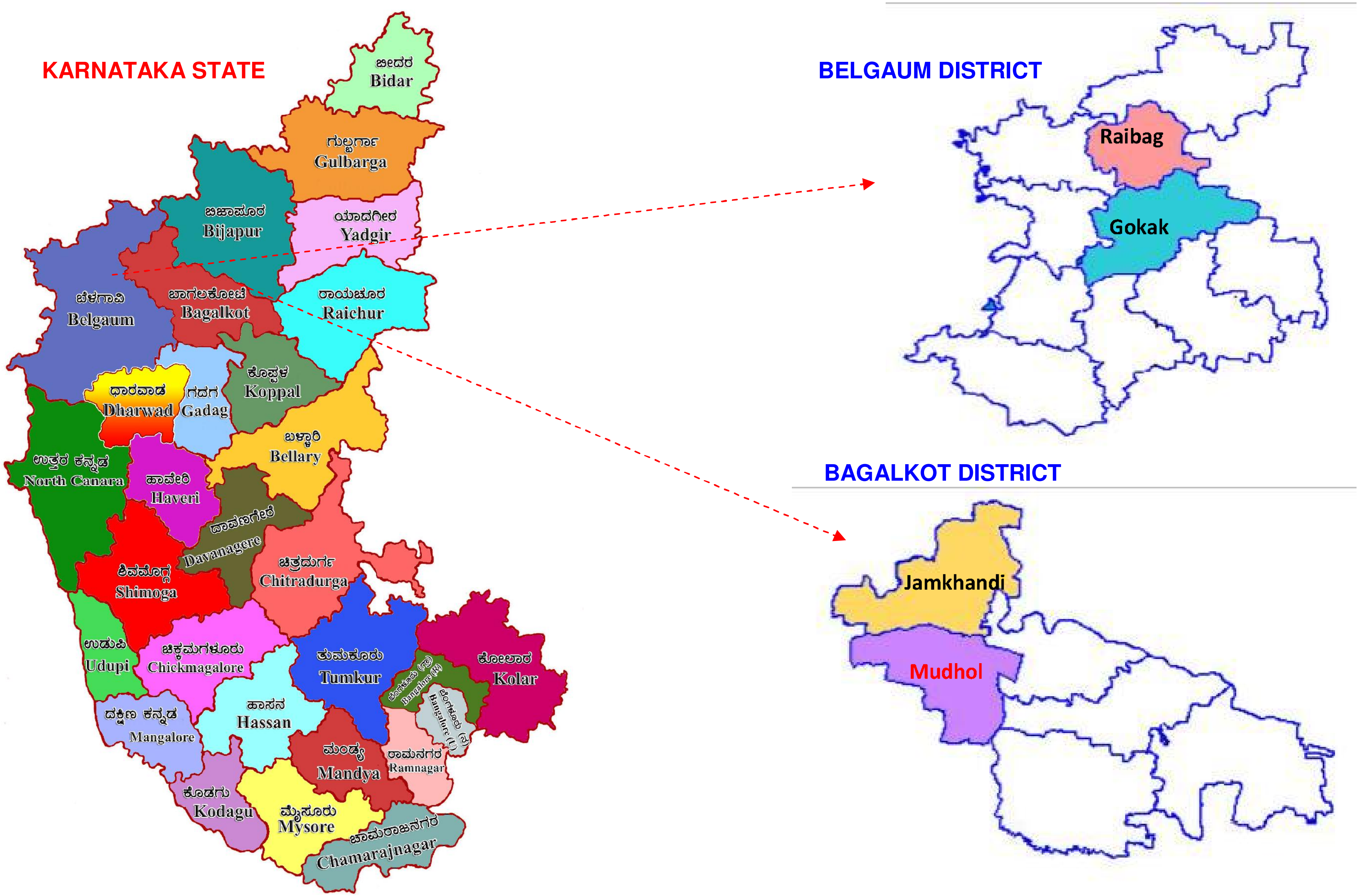

Fig. 1b: Maps of Belgaum and Bagalkot districts showing the study area

Table 3.6: Taluk-wise Area, production and yield of turmeric in the selected districts during 2011-12

Districts/Taluks	Area (Ha)	Production (tonnes)	Yield (t/ha)
Chamarajanagar			
Chamarajanagar	**5200**	**23400**	**4.50**
Gundlupet	**3867**	**17788**	**4.60**
Kollegal	2800	12900	4.61
Yalandur	106	490	4.62
Total	11973	54578	4.56
Mysore			
H D Kote	**4800**	**76800**	**16**
Hunasur	**480**	**7680**	**16**
Nanjangudu	350	4200	12
K R Nagar	285	4275	15
T. Narasipura	200	3000	15
Piriyapattan	120	600	5
Total	6320	97010	15.4
Bagalkot			
Jamakhndi	**2599**	**55228.75**	**21.25**
Mudhol	**1793**	**10470.98**	**5.84**
Bilagi	18	9	0.5
Bagalkot	1.6	10.88	6.8
Hunagund	0	0	0
Badami	0	0	0
Total	4411.6	65719.61	14.9
Belgaum			
Gokak	**1893**	**17983**	**9.5**
Raibag	**1126**	**5630**	**5**
Athani	333.6	1793.1	5.38
Chikkodi	210	840	4
Hukkeri	78	1092	14
Kanapur	19	152	8
Ramadurg	9.28	76.82	8.28
Bailahongal	5	60	12
Belgaum	0	0	0
Soudatti	0	0	0
Total	**3673.88**	**27627.42**	**7.52**

Source: District Horticultural Office

Table 3.7: Selected farm respondents from the study area

Sl. No	District	Taluks	Village	No.
1	Chamarajanagar	Chamarajanagar	Haradanahalli	12
			Chandakawadi	12
		Gundulpet	Terakanambi	12
			Begur	12
2	Mysore	H.D.Kote	Annur	12
			Bhimanahalli	12
		Hunasur	Karimuddanahalli	12
			Gaddige	12
3	Bagalkot	Jamakhandi	Teradal	12
			Jagadal	12
		Mudhol	Shirol	12
			Belagali	12
4	Belgaum	Gokak	Kalloli	12
			Hallur	12
		Raibag	Mugalkhod	12
			Handiganur	12
	Total			**192**

The primary data on cultivation of turmeric from farmers pertained to 2011-12 agricultural year.

3.5 Analytical tools and techniques employed

The analytical techniques used to evaluate the objectives of the present study have been summarized below.

3.5.1 Budgeting technique and tabular Presentation

The collected data were presented in tabular form to facilitate easy comparisons. The budgeting technique was employed for estimating the cost and return structure and tabular presentation technique was employed to analyse the marketing cost and margins under different channels of turmeric marketing, the data were summarized with the aid of statistical tools like averages and percentages to obtain the meaningful results.

3.5.2 Exponential growth Model

Growth rate of area, production, yield and exports of turmeric were computed for a period of 36 years from 1974-75 to 2010-11. This period is separated in a phased manner such as Pre-WTO (1974-75 to 1994-95) and Post- WTO (1995-96 to 2010-11) and Overall period (1974-75 to 2010-11).

The linear, log-linear, exponential and power functions were some of the important functional forms employed to study the growth rates. Different functional forms were tried in the past for working out growth rates in area, yield and production. Some of the important forms tried were the linear growth model (Y = a+ bt), exponential function ($Y = ab^t$) and quadratic function ($Y = a+b_t+c_t^2$). However, it was found that the exponential form of the function. $Y_t = ab^t$ was the better and most frequently used one.

Growth rates in area, production and productivity of turmeric as well as quantity and value of export of turmeric were computed for a period of 36 years from 1974-75 to 2010-11. Growth rates were computed using the exponential growth function of the form (Angles, 2001).

$$\ln y_t = \alpha_t + \beta_t + u_t \ldots (1)$$

Where,

y_t = Value at time t.

t = Time element which takes the value 1, 2…………..n for various years.

α_t = Intercept

β_t = Regression coefficient

$$\text{Annual compound growth rate (r)} = [(\text{Antilog } \beta_t)] - 1 \times (100) \ldots (2)$$

3.5.3 Instability Analysis

The extent of variability in area, production, productivity and export of turmeric were analyzed through coefficient of variation *i.e.,*

$$\text{C.V.} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100 \quad \ldots\ldots (3)$$

For any production function, the total change in output/income is affected by the change in the factors of production and in the parameters that define the function. In order to know the total change in per acre output/income the output decomposition model developed by Bisaliah (1977) is used.

In order to analyze the sources of instability in turmeric production, a method developed by Hazell (1982) was adopted. This method uses statistical identities to provide an exact decomposition of the components of change in the variance of turmeric production.

To estimate the variability of production of turmeric, the study period was divided into two, Pre - WTO and Post – WTO periods. The period-I extends from 1974-75 to 1994-95, while the period – II from 1995-96 to 2010-11. Before using the data for the analysis of instability, the time series data on area and productivity pertaining to turmeric were first detrended to remove the trend component, using linear trend equation of the form

$$Y_t = a + b_t + U_t \ldots\ldots\ldots\ldots (4)$$

Where,

Y_t = dependent variable (area in hectare and yield in kg/ha)

t = time period in years

a = intercept

b = regression coefficient

U_t = residual term

The residual were computed from the equation (4) and were then centered around their respective means for both periods. The resultant detrended time series data were of the following form.

$Y_t = \bar{Y} + U_t$ …………….. (5)

Where,

$\bar{Y}$ = Mean yield

U_t = error in't' year

The production of turmeric was computed using following equation.

$P_t = A_t \times Y_t$ …………… (6)

Where,

P_t = Production of turmeric in year 't'

A_t = Area under turmeric in year 't'

Y_t = Yield of turmeric in year 't'

The production variance and co-variance were decomposed to know the sources of change between the periods.

The variance in production during the period- I can be expressed as,

$V(P_1) = \bar{A}_1^2 V(Y_1) + \bar{Y}_1^2 V(A_1) + 2 \bar{A}_1 \bar{Y}_1 COV(A_1, Y_1) - COV(A_1, Y_1)^2 + R_1$ ….. (7)

Where,

$V(P_1)$	= Variance of production in period-I
$\bar{A}_1$	= Mean area in period-I
$\bar{Y}_1$	= Mean yield in period-I
$V(A_1)$	= Variance of area in period-I
$V(Y_1)$	= Variance of yield in period-I
$Cov(A_1, Y_1)$	= Covariance of area and yield in period-I
R_1	= Residuals in period-I

Similarly, each variable in period-II can be expressed in terms of its counterpart in period-I, plus the change in the variable between the two periods.

For example, $\bar{A}_2 = \bar{A}_1 + \Delta\bar{A}$ and $\bar{Y}_2 = \bar{Y}_1 + \Delta\bar{Y}$

Where,

$\Delta\bar{A} = \bar{A}_2 - \bar{A}_1$

$\Delta\bar{Y} = \bar{Y}_2 - \bar{Y}_1$

Therefore, the change in the variance of production of turmeric between two periods is given by,

$\Delta V(P) = V(P_2) - V(P_1)$

And this can be decomposed into various components as shown in Tables 3.9 and 3.10.

3.5.4 Functional analysis

The Cobb-Douglas type of production function was used to study the effect of various inputs on turmeric output. On account of its well known properties like its computational simplicity that justify its wide application in analyzing production relations (Handerson and **Quandt**, 1971). It being a homogenous function provided a scale factor enabling one to measure the returns to scale. The estimated regression coefficients represented the production elasticities.

The form of Cobb-Douglas production function used in the present study is as follows.

$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}e^u$ ………… (8)

Where,

Y = Gross returns (₹/Acre)

a = Intercept (efficiency) term

X_1 = Planting material (₹/Acre)

X_2 = Farm yard manure (₹/Acre)

X_3 = Human labour (₹/Acre)

X_4 = Bullock labour (₹/Acre)

X_5 = Machine labour (₹/Acre)

X_6 = Chemical fertilizers (₹/Acre)

X_7= Plant protection chemicals (₹/Acre)

e^u = Random error term

bi's = Output elasticities of respective factor inputs, i = 1, 2….7

The Cobb-Douglas production function was converted into log linear form and parameters (coefficients) were estimated by employing Ordinary Least Square Technique (OLS) as given below.

$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + u \log e$ ………………(9)

The regression coefficients (b_i's) were tested using 't' test at chosen level of significance.

$$t = \frac{b_i}{\text{Standard error of } b_i} \quad \text{…………………} (10)$$

In order to know the goodness of fit, the adjusted co-efficient of multiple determination R^2 was calculated by using the formula.

$$\bar{R}^2 = 1 - (1 - R^2)\frac{(n-1)}{(n-p)} \quad \text{………………………} (11)$$

Where,

$\bar{R}^2$ = adjusted coefficient of multiple determination (adjusted for the size of the sample)

R^2 = coefficient of multiple determination which is given by

$$R^2 = \frac{\text{Regression sum of squares}}{\text{Total sum of squares}}$$

n = Number of observations in the sample

P = Number of parameters in the function

3.5.4.1 Measurement of efficiency

The analysis of efficiency should help to identify the possibilities for increasing income while conserving resources. The role of efficiency may be viewed as an important component in policy making to stimulate income and/or promote resource conservation.

The concept of efficiency was first defined by Farrell (1957) in terms of its two dimensions, technical efficiency and allocative efficiency. Technical efficiency arises when the maximum output is obtained from a given bundle of inputs and allocative efficiency arises when inputs are used in proportion, which yield maximum output. Allocative efficiency exists when resources are allocated within the farm according to market prices. It is therefore, suggested that within a static framework measures of technical efficiency retain validity as a measure of goal achievement in a materialistic world (Russel and Young, 1983). The idea of frontier production function is built around the concept of efficiency given by Farrell (1957).

3.5.4.2 Technical efficiency

3.5.4.2.1 Timmer's output based measure of technical efficiency

Timmer (1971) imposed the Cobb-Douglas production function on the frontier and computed an output-based measure of efficiency. The approach adopted here is to specify a fixed parameter frontier amenable to statistical analysis. This takes the following general form.

$$Y = f(x)\, eu,\ u<0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots.\ (12)$$

and the Cobb-Douglas production function in natural logarithmic form would be:

$$1n\ Y = a + \sum_{j=1}^{n} b_j \log x_j + u,\ u<0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ (13)$$

In estimating the above equation, the Corrected Ordinary Least Squares (COLS) regression is chosen as the most convenient means. This method is briefly outlined as under.

As a first step, the foregoing equation is estimated by the method of OLS yielding the best linear unbiased estimates of b_i's coefficients. The intercept 'a' is then corrected by shifting the function until no residual is positive and one case is zero. This is done by adding the largest error term of the fitted model to the intercept. Greene (1980) has shown that a consistent, though biased, estimate of 'a' which imposes the sign uniformity on the residuals will be generated by this procedure.

Thus, Timmer measure of technical efficiency (TEi) of a farm 'i' is the ratio of actual output to potential (Frontier) output, given the level of input use on farm 'i'. It thus indicates how much extra output could be obtained if farm 'i' were on the frontier with the given technology and level of input.

Timmer measure of technical efficiency is given by:

$$TEi = \frac{Y}{Y^*} \leq 1 \qquad \ldots\ldots\ldots\ldots\ldots\ldots.\ (14)$$

Where,

Y = Actual output

Y* = Potential output obtainable for given level of inputs

3.5.4.2.2 The Kopp measure of technical efficiency (KTE)

Kopp (1981) suggested a different approach within the Farrell framework, which involves the econometric estimation of a parametric frontier function followed by the algebraic identification of the efficiency standard for each data point. The Kopp measure of technical efficiency compares the actual level of input use to the frontier level of input use given the input use ratios. For this, the following procedure was used.

$$R_i = X_2 \div X_1,\ R_2 = X_3 \div X_1, \ldots\ldots\ldots\ R_n = X_n \div X_1 \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots..\ (15)$$

Where, R_1 indicates input use ratios obtained by dividing the quantity of other inputs by one common X_1 input. Then the optimum use level of X_1 input *i.e.* frontier usage (X_1*) will be given as shown before.

$$\ln X_1^* = (\ln Y - A^* \sum_{i=1}^{n} b_i \ln R_i) \div \sum_{i=1}^{n} b_i \qquad \ldots\ldots\ldots\ (16)$$

... e respecti... and other terms are the same as ... assessed by dividing the frontier usage (X_1*) with the actual quantity used. Subsequently technical efficiency will be:

$$KTE = (X_1^* \div X_1) \qquad \ldots\ldots\ldots\ldots\ (17)$$

Similar procedure was used for calculating the frontier usage of other inputs.

3.5.4.2.3 Allocative efficiency

Given the technology, allocative efficiency exists when resources are allocated within the farm according to market prices and it implies the proper level of input use in production. To decide whether a particular input is used rationally or irrationally, its marginal value product will be computed. If the marginal value product of an input just covers its acquisition cost it is said to be used most efficiently.

The Marginal Value Product (MVP) was calculated at the geometric mean levels of variables by using the formula.

$$MVP\ i^{th}\ resource = b_i \frac{\overline{Y}}{\overline{X_i}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (18)$$

Where,

$\overline{Y}$ = Geometric mean of the output

X_i = Geometric mean of i^{th} independent variable

b_i = The regression coefficient of the i^{th} independent variable

In order to determine the efficiency of allocation of the resources or price efficiency, the value of the marginal product obtained by multiplying the marginal product (b_i) by the price of the product was compared with its marginal cost. A ratio of the value of marginal product to the factor price more than unity implied that the resources were advantageously employed. If the ratio was less than one, it suggested that resource was over utilized.

3.5.5 Time Series Analysis

Time series analysis was done to study the variations in Monthly prices and arrivals of turmeric for the period of 10 years. A time series is a complex mixture of four components namely, Trend (T), Seasonal (S), Cyclical (C) and Irregular (I). These four types of movements are frequently found either separately or in combination in a time series. The relationship among these components was assumed to be additive or multiplicative, but the multiplicative model was the most commonly used method in economic analysis, which can be represented as

$$O_t = T \times C \times S \times I \ \ldots\ldots\ldots\ldots\ldots\ldots\ (19)$$

Where,

O_t = Original observation at time‘t’

T = Trend component

S = Seasonal variations

C = Cyclical element

I = Irregular fluctuations

Linear trend (T): Over a long period of time, time series is very likely to show a tendency to increase or decrease over time. The factors responsible for such changes in time series are the growth of population, change in the taste of people, technological advances in the field *etc.*

There are different types of trends, some of them are linear and some are nonlinear in their form. For shorter period of time, in most of the situations the straight line provides the best description of trend and for longer period of time, the non-linear form generally provides a good description of the trend. Often, it may be possible to describe such movements with a structured mathematical model. In the absence of such a definite format, approximately a polynomial or a free hand curve describes the movements.

Seasonal variation (S): The variation in a year is called as seasonal variation. The main causes of seasonal variations are production periods, customs, climates *etc.* Such seasonal components can be analyzed through harmonic analysis.

Cyclical movements (C): Cyclical movements are fluctuations which differ from periodic movements. Cyclical movements have longer duration than a year and have of several years as in business cycles.

Irregular variations (I): Here the effects could be completely unpredictable, changing in a random manner. A given observation is affected by episodic and accidental factors. These are also known as causal series and are affected by the unknown causes. These unknown causes act in an unpredictable manner.

Table 3.9: Components of change in the average production of turmeric

Sl. No.	Sources of change	Symbols	Components of change
1.	Change in mean yield	$\Delta\bar{Y}$	$\bar{A}_1\Delta\bar{Y}$
2.	Change in mean area	$\Delta\bar{A}$	$\bar{Y}_1\Delta\bar{A}$
3.	Interaction between changes in mean area and mean yield	$\Delta\bar{A}\Delta\bar{Y}$	$\Delta\bar{A}_1\Delta\bar{Y}$
4.	Change in area – yield covariance	Δ Cov(A,Y)	Δ Cov(A,Y)

Table 3.10: Components of change in the variance of turmeric production

Sl. No.	Description change	Symbols	Components of change
1.	Change in mean yield	$\Delta\bar{Y}$	$[2\bar{A}_1, \Delta\bar{Y}\ Cov(A_1,Y_1) + [2\bar{Y}_1\Delta Y + (\Delta Y)^2]\ V(A_1)$
2.	Change in mean area	$\Delta\bar{A}$	$[2\bar{Y}_1, \Delta\bar{A}\ Cov(A_1,Y_1) + [2\bar{A}_1\Delta A + (\Delta A)^2]\ V(Y_1)$
3.	Change in yield variance	$\Delta V(Y)$	$(\bar{A}_1)^2\ \Delta V(Y)$
4.	Change in area variance	$\Delta V(A)$	$(\bar{Y}_1)^2\ \Delta V(A)$
5.	Change in area yield covariance	$\Delta Cov(A, Y)$	$[2\bar{A}_1\bar{Y}_1 - 2Cov(A_1,Y_1)]\ \Delta Cov(A,Y) - [\Delta Cov(A,Y)]^2$
6.	Interaction between changes in mean yield and mean area	$\Delta A, \Delta Y$	$2(\Delta\bar{Y})(\Delta A)\ Cov(A_1,Y_1)$
7.	Interaction between changes in mean area and yield variance	$\Delta\bar{A}, \Delta V(Y)$	$[2\bar{A}_1)(\Delta\bar{A}) + (\Delta\bar{A})^2]\ \Delta V(Y)$
8.	Interaction between changes in mean yield and area variance	$\Delta Y, \Delta V(A)$	$[2(Y_1)(Y) + (\Delta Y^2)]\ \Delta V(A)$
9.	Interaction between changes in mean area and yield and changes in area-yield Covariance	$\Delta\bar{Y}, \Delta A, \Delta Cov(A,Y)$	$[2(\bar{Y}_1)(\Delta\bar{A}) + 2(\bar{A}_1)(\Delta\bar{Y}) + 2(\Delta\bar{A})(\Delta Y)]\ \Delta Cov(A,Y)$
10.	Changes in residual	ΔR	$\Delta V(A\ Y)$ – Sum of other components

3.5.5.1 Estimation of seasonal indices of monthly data

To measure the seasonal variations in prices and arrivals, seasonal indices were calculated employing twelve months ratio to moving average method.

The seasonal indices were calculated by adopting the following steps

In the first step, 12 months moving total were generated. These totals were divided by 12 to compute 12 months moving average. Then a series of centered moving averages were worked out.

In the next step, original values were expressed as a percentage of corresponding centered moving average. Further, the irregular component in the series was removed. Afterwards, these percentages were arranged in terms of monthly averages. Then the average index for each month was computed, finally these monthly average indices were adjusted in such a way that their sum becomes 1200. This can be done by working out of correction factor and multiplying the average for each month by this correction factor. The correction factor (K) is worked out as follows.

$$K= 1200/S$$

Where, K is correction factor and S is sum of averages indices for 12 months, multiply K with the percentage of moving average for each month to obtain the seasonal indices.

3.5.5.2 Estimation of cyclical indices

The most commonly used method for estimating cyclical movement of time series is the residual method by eliminating the seasonal variation and trend. This is accomplished by dividing (Y_t) by corresponding (S) for time 't', Symbolically.

$$T. C. I. = T.C.S.I. / S \quad \text{.........................} \quad (20)$$

$$C. I. = T.C.I. / T$$

These deseasonalized data contain trend, cyclical and irregular components. This trend cycle components are plotted against time for examining cyclical behaviour. If there is any existence of cycle, periodicity of cycle is noted. Again moving average of length equal to periodicity of cycle is computed for eliminating cyclical behaviour.

These moving averages are arranged cycle wise. These are adjusted for cyclical indices, as in the case of seasonal indices. Then trend cycle values (TC) are divided by adjusted components CI.

The examination of both the graphs of trend cycle component as well as trend component will give a clear idea of the presence of cycle.

If there is similarity in these two graphs, it is an indication of non-existence of the cycle. However, the non-similarity in the two graphs is an indication of the presence of the cycle. If ultimately a cycle is reflected, then the cyclical effect is removed from T-C components. If no cycle is detected, then the trend cycle values are treated as pure trend values. The Friedman's two way analysis of variance was employed to know the significant difference among months within a cycle and also between cycles. A significant difference indicates the presence of changing cyclical behaviour and non-significant difference indicates the consistency of cyclical pattern.

3.5.5.3 Analysis of long-term movements (trend)

For estimating the long run trend of arrivals and prices, the method of least squares estimate was employed. This method of ascertaining the trend in a series of annual arrivals and prices involves estimating the co-efficient of intercept (a) and slope (b) in the linear functional form. The equation adopted for this purpose was specified as follows.

$$Y_t = a + bX+e \quad \text{……………..} \quad (21)$$

Y_t = Trend values at time t

X = Period

a = intercept parameter

b = slope parameter

e = Error

Annual trends of prices and arrivals for the selected markets were computed and compared. The goodness of fit of trend line to the data was tested by computing the coefficient of multiple determination which is denoted by R^2.

3.5.6 ARIMA technique

In statistics autoregressive moving average (ARMA) models, sometimes called Box-Jenkins models after the iterative Box-Jenkins methodology usually used to estimate them, are typically applied to time series data.

Given a time series of data X_t, the ARMA model is a tool for understanding and, perhaps, predicting future values in this series. The model consists of two parts, an autoregressive (AR) part and a moving average (MA) part. The model is usually then referred to as the ARMA (*p*,*q*) model where *p* is the order of the autoregressive part and *q* is the order of the moving average part.

The model is generally referred to as an ARIMA (*p*, *d, and q*) model where *p*, *d*, and *q* are integers greater than or equal to zero and refer to the order of the autoregressive, integrated, and moving average parts of the model respectively.

Given a time series of data X_t where *t* is an integer index and the X_t are real numbers, then an ARMA (*p*, *q*) model is given by

$$(1 - \sum_{i=1}^{p}\varphi_i L^i)\, X_t = (1 + \sum_{i=1}^{q}\varphi_i L^i)\, \varphi_t \text{ .... (22)}$$

Where *L* is the lag operator, the φ_i are the parameters of the autoregressive part of the model, the θ_i are the parameters of the moving average part and the φ_t are error terms. The error terms are generally assumed to be independent, identically, distributed variables sampled from a normal distribution with zero mean.

An ARIMA (*p*, *d, q*) process is obtained by integrating an ARMA (*p*, *q*) process. That is,

$$(1 - \sum_{i=1}^{p}\varphi_i L^i)\,(1 - L)\, X_t = (1 + \sum_{i=1}^{q}\varphi_i L^i)\, \varphi_t \text{ ....(23)}$$

Where *d* is a positive integer that controls the level of differencing (or, if *d* = 0, this model is equivalent to an ARMA model). Conversely, applying term-by-term differencing *d* times to an ARIMA (*p*, *d*, *q*) process gives an ARMA (*p*, *q*) process. Note that it is only necessary to difference the AR side of the ARMA representation, because the MA component is always I (0).

It should be noted that not all choices of parameters produce well-behaved models. In particular, if the model is required to be stationary then conditions on these parameters must be met.

Some well-known special cases arise naturally. For example, an ARIMA (0, 1, 0) model is given by:

$$X_t = X_{t-1} + \varphi_t \text{ .... (24)}$$

This is simply a random walk.

Generalizations

The dependence of X_t on past values and the error terms ε_t is assumed to be linear unless specified otherwise. If the dependence is nonlinear, the model is specifically called a nonlinear moving average (NMA), nonlinear autoregressive (NAR), or nonlinear autoregressive moving average (NARMA) model.

A number of variations on the ARIMA model are commonly used. For example, if multiple time series are used then the X_t can be thought of as vectors and a VARIMA model may be appropriate. Sometimes a seasonal effect is suspected in the model. For example, consider a model of daily road traffic volumes. Weekends clearly exhibit different behavior from weekdays. In this case it is often considered better to use a SARIMA (Seasonal ARIMA) model than to increase the order of the AR or MA parts of the model. If the time-series is suspected to exhibit long- range dependence then the *d* parameter may be replaced by certain non-integer values in a Fractional ARIMA (FARIMA also sometimes called ARFIMA) model.

Introduction to ARIMA

ARIMA (p, d, and q): ARIMA models are, in theory, the most general class of models for forecasting a time series which can be stationeries by transformations such as differencing and logging. In fact, the easiest way to think of ARIMA models is as fine-tuned versions of random-walk and random-trend models: the fine-tuning consists of adding lags of the differenced series and/or lags of the forecast errors to the prediction equation, as needed to remove any last traces of autocorrelation from the forecast errors.

The acronym ARIMA stands for "Auto-Regressive Integrated Moving Average." Lags of the differenced series appearing in the forecasting equation are called "auto-regressive" terms, lags of the forecast errors are called "moving average" terms, and a time series which needs to be differenced to be made stationary is said to be an "integrated" version of a stationary series. Random-walk and random-trend models, autoregressive models, and exponential smoothing models (*i.e.,* exponential weighted moving averages) are all special cases of ARIMA models.

A non seasonal ARIMA model is classified as an "ARIMA (p, d, q)" model, where:

- p is the number of autoregressive terms,
- d is the number of non seasonal differences, and
- q is the number of lagged forecast errors in the prediction equation.

To identify the appropriate ARIMA model for a time series, you begin by identifying the order(s) of differencing needing to stationeries the series and remove the gross features of seasonality, perhaps in conjunction with a variance-stabilizing transformation such as logging or deflating. If you stop at this point and predict that the differenced series is constant, you have merely fitted a random walk or random trend model. (Recall that the random walk model predicts the first difference of the series to be constant, the seasonal random walk model predicts the seasonal difference to be constant, and the seasonal random trend model predicts the first difference of the seasonal difference to be constant--usually zero.) However, the best random walk or random trend model may still have auto correlated errors, suggesting that additional factors of some kind are needed in the prediction equation.

3.5.6.1 The BOX-JENKINS (BJ) methodology

This method consists of four steps,

1. Identification
2. Estimation
3. Diagnostic checking
4. Forecasting

Identification

To find out the appropriate values of p, d and q. Chief tool identification are the autocorrelation function (ACF), the partial autocorrelation function (PAFC), and the resulting correlograms, which are simply the plots of ACF and PACFs against the lag length.

One way of accomplishing this is to consider the ACF AND PACF and the associates correlograms of a selected number of ARMA processes, such as AR(1), AR(2), MA(1), MA(2), ARMA (1,1), ARMA (2) and so on. Since each of these stochastic processes exhibits typical pattern of ACF and PACF, if the time series under study fits one of these patterns we can identify the time series with that process. Of course, we will have to apply diagnostic tests to find out if the chosen ARIMA model is reasonably accurate.

Note: Since in practice we do not observe the theoretical ACFs and PACFs and rely on their sample counterparts, the estimated ACFs and PACFs will not match exactly their theoretical counterparts.

Estimation

After identifying the appropriate values of p and q the next step is to estimate the parameters of the autoregressive and moving average terms included in the model. Sometime this calculation can be done by simple least squares' but sometimes we will have to resort to non linear (in parameter) estimation method.

Diagnostic checking

In this step we see the whether the chosen model fits the data reasonably well. One simple test of the chosen model is to see if the residuals estimated from this model white noise; if they are, we can accept the particular fit; if not, we start over thus the BJ Methodology is an iterative process.

Forecasting

One of the reasons for the popularity of the ARIMA modeling methodology is its success in forecasting.

To forecast the values of a time series, the basic BOX-JENKINS strategy is as fallows:

a. First examine the stationarity. This step can be done by computing the autocorrelation function (ACF) and partial autocorrelation (PACF) or by a normal root analysis.

b. If the time series is not stationary, difference it one or more times to achieve stationarity.

c. The ACF and PACF of the stationary time series are then computed to find out if the series is purely autoregressive or purely of the moving average type or a mixture of the two.

d. The tentative model is then estimated.

e. The residuals from this model are examined to find out if they are white noise. If they are, the tentative model is probably a good approximation to the underlying stochastic process. If they are not, the process is started all over again. Therefore, the BOX-JENKINS method is iterative.

The model finally selected can be used for forecasting.

3.5.7 Co -integration techniques

For examining integration between selected domestic markets as well as between the domestic and international markets, the present study adopted co integration technique. The co integration approach to market integration is intuitively appealing and straight forward in application. Integrated markets are those where prices are determined interdependently. This has generally been assumed to mean that the price changes in one market will be fully transmitted to the other markets. Markets that are not integrated may convey inaccurate price information that might distort marketing decisions and contribute to inefficient product movements.

Two series are said to be co-integrated when there exists a long run equilibrium relationship between them. In other words, two series cannot drift from one another in the long run. That is, there exists an equilibrium mechanism to bring the two series together. Applying this concept to any two given markets, co integration between their price series implies long run dependence between them. Since the very essence of market integration is the price dependence across markets, it follows that co integration between prices in two given markets implies integration of the markets.

To examine the price relation between two markets, the following basic relationship that is commonly used to test for the existence of market integration may be considered.

$$P_{it} = \alpha_0 + \alpha_1 P_{jt} + \varepsilon_t \quad \cdots\cdots\cdots\cdots\cdots \text{(25)}$$

Where P_i and P_j are price series of a specific commodity in two markets i and j. ε is the residual term assumed to be distributed identically and independently. The test of market integration is straight forward if p_i and p_j are stationary variables. Often, however, economic variables are non-stationary in which case the conventional tests are biased towards rejecting the null hypothesis. Thus, before proceeding to further analysis, it is important to check for the stationarity of the variables (Granger and Newbold, 1974).

Stationary series is defined as one whose parameters that describe the series (namely the mean, variance and autocorrelation) are independent of time; or rather exhibit constant mean and variance and have autocorrelation that are invariant through time. Once the non- stationarity status of the variables is determined, the next step is to test for the presence of co-integrating (long run equilibrium) relationship between the variables.

The augmented Dickey Fuller test (ADF test)) is used to determine the stationarity of a variable. The test is based on the Dickey Fuller value statistic of B_1 given by the following equation.

$$\Delta P_t = \beta_0 + \beta_1 P_{t-1} + \sum_{k=1}^{N} \delta_k \Delta P_{t-k} + \eta_t \quad \cdots\cdots\cdots\cdots\cdots\cdots \text{(26)}$$

Where,

$$\Delta P_t = P_t - P_{t-1}$$

The test statistic is simply the t statistic. However, under the null hypothesis, it is not distributed as student- t, but this ratio can be compared with critical values given in Dickey Fuller Table. In estimating Equation (27), the null hypothesis is Ho: P_t is I (1), which is rejected [in favour of I (0)] if β_1 is found to be negative and statistically significant. The above test can also be carried out for the first difference of the variables. That is, we estimate the following regression equation:

$$\Delta^2 P_t = \theta_0 + \theta_1 \Delta P_{t-1} + \sum_{k=1}^{N} \Phi_k \Delta^2 P_{t-k} + \mu_t \quad \text{……………. (27)}$$

Where the null hypothesis is Ho: P_t is I (2), which is rejected [in favour of I (1)] if θ_1 is found to be negative and statistically significant. In general, a series P_t is said to be integrated of order'd', if the series achieves stationarity after differencing d times, denoted $P_t \sim I(d)$. Consequently, if P_t is stationary after differencing once, this we may denote as $P_t \sim I(1)$.

Having established that the variables are non-stationary in level, we may then test for co integration. Only variables that are of the same order of integration may constitute a potential co-integrating relationship.

Alternative and quicker way of finding out whether the two price series are co-integrated is the Co-integrating Regression Durbin Watson (CRDW) test. In CRDW we use the Durbin Watson'd' obtained from the co-integrating regression. Here null hypothesis is d=0.

In the present study, integration between selected domestic markets as well as between the domestic and international markets was studied by using co integration technique for turmeric. For this analysis, monthly prices of each market were used for the period of ten years.

For this particular analysis statistical software called Eviews was used. EViews, which stands for Econometric Views, is a new version of a statistical package for manipulating time series data. It was originally the Time Series Processor (TSP) software for large mainframe computers. Although EViews was mostly formulated by economists, the program itself can also be used in other fields of study, such as sociology, statistics, finance, etc. EViews makes use of the user-friendly windows environment. In general, EViews can perform the Data Analysis and Evaluation, Regression, Forecasting and Simulation.

3.5.8 Direction of Trade

Annual export data for the period 1983-84 to 1994-95 and 1995-96 to 2009-10 were used to analyze the direction of trade and changing pattern of exports of turmeric during Pre-WTO and Post-WTO periods respectively. The major turmeric importing countries namely USA, UK, Iran, Japan and UAE were considered while rests of the countries in the world were considered as 'other' countries.

The trade directions of commodities exports were analyzed using the first order Markov chain approach. Central to Markov chain analysis is the estimation of the transitional probability matrix P. The elements P_{ij} of the matrix P indicates the probability that export will switch from country i to country j with the passage of time. The diagonal elements of the matrix measure the probability that the export share of a country will be retained. Hence, an examination of the diagonal elements indicates the loyalty of an importing country to a particular country's exports.

In the context of the current application, structural changes were treated as a random process with selected importing countries. The average exports to a particular country was considered to be a random variable which depends only on the past exports to that country, which can be denoted algebraically as

$$E_{jt} = \sum_{i=1}^{n} [Ei_{t-1}] P_{ij} + e_{jt} \quad \text{………………. (28)}$$

Where,

E_{jt} = Exports from India to j^{th} country during the year t.
E_{it-1} = Exports to i^{th} country during the period t-1.
P_{ij} = Probability that the exports will shift from i^{th} country to j^{th} country.
e_{jt} = The error term which is statistically independent of E_{it-1}.
t = Number of years considered for the analysis
r = Number of importing countries

The transitional probabilities P_{ij} which can be arranged in a (c * r) matrix have the following properties.

And $0 \le P_{Ij} \le 1$ $$\sum_{i=1}^{n} P_{Ij} = 1 \quad \text{………………. (29)}$$

Thus, the expected export shares of each country during period't' were obtained by multiplying the export to these countries in the previous period (t-1) with the transitional probability matrix.

To estimate the transitional probabilities of the Markov Chain Model, Minimum Absolute Deviations (MAD) estimation procedure was employed, which minimizes the sum of absolute deviations. The conventional Linear Programming Technique was used, as this satisfies the properties of transitional probabilities of non-negativity restrictions and row sum constraints in estimation.

The Linear Programming formulation is stated as

Min OP* + Ie ……………………… (30)

Subject to,

XP* + V = Y

z GP* = 1

$P^* \geq 0$

Where,

0 - is the vector of zeroes.

P* - is the vector in which probability P_{ij} are arranged.

I - is an apparently dimensioned vector of area.

E - is a vector of absolute error (1 U 1).

Y - is the vector of export to each country.

X - is the block diagonal matrix of lagged values of Y

V - is the vector of errors

G - is the grouping matrix to add the row elements of P arranged in P* to unity.

Using the estimated transitional probabilities, the exports of turmeric to various destinations were predicted by multiplying the same with the respective shares of base year. The values in the transitional probabilities matrix will have different interpretations. The value of diagonal elements indicates the probability of retention of the previous year values, while values in columns reveals probability of gain of a particular country from other countries, values in rows reveals probability that a country might lose to their countries in respect of a specific commodity exports. For this particular analysis software called LINGO was used.

3.5.9 Export competitiveness (Nominal Protection Coefficient-NPC)

Nominal Protection Coefficient (NPC) of Indian turmeric was estimated for the period (1983-84 to 2012-13) in order to examine its export competitiveness in the World market. Nominal Protection Coefficient is a straightforward measure of competitiveness. It is calculated as a ratio between the domestic prices to the International price of a comparable grades of commodity, adjusted for all the transfer costs such as freight, insurance, handling costs, margins, losses *etc.* If NPC is less than one, the commodity is competitive (under importable hypothesis it is considered a good import substitute and under exportable hypothesis it is worth exporting). If NPC is greater than one, the commodity is not competitive (not a good import substitute or not worth exporting).

NPC can be estimated under two main hypotheses *i.e.,* under importable hypothesis and exportable hypothesis. Under importable hypothesis the commodity in question *i.e.,* turmeric is regarded as an import substitute and it is imported and it competes with domestically produced commodity in domestic market. The transfer cost *i.e.*, the International and domestic transportation costs extend a sort of protection to the domestic commodity.

Under exportable hypothesis, the commodity in question is treated as exportable commodity and thus competes with internationally produced commodity at a foreign port. Therefore, the domestic commodity has to be extra efficient to the tune of international transportation costs at least.

In the present study nominal protection coefficient (NPC) was estimated under the exportable hypothesis. Under exportable hypothesis, Indian turmeric is assumed to compete with Vietnam, Netherlands and turmeric at European port. NPC calculated by using the formula,

$$NPC = \frac{P^D}{P^I} \quad \text{………………… (31)}$$

P^D and P^I are domestic price of turmeric and International price respectively.

Nominal protection coefficient, International reference price in case of exportable hypothesis was calculated as shown in Table 3.11.

Table 3.11: Calculation of Nominal Protection Coefficient (NPC) Under Exportable Hypothesis

Sl. No	Variable	Particulars	Place	Values (Rs/Qtl)
1	A1	Wholesale price in	Kochi	
2	A2	Transportation cost		
3	A3	Marketing margin @ 5 %		
4	A4	Port clearing & handling charges		
5	A5	Service charges		
6	A6	FOB Price(1+2+3+4+5)	Kochi	
7	A7	Freight charge		
8	A8	Insurance at 1% of price		
11	A9	Landed price (6+7+8)		
12	A10	FOB price	New York	
13	A11	NPC (row 11/row 12)		

3.5.10 Garrett ranking technique

The Garrett ranking technique was used to study the constraints faced by the turmeric growers in the selected districts.

Garrett ranking is applied to rank a set of items or factors as perceived by the sample respondents based on certain criteria. The order of merit assigned by the respondents was converted into scores using the formula.

$$\text{Per cent position} = \frac{100\,(R_{ij} - 0.5)}{N_j} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (32)$$

Where,

R_{ij} = The rank of the i th item by j th individual and

N_j = The number of items ranked by the j th individual.

By referring the Garrett's table, the per cent position estimated was converted into score. Then, for each factor the scores of various respondents were added and the mean score was calculated. The factor with the highest mean score was considered to be the most important factor.

3.6 Definition of terms and concepts used

3.6.1 Production aspects

A. Variable cost

Variable cost included the cost of human and bullock labour, cost of farm yard manure, fertilizer, plant protection chemicals and irrigation charges.

i) Labour cost

It was computed based on the actual wages paid by the producers (8 hours) in the study area for men, women and bullock pairs during the study period. The same wage rates were considered for imputing family labour.

ii) Bullock labour

It was measured in pair days. Here one pair means eight hours of work by a pair of bullocks and a person needed to operate the bullock pair.

iii) Cost of fertilizers, manures and plant protection chemicals

The cost of fertilizers, manures and plant protection chemicals were computed based on the actual prices paid by the growers.

iv) Interest on working capital

Interest on working capital was charged at the rate of 7 per cent per annum, which was the rate at which the farmers obtain short term loans.

3) Fixed cost

Fixed costs included interest on fixed capital, the land revenue, depreciation cost and rental value of owned land.

i) Interest on Fixed Capital

Interest on fixed capital was calculated at the rate of 9 per cent, based on the prevailing bank rate for long-term investments.

ii) Depreciation Cost

Depreciation on each capital equipment and machinery owned by the farmers and used for cultivation of land was calculated for individual farmer based on the purchase value using the straight line method.

$$\text{Annual depreciation} = \frac{\text{Purchase value – Junk value}}{\text{Economic life of the asset}}$$

iii) Land Revenue

Land revenue paid by the farmers during the current year was considered for this study.

iv) Land Rent

Rental value of land was imputed at the prevailing land rent per hectare per annum in the study area.

3.6.2 Marketing aspects

Marketing costs

Marketing cost is the cost incurred on packaging material, cleaning, grading, sorting, loading and unloading, storage and transportation *etc.*, paid in marketing the produce. It is the actual expenses incurred in bringing goods by the producer from the farm gate to the consumer.

3.6.2.1 Marketing Cost of the Producer Seller (MCP)

These costs included cost of packages and packing charges, loading and unloading charges, transportation cost, market fee and miscellaneous expenses.

3.6.2.2. Transaction Costs of the Wholesaler (TCWS)

These costs comprised storage cost, storage loss, transportation cost, loading and unloading charges, labour cost and miscellaneous charges including electricity and telephone charges.

3.6.3 Market functionaries (intermediaries)

3.6.3.1 Commission agent

Commission agent is a person who operates in the regulated market on behalf of producer-seller and purchasers (wholesale trader/ ginner). He receives commission (from purchaser) at a fixed rate on the amount involved in each transaction and is responsible for disbursement in each transaction, sales proceeds (To seller) received from buyers. Commission charges are usually paid in cash and vary from market to market.

3.6.3.2 Wholesaler (W.S)

Wholesalers are professional buyers. He purchases from the producer in large quantities and sells it to the retailer. The wholesaler is involved in buying and selling of the commodities in bulk at the wholesale market and is the first agency to receive the produce when it arrives in the market.

3.6.3.3 Retailers

Retailers sell the turmeric directly to consumer in the market. They purchase the produce from wholesaler.

3.6.3.4 Marketing channels

These are the routes through which the product flows from the producers to the consumers. The channels followed in the sale of turmeric in the study area are as follows:

1. Channel-I*:* Producer → Commission agent → Wholesalers →Retailer → Consumers
2. Channel-II : Producer → Distant market commission agent
3. Channel-III : Producer → TAPCMS
4. Channel-IV: Producer → Commission agent →Processers

3.6.4 Prices

Wholesale Price (WSP)

This was the price at which the wholesaler sold the produce to the retailer.

Retail Price (R.P)

It was the price at which the retailer sold the produce to the final consumer.

Producer's Net Price (PNP)

This is the difference between the price received (PR) and the cost incurred (MC) by the producer – seller.

$$PNP = PR - MC$$

Producer's share in the consumer's rupee (PSCR)

Producer's net price (PNP) expressed as a percentage of the retail price (RP) is defined as producer's share in the consumer's rupee.

$$PSCR = (PNP / RP) \times 100$$

Marketing margins

Margin refers to the difference between the price paid and received by a specific marketing agency such as a single retailer, or by any type of marketing agency, *i.e.* retailers or wholesalers or by any combination of marketing agencies in the marketing system as a whole.

Marketing efficiency

Marketing efficiency was estimated by using Shephard's formula,

$$ME = (V/I) - 1$$

Where,

ME= Index of marketing efficiency

V= Consumer price

I= Total marketing cost

RESULTS

Keeping in view the objectives, the data pertinent to the present study were elicited from various sources and analysed using appropriate techniques. The results of the analysis are presented in this chapter under the following headings.

4.1 Growth and instability in area, production and productivity of turmeric

4.2 Production performance of turmeric

4.3 Allocative and technical efficiency in turmeric production

4.4 Marketing channels for turmeric

4.5 Trend in arrivals and prices of turmeric and prediction of the future prices

4.6 Export performance of turmeric

4.7 Market integration

4.8 Production and post harvest constraints in turmeric production

4.1 Growth and instability in area, production and productivity of turmeric

The compound growth rates (used as growth rates hereafter) of area, production and productivity of turmeric in India and Karnataka during the period from 1974-75 to 2010-11 and 1979-80 to 2010-11 respectively were computed. Similarly for the selected districts the analysis was done for the period from 1998-99 to 2010-11.

4.1.1 India

The growth rate and instability index of area, production and productivity of turmeric in India is presented in Table 4.1. Perusal of the table revealed that, during pre-WTO period the growth rates in area, production and productivity of turmeric were 3.45 per cent, 8.09 per cent and 4. 48 per cent respectively with an average value of 104971 ha area, 299486 tonnes of production and 2688 kg/ha productivity and found to be significant at one per cent level of significance. Whereas, in the post-WTO period the growth rates of area, production and productivity of turmeric were 1.99 per cent, 3.96 per cent and 1.94 per cent respectively with an average value of 163806 ha area, 686337 tonnes of production and 4165 kg/ha productivity and found significant at one per cent level of significance. In the overall period (1974-75 to 2010-11) the growth rates in area, production and productivity of turmeric were 2.65 per cent, 5.60 per cent and 2.88 per cent respectively with an average value of 130414 ha area, 466773 tonnes of production and 3327 kg/ha productivity and found significant at one per cent level of significance.

The instability index was worked out for turmeric area, production and productivity in India for the three periods to analyse the extent of variability. It was observed from the table that, the instability index for area during post-WTO period (7.26%) was lower compared to pre-WTO period (7.92%) and overall period (8.24%). Instability index for production of turmeric was also lower in post-WTO period (10.37%) than both pre-WTO period (18.64%) and overall period (16.52%). Similarly the instability index for yield of turmeric in post-WTO period (9.57%) was lower than both pre-WTO period (12.44%) and overall period (12.51%).

4.1.2 Karnataka

The growth rate and instability index of area, production and productivity of turmeric in Karnataka has been presented in Table 4.2. It could be seen from the table that, during pre-WTO period (1979-80 to 1994-95) the area under turmeric was growing at the rate of 5.26 per cent per annum, production was growing at the rate of 15.36 per cent per annum and yield was growing at the rate of 9.54 per cent with an average value of 3388 ha area, 30149 tonnes of production and 7891 kg/ha productivity and found significant at one per cent level of significance. Whereas, in the post-WTO (1995-96 to 2010-11) the growth rates of area, production and productivity of turmeric were 9.31 per cent, 11.93 per cent and 2.27 per cent respectively with an average value of 8906 ha area, 53849 tonnes of production and 5405 kg/ha productivity and found significant at one per cent level of significance except the productivity growth being significant at 5 per cent level. In the overall period (1979-80 to 2010-11) the growth rates in area, production and productivity of turmeric were 5.92 per cent, 6.35 per cent and 0.47 per cent respectively with an average value of 6147 ha area, 41999 tonnes of production and 6648 kg/ha productivity and found significant at one per cent level of significance except the productivity growth being non-significant.

From the same table it could be seen that, the instability index for area during pre-WTO period (15.88%) was lower compared to post-WTO period (40.52%) and overall period (37.21%). Similarly instability index for production of turmeric was also lower in pre-WTO period (54.54%) than both post-WTO period (69.00%) and overall period (79.04%). Whereas, the instability index for yield of turmeric in post-WTO period (24.18%) was lower than both pre-WTO period (51.53%) and overall period (63.45%).

4.1.3 Selected districts

The growth rate and instability index of area, production and productivity of turmeric in the selected districts for the period 1998-99 to 2010-11 are presented in Table 4.3.

It is evident from the table that in Chamarajanagar district the growth rate in area and production showed significant positive growth rate of 13.59 per cent and 12.47 per cent respectively, whereas growth rate of productivity was negative (-0.98%) with an average value of 4913 ha area, 26377 tonnes of production and 5321 kg/ha productivity. With respect to instability index, it was found higher in production (46.48%) than area (35.56%) and productivity (15.25%).

In the case of Mysore district, the growth rate in area, production and productivity were 16.66 per cent, 25.74 per cent and 7.78 per cent respectively with an average value of 1244 ha area, 11346 tonnes of production and 5600 kg/ha productivity and found significant at one per cent level of significance. The instability index was higher in the case of production (143.71%) than area (85.94%) and productivity (40.78%).

Similarly in Bagalkot also the area, production and productivity were growing at the rate of 24.92 per cent, 33.70 per cent and 7.03 per cent respectively with an average value of 1057 ha area, 10574 tonnes of production and 7739 kg/ha productivity and instability also higher in the case of production (73.56%) than area (60.22%) and productivity (31.05%).

Whereas, in the case of Belgaum district, the area under turmeric was declining at the rate of 1.26 per cent per annum and production and productivity were growing marginally at the rate of 1.10 per cent and 2.40 per cent per annum respectively with an average value of 1525 ha area, 6792 tonnes of production and 4665 kg/ha productivity. The instability index was higher for production (54.75%) than area (47.76%) and productivity (34.96%). All the values of growth rate are non-significant.

4.1.4 Components of change in average turmeric production

To estimate the variability in production of turmeric in India and Karnataka, two periods were considered. The periods 1974-75 to 1994-95 (pre-WTO) and 1995-96 to 2010-11 (post-WTO) periods in the case of India and 1979-80 to 1994-95 (pre-WTO) and 1995-96 to 2010 -11 (post-WTO) periods in the case of Karnataka were considered. The components of change in average production during the post-WTO period over the pre-WTO period was analysed to identify the contribution of different sources to the change in mean production of turmeric and the results were presented in Table 4.4.

In the case of Karnataka, the variation in average production of turmeric was due to change in mean yield, change in mean area, interaction between changes in mean area and mean yield and change in yield and area co-variance which were accounted for -22.17 per cent, 122.95 per cent, -2.77 per cent and -0.43 per cent respectively. Thus change in the mean area was found to be the dominant source of output growth in the state.

In the case of India, the variation in average production of turmeric was due to change in mean yield, change in mean area, interaction between changes in mean area and mean yield and change in yield and area co-variance which were accounted for 58.39 per cent, 39.45 per cent, 2.55 per cent and -0.28 per cent respectively. Thus the change in mean yield was found to be the dominant source of output growth in the country.

4.1.5 Sources of change in the variance of average turmeric production

The sources of change in variance in turmeric production between the post-WTO period and the pre-WTO period for turmeric are presented in Table 4.5.

Perusal of the table revealed that, in the case of Karnataka, change in yield variance accounted for 79.95 per cent, change in residuals (75.83%), interaction between changes in mean area and yield variance (21.23%), change in area yield co-variance (18.66%), interaction between changes in mean area and mean yield and change in yield co-variance (1.87%), interaction between changes in mean yield and area variance (0.98%) and interaction between change in mean yield and mean area (0.13%) accounted positively to change in variance of turmeric production. On the contrary change in mean yield (-47.19%), change in mean area (-28.92%) and change in area variance (-22.55%) contributed to the reduction in variance of production in the state.

In the case of India, change in residuals contributed 47.30 per cent, change in yield variance (43.07%), change in the area yield co-variance (31.06%), change in area variance (12.14%), interaction between changes in mean area and yield variance (3.85%), interaction between change in mean area and yield and change in area yield co-variance (3.46%) and interaction between changes in mean yield area variance (1.62%) contributed positively to the change in variance of production. Whereas, change in mean yield (-36.69%), change in mean yield and mean area (-0.10%) accounted for the decline in the variance of production in the country.

4.2 Production performance of turmeric

The production performance of turmeric in the study area has been detailed under the important heads as under.

4.2.1 General characteristics of sample farmers

An understanding of general characters of the sample farmers is expected to provide a bird's eye view of the general features prevailing in the study area. Therefore, an attempt has been made in the study to analyze some of the important characters of the sample farmers. The general characters of the respondents are presented in Table 4.6.

The results revealed that, the average age of the sample farmers was higher in case of Bagalkot district (47 years) followed by Belgaum (46 years), Chamarajanagar (44 years) and Mysore (42 years) district. With respect to education level of the sample farmers, in Mysore district 22.92 per cent of the farmers were illiterate followed by Belgaum (14.58%), Bagalkot (10.42%) and Chamarajanagar (6.25%) districts. Whereas, in Bagalkot district 52.08 per cent of the sample farmers were having their education level up to primary only, followed by Chamarajanagar (50%), Belgaum (43.75%) and Mysore (20.83%) district. On an average 37.50 per cent of the sample farmers in Mysore district had their education up to high school level followed by Belgaum (29.71%), Chamarajanagar (29.17%) and Bagalkot (20.83%) district and finally 18.75 per cent of Mysore district farmers were having their education up to college level and above followed by Bagalkot (16.67%), Chamarajanagar (14.58%) and Belgaum (12.50%) districts.

It could be further seen that, occupation wise in all the selected districts the sample farmers were practicing agriculture as their main occupation. This was found to be highest in the case of Bagalkot district (87.50%) followed by Chamarajanagar (83.33%), Belgaum (79.17%) and Mysore (75%) district and rest of the sample farmers were opined that they were practicing agriculture as subsidiary occupation. The average size of the family was 8 in Chamarajanagar district sample farmers followed by Belgaum and Mysore (7) and Bagalkot (6) districts. With respect to land holding, the average holding size of irrigated area was found to be higher in the case of Belgaum (9.40 acres) as compared to Bagalkot (8.59 acres), Chamarajanagar (6.90 acres) and Mysore (5.20 acres) district. Whereas, the average rainfed holding was found to be the highest in the case of Chamarajanagar (2.40 acres) followed by Mysore (2.20 acres), but none of the farmers had rainfed area in Bagalkot and Belgaum districts. The average size of holding was the highest in Belgaum (9.40 acres) followed by Chamarajanagar (9.30 acres), Bagalkot (8.59 acres) and Mysore (7.40 acres) district of which the average area under turmeric was 1.70 acres, 1.80 acres, 1.60 acres and 1.52 acres respectively.

4.2.2 Cropping pattern and major crops grown

Cropping pattern of the sample farmers given in the Table 4.7 indicated that, all the four districts have grown variety of the crops in all the three seasons.

Chamarajanagar

In Chamarajanagar district, during Kharif season, paddy occupied 9.95 per cent of the gross cropped area, followed by maize (9.86%), cotton (7.98%), ragi (6.38%), groundnut (2.63%), onion (1.22%) and other crops (0.75%). In rabi season, sorghum occupied 5.16 per cent of the gross cropped area followed by sunflower (3.38%) and chickpea (1.03%). In summer season, maize occupied 3.00 per cent of the gross cropped area followed by vegetables (0.47%). In the case of annual crops sugarcane was the major crop which occupied 19.06 per cent of the gross cropped area followed by turmeric (16.90%). The perennial crops include mango (6.76%), coconut (2.82%) and others (2.63%). The gross cropped area was 10.65 acres with a cropping intensity of 114.52 per cent.

Mysore

Similarly in the case of Mysore district the sample farmers were growing variety of crops in all the seasons. It could be seen from the table that, during Kharif season, paddy was the major crop which occupied 12.04 per cent of the gross cropped area followed by maize (10.86%), other crops (9.89%), ragi (7.63%), groundnut (1.29%), onion (1.18%) and cotton (1.08%). In rabi season, sunflower was the major one which accounted for 6.56 per cent of the gross cropped area followed by sorghum (5.48%) and chickpea (3.76%). Maize was the major crop in summer season (2.37%) followed by vegetables (0.97%). The major annual crops in the district were sugarcane (11.29%) and turmeric (16.34%). The major perennial crops in the district were coconut (4.52%), mango (1.29%) and others (3.44%). The gross cropped area was 9.30 acres with a cropping intensity of 125.68 per cent.

Bagalkot

In Bagalkot district the major crop grown during Kharif season by sample farmers was maize as it occupied 10.02 per cent of the gross cropped area followed by Soybean (7.24%), groundnut (5.97%), onion (2.47%) and others (2.23%). During rabi season, sorghum occupied highest (8.19%) share of the gross cropped area, followed by chickpea (7.72%), wheat (6.44%) and sunflower (4.22%). Again maize (7.80%) occupied the highest area during summer season followed by vegetables (1.03%). The major annual crops grown in the district were sugarcane (21.64%) and turmeric (12.73%). In the case of perennial crops pomegranate occupied 1.27 per cent of the gross cropped area followed by others (0.88%) and mango (0.16%). The gross cropped area was 12.57 acres with a cropping intensity of 146.33 per cent.

Belgaum

In the case of Belgaum district the major crops grown during Kharif season by the sample farmers were maize, which occupied 8.66 per cent of the gross cropped area followed by soybean (7.57%), ground nut (6.65%), cotton (4.10%), onion (3.55%) and others (1.39%). During rabi season, sorghum was the major crop as it occupied 8.27 per cent of the gross cropped area followed by wheat (6.72%), chickpea (4.48%) and sunflower (3.01%). During summer season maize occupied 6.96 per cent of the gross cropped area followed by vegetables (4.10%). Sugarcane and turmeric were the only annual crops grown by the sample farmers in the district with a share of 18.39 per cent and 13.14 per cent respectively of the gross cropped area. Mango was the major perennial crop grown as it occupied 2.16 per cent of the gross cropped area followed by others (0.85%). The gross cropped area of the sample farmers was 12.94 acres and cropping intensity was 137.66 per cent.

4.2.3 Labour use pattern in the production of turmeric in the selected districts

The quantity of labour used, costs involved in different operations of turmeric production for an acre of land area are presented in the Tables 4.8, 4.9, 4.10 and 4.11.

Chamarajanagar

It could be seen from the Table 4.8 that, for ploughing and harrowing about 3 and 5 hours of machine labour were used respectively for an acre while for transportation of FYM about 5 trips of machine were used. The maximum cost involved was harrowing (₹2505) followed by ploughing (₹1534) and transportation of FYM (₹1314).

The per acre total human labour utilised was 98 mandays with a cost of ₹16017, which included weeding operation that required 34 mandays followed by irrigation (22 mandays), harvesting (15 mandays), planting (13 mandays), loading and spreading of FYM (6 mandays), seed bed preparation (4 mandays), spraying of plant protection chemicals (3 mandays) and fertilizer application (3 mandays) with cost of ₹ 5050, ₹ 4333, ₹ 2177, ₹ 1978, ₹ 890, ₹ 630, ₹ 608 and ₹ 350 respectively.

In the case of bullock labour, the total bullock labour utilised was 3 pair days with a total cost of ₹ 1389, in that for intercultivation operation and seed bed preparation 2 and 1 pair days of bullock labour was utilised respectively with a cost of ₹ 989 and ₹ 400 respectively.

Table 4.1: Compound growth rates and instability in area, production and productivity of Indian turmeric

Period	Compound growth rate (Per cent)			Instability index (Per cent)		
	Area (Ha)	Production (Tonnes)	Yield (Kg/ha)	Area	Production	Yield
Pre-WTO period (1974-75 to 1994-95)	3.45** (104971)	8.09** (299486)	4.48** (2688)	7.92	18.64	12.44
Post-WTO period (1995-96 to 2010-11)	1.99** (163806)	3.96** (686337)	1.94** (4165)	7.26	10.37	9.57
Overall period (1974-75 to 2010-11)	2.65** (130414)	5.60** (466773)	2.88** (3327)	8.24	16.52	12.51

*Note: ** Denote significant at 1 per cent level*
Figures in the parentheses indicate the average of respective years

Table 4.2: Compound growth rates and instability in area, production and productivity of turmeric in Karnataka

Period	Compound growth rate (Per cent)			Instability index (Per cent)		
	Area (Ha)	Production (Tonnes)	Yield (Kg/ha)	Area	Production	Yield
Pre-WTO period (1979-80 to 1994-95)	5.26** (3388)	15.36** (30149)	9.54** (7891)	15.88	54.54	51.53
Post-WTO period (1995-96 to 2010-11)	9.31** (8906)	11.93** (53849)	2.27* (5405)	40.52	69.00	24.18
Overall period (1979-80 to 2010-11)	5.92** (6147)	6.35** (41999)	0.47 (6648)	37.21	79.04	63.45

*Note: **,* Denote significant at 1 and 5 per cent levels respectively*
Figures in the parentheses indicate the average of respective years

Table 4.3: Compound growth rates and instability in area, production and productivity of turmeric in selected districts of Karnataka (1998-99 to 2010-11)

Districts	Compound growth rate (Per cent)			Instability index (Per cent)		
	Area (Ha)	Production (Tonnes)	Yield (Kg/ha)	Area	Production	Yield
Chamarajanagar	13.59** (4913)	12.47** (26377)	-0.98 (5321)	35.56	46.48	15.25
Mysore	16.66** (1244)	25.74** (11346)	7.78** (5600)	85.94	143.71	40.78
Bagalkot	24.92** (1057)	33.70** (10574)	7.03** (7739)	60.22	73.56	31.05
Belgaum	-1.26 (1525)	1.10 (6792)	2.40 (4665)	47.76	54.75	34.96

*Note: ** Denote significant at 1 per cent level*
Figures in the parentheses indicate the average values

Table 4.4: Components of change in average turmeric production in India and Karnataka

Sl. No	Components of Change	Karnataka	India
1	Change in Mean yield	-1.56 (-22.17)	5.86 (58.39)
2	Change in Mean Area	8.86 (122.95)	3.96 (39.45)
3	Interaction between Changes in mean area and mean yield	-0.19 (-2.77)	0.26 (2.55)
4	Change in yield and area covariance	-0.03 (-0.43)	-0.03 (-0.28)
5	Total	7.04 (100.00)	10.04 (100.00)

Note: Figures in the parentheses indicate percentages

Table 4.5: Sources of change in the variance of average turmeric production in India and Karnataka

(Per cent)

Sl. No	Components of Change	Karnataka	India
1	Change in mean yield	-47.19	-36.69
2	Change in mean area	-28.92	-5.71
3	Change in yield Variance	79.95	43.07
4	Change in area variance	-22.55	12.14
5	Interaction between changes in mean yield and mean area	0.13	-0.10
6	Change in area and yield covariance	18.66	31.06
7	Interaction between changes in mean area and yield variance	21.23	3.85
8	Interaction between changes in mean yield and area variance	0.98	1.62
9	Interaction between changes in mean area and yield and change in area-yield covariance	1.87	3.46
10	Change in residual	75.83	47.30
11	**Total**	**100.00**	**100.00**

Table 4.6: General characteristics of sample farmers in the selected districts

Sl. No	Particulars	Unit	Districts			
			Chamarajanagar (n=48)	Mysore (n=48)	Bagalkot (n=48)	Belgaum (n=48)
1	Age	Years	44	42	47	46
2	Education					
a.	Illiterate	No.	3 (6.25)	11 (22.92)	5 (10.42)	7 (14.58)
b.	Primary	No.	24 (50.00)	10 (20.83)	25 (52.08)	21 (43.75)
c.	High school	No.	14 (29.17)	18 (37.50)	10 (20.83)	14 (29.71)
d.	College	No.	7 (14.58)	9 (18.75)	8 (16.67)	6 (12.50)
3	Occupation					
a.	Agriculture as main occupation	No.	40 (83.33)	36 (75.00)	42 (87.50)	38 (79.17)
b.	Agriculture as subsidiary occupation	No.	8 (16.67)	12 (25.00)	6 (12.50)	10 (20.83)
4	Family size	No.	8	7	6	7
5	Land holdings					
a.	Irrigated	Acres	6.90	5.20	8.59	9.40
b.	Rainfed	Acres	2.40	2.20	-	-
	Total	Acres	9.30	7.40	8.59	9.40
6	Average area under turmeric	Acres	1.80	1.52	1.60	1.70

Note: Figures in the parentheses indicate percentages of total sample farmers.

Table 4.7: Cropping pattern of the sample farmers in the selected districts

(Acers)

Crops/season	Districts							
	Chamarajanagar		Mysore		Bagalkot		Belgaum	
	Area	Per cent	Area	Per cent	Area	Per cent	Area	Per cent
Kharif								
Maize	1.05	9.86	1.01	10.86	1.26	10.02	1.12	8.66
Soybean	-	-	-		0.91	7.24	0.98	7.57
Ground nut	0.28	2.63	0.12	1.29	0.75	5.97	0.86	6.65
Paddy	1.06	9.95	1.12	12.04	-	-	-	-
Ragi	0.68	6.38	0.71	7.63	-	-	-	-
Onion	0.13	1.22	0.11	1.18	0.31	2.47	0.46	3.55
Cotton	0.85	7.98	0.10	1.08	-	-	0.53	4.10
Others	0.08	0.75	0.92	9.89	0.28	2.23	0.18	1.39
Sub total	4.13	38.78	4.09	43.98	3.51	27.92	4.13	31.92
Rabi								
Wheat	-	-	-	-	0.81	6.44	0.87	6.72
Sorghum	0.55	5.16	0.51	5.48	1.03	8.19	1.07	8.27
Chickpea	0.11	1.03	0.35	3.76	0.97	7.72	0.58	4.48
Sunflower	0.36	3.38	0.61	6.56	0.53	4.22	0.39	3.01
Sub total	1.02	9.58	1.47	15.81	3.34	26.57	2.91	22.49
Crops/season	**Districts**							
	Chamarajanagar		**Mysore**		**Bagalkot**		**Belgaum**	
	Area	Per cent	Area	Per cent	Area	Per cent	Area	Per cent
Summer								
Maize	0.32	3.00	0.22	2.37	0.98	7.80	0.90	6.96
Vegetables	0.05	0.47	0.09	0.97	0.13	1.03	0.53	4.10
Sub total	0.37	3.47	0.31	3.33	1.11	8.83	1.43	11.05
Annual crops								
Sugarcane	2.03	19.06	1.05	11.29	2.72	21.64	2.38	18.39
Turmeric	1.80	16.90	1.52	16.34	1.60	12.73	1.70	13.14
Sub total	3.83	35.96	2.57	27.63	4.32	34.37	4.08	31.53
Perennial crops								
Mango	0.72	6.76	0.12	1.29	0.02	0.16	0.28	2.16
Coconut	0.30	2.82	0.42	4.52	-	-	-	-
Pomegranate	-	-	-		0.16	1.27	-	-
Others	0.28	2.63	0.32	3.44	0.11	0.88	0.11	0.85
Sub total	1.30	12.21	0.86	9.25	0.29	2.31	0.39	3.01
Gross cropped area	**10.65**	**100.00**	**9.30**	**100.00**	**12.57**	**100.00**	**12.94**	**100.00**
Size of land holding	**9.30**	**-**	**7.40**	**-**	**8.59**	**-**	**9.40**	**-**
Cropping intensity (%)	**114.52**	**-**	**125.68**	**-**	**146.33**	**-**	**137.66**	**-**

Table 4.8: Labour use pattern in the production of turmeric in Chamarajanagar district

(Per acre)

Sl. No	Particulars	Human labour		Bullock labour		Machine labour	
		Mandays (No)	Cost (₹)	Pair days (No)	Cost (₹)	Machine hours (No)	Cost (₹)
1	Ploughing	-	-	-	-	3	1534
2	Harrowing	-	-	-	-	5	2505
3	Loading, transportation and spreading of FYM	6	890	-	-	5	1314
4	Seed bed preparation	4	630	1	400	-	-
5	Planting	13	1978	-	-	-	-
6	Fertilizer application	3	350	-	-	-	-
7	Weeding	34	5050	-	-	-	-
8	Inter cultivation	-	-	2	989	-	-
9	PPC application	3	608	-	-	-	-
10	Irrigation	22	4333	-	-	-	-
10	Harvesting	15	2177	-	-	-	-
	Total	**98**	**16017**	**3**	**1389**	**13**	**5354**

Mysore

Perusal of the Table 4.9 revealed that, for ploughing and harrowing about 3 and 6 hours of machine labour were used respectively for an acre, for transportation of FYM about 4 trips of machine were used. The maximum cost involved was harrowing (₹ 2964) followed by ploughing (₹ 1682) and transportation of FYM (₹ 1113).

The per acre total human labour utilised was 98 mandays with a cost of ₹ 18065, in that weeding operation required 34 mandays followed by irrigation (23 mandays), harvesting (15 mandays), planting (13 mandays), loading and spreading of FYM (5 mandays), seed bed preparation (4 mandays), spraying of plant protection chemicals (3 mandays) and fertilizer application (2.00 mandays) with cost of ₹ 5848, ₹ 4776, ₹ 2549, ₹ 2274, ₹ 865, ₹ 726 ₹ 602 and ₹ 425 respectively.

In the case of bullock labour, the total bullock labour utilised was 4 pair days with a total cost of ₹ 1848, in that for intercultivation operation and seed bed preparation 3 and 1 pair days of bullock labour was utilised respectively with a cost of ₹ 1323 and ₹ 525 respectively.

Bagalkot

Per acre utilization of labour is presented in Table 4.10. It is evident from the table that, total human labour utilised was 99 mandays with a cost of ₹ 17677. Weeding required higher proportion of total human labour days (33 mandays) followed by irrigation (22 mandays), harvesting (16 mandays), planting (15 mandays), loading and spreading of FYM (5 mandays), seed bed preparation (3 mandays), fertilizer application and spraying of plant protection chemicals (2 mandays) each with cost of ₹ 5469, ₹ 4623, ₹ 2720, ₹ 2548, ₹ 923, ₹ 600, ₹ 400 and ₹ 395 respectively.

Ploughing and harrowing operations required about 3 and 4 hours of machine labour respectively for an acre, for transportation of FYM about 5 trips of machine were used. The maximum cost involved was harrowing (₹2182) followed by ploughing (₹1651) and transportation of FYM (₹1104).

The total bullock labour utilised was 3 pair days with cost of ₹1842. Intercultivation operation required higher proportion in that *i.e.,* 2 pair days with a cost of ₹ 1292 and seed bed preparation required 1 pair days with a cost of ₹ 550.

Belgaum

It could be seen from the Table 4.11 that, the total human labour utilised for the cultivation of one acre of turmeric in the district were 100 mandays with a cost of ₹16507. The weeding operation consumes higher proportion of human labour (34 mandays) followed by irrigation (23 mandays), harvesting (16 mandays), planting (14 mandays), loading and spreading of FYM (6 mandays), seed bed preparation (3 mandays), spraying of plant protection chemicals (3 mandays) and fertilizer application (2 mandays) with cost of ₹ 5197, ₹ 4431, ₹2447, ₹ 2203, ₹ 879, ₹ 478, ₹ 522 and ₹ 351 respectively.

The total bullock labour utilised was 3 pair days with cost of ₹1594. Intercultivation operation required higher proportion in that *i.e.,* 2 pair days with a cost of ₹ 1094 and seed bed preparation required 1 pairday with a cost of ₹ 500.

Ploughing and harrowing operations required about 4 and 5 hours of machine labour respectively for an acre, for transportation of FYM about 4 trips of machine were used. The maximum cost involved was harrowing (₹ 2551) followed by ploughing (₹1836) and transportation of FYM (₹ 925).

4.2.4 Input use pattern and output obtained in turmeric cultivation

Table 4.12 gives the per acre utilization of different inputs and output realized by the sample farmers in the selected districts. The different inputs utilized were planting material, human labour, bullock labour, machine labour, farm yard manure (FYM), fertilizers and plant protection chemicals.

Chamarajanagar

It could be seen from the table that, the average per acre utilization of the planting material in the district was 9.29 quintals. The farmers used 98 mandays of human labour, 3 pair days of bullock labour and 13 hours of machine labour in the cultivation of turmeric. Application of FYM was 5 tractor loads and that of different chemical fertilizers include DAP, urea and potash were 85 kg, 63 kg and 58 kg respectively. On an average the cost of plant protection chemicals was ₹ 3209. The output realized in the district was 26.52 quintal of finger as main product and 9.31 quintal of mother rhizome as by-product.

Mysore

Similarly in the Mysore district, sample farmers used on an average 9.35 quintal of planting material per acre. The farmers used 98 mandays of human labour, 4 pair days of bullock labour and 14 hours of machine labour in the cultivation of turmeric. They applied 4 tractor loads of FYM, 91 kg DAP, 61 kg urea and 53 kg potash. The average cost on usage of plant protection chemicals was ₹ 2715 and per acre output realized was 26.69 quintal of main product and 8.66 quintal of by-product.

Bagalkot

Further it could be seen from the table that, in Bagalkot district farmers used 10.40 quintals of planting material per acre, 99 mandays of human labour, 3 pair days of bullock labour and 12 hours of machine labour in the cultivation of turmeric, application of FYM was to the tune of 5 tractor loads and 93 kg DAP, 73 kg urea and 56 kg potash. The cost on usage of plant protection chemicals was ₹ 2561. On an average they got 27.72 quintal of finger and 9.27 quintal of mother rhizome.

Belgaum

The usage of planting material in the district was 9.83 quintal per acre; the farmers used 100 mandays of human labour, 3 pair days of bullock labour and 13 hours of machine labour in the cultivation of turmeric.The farmers applied 4 tractor loads of FYM, 107 kg DAP, 76 kg urea and 59 kg potash and the cost of plant protection chemicals was ₹ 3078. The output realized by the sample farmers was 25.68 quintal of main product and 9.23 quintal of by-product.

4.2.5 Cost of cultivation of turmeric

The per acre cost of cultivation of turmeric in the selected districts is presented in the Table 4.13. Perusal of the table indicated that, in all the districts variable costs accounted for a major share in the total cost of cultivation. The variable costs mainly comprised of cost of human labour, bullock labour, planting material, FYM, fertilizers and plant protection chemicals.

Chamarajanagar

In Chamarajanagar district, the per acre average cost of cultivation of turmeric was ₹ 77263, in that cost of planting material, cost of human labour and cost of FYM were having the major share, which were ₹ 29439, ₹ 16017 and ₹ 10165 accounting for 38.10 per cent, 20.73 per cent and 13.16 per cent respectively. The expenditure on the planting material was found to be an important item in the total cost of cultivation of turmeric. The other variable cost items such as cost of bullock labour, cost of machine labour, cost of fertilizers, cost of plant protection chemicals and interest on working capital accounting for 1.80 per cent (₹ 1389), 6.93 per cent (₹5354), 2.56 per cent (₹ 1980), 4.15 per cent (₹3209) and 6.99 per cent (₹ 5404) of the total cost of cultivation of turmeric respectively.

The share of fixed costs in the total cost of cultivation was 5.57 per cent (₹ 4307). Among the items of fixed costs, the rental value of land (3.88%) had a maximum share in the total cost of cultivation followed by depreciation charges (1.12%), interest on fixed capital (0.55%) and land revenue (0.02%).

Mysore

It could be seen from the table that, the total cost of cultivation of turmeric was ₹ 76985 per acre. The share of the variable cost was ₹ 72564, in that cost of planting material, cost of human labour, and cost of FYM were having the major share, which were ₹ 29123, ₹ 18065 and ₹ 7720 accounting for 37.83 per cent, 23.47 per cent and 10.03 per cent respectively. The expenditure on the planting material found to be an important item in the total cost of cultivation of turmeric. The other variable cost items such as cost of bullock labour, cost of machine labour, cost of fertilizers, cost of plant protection chemicals and interest on working capital accounting for 2.40 per cent (₹ 1848), 7.48 per cent (₹ 5758), 2.55 per cent (₹ 1961), 3.53 per cent (₹ 2715) and 6.98 per cent (₹ 5375) of the total cost of cultivation of turmeric respectively.

The total fixed costs in the cultivation turmeric was ₹ 4420, in that again rental value of the land was the main cost item which accounts for 3.97 per cent of the total cost of cultivation (₹ 3060) followed by depreciation charges (1.18%), interest on fixed capital (0.57%) and land revenue (0.02%).

Bagalkot

In Bagalkot district the total cost of cultivation of turmeric was ₹ 82949 per acre, in that variable costs account for ₹ 78192 and fixed costs accounts for ₹ 4756 with an share of 94.27 per cent and 5.73per cent respectively. Among the different variable cost items, cost of planting material, cost of human labour, cost of FYM were having the major share, which were ₹ 34031, ₹ 17677 and ₹ 10003 accounting for 41.03 per cent, 21.31 per cent and 12.06 per cent respectively. The other variable cost items such as cost of bullock labour, cost of machine labour, cost of fertilizers, cost of plant protection chemicals and interest on working capital accounting for 2.22 per cent (₹ 1842), 5.95

per cent (₹ 4938), 2.44 per cent (₹ 2025), 3.09 per cent (₹ 2561) and 6.17 per cent (₹ 5115) of the total cost of cultivation of turmeric respectively.

Among the items of fixed costs, the rental value of land (3.92%) had a maximum share in the total cost of cultivation followed by depreciation charges (1.23%), interest on fixed capital (0.57%) and land revenue (0.02%).

Belgaum

It is also evident from the table that, the total cost of cultivation of turmeric was ₹ 83402. The major cost items in the total cost of cultivation were cost of planting material (₹ 35564), cost of human labour (₹ 16507) and cost of FYM (₹ 8793) which accounts for 42.64 per cent, 19.79 per cent and 10.54 per cent respectively to the total cost of cultivation of turmeric. The other minor variable cost components included in the total cost were cost of bullock labour (1.91%), cost of machine labour (6.37%), cost of fertilizers (2.71%), cost of plant protection chemicals (3.69%) and interest on working capital (6.14%).

The share of fixed costs in the total cost of cultivation was 6.21 per cent (₹ 5178). Among the items of fixed costs, the rental value of land (4.50%) had a maximum share in the total cost of cultivation followed by depreciation charges (1.07%), interest on fixed capital (0.62%) and land revenue (0.03%).

4.2.6 Cost of processing of turmeric

The turmeric crop is harvested in the form of wet rhizomes which are not used for the direct consumption. Farm level processing starts from separation of fingers from rhizomes. It consists of curing, drying and polishing of cooked fingers. The detailed per acre cost of farm level processing of turmeric is presented in Table 4.14.

It is evident from the table that, the total cost of processing of turmeric in Chamarajanagar district was ₹ 11003 per acre. For curing of turmeric the cost of human labour was ₹ 1383 and cost of machine labour was ₹ 3264, drying operation required ₹ 1181 for human labour and ₹ 524 for the purchase of utensils *i.e.,* sarees and nets and for the polishing of turmeric ₹ 1726 for human labour and ₹ 2925 for machine labour were required.

In the case of Mysore district the total cost of processing of turmeric was ₹ 11739 per acre. In that the cost of curing operation was ₹ 1607 for human labour, ₹ 3277 for machine labour and ₹ 1073 for the purchase of wood. About ₹ 1367 of human labour and ₹ 417 for the purchase of utensils was required while drying of cooked rhizomes and in case of polishing ₹ 1777 of human labour and ₹ 2221 of machine labour was used.

The total cost of processing in Bagalkot district was ₹ 12531, in that the curing operation required ₹ 1553 of human labour, ₹ 3650 of machine labour and ₹ 292 of wood. The drying required ₹ 1272 of human labour and ₹ 1486 for the purchase of utensils. Finally for the polishing operation, the farmers spent ₹ 1820 on human labour and ₹ 2458 on machine labour.

Similarly in Belgaum district the total cost of processing was ₹ 11123 per acre. On an average the sample farmers spent ₹ 1667 on human labour, ₹ 3266 on machine labour and ₹ 220 on wood while curing of wet rhizomes. For drying of cooked rhizomes the sample farmers spent ₹ 1165 on human labour and ₹ 1108 for the purchase of utensils and for polishing the sample farmers spent ₹ 1679 on human labour and ₹ 2018 on machine labour.

4.2.7 Cost and returns profile of turmeric production

The details of per acre costs and returns structure in turmeric production in the selected districts are presented in Table 4.15.

It could be seen from the table that, in Chamarajanagar district the total cost of cultivation of turmeric was ₹ 77263, cost of processing was ₹ 11003 and cost of marketing which includes loading, unloading, transportation and commission charges was ₹ 8273. Returns from the main produce (Finger) and by-produce (mother rhizome) was ₹141383 and ₹53666 respectively. Thus the gross returns obtained in the production of one acre of turmeric were ₹195049 with net returns of ₹ 98511 and B: C ratio of 2.02.

In the case of Mysore district, the total cost of cultivation, cost of processing and cost of marketing were ₹ 76985, ₹ 11739 and ₹ 8011 respectively. The returns from the main produce was ₹ 141790 and from the by-produce was ₹ 51384 and the gross returns obtained from the one acre of turmeric production was ₹ 191909 with net returns of ₹ 95174 and B: C ratio of 1.98.

Similarly it is also evident from the table that, in Bagalkot district the total cost of cultivation, cost of processing and cost of marketing were ₹ 82949, ₹ 12531 and ₹ 8006 respectively. The returns from the main produce, returns from the by-produce and gross returns were ₹ 142885, ₹ 59144 and ₹ 202029 respectively. The net returns realized by the farmers were ₹ 98543 and B: C ratio was 1.96.

In the case of Belgaum district, per acre total cost of cultivation was ₹ 83402, the cost of processing was ₹ 11123 and cost of marketing was ₹ 7984. The gross returns realised by the farmers were ₹ 175099 (₹ 122017 from main produce and ₹ 53082 from the by-produce) with a net returns of ₹ 72590 and B: C ratio of 1.71.

Table 4.9: Labour use pattern in the production of turmeric in Mysore district

(Per acre)

Sl. No	Particulars	Human labour		Bullock labour		Machine labour	
		Mandays (No)	Cost (₹)	Pair days (No)	Cost (₹)	Machine hours (No)	Cost (₹)
1	Ploughing	-	-	-	-	3	1682
2	Harrowing	-	-	-	-	6	2964
3	Loading, transportation and spreading of FYM	5	865	-	-	4	1113
4	Seed bed preparation	4	726	1	525	-	-
5	Planting	13	2274	-	-	-	-
6	Fertilizer application	2	425	-	-	-	-
7	Weeding	34	5848	-	-	-	-
8	Inter cultivation	-	-	3	1323	-	-
9	PPC application	3	602	-	-	-	-
10	Irrigation	23	4776	-	-	-	-
11	Harvesting	15	2549	-	-	-	-
	Total	**98**	**18065**	**4**	**1848**	**14**	**5758**

Table 4.10: Labour use pattern in the production of turmeric in Bagalkot district

(Per acre)

Sl. No	Particulars	Human labour		Bullock labour		Machine labour	
		Mandays (No)	Cost (₹)	Pair days (No)	Cost (₹)	Machine hours (No)	Cost (₹)
1	Ploughing	-	-	-	-	3	1651
2	Harrowing	-	-	-	-	4	2182
3	Loading, transportation and spreading of FYM	5	923	-	-	5	1104
4	Seed bed preparation	3	600	1	550	-	-
5	Planting	15	2548	-	-	-	-
6	Fertilizer application	2	400	-	-	-	-
7	Weeding	33	5469	-	-	-	-
8	Inter cultivation	-	-	2	1292	-	-
9	PPC application	2	395	-	-	-	-
10	Irrigation	22	4623	-	-	-	-
11	Harvesting	16	2720	-	-	-	-
	Total	**99**	**17677**	**3**	**1842**	**12**	**4938**

Table 4.11: Labour use pattern in the production of turmeric in Belgaum district

(Per acre)

Sl. No	Particulars	Human labour		Bullock labour		Machine labour	
		Mandays (No)	Cost (₹)	Pair days (No)	Cost (₹)	Machine hours (No)	Cost (₹)
1	Ploughing	-	-	-	-	4	1836
2	Harrowing	-	-	-	-	5	2551
3	Loading, transportation and spreading of FYM	6	879	-	-	4	925
4	Seed bed preparation	3	478	1	500	-	-
5	Planting	14	2203	-	-	-	-
6	Fertilizer application	2	351	-	-	-	-
7	Weeding	34	5197	-	-	-	-
8	Inter cultivation	-	-	2	1094		
9	PPC application	3	522	-	-	-	-
10	Irrigation	23	4431	-	-	-	-
11	Harvesting	16	2447	-	-	-	-
	Total	**100**	**16507**	**3**	**1594**	**13**	**5312**

Table 4.12: Input use pattern and output obtained in turmeric cultivation in the selected districts

(Per acre)

Sl. No.	Particulars	Units	Districts			
			Chamarajanagar	Mysore	Bagalkot	Belgaum
1	Planting material	Qtls.	9.29	9.35	10.40	9.83
2	Human labour	Mandays	98	98	99	100
3	Bullock labour	Pair days	3	4	3	3
4	Machine labour	Hours	13	14	12	13
5	Farm yard manure	Tractor loads	5.00	4.00	5.00	4.00
6	Fertilizers					
i.	DAP	Kgs	85.00	91.00	93.00	107.00
ii.	Urea	Kgs	63.00	61.00	73.00	76.00
iii.	Potash	Kgs	58.00	53.00	56.00	59.00
7	PPC	₹	3209.00	2715.00	2561.00	3078.00
i.	Main Product (Finger)	Qtls.	26.52	26.69	27.72	25.68
ii.	By-product (Mother rhizome)	Qtls.	9.31	8.66	9.27	9.23

Table 4.13: Cost of cultivation of turmeric in the selected districts

(₹/acre)

Sl. No.	Particulars	Districts							
		Chamarajanagar (n=48)	Per cent	Mysore (n=48)	Per cent	Bagalkot (n=48)	Per cent	Belgaum (n=48)	Per cent
I. Variable cost									
1	Human labour	16017	20.73	18065	23.47	17677	21.31	16507	19.79
2	Bullock labour	1389	1.80	1848	2.40	1842	2.22	1594	1.91
3	Machine labour	5354	6.93	5758	7.48	4938	5.95	5312	6.37
4	Planting material	29439	38.10	29123	37.83	34031	41.03	35564	42.64
5	Farm yard manure	10165	13.16	7720	10.03	10003	12.06	8793	10.54
6	Fertilizers	1980	2.56	1961	2.55	2025	2.44	2259	2.71
7	PPC	3209	4.15	2715	3.53	2561	3.09	3078	3.69
8	Interest on working capital	5404	6.99	5375	6.98	5115	6.17	5117	6.14
	Subtotal (I)	72956	94.43	72564	94.26	78192	94.27	78224	93.79
II. Fixed cost									
1	Rental value of land	3000	3.88	3060	3.97	3250	3.92	3750	4.50
2	Land revenue	14	0.02	15	0.02	15.00	0.02	25	0.03
3	Depreciation	866	1.12	907	1.18	1020	1.23	890	1.07
4	Interest on fixed capital	427	0.55	438	0.57	471	0.57	513	0.62
Subtotal (II)		4307	5.57	4420	5.74	4756	5.73	5178	6.21
Total cost of cultivation (I)+ (II)		**77263**	**100.00**	**76985**	**100.00**	**82949**	**100.00**	**83402**	**100.00**

Table 4.14: Cost of processing of turmeric in the selected districts

(₹/acre)

Sl. No	Particulars	Districts			
		Chamarajanagar	Mysore	Bagalkot	Belgaum
I	**Curing**				
1	Human labour	1383	1607	1553	1667
2	Machine labour	3264	3277	3650	3266
3.	Wood	-	1073	292	220
II	**Drying**				
1	Human labour	1181	1367	1272	1165
2	Utensils	524	417	1486	1108
III	**Polishing**				
1	Human labour	1726	1777	1820	1679
2	Machine labour	2925	2221	2458	2018
IV	**Total**	**11003**	**11739**	**12531**	**11123**

Table 4.15: Costs and returns profile of turmeric production in the selected districts

₹/acre)

Sl. No	Particulars	Districts			
		Chamarajanagar	Mysore	Bagalkot	Belgaum
1	Total cost of cultivation	77263	76985	82949	83402
2	Total cost of processing	11003	11739	12531	11123
3	Total cost of marketing	8273	8011	8006	7984
4	Price (₹/qtl)	5300	5262	5131	4764
5	Returns from main produce	141383	141790	142885	122017
6	Returns from the by-produce	53666	51384	59144	53082
7	Gross returns	195049	191909	202029	175099
8	Net return	98511	95174	98543	72590
9	B:C ratio	2.02	1.98	1.96	1.71

4.3 Resource use efficiency in turmeric production

The estimated coefficients of the Cobb-Douglas production function are presented in Table 4.16 for turmeric production in the selected districts.

Perusal of the table revealed that, in Chamarajanagar the output elasticities for planting material (0.4287), FYM (0.0138), chemical fertilizers (0.3843) and plant protection chemicals (0.0954) were positive and found significant at one per cent level. Whereas, the output elasticities for bullock labour (0.0078) and machine labour (0.0263) were also positive but found non-significant. The output elasticity for human labour was negative (-0.0455) and found non-significant. The co-efficient of multiple determination was 0.895 and return to scale was 0.91indicating decreasing output.

In the case of Mysore district, the output elasticities for machine labour (0.5028) was positive and found significant at one per cent level of significance and planting material (0.5149) and chemical fertilizers (0.0339) were found to be significant at five per cent level but the output elasticities for FYM (0.0021) and plant protection chemicals (0.1421) were also positive but they were statistically non-significant. Whereas, the output elasticities for human labour (-0.0619) and bullock labour (-0.0258) were found negative and non-significant. The co-efficient of multiple determination was 0.921 and return to scale was 1.11 indicating increasing output for use of inputs.

It is also evident from the table that, in case of Bagalkot district the output elasticities for bullock labour (0.4299) and machine labour (0.5128) were positive and significant at one per cent level. The output elasticities for planting material (0.0191), human labour (0.0128), chemical fertilizers (0.0308) and plant protection chemicals (0.0027) were also positive but found non-significant. In the case of FYM, the output elasticity was (-0.0022) negative and non-significant. The co-efficient of multiple determination was 0.938 and return to scale was 1.01 indicating increasing output for input use.

Similarly in Belgaum district, the output elasticities for planting material (0.3588) was positive and found significant at one per cent, human labour (0.5336) and chemical fertilizers (0.0702) were also positive and found significant at five per cent level. Though the output elasticities for FYM (0.0303) and plant protection chemicals (0.0311) were positive but they were non-significant. The output elasticities for bullock labour (-0.0352) and machine labour (-0.0694) were negative and non-significant. The co-efficient of multiple determination was 0.901 and return to scale was 0.92 indicating decreasing output the input use.

4.3.1 Allocative efficiency in turmeric production

The Marginal Value Product (MVP) to Marginal Factor Cost (MFC) ratios of resources in the production of turmeric has been presented in Table 4.17.

It is evident from the table that, in Chamarajanagar district the MVP: MFC ratio was found to be more than one in the case of planting material, bullock labour, chemical fertilizers and plant protection chemicals with a value of 2.823, 1.127, 38.022 and 6.041 respectively. In the case of FYM (0.383) and machine labour (0.437) the ratio was found less than unity. Whereas, the ratio was found negative (-0.428) in the case of human labour.

In the case of Mysore district, the ratio was found more than unity in the case of planting material (3.380), machine labour (8.511) and plant protection chemicals (10.517). On the contrary the ratio was found less than unity in the case of FYM (0.090) and negative in the case of human labour (-0.515) and bullock labour (-2.749).

It could also be seen from the table that, in Bagalkot district, the ratio was found more than one in the case of bullock labour (49.123), machine labour (9.484) and chemical fertilizers (3.203), whereas , the ratio was found less than unity in the case of planting material (0.116), human labour (0.117) and plant protection chemicals (0.516). In the case of FYM (-0.113) the ratio was found less than zero.

The MVP: MFC ratio in the case of planting material (1.769), human labour (4.616), chemical fertilizers (5.681) and plant protection chemicals (1.880) were found greater than unity in Belgaum district, whereas, the ratio was found less than unity in the case of FYM (0.738) and negative in the case of bullock labour (-4.976) and machine labour (-1.153).

Table 4.16: Estimated Cobb-Douglas production function coefficients

Sl. No.	Explanatory variables	Parameter	Districts			
			Chamarajanagar	Mysore	Bagalkot	Belgaum
1	No. of observations	N	48	48	48	48
2	Intercept	a	4.1116 (0.5752)	1.6338 (0.8557)	3.6699 (0.9485)	2.9082 (1.9376)
3	Planting material(₹)	X_1	0.4287** (0.0550)	0.5149* (0.2250)	0.0191 (0.0368)	0.3588** (0.1001)
4	FYM (₹)	X_2	0.0138** (0.0016)	0.0021 (0.0034)	-0.0022 (0.0025)	0.0303 (0.0190)
5	Human labour (₹)	X_3	-0.0455 (0.0375)	-0.0619 (0.086)	0.0128 (0.0742)	0.5336* (0.0276)
6	Bullock labour (₹)	X_4	0.0078 (0.0125)	-0.0258 (0.0374)	0.4299** (0.0750)	-0.0352 (0.0162)
7	Machine labour (₹)	X_5	0.0263 (0.0180)	0.5028** (0.0316)	0.5128** (0.0065)	-0.0694 (0.0649)
8	Chemical fertilizers (₹)	X_6	0.3843** (0.0353)	0.0339* (0.011)	0.0308 (0.0251)	0.0702* (0.0178)
9	Plant protection chemicals (₹)	X_7	0.0954** (0.0268)	0.1421 (0.018)	0.0027 (0.0028)	0.0311 (0.0301)
10	Coefficient of multiple determination	R^2	0.895	0.921	0.938	0.901
	Returns to scale	Σb_i	**0.91**	**1.11**	**1.01**	**0.92**

*Note: **,* Denote significant at 1 and 5 per cent levels respectively*
Figures in the parentheses indicate standard errors of coefficients

Table 4.17: MVP to MFC ratios of resources in turmeric production in the selected districts

Sl. No.	Explanatory variables	Parameter	Districts			
			Chamarajanagar	Mysore	Bagalkot	Belgaum
			MVP:MFC	MVP:MFC	MVP:MFC	MVP:MFC
1	Planting material(₹)	X_1	2.823	3.380	0.116	1.769
2	FYM (₹)	X_2	0.383	0.090	-0.113	0.738
3	Human labour (₹)	X_3	-0.428	-0.515	0.117	4.616
4	Bullock labour (₹)	X_4	1.127	-2.749	49.123	-4.976
5	Machine labour (₹)	X_5	0.437	8.511	9.484	-1.153
6	Chemical fertilizers (₹)	X_6	38.022	3.362	3.203	5.681
7	Plant protection chemicals (₹)	X_7	6.041	10.517	0.516	1.880

4.3.2 Technical efficiency in turmeric production

The frontier production function was used to study the technical efficiency in the production of turmeric. The frontier functions were estimated in Cobb-Douglas production function setting using the corrected method of OLS. The results of the analysis are presented in Table 4.18 and 4.19.

4.3.2.1 Timmers measure of technical efficiency in turmeric production

The technical efficiency in turmeric cultivation was worked out by using Timmer's method. The distribution of sample farmers in the selected districts according to different technical efficiency ratings for turmeric has been presented in Table 4.18.

Perusal of the table revealed that, in Chamarajanagar district, the proportion of farms achieving high level of technical efficiency were higher as compared to all other districts. Most of the farms in the district (41.67%) were grouped under 90-95 per cent efficiency rating, followed by 80-90 per cent efficiency rating (20.83%), 95-100 per cent efficiency rating (18.75%), 70-80 per cent efficiency rating (12.50%) and 60-70 per cent efficiency rating (4.17%).

In Mysore district, maximum number of farmers falls under the (39.58%) category of 90-95 per cent efficiency rating followed by, 80-90 per cent efficiency rating (29.17%), 70-80 per cent efficiency rating (20.83%), 95-100 per cent and 50-60 per cent efficiency rating (4.17%) and 2.08 per cent of the sample farmers falls under 60-70 per cent efficiency rating.

Similarly in Bagalkot district also 37.50 per cent of the sample farmers falls under the category of 90-95 per cent efficiency rating followed by 80-90 per cent efficiency rating (25.00%), 70-80 per cent efficiency rating (18.75%), 95-100 per cent and 50-60 per cent efficiency rating (8.33%) and 50-60 efficiency rating (2.08%).

In the case of Belgaum district also more number of sample farmers (35.42%) falls under 90-95 per cent efficiency rating category, followed by 80-90 per cent efficiency rating (29.17%), 95-100 per cent efficiency rating (16.67%), 70- 80 per cent efficiency rating (10.42%), 60-70 per cent efficiency rating (6.25%) and 50-60 per cent efficiency rating (2.08%).

4.3.2.2 Kopp measure of technical efficiency

The technical efficiency in terms of excessive resources used by the farmers in crop production was worked out using Kopp measure of technical efficiency for turmeric. The actual and frontier use of different resources for the turmeric production are presented in Table 4.19.

It could be seen from the table that farmers growing turmeric in Chamarajanagar district could save 126.38 per cent of amount on the usage of plant protection chemicals followed by, chemical fertilizers (109.54%), bullock labour (108.23%), FYM (54.03%), planting material (5.94%), machine labour (4.83%) and human labour (4.23%) if they enhance their efficiency to the highest level of technical efficiency.

In the case of Mysore district, the farmers could save 97.54 per cent of their expenditure on FYM, followed by 21.81 per cent on plant protection chemicals, 19.24 per cent on bullock labour, 17.96 per cent on chemical fertilizers, 15.96 per cent on planting material, 15.59 per cent on machine labour and 15.00 per cent on human labour if they enhance their efficiency to the highest level of technical efficiency.

It could be also seen from the table that, in the case of Bagalkot district, the farmers could save 172.47 per cent of their expenditure on FYM, followed by 168.82 per cent on plant protection chemicals, 14.52 per cent on bullock labour, 14.35 per cent on chemical fertilizers 12.09 per cent on planting material, 11.15 per cent on machine labour and 10.43 per cent on human labour if they enhance their efficiency to the highest level of technical efficiency.

Similarly in Belgaum district, the farmers could save 40.92 per cent of their expenditure on bullock labour followed by FYM (33.65%), plant protection chemicals (16.40%), chemical fertilizers (14.20%), human labour (13.70%), machine labour (10.02%) and planting material (9.63%) if they enhance their efficiency to the highest level of technical efficiency.

Table 4.18: Distribution of turmeric farmers according to technical efficiency ratings in the selected districts

Sl. No.	Relative efficiency (%)	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1	50-60	-	-	2	4.17	1	2.08	1	2.08
2	60-70	2	4.17	1	2.08	4	8.33	3	6.25
3	70-80	6	12.50	10	20.83	9	18.75	5	10.42
4	80-90	10	20.83	14	29.17	12	25.00	14	29.17
5	90-95	20	41.67	19	39.58	18	37.50	17	35.42
6	95-100	9	18.75	2	4.17	4	8.33	8	16.67

Table 4.19: Actual and frontier input use level in turmeric production in the selected districts

Sl. No.	Items	Districts											
		Chamarajanagar			Mysore			Bagalkot			Belgaum		
		F	A	E (%)	F	A	E (%)	F	A	E (%)	F	A	E (%)
1	Planting material(₹)	27787	29439	5.94	25114	29123	15.96	30362	34031	12.09	32440	35564	9.63
2	FYM (₹)	6599	10165	54.03	3908	7720	97.54	3671	10003	172.47	6579	8793	33.65
3	Human labour (₹)	19483	20307	4.23	19840	22816	15.00	20214	22322	10.43	18485	21018	13.70
4	Machine labour (₹)	11010	11542	4.83	9739	11257	15.59	9938	11046	11.15	9630	10595	10.02
5	Bullock labour (₹)	667	1389	108.23	1550	1848	19.24	1608	1842	14.52	1131	1594	40.92
6	Chemical fertilizers (₹)	945	1980	109.54	1663	1961	17.96	1771	2025	14.35	1978	2259	14.20
7	Plant protection chemicals (₹)	1418	3209	126.38	2229	2715	21.81	953	2561	168.82	2645	3078	16.40

Note: F= Frontier, A= Actual and E= Excess

Table 4.20: Preference of marketing channels by turmeric growers in the study area

Sl. No.	Particulars	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Number of farmers	Quantity (qtl)	Number of farmers	Quantity (qtl)	Number of farmers	Quantity (qtl)	Number of farmers	Quantity (qtl)
1	Channel-I	28 (58.33)	731 (57.42)	11 (22.92)	297 (23.17)	25 (52.08)	681 (51.16)	34 (70.83)	876 (71.05)
2	Channel-II	6 (12.50)	170 (13.35)	13 (27.08)	354 (27.61)	0 (0.00)	-	0 (0.00)	-
3	Channel-III	10 (20.84)	273 (21.45)	18 (37.50)	468 (36.51)	20 (41.67)	565 (42.45)	11 (22.92)	276 (22.38)
4	Channel-IV	4 (8.33)	99 (7.78)	6 (12.50)	163 (12.71)	3 (6.25)	85 (6.39)	3 (6.25)	81 (6.57)
	Total	**48 (100.00)**	**1273 (100.00)**	**48 (100.00)**	**1282 (100.00)**	**48 (100.00)**	**1331 (100.00)**	**48 (100.00)**	**1233 (100.00)**

Note: Figures in the parentheses indicate percentages to column the total

Table 4.21: Marketing cost incurred by the farmers in channel I and III

(₹/qtl.)

Sl. No.	Item cost	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent
	Producer – Commission agents								
1	Cleaning/sorting	49	14.30	47	13.83	43	11.16	55	15.40
2	Packing	43	12.39	38	11.17	48	12.45	45	12.43
3	Transportation	41	12.00	56	16.36	98	25.30	83	22.98
4	Weighment	7	2.04	7	2.06	5	1.29	5	1.39
5	Commission charges	164	47.80	162	47.31	157	40.50	141	39.22
6	Storage	8	2.38	-	-	-	-	-	-
7	Loading and unloading	22	6.37	22	6.39	26	6.76	19	5.27
8	Miscellaneous	9	2.65	10	2.94	10	2.65	12	3.36
	Total	**343**	**100**	**343**	**100**	**387**	**100**	**359**	**100**
	Producer-TAPCMS								
1	Cleaning/sorting	45	28.76	49	27.20	44	24.90	51	26.30
2	Packing	41	26.15	39	21.53	47	26.64	47	24.17
3	Transportation	38	24.11	58	32.45	52	29.55	75	38.26
4	Weighment	-	-	-	-	-	-	-	-
5	Commission charges	-	-	-	-	-	-	-	-
6	Storage	-	-	-	-	-	-	-	-
7	Loading and unloading	25	15.54	25	14.02	26	14.70	14	7.36
8	Miscellaneous	9	5.66	9	5.07	7	4.13	8	4.15
	Total	**158**	**100**	**179**	**100**	**176**	**100**	**195**	**100**

4.4 Marketing performance of turmeric

The details relating to marketing of turmeric has been presented in following heads.

4.4.1 Preference of marketing channels by turmeric producers in the study area

In this section marketing channels were identified and preferences of producer for different channels were assessed. Four channels were identified in the study area and they were as follows.

i. Producer → Commission agent → Wholesalers → Retailers →Consumer

ii. Producer → Distant market commission agents

iii. Producer → TAPCMS

iv. Producer → Commission agent →Processors

In the first channel the producers bring the produce to the market place and sell through commission agents as mediator between producer and wholesalers depending on the market price and quality of the produce. This channel was most popular in the study area as 28 farmers (58.33%) in Chamarajanagar, 11 (22.92%) in Mysore district, 25 (52.08%) in Bagalkot district and 34 (70.83%) in Belgaum district sold their produce through this channel (Table 4.20). The total quantity of turmeric sold by the sample farmers through this channel were 731 quintals in the case of Chamarajanagar district, 297 quintals in the case of Mysore district, 681 quintals in the case of Bagalkot district and 876 quintals in the case of Belgaum district.

In the second channel, the producer himself sells the produce in the distant market that is Erode market of Tamil Nadu. This channel was seen only in Chamarajanagar and Mysore district. In these districts, 6 (12.50%) farmers in Chamarajanagar and 13 farmers (27.08%) in Mysore district sold 174 quintals and 354 quintals of their produce respectively through this channel.

The third channel was the second most popular channel in the study area, as this channel was introduced by the government mainly because of crash in the prices of turmeric in the state during 2011-12 through market intervention scheme. In Chamarajanagar district 10 farmers (20.84%), 18 farmers in Mysore district (37.50%), 20 farmers (41.07%) in Bagalkot district and 11 farmers (22.92%) in Belgaum district were sold their produce through this channel. Through this cahnnel maximum quantity was sold in the case of Bagalkot district (565 quintals) followed by Mysore district (468 quintals), Belgaum district (276 quintals) and Chamarajanagar district (273 quintals).

In the fourth channel, the producer used to bring the produce to commission agents, through which it will reach processors. In the case of Chamarajanagar district, 4 farmers (8.33%), 6 farmers (12.50%) in Mysore district, 3 farmers each (6.25%) in Bagalkot and Belgaum districts sold their produce through this channel. Through this channel the total quantity sold by the sample farmers in Chamarajanagr, Mysore, Bagalkot and Belgaum district were 99 quintals, 163 quintals, 85 quintals and 81 quintals respectively.

4.4.2 Marketing costs incurred by the farmers under different channels

The per quintal marketing cost incurred by the sample farmers in the selected districts through different channels are presented Table 4.21 and 4.22.

4.4.2.1 Marketing costs incurred by the farmers in channel-I and Channel-III

It was seen from Table 4.21 which narrates the per quintal cost incurred by sample farmers in marketing of the turmeric through channel I and III. The marketing cost incurred varied from market to market and channel to channel. The various items of marketing cost included in channel-I (Producer to commission agents) were the cost of cleaning, packing, loading and unloading, transportation, weighment charges, miscellaneous, commission charges and in channel III (Producer to TAPCMS) were cleaning, packing, loading and unloading, transportation and miscellaneous charges.

Chamarajanagar

It could be seen from the table that, the per quintal total marketing cost incurred by the sample farmers in channel-I was ₹ 343. In that, major share is of commission charges of the commission agents (₹ 164) *i.e.*, 47.80 per cent of the total marketing cost, followed by cleaning and sorting (₹ 49), packing (₹ 43), transportation (₹ 41), loading and unloading (₹ 22), miscellaneous charges (₹ 9), storage charges (₹ 8) and weighment charges (₹ 7.00) with an share of 14.30 per cent, 12.39 per cent, 12.00 per cent, 6.37 per cent, 2.65 per cent, 2.38 per cent and 2.04 per cent of the total marketing cost respectively.

The total marketing cost incurred by the sample farmers in channel-III was ₹ 158 per quintal. In this channel the major share was from the cost of cleaning and sorting (₹ 45) followed by cost of packing (₹ 41), transportation charges (₹ 38), loading and unloading charges (₹ 25) and miscellaneous charges (₹ 9) accounting for 28.76 per cent, 26.15 per cent, 24.11 per cent, 15.54 per cent and 5.66 per cent respectively

Mysore

The total marketing cost incurred by the producers in Mysore district in the channel-I amounted to ₹ 343 per quintal. The major item of cost was commission charges (₹ 162), followed by transportation charges (₹ 56), cleaning and sorting (₹ 47), packing (₹ 38), loading and unloading charges (₹ 22), miscellaneous charges (₹10) and weighment charges (₹ 7) accounting for 47.31 per cent, 16.36 per cent, 13.83 per cent, 11.17 per cent, 6.39 per cent, 2.94 per cent and 2.06 per cent of the total marketing cost respectively.

In channel-III, the sample farmers incurred ₹ 179 per quintal of total marketing cost. The major cost items in the channel were cost of transportation (₹ 58) followed by cost of cleaning and sorting (₹ 49), cost of packing (₹ 39), loading and unloading charges (₹ 25) and miscellaneous charges (₹ 9) which were accounting for 32.45 per cent, 27.20 per cent, 21.53 per cent, 14.02 per cent and 5.07 per cent respectively.

Bagalkot

The total marketing cost incurred by the sample farmers in the district was ₹ 387 per quintal when sold through channel-I. In that major cost items were commission charges (₹ 157), followed by cost of transportation (₹ 98), cost of packing (₹ 48), cost of cleaning and sorting (₹ 43), loading and unloading charges (₹ 26), miscellaneous charges (₹ 10) and weighment charges (₹ 5.00) accounting to 40.50 per cent, 25.30 per cent, 12.45 per cent, 11.16 per cent, 6.76 per cent, 2.65 per cent and 1.29 per cent of the total marketing cost, respectively.

When sold the produce through the channel-III, sample farmers incurred ₹176 total marketing costs. Transportation charges was the major cost item in that with an amount of ₹ 52 per quintal followed by cost of packing (₹ 47), cost of cleaning and sorting (₹ 44), loading and unloading charges (₹ 26) and miscellaneous charges (₹ 7) which were accounting to 29.55 per cent, 26.64 per cent, 24.90 per cent, 14.70 per cent and 4.13 per cent to the total marketing cost, respectively.

Belgaum

It is also evident from the table that, the total marketing cost incurred by the sample farmers in the district was ₹ 359 in channel-I. The major cost items were commission charges (₹ 141), followed by cost of transportation (₹ 83), cost of cleaning and sorting (₹ 55), cost of packing (₹ 45), loading and unloading charges (₹ 19), miscellaneous charges (₹ 12) and weighment charges (₹ 5.00) accounting to 39.22 per cent, 22.98 per cent, 15.40 per cent, 12.43 per cent, 5.27 per cent, 3.36 per cent and 1.39 per cent of the total marketing cost respectively.

In channel-III, the sample farmers incurred ₹ 195 per quintal of total marketing cost. The major cost items in the channel were cost of transportation (₹ 75) followed by cost of cleaning and sorting (₹51), cost of packing (₹47), loading and unloading charges (₹ 14) and miscellaneous charges (₹ 8) which were accounting for 38.26 per cent, 26.30 per cent, 24.17 per cent, 7.36 per cent and 4.15 per cent, respectively.

4.4.2.2 Marketing costs incurred by the farmers in channel-II

The marketing cost incurred by the sample farmers in Chamarajanagar and Mysore districts when sold to the distant market commission agents are presented in Table 4.22.

Perusal of the table revealed that, the total marketing cost incurred by the Chamarajanagar district farmers was ₹ 479 per quintal. The major cost items in that channel were commission charges (₹ 148) followed by cost of transportation (₹ 110), storage charges (₹ 91), cleaning and sorting (₹ 43), cost of packing (₹ 40), loading and unloading charges (₹ 27), miscellaneous charges (₹ 15) and weighment charges (₹ 5) which were accounting to 30.90 per cent, 22.96 per cent, 19.00 per cent, 8.98 per cent, 8.35 per cent, 5.64 per cent, 3.13 per cent and 1.04 per cent to the total cost respectively.

Similarly in the case of Mysore district, the total marketing cost incurred by the sample farmers in channel-II was ₹ 448 per quintal. The cost of commission charges was the major cost item (₹ 158), followed by cost of transportation (₹ 128), storage charges (₹ 42), cleaning and sorting (₹ 41), cost of packing (₹ 37), loading and unloading charges (₹ 24), miscellaneous charges (₹ 13) and weighment charges (₹ 5).

4.4.3 Marketing cost incurred by various market intermediaries

Marketing of turmeric is routed through commission agents to retailers and commission agents to processors. In the case of channel-IV, the channel was traced up to processor and hence the same was considered as an end consumer.

4.4.3.1 Marketing cost incurred by the commission agents

As revealed by the results presented in the Table 4.23, the total marketing cost incurred by the commission agents in Chamarajanagar district was ₹ 304 per quintal. The major items of cost was storage loss for which they incurred ₹ 123 per quintal accounting for 40.46 per cent, followed by tax (22.37%), packing cost (13.82%), miscellaneous charges (9.54%), labour cost (4.93%), market fee (4.61%) and shop rent (4.28%).

Similarly, the total marketing cost incurred by commission agents in Mysore district was ₹ 295 per quintal which is marginally lower, compared to Chamarajanagar district. Here also, among various items of cost, storage loss accounted for the major share (36.61%), followed by tax (23.05%), packing cost (15.59%), miscellaneous charges (10.17%), labour cost (5.76%), market fee (4.75%) and shop rent (4.07%).

In case of Bagalkot district, the total marketing cost incurred by the commission agents was ₹ 351 per quintal. The major cost items were cost of storage loss (29.91%) followed by tax (27.92%), packing cost (12.54%), miscellaneous charges (10.26%), labour cost (9.69%), shop rent (6.55%) and market fee (3.13%).

The marketing cost incurred by the commission agents in the case of Belgaum district was ₹ 340 per quintal. Among the various items of cost, tax accounted for the major share (28.82%), followed by storage loss (27.65%), packing cost (12.94%), miscellaneous charges (10.59%), labour cost (10.00%), shop rent (6.76%) and market fee (3.24%).

4.4.3.2 Marketing cost incurred by the wholesalers

In the process of marketing of turmeric, the wholesaler is an important intermediary, who purchase produce by staying in market yard itself from the commission agents and sells to the retailers directly. In the process of doing so, he incurred costs on various items such as cost of storage loss, tax, labour cost, shop rent, market fee, packing and miscellaneous charges. The details cost of marketing of wholesaler is presented in the Table 4.24.

It is evident from the table that, the total marketing cost incurred by the wholesaler in Chamarajanagar district amounted to ₹ 327 per quintal. Among various items of cost, storage loss constituted the highest share (41.28%), followed by tax paid (22.63%), packing cost (12.54%), miscellaneous charges (7.95%), shop rent (5.50%), market fee (5.20%) and labour cost (4.89%).

Almost similar trend was noticed in the case of Mysore district where the total cost incurred by wholesaler amounted to ₹ 342 per quintal. Among various items of cost, storage loss constituted the highest share (42.11%), followed by tax paid (22.22%), packing cost (11.70%), miscellaneous charges (8.48%), labour cost (5.85%), market fee (4.97%) and shop rent (4.68%).

In the case of Bagalkot and Belgaum districts the total cost of marketing incurred by the wholesaler was ₹ 426 per quintal in each district. Among the major items of cost, storage loss constituted the highest share (38.50%), followed by tax paid (26.53%), packing cost (10.09%), miscellaneous charges (8.22%), labour cost (7.75%), shop rent (6.10%) and market fee (2.82%) in each districts.

Table 4.22: Marketing cost incurred by the farmers in channel II

(₹/qtl.)

Sl. No.	Item of cost	Districts			
		Chamarajanagar		Mysore	
		Amount (₹)	Per cent	Amount (₹)	Per cent
1	Cleaning/sorting	43	8.98	41	9.15
2	Packing	40	8.35	37	8.26
3	Transportation	110	22.96	128	28.57
4	Weighment	5	1.04	5	1.12
5	Commission charges	148	30.90	158	35.27
6	Storage	91	19.00	42	9.38
7	Loading and unloading	27	5.64	24	5.36
8	Miscellaneous	15	3.13	13	2.90
	Total	**479**	**100**	**448**	**100**

Note: Channel II was seen only in Chamarajanagar and Mysore districts

Table 4.23: Marketing cost incurred by the commission agents in the selected districts

(₹/qtl.)

Sl. No.	Item of cost	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent
1	Packing	42	13.82	46	15.59	44	12.54	44	12.94
2	Market fee	14	4.61	14	4.75	11	3.13	11	3.24
3	Tax	68	22.37	68	23.05	98	27.92	98	28.82
4	Storage loss	123	40.46	108	36.61	105	29.91	94	27.65
5	Labour cost	15	4.93	17	5.76	34	9.69	34	10.00
6	Shop rent	13	4.28	12	4.07	23	6.55	23	6.76
7	Miscellaneous cost	29	9.54	30	10.17	36	10.26	36	10.59
	Total cost	**304**	**100**	**295**	**100**	**351**	**100**	**340**	**100**

Table 4.24: Marketing cost incurred by the wholesalers in the selected districts

(₹/qtl.)

Sl. No.	Item of cost	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent
1	Packing	41	12.54	40	11.70	43	10.09	43	10.09
2	Market fee	17	5.20	17	4.97	12	2.82	12	2.82
3	Tax	74	22.63	76	22.22	113	26.53	113	26.53
4	Storage loss	135	41.28	144	42.11	164	38.50	164	38.50
5	Labour cost	16	4.89	20	5.85	33	7.75	33	7.75
6	Shop rent	18	5.50	16	4.68	26	6.10	26	6.10
7	Miscellaneous cost	26	7.95	29	8.48	35	8.22	35	8.22
	Total cost	**327**	**100**	**342**	**100**	**426**	**100**	**426**	**100**

Table 4.25: Marketing cost incurred by the retailers in the selected districts

(₹/qtl.)

Sl. No.	Item of cost	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent
1	Packing	40	11.83	42	11.81	40	11.25	40	11.25
2	Transportation	30	8.88	32	9.11	38	10.68	38	10.68
3	Loading and unloading	20	5.92	20	5.68	21	5.78	21	5.78
4	Storage loss	222	65.68	227	64.45	226	63.07	226	63.07
5	Municipality charges	8	2.37	9	2.65	10	2.86	10	2.86
6	Miscellaneous cost	18	5.33	22	6.20	23	6.47	23	6.47
	Total cost	**338**	**100**	**352**	**100**	**358**	**100**	**358**	**100**

Table 4.26: Costs and margins in different channels of turmeric marketing in the selected districts

(₹/qtl.)

Sl. No.	Particulars	Districts			
		Chamarajanagar	Mysore	Bagalkot	Belgaum
Channel -I					
1.	Gross Price received by the producer	5466	5409	5225	4640
2.	Marketing cost of producer	343	343	387	359
3.	Net price received by producer	5123	5066	4838	4280
4.	Cost incurred by the commission agent	304	295	351	340
5	Profit of the commission agent	982	1111	950	1546
6	Price paid by the wholesaler	6750	6815	6525	6525
7	Cost incurred by the wholesaler	327	342	426	426
8	Profit of the wholesaler	308	405	574	574
9	Price paid by the retailer	7385	7562	7526	7526
10	Cost of the retailer	338	352	358	358
11	Profit of the retailer	601	594	816	816
12	Consumer purchase price	8325	8508	8700	8700
13	Marketing Margin/price spread	2860	3098	3475	4061
14	Producer's share in consumer rupee (%)	61.53	59.55	55.60	49.20
15	Marketing efficiency	5.35	5.39	4.71	4.87
Channel -IV					
1	Net price received by producer	5123	5066	4838	4280
2	Marketing cost of producer	343	343	387	359
3	Price paid by the commission agent	5466	5409	5225	4640
4	Cost incurred by the commission agent	304	295	351	340
5	Price paid by the processor	6750	6815	6525	6525
6	Producer's share in processors rupee (%)	75.89	74.34	74.14	65.60
7	Marketing efficiency	9.44	9.68	7.84	8.34

4.4.3.3 Marketing cost incurred by the retailers

The cost incurred by the retailer on various items in marketing of turmeric in the study area is presented in Table 4.25.

It could be revealed from the table that in Chamarajanagar district, the retailer incurred major cost on storage loss with ₹ 222 per quintal (65.68%), followed by packing cost (11.83%), transportation cost (8.88%), loading and unloading charges (5.92%), miscellaneous charges (5.33%) and municipality charges (2.37%). The total cost incurred by the retailer was ₹ 338.

In case of Mysore district, the total cost incurred by the retailer was ₹ 352. Among various items of cost, storage loss constituted the highest share (64.45%), followed by packing cost (11.81%), transportation cost (9.11%), miscellaneous charges (6.20%), loading and unloading charges (5.68%) and municipality charges (2.65%).

In the case of Bagalkot and Belgaum districts the per quintal total cost of marketing incurred by the retailer was ₹ 358 each district. The retailer incurred major cost on storage loss (63.07%), followed by packing cost (11.25%), transportation cost (10.68%), miscellaneous charges (6.47%) loading and unloading charges (5.78%) and municipality charges (2.86%) in each district.

4.4.3.3 Marketing margins and marketing efficiency under different channels of turmeric marketing

Table 4.26 reveals the marketing margins under channel-I and channel-IV of turmeric marketing. A clear perusal of the table revealed that the producer's share in consumer/processor rupee was more in channel IV than channel I. As far as districts are concerned under channel I, the highest producer's share was noticed in Chamarajanagar district (61.53%), marketing margin was highest in case of Belgaum district (₹ 4061).

Producer's share in processors purchase price was fairly better in all the four selected districts under channel IV *i.e.* highest was observed in Chamarajanagar district (75.89%) followed by Mysore (74.34%), Bagalkot (74.14%) and Belgaum district (65.60%).

The marketing efficiency of different channels of turmeric has been worked out by Shephard's formula and it is shown in the same table. A perusal of the Table reveals that channel IV was the most efficient marketing channel as efficiency index was high in all the districts than that of channel-I. The index was found high in case of Mysore (9.68), followed by Chamarajanagar (9.44), Belgaum (8.34) and Bagalkot (7.84) in channel-IV and similarly in case of channel-I also same trend was seen.

4.5 Pace and pattern of market arrivals and prices of turmeric

The details of pace and pattern of turmeric arrivals and prices in different markets has been presented under the following heads.

4.5.1 Trend in arrivals of turmeric in the selected markets

The linear trend was computed in order to ascertain the long-run movement of market arrivals of turmeric in the selected markets and the results are presented in the Table 4.27 and Fig. 2.

From the table, it could be seen that, in the long-run, there is an increase in the arrivals of turmeric in all the selected markets over the years. In Sangli market, the market arrivals was highest and were increasing every year by 4911.67 quintals and was found to be statistically significant at 1 per cent followed by Gundlupet market (1480.76 quintals), Chamarajanagar market (270.80 quintals) and Kollegal market (156.77 quintal).

Annual increase in the arrivals in Chamarajanagar and Gundlupet market were found to be non-significant whereas, in case of Sangli and Kollegal markets it was found significant at one and five per cent respectively.

4.5.2 Trend in prices of turmeric in the selected markets

There was an increasing trend in the prices of turmeric in all the selected markets (Table 4.28 and Fig. 3). The annual increase in prices of turmeric was found to be the highest in the case of Gundlupet (₹ 1119.28/qtl) followed by, Kollegal market (₹ 887.03/qtl), New York market (₹ 659.46/quintal), Chamarajanagar (₹ 598.66/qtl), Sangli market (₹ 307.00/qtl), Kochi market (₹ 231.25/qtl) and Erode market (₹ 199.35/qtl).

The increasing trend in the prices were found significant in the case of Sangli, Kochi and New York markets at one per cent whereas, in the case of Erode market the increasing trend was significant at five per cent. On the contrary the increasing trends in the prices were found non-significant in the case of Chamarajanagar, Gundlupet and Kollegal markets.

Table 4.25: Marketing cost incurred by the retailers in the selected districts

(₹/qtl.)

Sl. No.	Item of cost	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent	Amount (₹)	Per cent
1	Packing	40	11.83	42	11.81	40	11.25	40	11.25
2	Transportation	30	8.88	32	9.11	38	10.68	38	10.68
3	Loading and unloading	20	5.92	20	5.68	21	5.78	21	5.78
4	Storage loss	222	65.68	227	64.45	226	63.07	226	63.07
5	Municipality charges	8	2.37	9	2.65	10	2.86	10	2.86
6	Miscellaneous cost	18	5.33	22	6.20	23	6.47	23	6.47
	Total cost	**338**	**100**	**352**	**100**	**358**	**100**	**358**	**100**

Table 4.26: Costs and margins in different channels of turmeric marketing in the selected districts

(₹/qtl.)

Sl. No.	Particulars	Districts			
		Chamarajanagar	Mysore	Bagalkot	Belgaum
Channel -I					
1.	Gross Price received by the producer	5466	5409	5225	4640
2.	Marketing cost of producer	343	343	387	359
3.	Net price received by producer	5123	5066	4838	4280
4.	Cost incurred by the commission agent	304	295	351	340
5	Profit of the commission agent	982	1111	950	1546
6	Price paid by the wholesaler	6750	6815	6525	6525
7	Cost incurred by the wholesaler	327	342	426	426
8	Profit of the wholesaler	308	405	574	574
9	Price paid by the retailer	7385	7562	7526	7526
10	Cost of the retailer	338	352	358	358
11	Profit of the retailer	601	594	816	816
12	Consumer purchase price	8325	8508	8700	8700
13	Marketing Margin/price spread	2860	3098	3475	4061
14	Producer’s share in consumer rupee (%)	61.53	59.55	55.60	49.20
15	Marketing efficiency	5.35	5.39	4.71	4.87
Channel -IV					
1	Net price received by producer	5123	5066	4838	4280
2	Marketing cost of producer	343	343	387	359
3	Price paid by the commission agent	5466	5409	5225	4640
4	Cost incurred by the commission agent	304	295	351	340
5	Price paid by the processor	6750	6815	6525	6525
6	Producer’s share in processors rupee (%)	75.89	74.34	74.14	65.60
7	Marketing efficiency	9.44	9.68	7.84	8.34

Table 4.27: Trends in the arrivals of turmeric in the selected markets

Market	Equation	R^2	F value
Sangli	$Y=-212.99+4911.67t^{**}$	0.77	28.05^{**}
Chamarajanagar	$Y=-92.02+270.80t$	0.39	3.870
Gundlupet	$Y=-915.29+1480.76t$	0.38	3.00
Kollegal	$Y=-70.59+156.77t^{*}$	0.63	8.56^{*}

** & * Significant at 1 and 5 per cent respectively

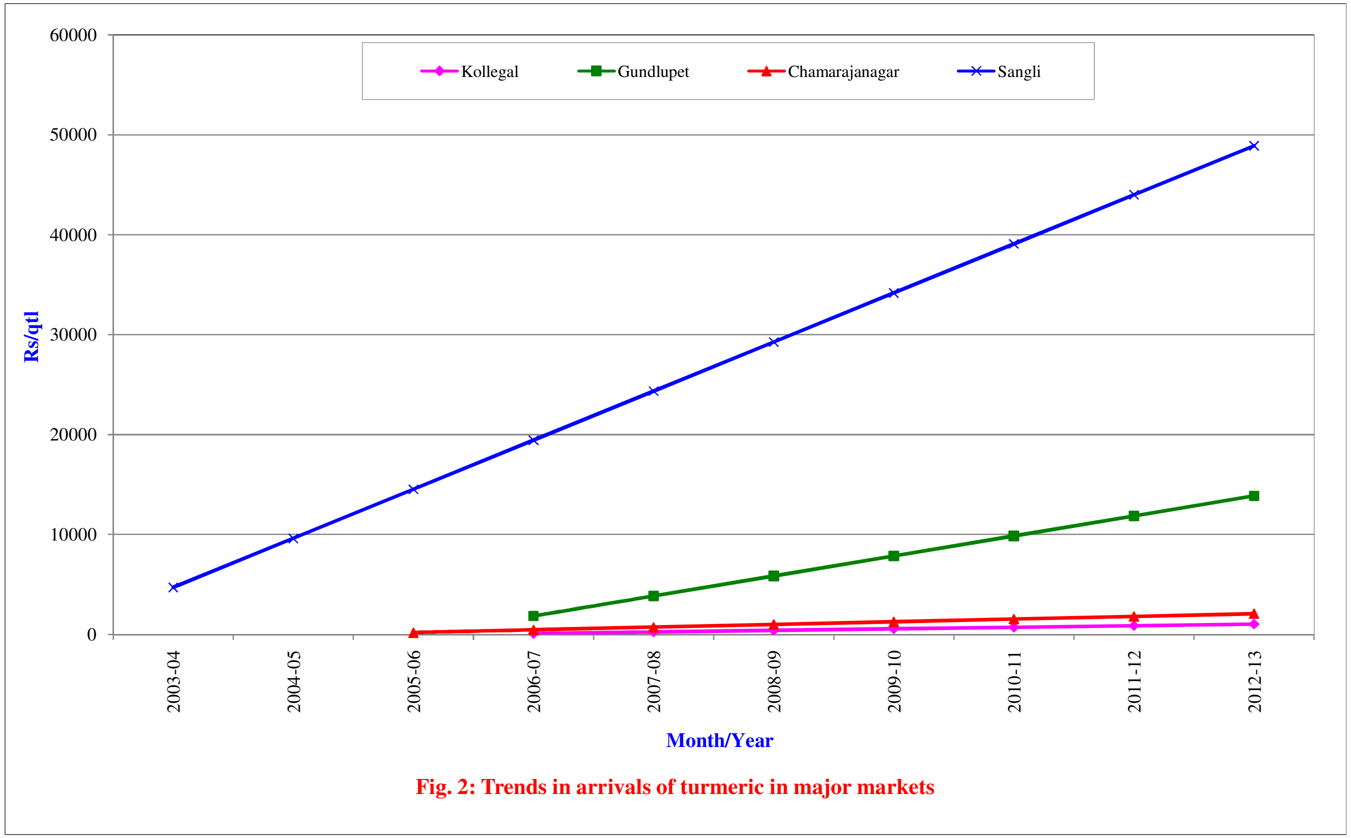

Fig.2: Trends in arrivals of turmeric in major markets

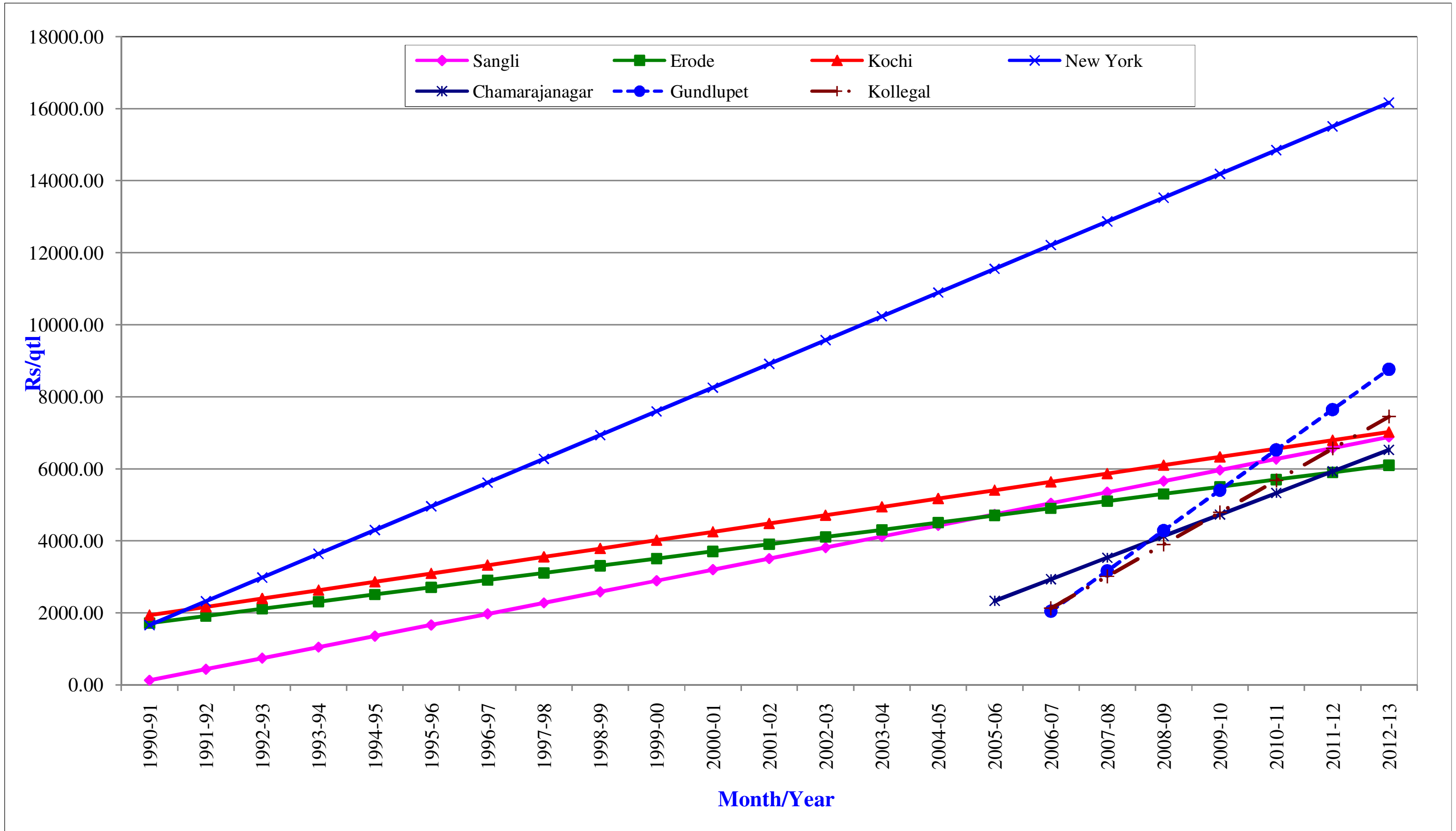

Fig. 3: Trends in prices of turmeric in major markets

Fig.3: Trends in prices of turmeric in major markets

4.5.3 Seasonal indices of market arrivals of turmeric in the selected markets

In order to ascertain the seasonal variation in the long-run, with respect to arrivals of turmeric in the selected markets, the seasonal indices for arrivals were calculated following 12 months moving averages. The seasonal indices of monthly arrivals of turmeric in the selected markets are presented in the Table 4.29 and Fig. 4.

Perusal of the table revealed the existence of seasonal variation in the arrivals of turmeric. Chamarajanagar, Gundlupet and Kollegal markets the highest market arrivals was seen during the month of June (198.94, 323.20 and 146.63 respectively) whereas, in Sangli market the highest market arrivals was seen during the month of April (304.31).

The arrivals were observed to be low during the month of November in the case of Sangli market, during January in the case of Chamarajanagar market, during February in the case of Gundlupet market and during August in the case of Kollegal market.

4.5.4 Seasonal indices of prices of turmeric in the selected markets

The seasonal indices of monthly prices of turmeric in the selected markets are presented in the Table 4.30 and Fig. 5. It could be seen from the table that, the highest seasonal indices was observed in all the markets during December month except in case of Sangli and Gundlupet market. In Chamarajanagar, Kollegal, Erode, Kochi and New York markets, the highest prices was observed during December (107.75, 108.40, 110.73, 111.27 and 105.32 respectively) whereas, in Sangli and Gundlupet markets the highest price was observed during the month of January (108.50 and 108.22 respectively).

The lowest price was observed during the month of September in case of Sangli market (91.38), during the month of October in case of Chamarajanagar market (91.88), during the month of August in the case of Gundlupet (92.93), during the month of May in the case of Kollegal market (89.82), during the month of March in the case of Erode (90.14) and during the month of April in case of Kochi and New York markets (94.48 and 94.58 respectively).

4.5.5 Cyclical variation in market arrivals of turmeric in the selected markets

Cyclical variation in arrivals was analyzed in order to know the variation in arrivals over the years. For this multiplicative model was employed. Since the data were of very short period *i.e.,*2003-04 to 2012-13 in the case of Sangli market, 2005-06 to 2012-13 in the case of Chamarajanagar market and 2006-07 to 2012-13 in the case of Gundlupet and Kollegal markets, no cyclical variations of arrivals of turmeric could be derived (Table 4.31).

4.5.6 Cyclical variation in prices of turmeric in the selected markets

Similarly in order to to know the variation in prices over the years, cyclical variation in prices was analysed (Table 4.32). In this case also due to very short period of data, no cyclical variations of prices of turmeric could be derived in the case of Chamarajanagar, Gundlupet and Kollegal markets.

Whereas, in the case of Sangli, Erode, Kochi and New York markets, uneven cycles were being observed. The number of cycles observed in Sangli, Erode, Kochi and New York markets were 6, 7,5,5 and these cycles occurred for every 2.83, 2.71, 4.00 and 4.20 years respectively (Fig. 6).

4.5.7 Forecasting of turmeric prices in the selected markets

Box-Jenkins model is concerned with fitting of a mixed Auto-Regressive Integrated Moving Average (ARIMA) to a given set of time series data. The main objective in fitting ARIMA model is to identify the stochastic process of time series and predict the future values accurately. For the present study ARIMA model was used for predicting the future prices of turmeric in the selected markets of India and international market and the results are presented as below.

Residual analysis was carried out to check the adequacy of the models. The adequacy of the model was judged based on the values of Box-Pierce Q statistics Akike Information Coefficient (AIC) and Swarz Baysian Criteria (SBC) (Been Stock and Bansali, 1981) and sum of squares of residuals. The price behaviour in the markets were tested with their AIC and SBC values to know the accuracy of the model.

Table 4.28: Trends in the prices of turmeric in the selected markets

Market	Equation	R^2	F value
Sangli [1]	$Y=-176.63+307.00t^{**}$	0.49	19.93**
Chamarajanagar [2]	$Y=1736.94+598.66t$	0.40	4.11
Gundlupet [3]	$Y=928.41+1119.28t$	0.31	2.32
Kollegal [3]	$Y=1239.54+887.03t$	0.42	3.69
Erode [1]	$Y=1516.19+199.35t^{*}$	0.26	7.47*
Kochi [1]	$Y=1706.30+231.25t^{**}$	0.44	16.63**
New York [1]	$Y=1001.02+659.46t^{**}$	0.57	27.71**

** & * Significant at 1 and 5 per cent respectively
Note: 1= Calculated for the period 1990-91 to 2012-13
2= Calculated for the period 2005-06 to 2012-13
3= Calculated for the period 2006-07 to 2012-13

Table 4.29: Seasonal indices of arrivals of turmeric in the selected markets

Month	Markets			
	Sangli	Chamarajanagar	Gundlupet	Kollegal
January	17.05	28.05	31.76	75.87
February	162.89	59.05	21.44	96.68
March	252.01	104.04	75.94	112.57
April	304.31	152.37	72.56	123.61
May	215.40	169.85	51.66	93.64
June	72.33	198.94	323.20	146.63
July	60.73	162.85	60.79	114.57
August	38.91	98.52	371.39	65.30
September	30.09	74.50	44.38	85.51
October	13.35	37.25	66.12	83.07
November	6.68	39.00	45.73	100.56
December	26.26	75.59	35.04	100.32

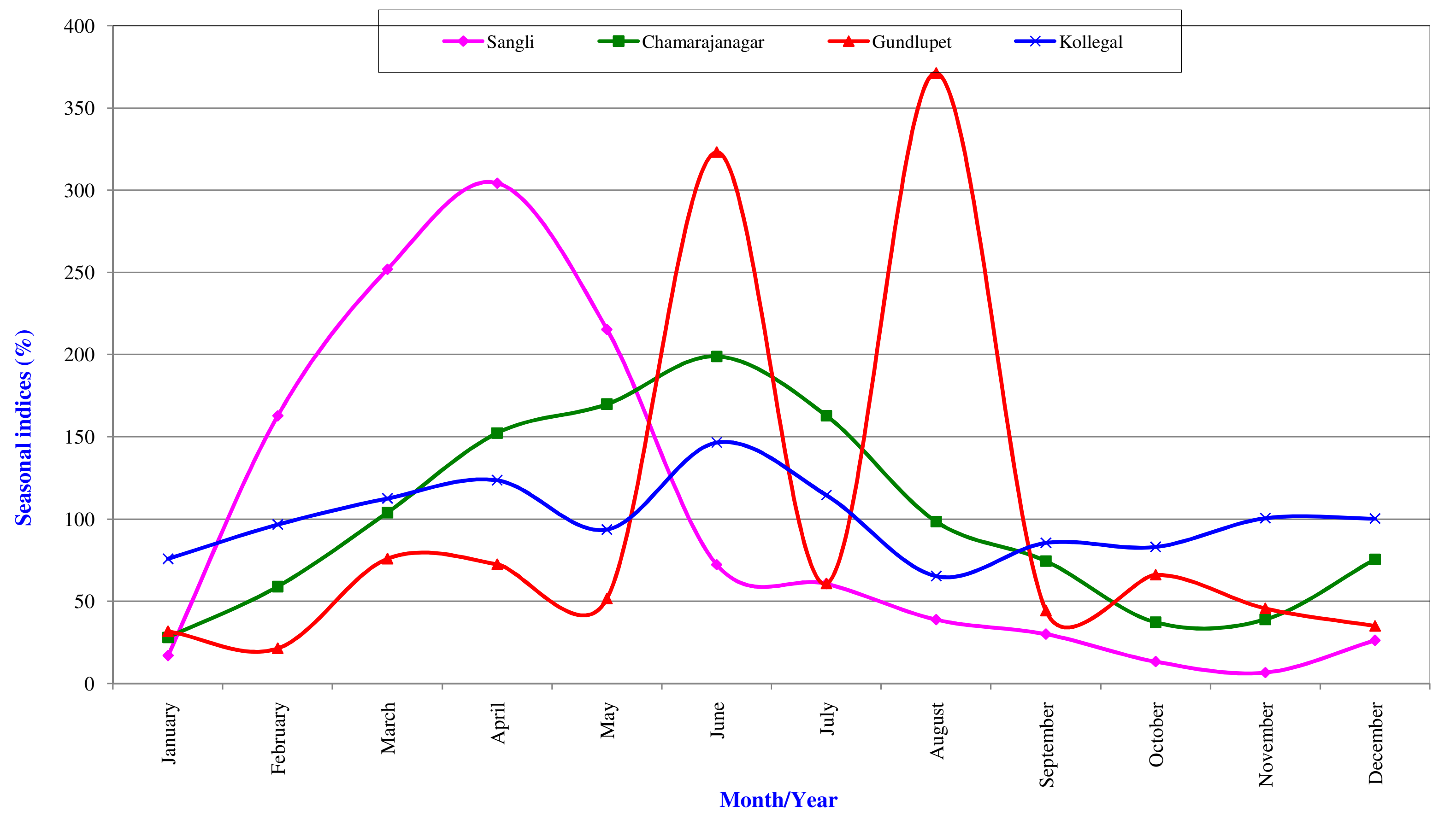

Fig. 4: Monthly seasonal indices for turmeric arrivals in major markets

Fig.4: Monthly seasonal indices for turmeric arrivals in major markets

Table 4.30: Seasonal indices of prices of turmeric in the selected markets

Month	Domestic markets						International market
	Sangli	Chamarajanagar	Gundlupet	Kollegal	Erode	Kochi	New York
January	108.50	96.84	108.22	104.42	101.39	101.16	96.35
February	106.92	101.55	94.25	102.85	92.93	98.56	95.97
March	106.82	101.97	94.61	98.92	90.14	96.86	96.13
April	103.58	100.60	9 9.45	91.00	96.21	94.48	94.58
May	102.62	96.80	101.78	89.82	95.79	97.58	100.09
June	96.35	99.65	96.14	90.51	95.02	95.22	100.07
July	98.41	100.08	95.92	98.80	101.14	96.45	99.95
August	96.66	103.06	92.93	98.02	103.34	101.97	100.80
September	91.38	94.84	99.63	103.95	100.99	99.71	102.34
October	96.08	91.88	104.26	108.28	101.05	101.63	103.47
November	94.57	104.98	105.60	104.94	111.27	105.11	104.93
December	98.03	107.75	107.22	108.40	110.73	111.27	105.32

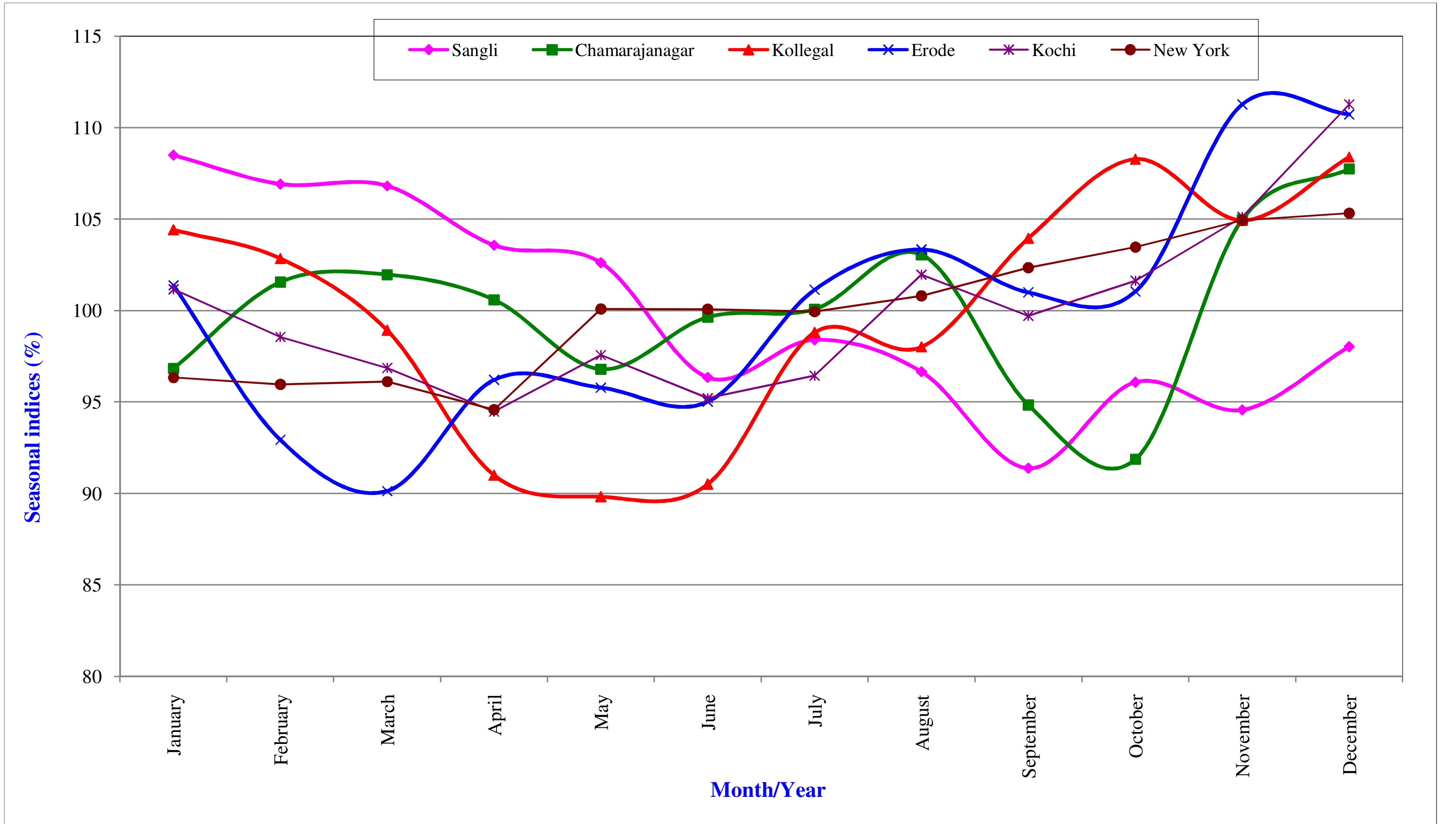

Fig. 5: Monthly seasonal indices for turmeric prices in major markets

Fig.5: Monthly seasonal indices for turmeric prices in major markets

4.5.7.1 Forecasting of turmeric prices in Sangli market

ARIMA model was estimated after transforming the variables under study into stationary series through computation of either seasonal or non-seasonal or both order of differencing and finally the model (111,111) was found to be the best model for prices of turmeric in Sangli market (Table 4.33), since the statistics of AIC and SBC (1925 and 1931 respectively) were found to be the lowest among the various models.

The method of forecasting has been explained in detail in chapter 3. Both Ex-ante and Ex-post forecasting were done and it was compared with actual values of observations. The forecasting was done up to December 2013. The results of ex- ante and ex-post forecast of prices of turmeric in the Sangli market are shown in Table 4.34 and Fig. 7. It could be seen from the table that there is narrow variation between the actual and forecasted values of prices of turmeric in Sangli market and the forecasted values of prices showed a decreasing trend in the future months. The actual prices during the month of July 2012 were ₹ 6138 per quintal declined to ₹ 5332 per quintal in December 2012. The predicted prices also more or less followed the same trend. The forecasted price for the month of January 2013 would be around ₹ 6083 per quintal and it may drop substantially to ₹ 4965 and ₹ 5134 per quintal in the month of November and December 2013 respectively.

4.5.7.2 Forecasting of turmeric prices in Chamarajanagar market

It could be seen from the Table 4.33 that, the best model identified for the forecasting of turmeric in Chamarajanagar market was (010,010) as it witnessed lower values of AIC and SBC (1400 and 1403 respectively). The values of actual and forecasted prices of turmeric in the market are presented in Table 4.35 and Fig. 8. The perusal of the table revealed that, there is increasing trend in the actual prices from January 2012 (₹ 3245 per quintal) up to September 2012 (₹ 5860/quintal) there after it shows the declining trend. Similarly in the case of future price also there was an increasing trend in the prices of turmeric from January 2013 (₹ 4633/quintal) to September 2013 (₹ 7386/quintal) and there after the prices started declining to ₹ 6244 per quintal in the month of December 2013.

4.5.7.3 Forecasting of turmeric prices in Gundlupet market

Based on the suitability of the model, several models with different p d q values were tried and finally the model (010,010) was found to be the best model (Table 4.33), as revealed by the lowest AIC and SBC values (1273 and 1276 respectively) and was used for the forecasting of turmeric prices in the case of Gundlupet market. The forecasted prices are presented in the Table 4.36 and Fig. 9. The table revealed that increasing trend was observed in the case of actual prices of turmeric in the market. The forecasted price suggested that, price of turmeric would be around ₹ 5629 per quintal during the month of July 2013 and it may increase up to ₹ 7800 per quintal in the month of September 2013 and again it may decline to ₹ 6403 per quintal during December 2013.

4.5.7.4 Forecasting of turmeric prices in Kollegal market

Perusal of the Table 4.33 revealed that, model (010,010) was best suited for forecasting of prices of turmeric in Kollegal market as it revealed the lowest AIC (1206) and SBC (1208) values and the results of ex-ante and ex-post forecast of prices of turmeric in the market are presented in Table 4.37 and Fig. 10. The results of the forecasted values revealed that, there was marginal increase in the actual price of turmeric from January 2012 (₹ 4200/quintal) to December 2012 (₹ 4700/quintal) and on the contrary the future prices showed the declining trend in the prices of turmeric from January 2013 (₹ 4716/quintal) to May 2013 (₹ 4179/quintal) and there after the price may increase up to ₹ 6859/quintal during October 2013.

4.5.7.5 Forecasting of turmeric prices in Erode market

Out of the models identified ARIMA (111,111) was found to be the good fit (Table 4.33 and Fig. 11) and was also showed the lowest AIC (1965) and SBC (1979) values. The forecast values for the 2013 up to December are presented in the Table 4.38. It could be seen from the table that, the forecasted values of turmeric prices in the market showed the declining trend. The price may decline to ₹ 4744 per quintal during December 2013 from ₹ 5250 per quintal during January 2013.

4.5.7.6 Forecasting of turmeric prices in Kochi market

It could be seen from the Table 4.33 and Fig. 12 that, for forecasting of prices of turmeric in Kochi market (011,011) was found to be the best model as it gave the lowest values of AIC and SBC (2094 and 2103 respectively) values. The results of the ex-ante and ex-post forecast values for the prices of turmeric in the market are given in the Table 4.39. It was evident from the table that, there was narrow variation in the actual and future prices of turmeric in the market. Both actual and future prices showed the declining trend. The future price of turmeric would decline to ₹ 4272 per quintal during July 2013 from ₹ 4993 per quintal during January 2013 and again it may increase marginally to ₹ 4750 during December 2013.

Table 4.31: Cyclical variations in arrivals of turmeric in the selected markets

Year	Markets			
	Sangli	Chamarajanagar	Gundlupet	Kollegal
2003	-	-	-	-
2004	137.59	-	-	-
2005	138.92	-	-	-
2006	101.38	14.66	-	-
2007	103.10	30.21	267.20	45.45
2008	58.13	9.62	86.99	33.25
2009	75.61	9.35	17.98	24.51
2010	74.13	19.15	31.05	23.40
2011	114.16	14.26	68.38	68.96
2012	-	-	-	-

Table 4.32: Cyclical variations in prices of turmeric in the selected markets

Year	Domestic markets						International market
	Sangli	Chamarajanagar	Gundlupet	Kollegal	Erode	Kochi	New York
1990	-	-	-	-	-	-	-
1991	385.04	-	-	-	139.28	154.09	221.62
1992	301.07	-	-	-	152.68	148.12	195.61
1993	157.61	-	-	-	115.06	92.77	117.69
1994	82.45	-	-	-	80.82	87.47	100.44
1995	72.54	-	-	-	79.53	78.61	94.34
1996	97.25	-	-	-	196.18	93.56	98.90
1997	111.04	-	-	-	122.69	119.73	102.79
1998	95.35	-	-	-	138.44	159.36	127.97
1999	101.09	-	-	-	100.89	106.35	108.21
2000	70.90	-	-	-	70.31	71.93	84.16
2001	71.56	-	-	-	64.91	59.26	73.34
2002	72.12	-	-	-	60.03	80.41	74.34
2003	82.87	-	-	-	74.99	97.90	79.65
2004	75.34	-	-	-	69.76	102.42	80.36
2005	59.02	-	-	-	54.86	91.85	75.57
2006	55.88	85.38	-	-	48.66	79.76	69.51
2007	46.38	59.50	72.00	64.44	43.17	46.50	56.94
2008	68.17	83.26	63.25	75.55	71.13	64.96	60.18
2009	115.80	116.40	90.40	104.25	128.57	97.10	72.28
2010	222.84	167.46	212.02	177.93	238.09	183.78	139.82
2011	143.32	102.10	104.78	105.09	132.54	137.40	175.68
2012	-	-	-	-	-	-	-
No. of cycles (x)	6	-	-	-	7	5	5
No. of years (y)	17	-	-	-	19	20	21
Average Duration of one cycle (y/x)	2.83	-	-	-	2.71	4.00	4.20

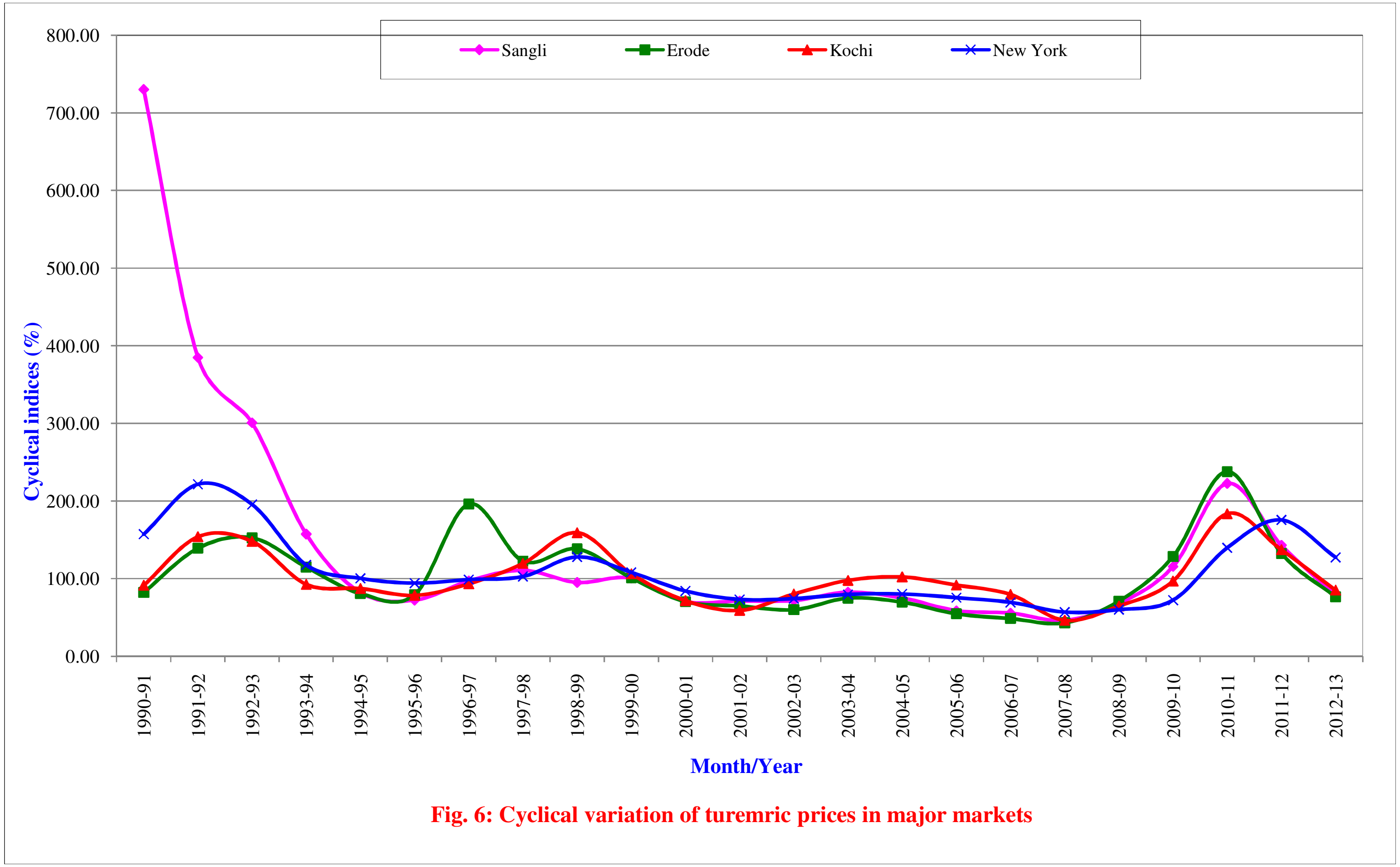

Fig.6: Cyclical variation of turemric prices in major markets

Table 4.33: Residual analysis of monthly prices of turmeric in selected markets

Market	ARIMA (p, d, q) (P, D, Q)	AIC	SBC
Sangli	(1,1,1) (1,1,1)	1925	1931
Chamarajanagar	(0,1,0) (0,1,0)	1400	1403
Gundlupet	(0,1,0) (0,1,0)	1273	1276
Kollegal	(0,1,0) (0,1,0)	1206	1208
Erode	(1,1,1) (1,1,1)	1965	1979
Kochi	(0,1,1) (0,1,1)	2094	2103
New York	(1,1,0) (1,1,0)	2197	2206

Note: AIC – Akike Information Coefficient
SBC – Swarz Baysian Criteria
(p, d, q) – Non-seasonal part of the model
(P, D, Q) - Seasonal part of the model

Table 4.34: EX-ANTE and EX-POST forecast of monthly prices of turmeric in Sangli market

(₹/qtl.)

Year	Actual	Predicted	Year	Actual	Predicted
Jan 2009	4800	4518	Jul 2011	8083	8009
Feb 2009	5114	5216	Aug 2011	6576	7509
Mar 2009	5483	5064	Sep 2011	5339	5616
Apr 2009	5899	5454	Oct 2011	5823	5136
May 2009	5738	5999	Nov 2011	5588	5176
Jun 2009	5080	5811	Dec 2011	5336	5607
Jul 2009	6004	4894	Jan 2012	5603	5884
Aug 2009	8386	5908	Feb 2012	6121	4831
Sep 2009	8277	8874	Mar 2012	5951	6005
Oct 2009	9081	8689	Apr 2012	5252	5613
Nov 2009	9000	9428	May 2012	4966	4920
Dec 2009	10000	9169	Jun 2012	4142	4369
Jan 2010	12874	10813	Jul 2012	6138	3830
Feb 2010	11635	13769	Aug 2012	5965	6120
Mar 2010	12312	11824	Sep 2012	5535	5715
Apr 2010	12966	12528	Oct 2012	4918	6035
May 2010	15015	13145	Nov 2012	5247	4685
Jun 2010	15398	15326	Dec 2012	5332	5441
Jul 2010	15091	15951	Jan 2013	6123	6083
Aug 2010	14590	15739	Feb 2013	7028	5966
Sep 2010	13439	14618	Mar 2013		5940
Oct 2010	14811	13551	Apr 2013		5677
Nov 2010	14129	14838	May 2013		5569
Dec 2010	15409	14269	Jun 2013		5116
Jan 2011	16442	16550	Jul 2013		5400
Feb 2011	14083	16512	Aug 2013		5251
Mar 2011	13803	13919	Sep 2013		4876
Apr 2011	12516	13631	Oct 2013		5042
May 2011	10745	12489	Nov 2013		4965
Jun 2011	8786	10087	Dec 2013		5134

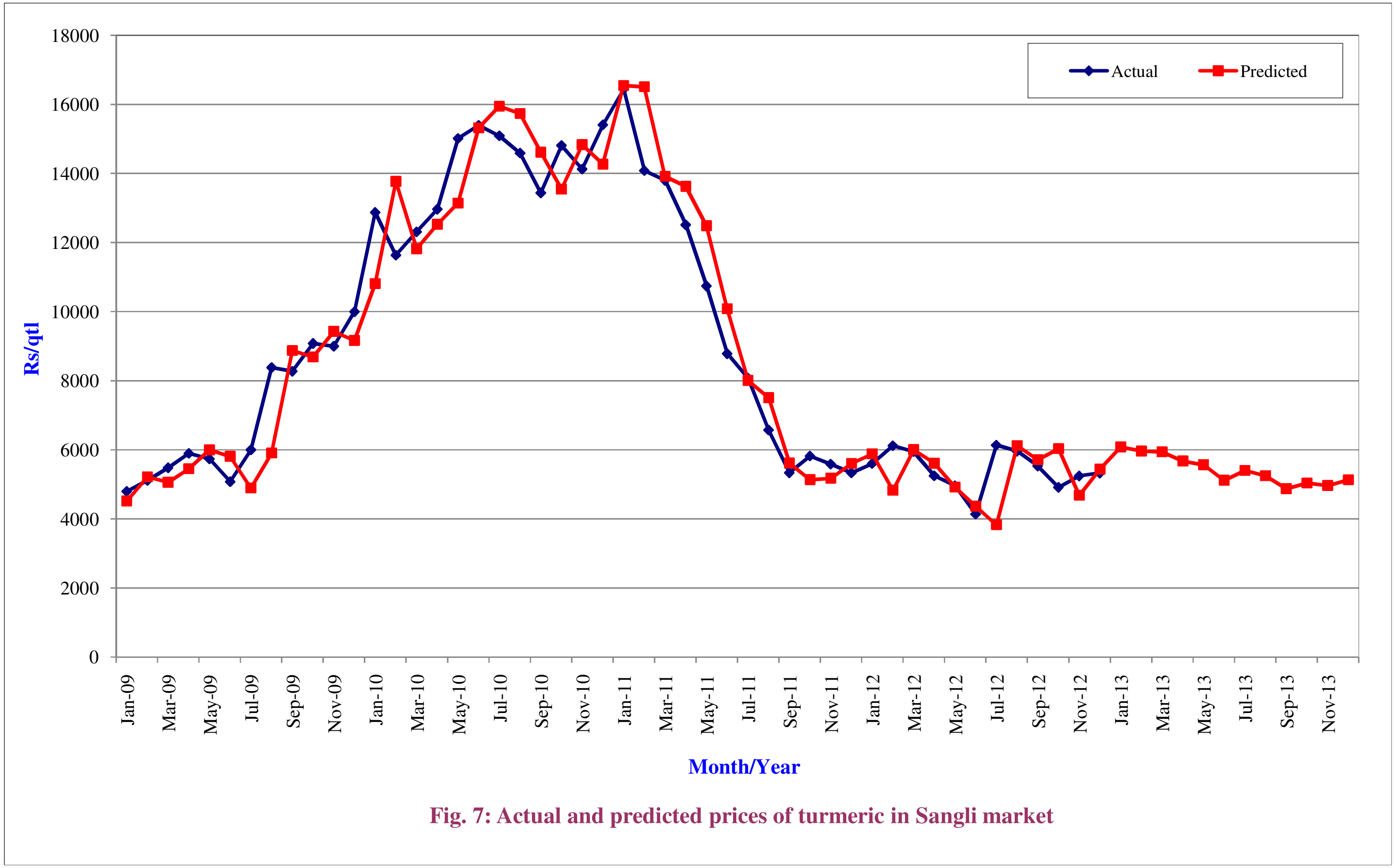

Fig.7: Actual and predicted prices of turmeric in Sangli market

Table 4.35: EX-ANTE and EX-POST forecast of monthly prices of turmeric in Chamarajanagar market

(₹/qtl.)

Year	Actual	Predicted	Year	Actual	Predicted
Jan 2009	4060	4267	Jul 2011	5682	2384
Feb 2009	4060	4268	Aug 2011	5751	5375
Mar 2009	4656	4421	Sep 2011	3625	4617
Apr 2009	5252	4474	Oct 2011	4100	2492
May 2009	4820	5646	Nov 2011	4211	5180
Jun 2009	4773	4951	Dec 2011	3296	4838
Jul 2009	5224	4904	Jan 2012	3245	3540
Aug 2009	5376	5339	Feb 2012	3951	3489
Sep 2009	5000	5492	Mar 2012	3120	4277
Oct 2009	5650	4992	Apr 2012	3237	3446
Nov 2009	9400	5642	May 2012	2944	2752
Dec 2009	7800	9728	Jun 2012	2828	2721
Jan 2010	8500	7817	Jul 2012	4799	3268
Feb 2010	9000	8517	Aug 2012	5701	4885
Mar 2010	9250	9613	Sep 2012	5860	3593
Apr 2010	9757	9863	Oct 2012	4874	6352
May 2010	10746	9342	Nov 2012	4874	5003
Jun 2010	12018	10716	Dec 2012	4666	3977
Jul 2010	9126	12486	Jan 2013	5328	4633
Aug 2010	8802	9296	Feb 2013	4916	5356
Sep 2010	7651	8443	Mar 2013	5998	4542
Oct 2010	6500	8318	Apr 2013		4677
Nov 2010	7563	10267	May 2013		4401
Dec 2010	8172	5980	Jun 2013		4302
Jan 2011	8398	8889	Jul 2013		6290
Feb 2011	8625	8916	Aug 2013		7210
Mar 2011	8933	8892	Sep 2013		7386
Apr 2011	9241	9458	Oct 2013		6418
May 2011	5500	10247	Nov 2013		6435
Jun 2011	5259	6789	Dec 2013		6244

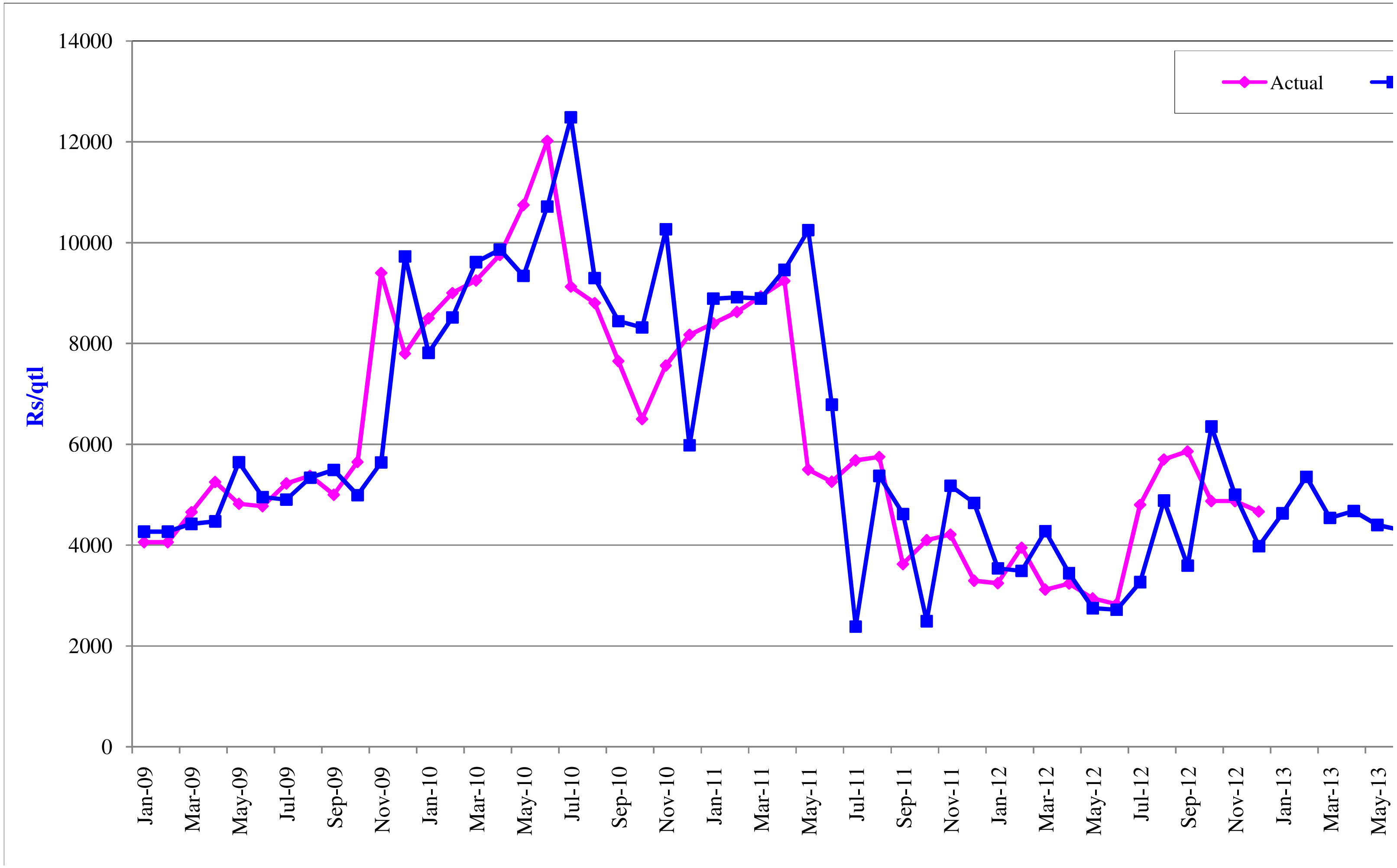

Fig.8: Actual and predicted prices of turmeric in Chamarajnagar market

Table 4.36: EX-ANTE and EX-POST forecast of monthly prices of turmeric in Gundlupet market

(₹/qtl.)

Year	Actual	Predicted	Year	Actual	Predicted
Jan 2009	2822	3823	Jul 2011	7503	6778
Feb 2009	2550	2847	Aug 2011	6552	6693
Mar 2009	3093	2366	Sep 2011	5033	4780
Apr 2009	2250	3340	Oct 2011	5213	6761
May 2009	2800	3021	Nov 2011	4521	4935
Jun 2009	4000	3538	Dec 2011	4041	5425
Jul 2009	3775	4181	Jan 2012	4059	4298
Aug 2009	4800	3803	Feb 2012	5248	4300
Sep 2009	6800	5808	Mar 2012	3784	5715
Oct 2009	8800	5848	Apr 2012	3441	1869
Nov 2009	8200	10273	May 2012	3539	3179
Dec 2009	8750	8356	Jun 2012	3954	1648
Jan 2010	10000	8506	Jul 2012	4420	4432
Feb 2010	10000	9756	Aug 2012	4026	3497
Mar 2010	10000	10571	Sep 2012	6535	2535
Apr 2010	13880	9185	Oct 2012	5276	6743
May 2010	14885	14458	Nov 2012	4880	4612
Jun 2010	16440	16113	Dec 2012	5054	4428
Jul 2010	16138	16243	Jan 2013	5406	5101
Aug 2010	15300	17191	Feb 2013	6017	6318
Sep 2010	13500	17328	Mar 2013	6665	4881
Oct 2010	15200	15528	Apr 2013		4567
Nov 2010	14894	14628	May 2013		4692
Dec 2010	15770	15472	Jun 2013		5135
Jan 2011	16000	17048	Jul 2013		5629
Feb 2011	10765	16028	Aug 2013		5263
Mar 2011	11204	10793	Sep 2013		7800
Apr 2011	9262	15112	Oct 2013		6569
May 2011	8971	10295	Nov 2013		6201
Jun 2011	7053	10554	Dec 2013		6403

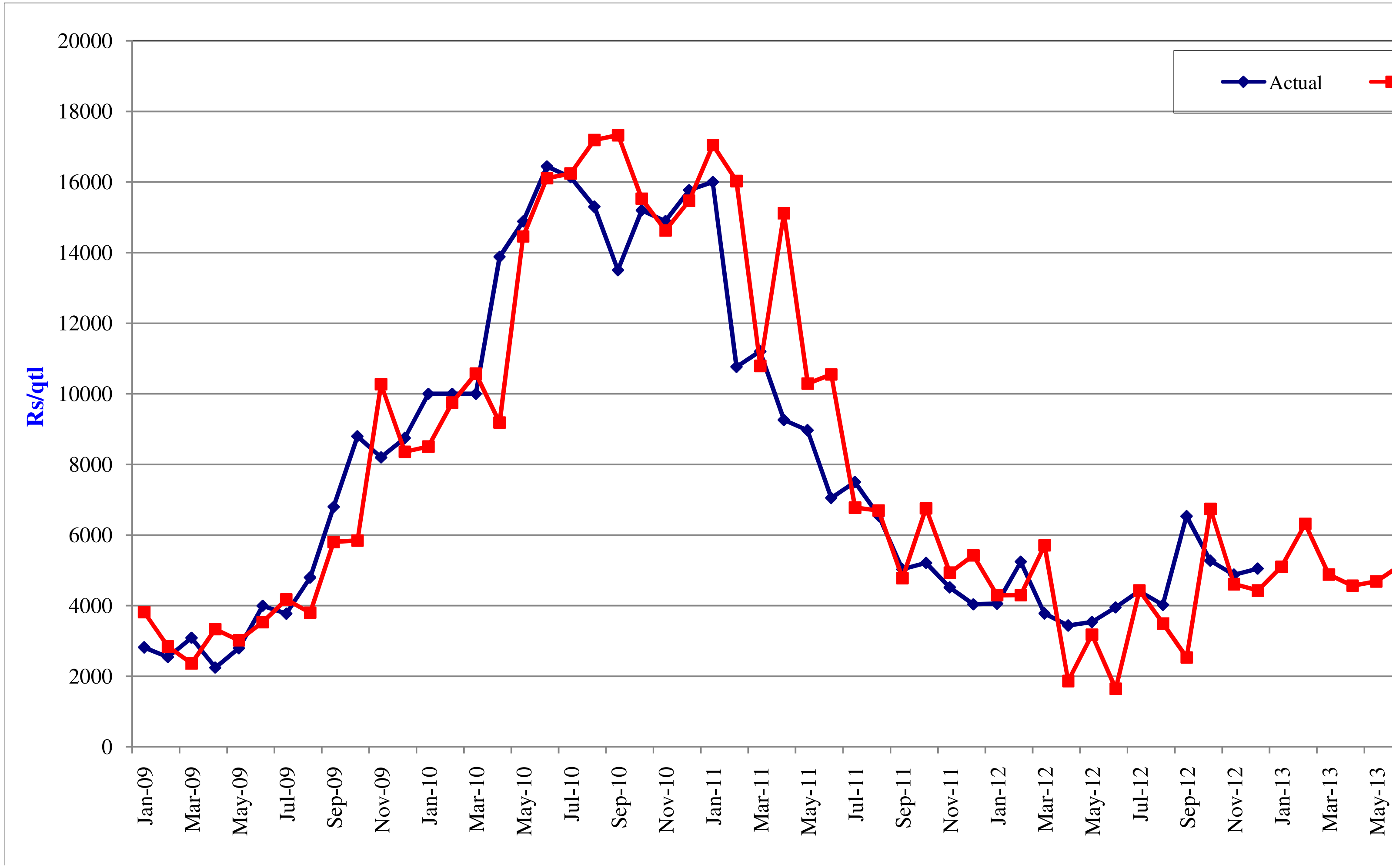

Fig.9: Actual and predicted prices of turmeric in Gundlupet market

Table 4.37: EX-ANTE and EX-POST forecast of monthly prices of turmeric in Kollegal market

(₹/qtl.)

Year	Actual	Predicted	Year	Actual	Predicted
Jan 2009	3800	3380	Jul 2011	5967	6416
Feb 2009	3842	4289	Aug 2011	5716	6983
Mar 2009	3900	3472	Sep 2011	5000	4732
Apr 2009	2100	4209	Oct 2011	5000	5016
May 2009	1900	2409	Nov 2011	4000	5016
Jun 2009	3000	1701	Dec 2011	4200	5683
Jul 2009	5000	3640	Jan 2012	4200	3049
Aug 2009	4750	5430	Feb 2012	4150	3716
Sep 2009	6600	5032	Mar 2012	4150	4213
Oct 2009	8500	5487	Apr 2012	4000	2262
Nov 2009	8000	9556	May 2012	3600	3651
Dec 2009	8500	7466	Jun 2012	4000	2238
Jan 2010	10000	9066	Jul 2012	4800	3583
Feb 2010	9500	10058	Aug 2012	4600	4565
Mar 2010	9000	9574	Sep 2012	5500	3900
Apr 2010	10000	7216	Oct 2012	6200	5516
May 2010	10000	9816	Nov 2012	5500	5216
Jun 2010	10000	11116	Dec 2012	4700	5716
Jul 2010	10000	12016	Jan 2013	4913	4716
Aug 2010	11000	9766	Feb 2013	5691	4682
Sep 2010	10000	12866	Mar 2013	4912	4698
Oct 2010	10000	11916	Apr 2013		4564
Nov 2010	10000	9516	May 2013		4179
Dec 2010	11667	10516	Jun 2013		4595
Jan 2011	10500	13183	Jul 2013		5411
Feb 2011	10000	10016	Aug 2013		5227
Mar 2011	10047	9516	Sep 2013		6143
Apr 2011	8143	11063	Oct 2013		6859
May 2011	7778	8159	Nov 2013		6175
Jun 2011	6400	7794	Dec 2013		5391

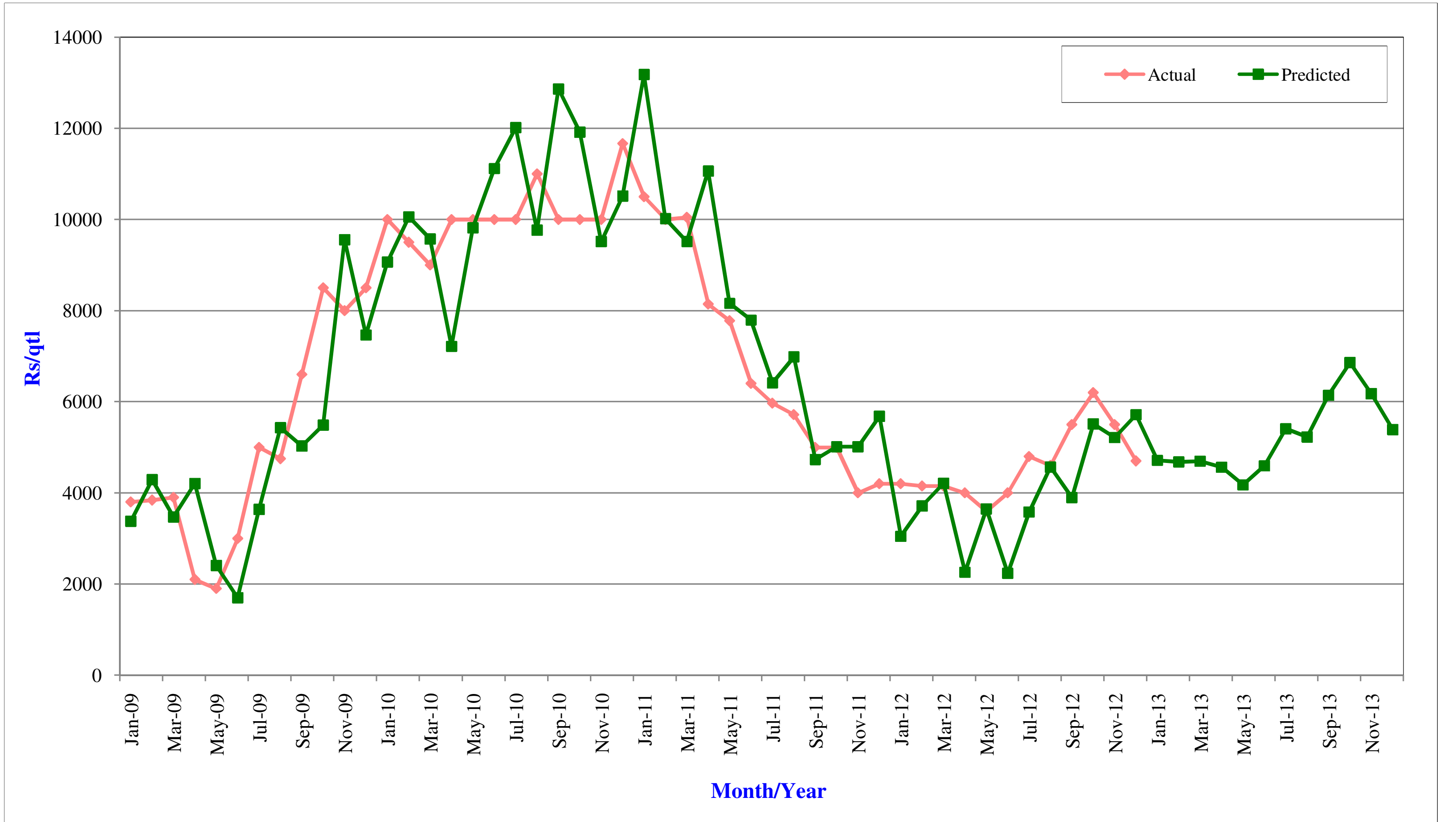

Fig. 10: Actual and predicted prices of turmeric in Kollegal market

Fig.10: Actual and predicted prices of turmeric in Kollegal market

4.5.7.7 Forecasting of turmeric prices in New York market

The accuracy of the forecast depends upon selection of model (Table 4.33 and Fig. 13) used in the forecast and the model (110,110) indicated the lowest values of AIC (2197) and SBC (2206). The forecasting was done up to December 2013 and the results depicted in the Table 4.40 indicated that there was thin variation among actual and predicted prices of turmeric in New York market. The actual price of the turmeric was ₹ 28859 per quintal during January 2012 and was declined substantially to ₹ 18089 per quintal. Similarly the forecasted prices also showed the declining trend in the prices of turmeric. The future price would decline from ₹ 16536 per quintal during January 2013 to ₹12933 during August 2013 and it may increase marginally to ₹13664 in the month of December 2013.

4.6 Export performance of turmeric in India

Different dimensions of export of turmeric have been explained under different heads.

4.6.1 Growth rate and instability analysis of turmeric export from India

The growth rate and instability index of turmeric export in both quantity and value terms period from 1974-75 to 2010-11 is presented in Table 4.41. The results revealed that the growth rate in turmeric export during pre-WTO period the export of turmeric in terms of quantity increased at 3.49 per cent per annum with an average quantity of about 15231 tonnes, while value wise it increased at the rate of 11.69 per cent per annum with an average value of about ₹ 1784 lakh. Whereas during post-WTO period quantity wise export of turmeric was increasing at the rate of 4.70 per cent per annum with an average quantity of about 49250 tonnes and value wise the growth rate of turmeric was increasing at the rate of 13.20 per cent per annum with an average value of about ₹17786 lakh. In the overall period, the growth rate of export quantity of turmeric is increasing at the rate of 5.20 per cent per annum with an average quantity of about 26181 tonnes and export value is increasing at the rate of 13.29 per cent per annum with average value of about ₹ 8704 lakh. All the growth rate values were found to be significant at one per cent level.

The instability index of export quantity of turmeric was higher in pre-WTO period (33.47%) than both post-WTO (9.30%) and overall (24.72%) periods and with regard to instability index of export value of turmeric, it was higher during post-WTO period (90.51%) than both pre-WTO (46.66%) and overall (42.55%) periods.

4.6.2 Direction of trade of turmeric export from India

The transitional probability matrix presented in Tables 4.42 to 4.45, depicts a broad idea of change in the direction of trade of Indian turmeric during pre-WTO and post-WTO period. The five major countries which imported Indian turmeric were: UAE, USA, UK, Iran and Japan. The export to remaining countries was pooled under the category of 'other countries'. It could be seen from Table 4.42, that during pre-WTO period, 'other countries' were the most stable importers of Indian turmeric as they retained their original share of about 59.74 per cent from the previous year. They lost their share of about 21.73 per cent to UAE, 10.81 per cent to Iran, 6.50 per cent to Japan and 1.22 per cent to UK even though the other countries gained considerable amount from UAE (72.43%) and Iran (41.99%).

UK is another stable importer of Indian turmeric as it retained 39.91 per cent of its share from previous year by losing 39.79 per cent to USA and 20.30 per cent to Japan, even though it gained considerable share from Japan (19.31%), Iran (15.08%), UAE (5.61%) and other countries (1.22%). UAE is least stable importer of Indian turmeric because it retained only 3.99 per cent of its share from the previous year by losing 72.43 per cent share to other countries, 9.29 per cent to Japan, 8.68 per cent to USA and 5.61 per cent to UK but it gained 100.00 per cent share from USA, followed by Japan (61.43%) and other countries (21.73%). Iran was another least stable importer of Indian turmeric as it retained only 0.98 per cent of its share from the previous year. It lost its major share to other countries (41.99%) followed by USA (23.82%), Japan (18.13%) and UK (15.08%) but it gained little amount of share from other countries (10.81%). USA and Japan were the most unstable importers of Indian turmeric during the pre-WTO period as both the countries did not retain any amount of their share from the previous year.

On the contrary UAE was found to be the most stable importer of Indian turmeric when we analysed the direction of trade by considering only top five countries as it retained 43.84 per cent of its share from the previous year during pre-WTO period (Table 4.43) by losing 23.19 per cent to USA, 16.61 per cent to Japan and 16.37 per cent to UK. It gained 70.59 per cent from UAE followed by USA (52.62%), UK (43.04%) and Iran (23.24%). UK and Iran were found to be least stable importers of Indian turmeric as they retained only 13.94 per cent and 3.96 per cent of their share from the previous year respectively. Whereas, USA and Japan were found to be unstable importers of Indian turmeric as they did not retain any amount of their share from the previous year by losing their major share to UAE.

Whereas it could be seen from the Table 4.44 (Post-WTO period) that Japan was unstable importer of Indian turmeric as it did not retain any of its original share from the previous year. The Japan would lose its share of 87.09 per cent to the UAE and 12.91 per cent share to USA, even though Japan gained considerable share from USA (38.36%), Iran (21.43%), other countries (3.29%) and UAE (1.10%). The USA was found to be one of the stable importers of Indian turmeric because it retained its original share of around 48.68 per cent over the period. It lost its major share of 38.36 per cent to Japan, 10.05 per cent to other countries and 2.90 per cent to UK by gaining 12.91 per cent from Japan, 9.89 per cent from UAE and 1.24 per cent from the other countries.

UK is another stable importer of Indian turmeric because it retained its original share of 32.40 per cent by losing 67.60 per cent of its shares to UAE and it gained 5.65 per cent from other countries, 2.90 per cent from USA and 1 per cent from Iran. Iran is also one of the stable importer of Indian turmeric as it retained 55.57 per cent of its original share. It lost its major share to other countries (22.00%) followed by Japan (21.43%) and UK (1%). On the other hand it gained little amount of share from UAE (4.60%) and other countries (4.57%).

The UAE has retained 35.66 per cent of its original share and it is the one of the stable importers of Indian turmeric. It lost its major share to other countries category (48.75%) and to some extent to Iran, USA and Japan. But it gained high share of 87.09 per cent from Japan, followed by UK (67.60%) and others (1.79%). The countries pooled under the ‘Other’ category retained 83.45 per cent of their original share, which implied that even though they import in lower quantities, there was high stability, they have retained most of their original share. It gained 48.75 per cent of the UAE, 22.00 per cent of Iran share and 10.05 per cent of USA share.

Similarly Iran was the most stable importer of Indian turmeric during post-WTO period when we analysed the direction of trade by considering only top five countries as it retained 56.19 per cent of its share from the previous year (Table 4.45). It lost 19.23 per cent of its share to UK followed by Japan, USA and UAE. USA, UK, and UAE were also found to be stable importers as they retained 55.47 per cent, 55.68 per cent and 39.04 per cent of their share from the previous year respectively. Whereas, Japan was found to be the least stable importer of Indian turmeric as it retained only 7.96 per cent of its share from the previous year by losing its major share to UAE (92.04%).

4.6.3 Projections of Indian turmeric export to major importing countries

The projection of the Indian turmeric export to different countries was computed using the transitional probability matrix and the results of actual and projected exports of Indian turmeric have been presented in Table 4.46 and Fig. 14-19. The market share projections of turmeric exports to different countries have been computed up to 2014. Even though the total quantity increased, the percentage share of actual and estimated export of turmeric to USA declined between 1999-2000 and 2010-11. However, the projected value suggests that the percentage of quantity would slightly increase from 5.06 per cent in 2010-11 to 5.96 per cent by 2014-15. In the case of UK, the actual export had increased from 1999-2000 to 2010-11 and the estimated value showed that the share of UK was increased for the same period and the projected market share is expected to decrease during 2010-11 to 2014-15 from 5.80 per cent to 5.26 per cent. In the case of Iran, the actual and estimated export had increased from 1999-2000 to 2010-11. The projected market share was expected to decrease marginally from 8.06 per cent to 8.05 per cent during 2010-11 to 2014-15. In the case of Japan, the actual export value had increased between 1999-2000 and 2010-11 and also projected value from 5.68 per cent to 6.16 per cent during 2010-11 to 2014-15. The actual export share of turmeric to UAE had decreased drastically from 21.61 per cent in 1999-2000 to 16.51 per cent in 2010-11. However, the estimated value decreased from 17.67 per cent in 1999-2000 to 15.67 per cent in 2010-11. The projected market share is also expected to decrease marginally from 15.67 per cent to 15.58 per cent during 2010-11 to 2014-15. The actual export share to the countries pooled under ‘others’ showed a decrease during 1999-2000 to 2010-11 from 57.06 to 54.83 per cent. The projected market share is also expected to decrease to less extent from 2010-11 to 2014-15.

Table 4.38: EX-ANTE and EX-POST forecast of monthly prices of turmeric in Erode market

(₹/qtl.)

Year	Actual	Predicted	Year	Actual	Predicted
Jan 2009	4216	3985	Jul 2011	7162	6571
Feb 2009	4324	4300	Aug 2011	5838	7810
Mar 2009	4662	4277	Sep 2011	4737	4686
Apr 2009	5257	4721	Oct 2011	5398	5334
May 2009	5299	5303	Nov 2011	4641	5697
Jun 2009	5328	5322	Dec 2011	4193	4458
Jul 2009	5804	5467	Jan 2012	4226	3997
Aug 2009	8234	5833	Feb 2012	4578	3491
Sep 2009	8209	9059	Mar 2012	3688	4736
Oct 2009	8190	7309	Apr 2012	3383	3291
Nov 2009	13290	8995	May 2012	3544	3546
Dec 2009	12095	14318	Jun 2012	3582	3143
Jan 2010	10900	10679	Jul 2012	5337	3939
Feb 2010	10216	11790	Aug 2012	6263	5536
Mar 2010	9899	9138	Sep 2012	5943	6096
Apr 2010	14035	10837	Oct 2012	5302	5871
May 2010	15116	14607	Nov 2012	5079	5553
Jun 2010	14889	14946	Dec 2012	5214	4826
Jul 2010	14927	15114	Jan 2013	6134	5250
Aug 2010	14009	15204	Feb 2013	5987	4704
Sep 2010	13826	13618	Mar 2013	6925	4503
Oct 2010	14050	14026	Apr 2013		4632
Nov 2010	14907	14833	May 2013		4564
Dec 2010	16154	14725	Jun 2013		4435
Jan 2011	15548	16408	Jul 2013		4755
Feb 2011	11289	14798	Aug 2013		4828
Mar 2011	10343	10289	Sep 2013		4625
Apr 2011	9550	11584	Oct 2013		4492
May 2011	7999	8589	Nov 2013		4863
Jun 2011	7170	8371	Dec 2013		4744

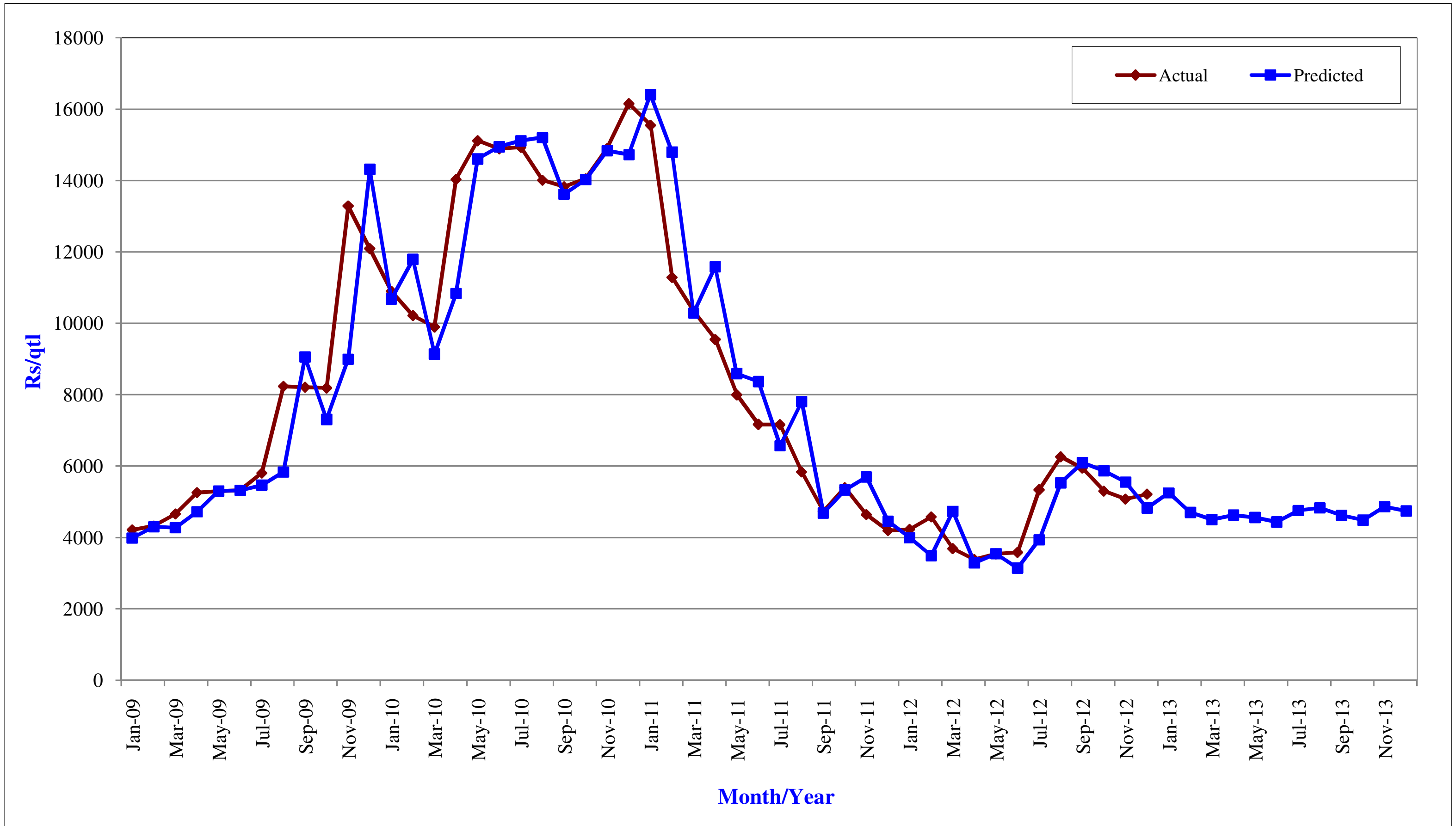

Fig. 11: Actual and predicted prices of turmeric in Erode market

Fig.11: Actual and predicted prices of turmeric in Erode market

Table 4.39: EX-ANTE and EX-POST forecast of monthly prices of turmeric in Kochi market

(₹/qtl.)

Year	Actual	Predicted	Year	Actual	Predicted
Jan 2009	4650	4333	Jul 2011	8340	7447
Feb 2009	4650	4929	Aug 2011	7900	8935
Mar 2009	4867	4472	Sep 2011	6162	7417
Apr 2009	4867	4938	Oct 2011	5980	5725
May 2009	4710	4867	Nov 2011	5850	6283
Jun 2009	4838	4550	Dec 2011	5530	6142
Jul 2009	4838	4866	Jan 2012	5025	4871
Aug 2009	5938	4961	Feb 2012	5412	4791
Sep 2009	6128	6379	Mar 2012	5080	5542
Oct 2009	8200	5921	Apr 2012	4375	4728
Nov 2009	9583	9168	May 2012	4038	4376
Dec 2009	10500	9818	Jun 2012	4000	3677
Jan 2010	8650	10554	Jul 2012	5450	4020
Feb 2010	8917	7919	Aug 2012	7000	6208
Mar 2010	9313	9318	Sep 2012	6910	7144
Apr 2010	9750	9209	Oct 2012	6662	6883
May 2010	12812	9987	Nov 2012	6700	6713
Jun 2010	13375	13983	Dec 2012	5920	7087
Jul 2010	13000	13008	Jan 2013		4993
Aug 2010	13000	13234	Feb 2013		4748
Sep 2010	12688	12917	Mar 2013		4577
Oct 2010	12658	12734	Apr 2013		4367
Nov 2010	13563	12742	May 2013		4468
Dec 2010	17000	14068	Jun 2013		4261
Jan 2011	17180	17849	Jul 2013		4272
Feb 2011	13458	16998	Aug 2013		4518
Mar 2011	12125	11907	Sep 2013		4312
Apr 2011	11240	12165	Oct 2013		4348
May 2011	10062	11146	Nov 2013		4475
Jun 2011	8192	9565	Dec 2013		4750

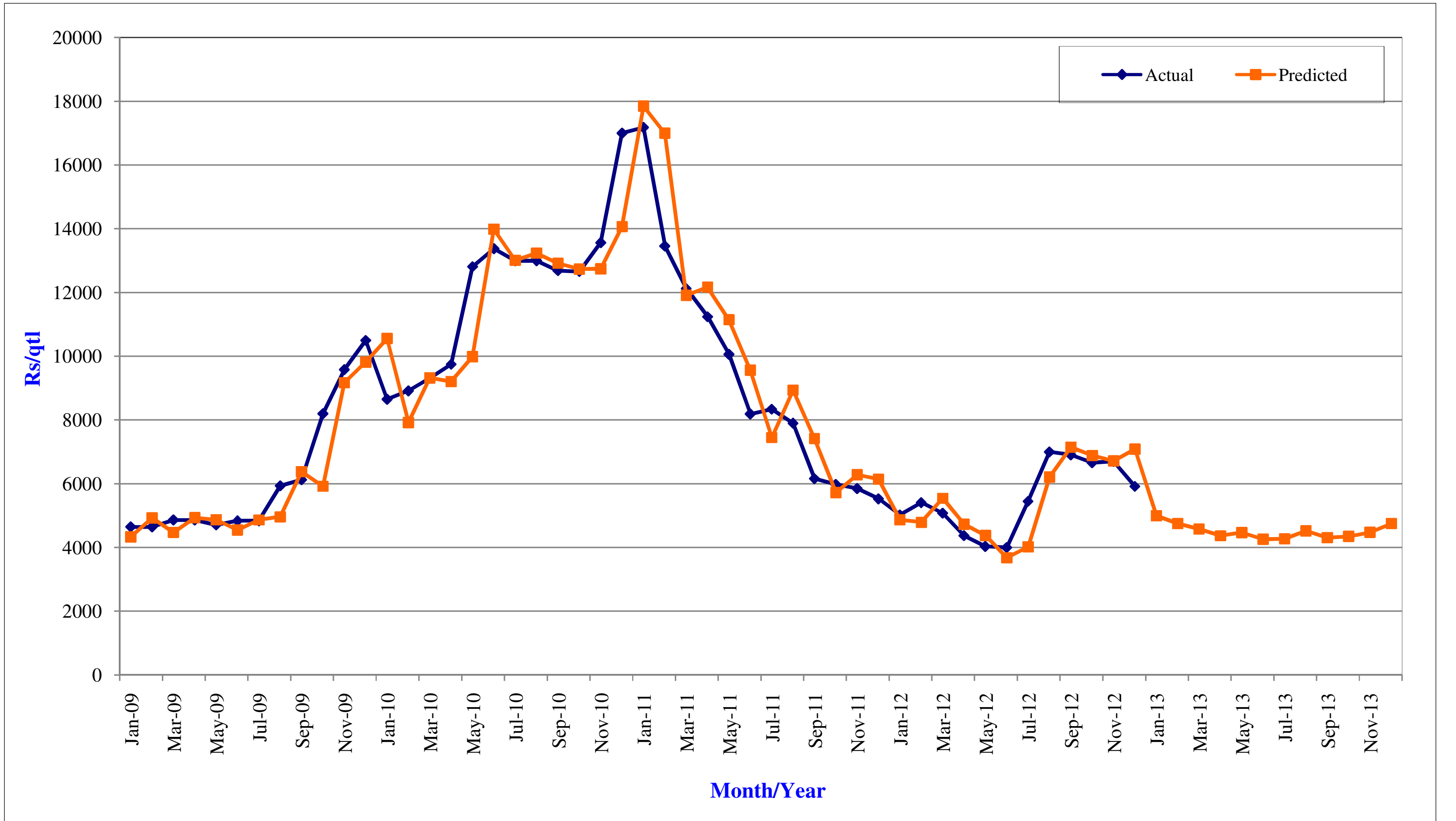

Fig. 12: Actual and predicted prices of turmeric in Kochi market

Fig.12: Actual and predicted prices of turmeric in Kochi market

Table 4.40: EX-ANTE and EX-POST forecast of monthly prices of turmeric in New York market

(₹/qtl.)

Year	Actual	Predicted	Year	Actual	Predicted
Jan 2009	9131	8598	Jul 2011	27407	27543
Feb 2009	9204	9085	Aug 2011	27440	28208
Mar 2009	9269	9262	Sep 2011	28870	27437
Apr 2009	9360	9019	Oct 2011	29882	29503
May 2009	9075	9489	Nov 2011	29691	31118
Jun 2009	9073	8944	Dec 2011	29660	29382
Jul 2009	9073	8858	Jan 2012	28859	28976
Aug 2009	10683	9130	Feb 2012	27628	28756
Sep 2009	11771	11472	Mar 2012	26166	27737
Oct 2009	11727	12290	Apr 2012	18285	27842
Nov 2009	12357	11487	May 2012	19228	17532
Dec 2009	12357	12942	Jun 2012	18546	18134
Jan 2010	12970	12218	Jul 2012	18367	18055
Feb 2010	13065	13229	Aug 2012	18390	18509
Mar 2010	14560	13121	Sep 2012	18076	18776
Apr 2010	17444	15109	Oct 2012	17550	18499
May 2010	22534	18684	Nov 2012	18132	17597
Jun 2010	23094	24658	Dec 2012	18089	18307
Jul 2010	23233	23254	Jan 2013	17980	16536
Aug 2010	23611	23992	Feb 2013	17798	15860
Sep 2010	23352	24171	Mar 2013	19747	14961
Oct 2010	24008	23165	Apr 2013		12515
Nov 2010	25391	24525	May 2013		13988
Dec 2010	25890	25585	Jun 2013		13370
Jan 2011	24020	26465	Jul 2013		12988
Feb 2011	24038	23125	Aug 2013		12933
Mar 2011	23800	24684	Sep 2013		13479
Apr 2011	26134	24722	Oct 2013		13702
May 2011	28216	28672	Nov 2013		13783
Jun 2011	27807	28382	Dec 2013		13664

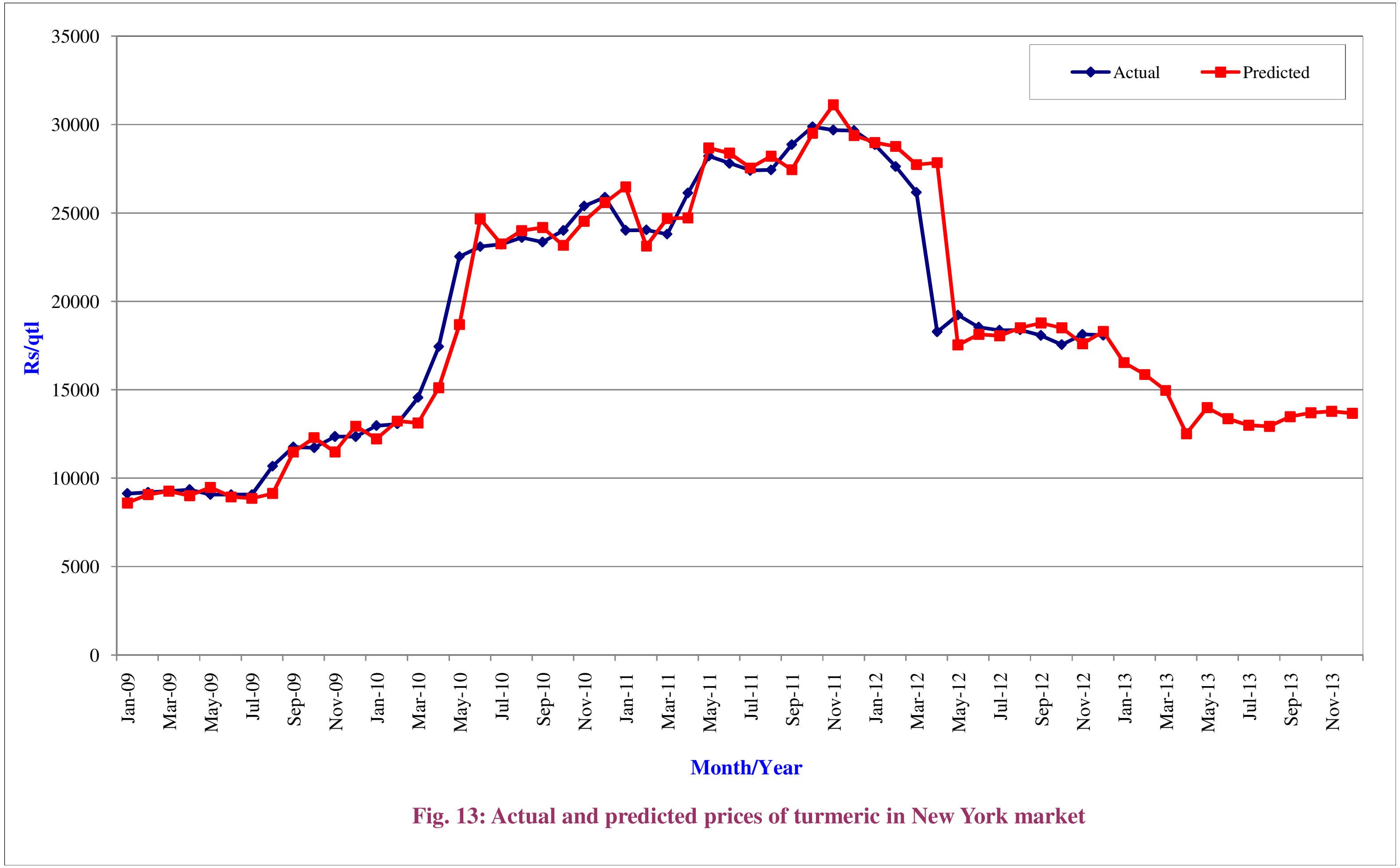

Fig.13: Actual and predicted prices of turmeric in New York market

Table 4.41: Compound growth rates and instability in export quantity and value of Indian turmeric

Period	Compound growth rate (Per cent)		Instability index (Per cent)	
	Export quantity (Tonnes)	Export value (₹ in lakh)	Export quantity	Export value
Pre-WTO period (1974-75 to 1994-95)	3.49** (15231)	11.69** (1784)	33.47	46.66
Post-WTO period (1995-96 to 2010-11)	4.70** (49250)	13.20** (17786)	9.30	90.51
Overall period (1974-75 to 2010-11)	5.20** (26181)	13.29** (8704)	24.72	42.55

*Note: **, Denote significant at 1 per cent level.*
Figures in the parentheses indicate the average of respective years

Table 4.42: Transitional probability matrix of Indian turmeric export in pre-WTO period (1983-84 to 1994-95)

Countries	USA	UK	IRAN	JAPAN	UAE	OTHERS
USA	**0.0000**	0.0000	0.0000	0.0000	1.0000	0.0000
UK	0.3979	**0.3991**	0.0000	0.2030	0.0000	0.0000
IRAN	0.2382	0.1508	**0.0098**	0.1813	0.0000	0.4199
JAPAN	0.1926	0.1931	0.0000	**0.0000**	0.6143	0.0000
UAE	0.0868	0.0561	0.0000	0.0929	**0.0399**	0.7243
OTHERS	0.0000	0.0122	0.1081	0.0650	0.2173	**0.5974**

Table 4.43: Transitional probability matrix of Indian turmeric export to top five countries during pre-WTO period (1983-84 to 1994-95)

Countries	USA	UK	IRAN	JAPAN	UAE
USA	**0.0000**	0.0000	0.4738	0.0000	0.5262
UK	0.1833	**0.1394**	0.0000	0.2469	0.4304
IRAN	0.4455	0.1127	**0.0396**	0.1698	0.2324
JAPAN	0.0417	0.2524	0.0000	**0.0000**	0.7059
UAE	0.2319	0.1637	0.0000	0.1661	**0.4384**

Table 4.44: Transitional probability matrix of Indian turmeric export in post-WTO period: 1995-96 to 2010-11

Countries	USA	UK	IRAN	JAPAN	UAE	OTHERS
USA	**0.4868**	0.0290	0.0000	0.3836	0.0000	0.1005
UK	0.0000	**0.3240**	0.0000	0.0000	0.6760	0.0000
IRAN	0.0000	0.0100	**0.5557**	0.2143	0.0000	0.2200
JAPAN	0.1291	0.0000	0.0000	**0.0000**	0.8709	0.0000
UAE	0.0989	0.0000	0.0460	0.0110	**0.3566**	0.4875
OTHERS	0.0124	0.0565	0.0457	0.0329	0.0179	**0.8345**

Table 4.45: Transitional probability matrix of Indian turmeric export to top five countries during post-WTO period (1995-96 to 2010-11)

Countries	USA	UK	IRAN	JAPAN	UAE
USA	**0.5547**	0.0848	0.0000	0.2137	0.1469
UK	0.0000	**0.5568**	0.0482	0.0000	0.3951
IRAN	0.0610	0.1923	**0.5619**	0.1746	0.0102
JAPAN	0.0000	0.0000	0.0000	**0.0796**	0.9204
UAE	0.1377	0.0333	0.1994	0.2392	**0.3904**

Table 4.46: Actual and predicted quantity of turmeric export from India to selected countries

Year	USA		UK		IRAN		JAPAN		UAE		OTHERS	
	A	P	A	P	A	P	A	P	A	P	A	P
1999-2000	2427 (6.43)	2381 (6.38)	1676 (4.44)	1903 (5.10)	2077 (5.50)	1985 (5.32)	1878 (4.97)	1853 (4.97)	8162 (21.61)	6591 (17.67)	21555 (57.06)	22584 (60.55)
2000-2001	2584 (5.79)	2499 (6.62)	1837 (4.12)	1853 (4.90)	2971 (6.66)	2516 (6.66)	3027 (6.78)	2175 (5.76)	6044 (13.54)	6066 (16.06)	28165 (63.11)	22667 (60.00)
2001-2002	2739 (7.25)	2596 (5.82)	1842 (4.88)	2292 (5.14)	2724 (7.21)	3217 (7.21)	2559 (6.78)	2621 (5.87)	5272 (13.95)	6539 (14.65)	22641 (59.93)	27362 (61.31)
2002-2003	3914 (12.08)	2467 (6.53)	2006 (6.19)	1983 (5.25)	949 (2.93)	2792 (7.39)	2614 (8.07)	2437 (6.45)	4724 (14.58)	5761 (15.25)	18196 (56.16)	22338 (59.13)
2003-2004	3880 (10.47)	2936 (9.06)	2060 (5.56)	1801 (5.56)	488 (1.32)	1577 (4.87)	2694 (7.27)	2355 (7.27)	7239 (19.54)	5644 (17.42)	20683 (55.83)	18089 (55.83)
2004-2005	2508 (5.82)	3210 (8.66)	2576 (5.98)	1954 (5.28)	800 (1.86)	1550 (4.18)	2686 (6.23)	2353 (6.35)	5215 (12.10)	6692 (18.06)	29312 (68.02)	21286 (57.46)
2005-2006	2635 (5.68)	2448 (5.68)	2772 (5.97)	2572 (5.97)	1447 (3.12)	2025 (4.70)	2608 (5.62)	2155 (5.00)	7361 (15.86)	6466 (15.00)	29582 (63.75)	27430 (63.65)
2006-2007	2492 (4.82)	2715 (5.85)	2893 (5.59)	2661 (5.73)	6095 (11.79)	2496 (5.38)	2632 (5.09)	2375 (5.12)	8133 (15.73)	7301 (15.73)	29467 (56.98)	28857 (62.18)
2007-2008	2649 (5.38)	2724 (5.27)	2461 (5.00)	2736 (5.29)	3709 (7.53)	5109 (9.88)	2797 (5.68)	3321 (6.42)	5151 (10.46)	7677 (14.85)	32483 (65.96)	30145 (58.29)
2008-2009	2532 (4.82)	2564 (5.21)	2927 (5.58)	2748 (5.58)	5335 (10.16)	3784 (7.68)	3090 (5.89)	2936 (5.96)	5911 (11.26)	6519 (13.24)	32705 (62.30)	30699 (62.33)
2009-2010	2285 (4.50)	2623 (5.00)	3340 (6.58)	2924 (5.57)	4255 (8.38)	4732 (9.01)	3149 (6.20)	3256 (6.20)	6719 (13.24)	7364 (14.03)	31002 (61.09)	31601 (60.19)
2010-2011	2492 (5.06)	2569 (5.06)	2893 (5.87)	2944 (5.80)	6095 (12.38)	4091 (8.06)	2632 (5.34)	2882 (5.68)	8133 (16.51)	7953 (15.67)	27005 (54.83)	30311 (59.73)
2011-2012	-	2693 (5.47)	-	2597 (5.27)	-	4996 (10.14)	-	3240 (6.58)	-	7633 (15.50)	-	28091 (57.04)
2012-2013	-	2833 (5.75)	-	2558 (5.19)	-	4412 (8.96)	-	3112 (6.32)	-	7804 (15.84)	-	28532 (57.73)
2013-2014	-	2907 (5.90)	-	2568 (5.21)	-	4116 (8.36)	-	3057 (6.21)	-	7734 (15.70)	-	28868 (58.62)
2014-2015	-	2934 (5.96)	-	2589 (5.26)	-	3963 (8.05)	-	3032 (6.16)	-	7674 (15.58)	-	29058 (59.00)

Note: A-Actual exports in tonnes. P- Predicted exports in tonnes. Figures in the parentheses indicate export share in percent

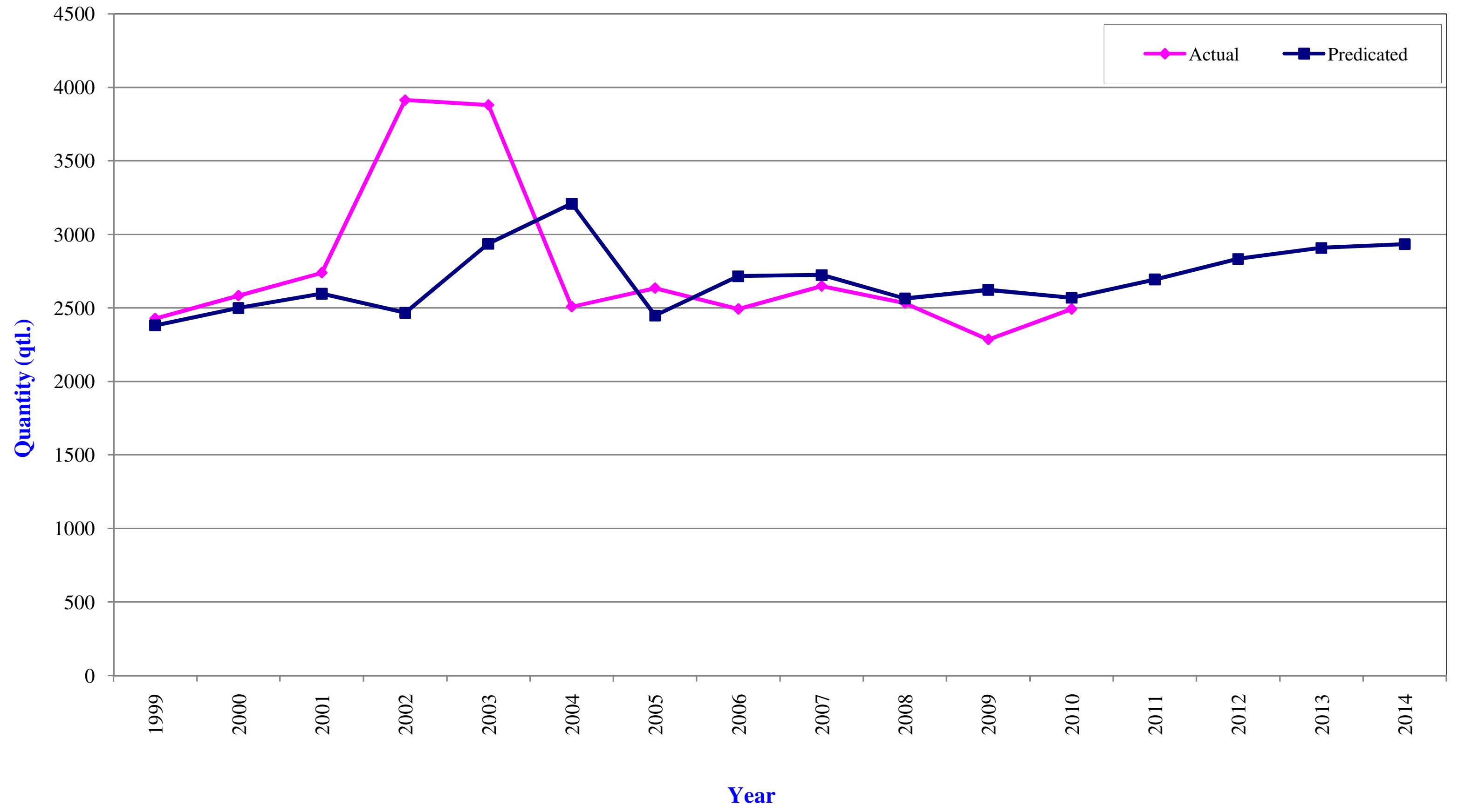

Fig. 14: Actual and predicted quantity of turmeric export to USA

Fig.14: Actual and predicted quantity of turmeric export to USA

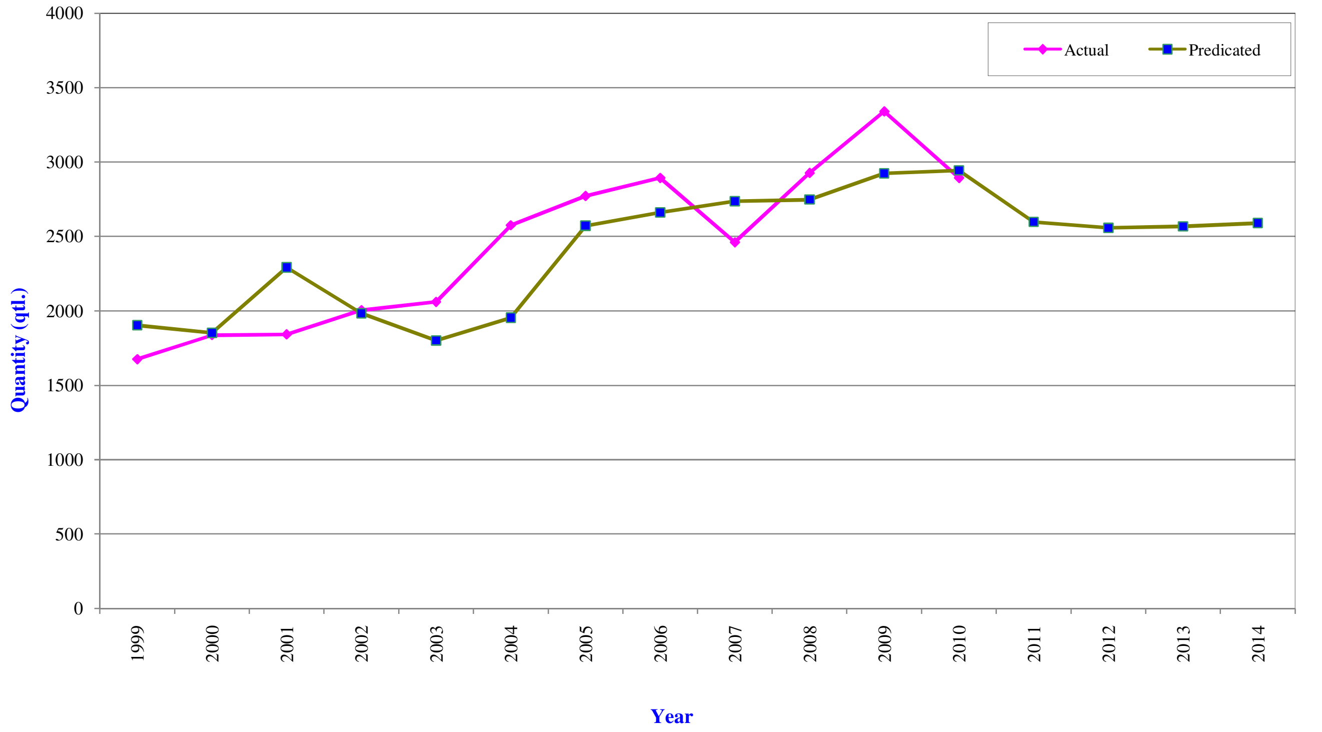

Fig. 15: Actual and predicted quantity of turmeric export to UK

Fig.15: Actual and predicted quantity of turmeric export to UK

Fig.16: Actual and predicted quantity of turmeric export to Iran

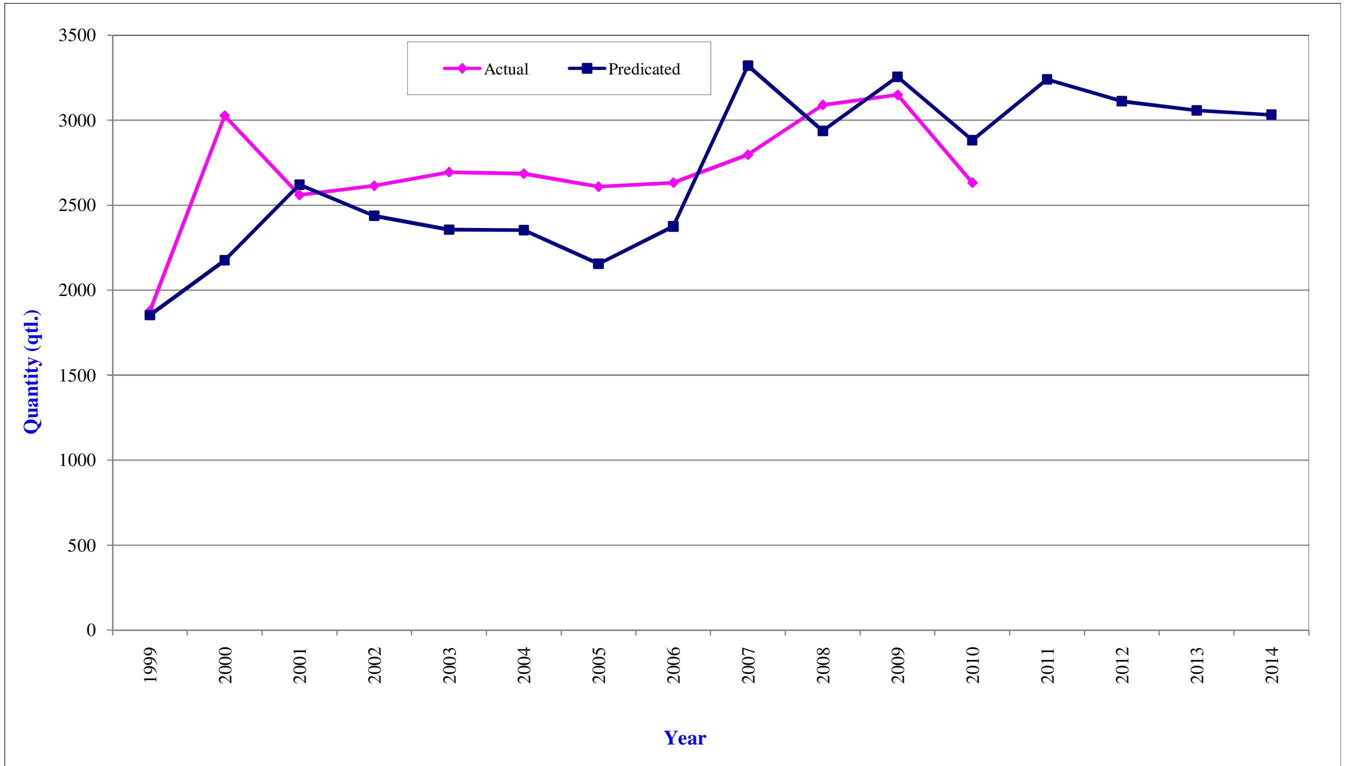

Fig. 17: Actual and predicted quantity of turmeric export to Japan

Fig.17: Actual and predicted quantity of turmeric export to Japan

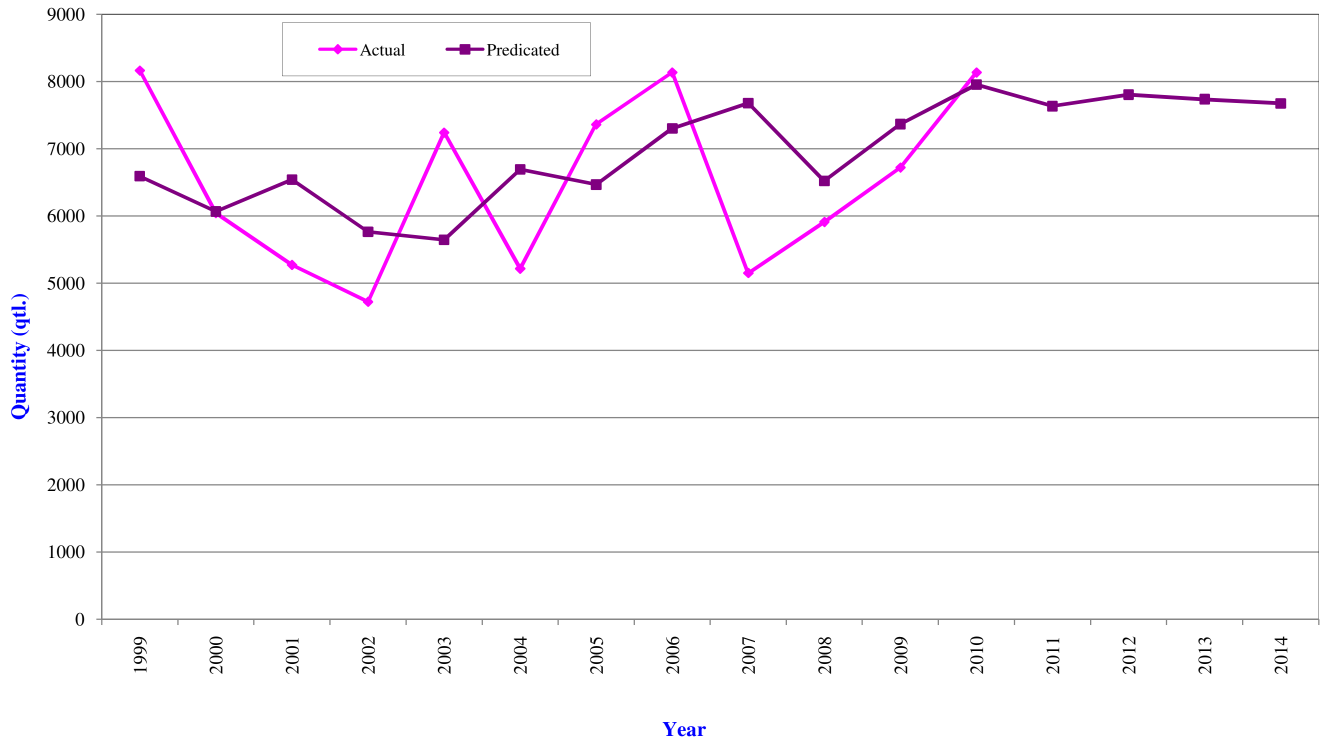

Fig. 18: Actual and predicted quantity of turmeric export to UAE

Fig.18: Actual and predicted quantity of turmeric export to UAE

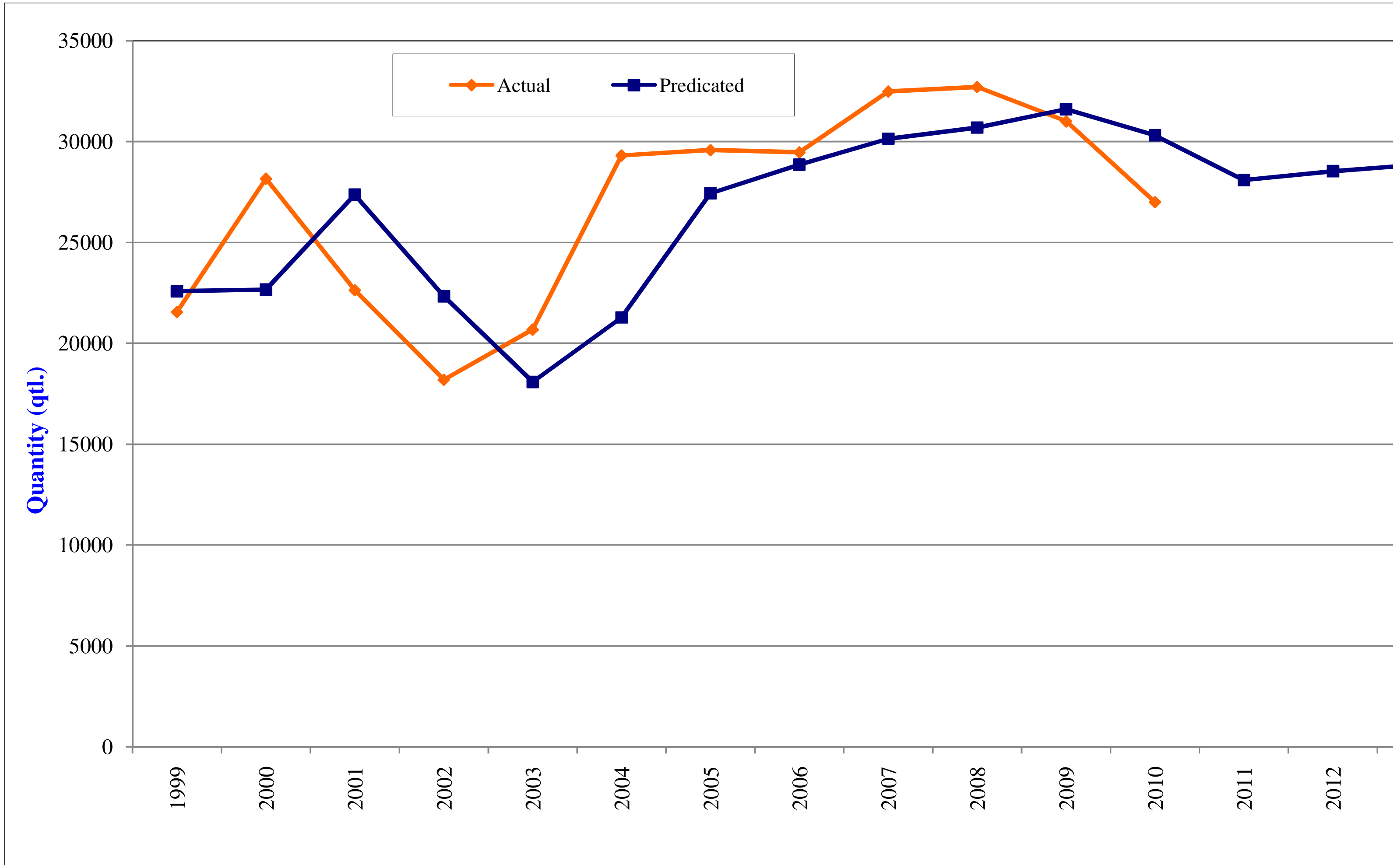

Fig.19: Actual and predicted quantity of turmeric export to other countries

Table 4.47: Nominal protection coefficients for Indian turmeric from 1983-84 to 2012-2013 integrating New York and Kochi markets

Pre-WTO regime (1983-84 to 1994-95)		Post-WTO regime (1995-96 to 2012-13)	
Year	NPC	Year	NPC
1983-84	0.73	1995-96	0.52
1984-85	0.69	1996-97	0.56
1985-86	0.68	1997-98	0.66
1986-87	0.56	1998-99	0.68
1987-88	0.66	1999-00	0.52
1988-89	0.56	2000-01	0.44
1989-90	0.60	2001-02	0.41
1990-91	0.68	2002-03	0.53
1991-92	0.65	2003-04	0.59
1992-93	0.61	2004-05	0.61
1993-94	0.57	2005-06	0.57
1994-95	0.58	2006-07	0.53
		2007-08	0.37
		2008-09	0.49
		2009-10	0.60
		2010-11	0.58
		2011-12	0.34
		2012-13	0.29

Table 4.48: Nominal protection coefficients for Indian turmeric in 2012-13

Sl. No	Variable	Particulars	Place	Values (₹/Qtl)
1	A1	Wholesale price in	Kochi	5548.00
2	A2	Transportation cost		20.00
3	A3	Marketing margin @ 5 %		277.40
4	A4	Port clearing & handling charges		14.00
5	A5	Service charges		4.75
6	A6	FOB Price(1+2+3+4+5)	Kochi	5864.15
7	A7	Freight charge		154.00
8	A8	Insurance at 1% of price		58.64
11	A9	Landed price (6+7+8)		6076.79
12	A10	FOB price	New York	20610
13	A11	NPC (row 11/row 12)		0.29

Table 4.49: Dickey –Fuller test for co-integration of the price series of turmeric in the selected markets

Markets	Domestic markets						International market
	Chamarajanagar	**Erode**	**Gundlupet**	**Kochi**	**Kollegal**	**Sangli**	**New York**
Chamarajanagar(-1)	0.4932 [3.80590*]	-0.1054 [-0.64353]	-0.1203 [-0.64722]	-0.0310 [-0.28245]	-0.0635 [-0.58451]	-0.0549 [-0.41975]	0.1284 [0.65873]
Chamarajanagar (-2)	-0.0604 [-0.46880]	0.0247 [0.15175]	0.0921 [0.49792]	-0.3152 [-2.88061*]	0.0097 [0.09034]	0.0484 [0.37232]	0.1883 [0.97115]
Erode(-1)	-0.0484 [-0.38071]	0.7567 [4.70439*]	0.3581 [1.96193*]	0.4687 [4.33921*]	0.3705 [3.47347*]	0.4085 [3.17924*]	0.1318 [0.68878]
Erode(-2)	0.1252 [0.86616]	-0.1433 [-0.78392]	0.1174 [0.56570]	-0.2787 [-2.27005*]	0.2950 [2.43240*]	0.0569 [0.38966]	-0.4866 [-2.23607*]
Gundlupet(-1)	-0.0493 [-0.47793]	-0.0588 [-0.45060]	0.4781 [3.22432*]	0.0101 [0.11621]	-0.0550 [-0.63543]	-0.0971 [-0.93033]	0.3366 [2.16452*]
Gundlupet (-2)	-0.1278 [-1.22603]	0.1407 [1.06719]	0.1709 [1.14260]	-0.0276 [-0.31263]	-0.0738 [-0.84421]	0.0822 [0.78082]	-0.2487 [-1.58538]
Kochi(-1)	0.0544 [0.37982]	0.0831 [0.45854]	-0.1171 [-0.56960]	0.6454 [5.30183*]	-0.2179 [-1.81274*]	-0.1119 [-0.77329]	-0.3117 [-1.44523]
Kochi (-2)	-0.2221 [-1.62068]	-0.4661 [-2.68855*]	-0.3874 [-1.96901*]	-0.0515 [-0.44246]	-0.0913 [-0.79460]	-0.1220 [-0.88088]	0.3777 [1.83102*]
Kollegal(-1)	0.5315 [3.58077*]	0.6646 [3.54016*]	0.0459 [0.21563]	0.5007 [3.97158*]	0.6438 [5.17063*]	0.3343 [2.22886*]	0.0396 [0.17741]
Kollegal (-2)	-0.0724 [-0.44076]	-0.2496 [-1.20039]	0.1173 [0.49719]	-0.3546 [-2.53952*]	-0.0270 [-0.19629]	-0.1428 [-0.85967]	0.4104 [1.65837]
Sangli(-1)	0.2524 [1.77224*]	0.1393 [0.77355]	0.0495 [0.24216]	-0.1574 [-1.30148]	-0.1511 [-1.26517]	0.5683 [3.94854*]	-0.2484 [-1.15867]
Sangli (-2)	-0.0121 [-0.08983]	0.2144 [1.24967]	0.1170 [0.60096]	0.4075 [3.53669*]	0.1545 [1.35817]	0.0384 [0.28063]	0.1382 [0.67706]
New York(-1)	0.0441 [0.59456]	0.0524 [0.55759]	0.1645 [1.54248]	0.1643 [2.60260*]	0.0289 [0.46497]	0.0138 [0.18410]	1.0075 [9.00611*]
New York (-2)	-0.0691 [-0.96363]	-0.0890 [-0.98128]	-0.1620 [-1.57376]	-0.1658 [-2.72206*]	-0.0118 [-0.19733]	-0.0184 [-0.25473]	-0.0983 [-0.91112]

Figures in the parentheses are ‘t’ values

Table 4.50: Problems faced by the farmers in production of turmeric in the selected districts

Sl. No.	Problems	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Garrett score	Rank	Garrett score	Rank	Garrett score	Rank	Garrett score	Rank
1	Non – availability of suitable varieties	23.88	VI	28.86	VI	47.98	IV	13.11	VIII
2	Non – availability of quality planting material	61.94	IV	43.97	V	45.97	VI	12.04	IX
3	Non – availability of labour during peak season	92.45	II	93.19	II	96.99	II	91.67	III
4	Non – availability of fertilizers during appropriate time	54.03	V	47.98	IV	47.98	V	41.97	IV
5	Pest and disease attack	98.32	I	98.04	I	98.04	I	98.32	I
6	Higher cost of production	80.61	III	86.89	III	79.17	III	94.49	II
7	Financial constraints	4.38	IX	7.55	VIII	8.33	VIII	14.25	VII
8	Lack of awareness about IPM	12.04	VIII	16.69	VII	5.51	IX	18.01	VI
9	Lack of support from department	13.11	VII	3.89	IX	9.17	VII	32.42	V

Table 4.51: Post-harvest problems faced by the farmers in turmeric production in the selected districts

Sl. No.	Problems	Districts							
		Chamarajanagar		Mysore		Bagalkot		Belgaum	
		Garrett score	Rank	Garrett score	Rank	Garrett score	Rank	Garrett score	Rank
1	Lack of market infrastructure	4.92	XIII	5.51	XIII	12.04	XIII	19.39	XIII
2	Lack of market information and intelligence	8.33	XII	13.11	XII	13.11	XII	20.93	XII
3	Involvement of large number of intermediaries	25.48	XI	43.97	VI	27.15	X	22.32	XI
4	Lack of remunerative price for the produce	94.49	II	96.11	II	97.37	II	96.99	Ii
5	Inaccessibility to regulated market	89.94	III	89.94	III	93.86	III	56.03	V
6	Non- availability of grading facility	32.42	VII	15.44	XI	14.25	XI	30.61	VIII
7	High commission charges	55.75	V	83.31	IV	63.85	IV	59.99	IV
8	Unauthorized deduction	30.61	VIII	25.48	X	38.06	VI	36.15	VII
9	Malpractices in weighment	27.15	X	25.48	IX	30.61	VII	22.32	X
10	Inadequate storage facilities	47.98	VI	28.86	VIII	28.86	IX	23.88	IX
11	Transportation problems	69.39	IV	67.48	V	59.99	V	72.85	III
12	Lack of processing facilities	30.61	IX	30.61	VII	30.61	VIII	56.03	VI
13	Price fluctuations	98.82	I	97.72	I	98.82	I	99.55	I

4.6.4 Competitiveness of Indian turmeric in international market

In the era of globalization, foreign trade policies have given high importance to boost up the agricultural exports. This has resulted in cutthroat competition among world nations in the trade scenario of various commodities, and in this connection a country's exports will be decided by its efficiency promotion and its price competitiveness. Under the WTO regime, the bilateral agreements between the countries as per which the trade of different items have taken place, is of not much importance. Hence, examining the export competitiveness of the commodities of interest for a country is utmost importance. In this context, the competitiveness of Indian turmeric export was examined using nominal protection coefficient (NPC). The nominal protection coefficients of turmeric were estimated for the year 1983-84 to 2012-13 under exportable hypothesis and the results of the analysis are presented in Table 4.47 and 4.48.

It could be seen from the Table 4.47 that, Nominal protection coefficient (NPC) is less than unity over the study period. It has decreased from 0.73 to 0.29 from 1983-84 to 2012-13. During pre-WTO period the NPC for turmeric was comparatively poor (0.56 to 0.73). Whereas, during post-WTO regime the NPC for Indian turmeric was better, this varied between 0.29 during 2012-13 to 0.68 during 1998-99. Results of NPC under exportable hypothesis revealed that in the post-WTO period, the country had better competitiveness for turmeric exports in the international market.

The estimation of Nominal Protection Coefficient for turmeric under exportable hypothesis for period 2012-13 is presented in Table 4.48 Nominal Protection Coefficient was less than unity *i.e.* 0.29 representing that turmeric was efficient export crop and prices were competitive.

As per the procedure given in the methodology (Table 3.11) NPC for turmeric was calculated. In 2012-13 the average wholesale price for turmeric was ₹ 5548 per quintal in Kochi market. In order to export turmeric the exporters need to send the consignment to Kochi port so it costs ₹ 20 per quintal and marketing margin was 5 per cent of the wholesale price *i.e.,* ₹ 277.40. Clearing and forwarding handling charge was ₹14, this was cost for clearing and forwarding of consignment. The exporters have to pay the service charges of about ₹ 4.75 to add all above mentioned variable to get free on board (FOB) price at Kochi, which was ₹ 5864.15. This pricing term indicates that the cost of the goods, including all transportation and insurance costs from the manufacturer to the port of departure, as well as the costs of loading the vessel are read filed in the quoted price. This means that the buyer has to bear all costs and risks of loss or damage to the goods from that point. The FOB term requires the seller to clear the goods for export.

To free on board (FOB) price we have added ₹154 freight charges from Kochi to New York and insurance at 1 per cent of FOB price *i.e.* ₹ 58.64. The sum of all above variables gave domestic price (₹ 6076.79). The FOB price for turmeric in New York was ₹ 20610; this was an international price for the Indian turmeric. To work out NPC, the domestic price was divided by international price and resulted value was 0.29, representing that turmeric was efficient export crop and prices were competitive.

4.7 Market integration

Spatial market integration refers to a situation in which prices of a commodity in separated markets move together and price signals and information are transmitted smoothly across the markets, hence, spatial market performance may be evaluated in terms of the relationship between the prices of spatially separated markets and spatial price behavior in the markets may be used as a measure of overall market performance.

The present study empirically evaluates spatial integration of turmeric markets of Sangli, Chamarajanagar, Gundlupet, Kollegal, Erode, Kochi and New York markets. The market integration was assessed by employing co-integration technique. In the present context, co-integration analysis is employed to examine whether the seven markets are integrated with each other or not. This is studied by testing whether the Law of One Price (LOP) holds in these markets. The analysis was conducted by using the monthly data of seven years (2006-07 to 2012-13).

Co-integration is a two step process: first any long run equilibrium relationships between markets are established, and then a dynamic correlation model is estimated. The first step in co-integration is Augmented Dicky Fuller-Unit Root Test (ADF Test) is conducted to check the data for stationarity. On conducting ADF Test for major markets of turmeric prices, it was found that all the seven markets were in non-stationarity position with respect to price series. Hence, all markets taken in to consideration for co-integration test and they were made stationary taking first order differentiation.

In order to know the co-integration between the markets considered under study, Vector Error Correction Mechanism was conducted and the results of the same are presented in Table 4.49. The co-integration coefficients were tested for the significance by comparing the ‘t’ values with the table ‘t’ values (1.7) and the significance was established.

It could be seen from the table that, the present market price of Chamarajanagar was influenced by the one month lagged price of that market to the tune of 49.32 per cent. Two months previous price of the Chamarajanagar market have an impact on the Kochi market to the extent of 31.52 per cent. The one month previous price of Erode market have an impact on present month price of that market, Gundlupet market, Kochi market, Kollegal and Sangli markets to the tune of 75.67 per cent, 35.81 per cent, 46.87 per cent, 37.05 per cent, and 40.85 per cent respectively. The two months lagged price of Erode market influence have more impact on the New York market prices (48.66%) followed by Kollegal (29.50%) and Kochi (27.87%). Further the one month previous price of the Gundlupet market could able affect the present price of that market (47.81%) and also New York market (33.66%) whereas, the two months lagged price of the Gundlupet market does not have any effect on the any other markets. The present market price of the Kochi market and Kollegal markets were influenced by the one month previous price of the Kochi market to the tune of 64.54 per cent and 21.79 per cent respectively. The two months lagged price of the Kochi market also able to influence the prices in Erode (46.61%), Gundlupet (38.74%) and New York market price (37.77%).

One month lagged price of Kollegal market influence price of Chamarajanagar, Erode, Kochi, present price of Kollegal and Sangli market prices to the extent of 53.15 per cent, 66.46 per cent, 50.07 per cent, 64.38 per cent and 33.43 per cent respectively and the two month lagged price of Kollegal market also influence Kochi market prices to the tune of 35.46 per cent. The Chamarajanagar (25.24%) and present price of the Sangli market (56.83%) price were influenced by one month lagged price of the Sangli market and similarly the two month lagged price of Sangli market could able to influence the Kochi market prices (40.75%) and it does not have any effect on the remaining markets. It is very interesting to see that, the present price of New York market was influenced alone by one month lagged price of New York market (100.75%) and to some extent Kochi market price also influenced by one month and two month lagged price of New York market price.

4.8 Production and post harvest constraints in turmeric production

An opinion survey was conducted to identify the problems faced by the farmers at different stages of production and marketing of turmeric in the study area. Problems were analysed using Garrett’s Ranking Techniques and the results of the study are presented in Table 4.50 and 4.51.

4.8.1 Problems faced by the farmers in production of turmeric

The major production problems faced by the sample farmers in the production of turmeric are presented in Table 4.50. Perusal of the table revealed that in all the districts major problem faced by the sample farmers in the production of turmeric was pest and disease attack which ranked first among all the problems as perceived by the farmers, followed by non-availability of labour during the peak season except in the case of Belgaum district where it ranked as third important problem and the second most important problem faced was higher cost of production, which was third important problem in the case of remaining districts. Non-availability of fertilizers during appropriate time was the fourth most important problem in the case of Mysore and Belgaum district, whereas it was fifth most important problem in the case of Chamarajanagar and Bagalkot district and fourth important problem in these districts was non-availability of quality planting material and non-availability of suitable varieties respectively. The lack of support from the department, lack of awareness about IPM, financial constraints were the other minor problems as perceived by the farmers in the study area.

4.8.2 Post-harvest problems faced by the farmers in turmeric production

Table 4.51 depicts the major post-harvest problems faced by the sample farmers in the study area. It is evident from the table that, in all the districts price fluctuations of the commodity in the market was the major problem faced by the sample farmers which ranked first among all the other problems as perceived by the farmers followed by lack of remunerative price for the produce, inaccessibility to regulated market except in the case of Belgaum district where which ranked fifth most important problem and third important problem in Belgaum district was transportation problem. High commission charges was the fourth most severe problem in all the districts except in the case of Chamarajanagar district, where which ranked as fifth important post-harvest problem and fourth one was transportation problem. In the case of Mysore and Bagalkot district transportation problem was the fifth most important post-harvest problem. The other minor important problems perceived by the farmers were involvement of large number of intermediaries, lack of processing facilities, inadequate storage facilities, unauthorized deduction, malpractices in weighment, non- availability of grading facility, lack of market information and intelligence lack of market infrastructure.

DISCUSSION

The results of the investigation presented in the preceding chapter are discussed in detail in this chapter. The discussion throw light on the possible causes for the results obtained and are presented under the following heads.

5.1 Growth and instability in area, production and productivity of turmeric

5.2 Production performance of turmeric

5.3 Allocative and technical efficiency in turmeric production

5.4 Marketing channels for turmeric

5.5 Trend in arrivals and prices of turmeric and prediction of the future prices

5.6 Export performance of turmeric

5.7 Market integration

5.8 Production and post harvest constraints in turmeric production

5.1 Growth and instability in area, production and productivity of turmeric

5.1.1 India

The growth rate and instability index of area, production and productivity of turmeric in India is presented in Table 4.1. It could be seen from the table that, during pre-WTO period the growth rates in area, production and productivity of turmeric were 3.45 per cent, 8.09 per cent and 4.48 per cent respectively, in the post-WTO period the growth rates of area, production and productivity of turmeric were 1.99 per cent, 3.96 per cent and 1.94 per cent and in the overall period (1974-75 to 2010-11) the growth rates in area, production and productivity of turmeric were 2.65 per cent, 5.60 per cent and 2.88 per cent respectively. The growths in area, production and productivity were found to be higher during pre-WTO period than overall and post-WTO periods. The lower growth in area and productivity in post-WTO period might be due to stability in area under turmeric, *i.e.* no scope to allocate more area under new planting. Growth recorded in all periods was significant at one per cent level.

India virtually has a monopoly in supplying of turmeric to the world with a share of about 78 per cent in the total global output and 60 per cent in the global trade. Favorable weather conditions prevailing in the major turmeric growing areas in the country (Andhra Pradesh, Tamil Nadu, Orissa, Karnataka and West Bengal) and the important steps taken by the Spices Board, such as providing drying sheets to small and marginal growers of turmeric and other spices for drying under hygienic conditions, providing subsidies for the small and marginal farmers for the construction of concrete drying yards and warehouses, organization of educational programmes for growers on improved technologies, have led to increased productivity of turmeric. Besides, release of high-yielding varieties over the years also has made a significant contribution. The other reasons for the positive growth in the production of turmeric were development programmes taken during 8th and 9th Five Year Plans by Directorate of Arecanut and Spices in the country under central sector and also for the co-ordination of state sector activities on the spices, “Centrally Sponsored Scheme on Integrated Programme for Development of Spices” which envisages the overall development of more than 25 spices grown in India including turmeric for increasing the production, productivity and improving the quality of the produce including turmeric.

It was observed from the table that, the instability indices for area, production and productivity of turmeric were lower during post-WTO period compared to pre-WTO period and overall period. These fluctuations in yield of turmeric were mainly influenced by the rainfall and other climatic factors. The release of new varieties and innovative cultural practices developed in recent years were also responsible for the variations in productivity, which affected the levels of production in different years. The instability in the production of turmeric was due to changes in the rate of productivity and area of cultivation. The market price has also played an important role in annual production. As in any other agricultural commodities, production in one year is strongly influenced by the price that prevailed in previous year. Production of turmeric in India is showing an increasing trend from 1997 to 2001, from 2002 onwards again production level decreased due to shift in cultivation from turmeric to sugarcane and low remunerative prices. In 2003 production and area under turmeric has decreased due to drought occurrence. In India increasing trend in last 2-3 years in production concerns on the back of farmers shifting from chilli and sugarcane cultivation to turmeric, in time favorable rainfall accompanied by high yields. Angels *et.al* (2011) had also observed similar findings. The results are in line with the study conducted by Madan (2008) and Krishndas (2010) where it can be inferred that the increase in production was due to both increase in area and productivity.The findings of the present study are in consonance with these studies.

India shows an encouraging trend in area and production of turmeric, as the climatic conditions, fertility of the soil, rainfall and cultivation practices are highly favorable in the majority of states in India. The expansion of area under turmeric cultivation will enrich the existing quantity of turmeric production in the country. Though price fluctuations may exist due to instability in the market, these can be eliminated by effective export promotional measures taken by the government. Promoting turmeric cultivation in the country will enhance the inflow of foreign exchange and improve the economic condition of the Indian farmer.

5.1.2 Karnataka

The growth in area under turmeric was lower during pre-WTO period (5.26%) compared to post-WTO and overall period, the growth in the production (6.35%) and yield (0.47%) of turmeric was lower in overall period than both pre and post-WTO periods (Table 4.2).

Whereas, instability index of area (40.52%) was found to be highest during post-WTO period than that of overall and pre-WTO periods, whereas, production (79.04%) and productivity (63.45%) was found highest during overall period than both post and pre-WTO periods. This may be due to stability in yield of turmeric during post-WTO period. Both area and production growth were found to be significant at one per cent level. This indicated that the farmers perceived the high profitability of turmeric production but they were not encouraged by the spice producing and marketing agencies. The problem in Karnataka has been the lack of proper marketing facility. Most of the Karnataka farmers depend on Sangli market on Northern part and Erode market on Southern part of the state. The middlemen exploited the farmers and in turn the farmers were discouraged due to less profit. The product being bulky and majority of the farmers being small and marginal they find it extremely difficult to dispose off the produce. The lack of knowledge regarding the marketing of their produce was also one of the main problems for the farmers to bring down the area under turmeric. The productivity was highly unstable and the regulated markets were unable to help the farmers in that situation. The growth rate of turmeric productivity was marginal and non-significant. The possible reasons might be the lack of improved technologies and location specific varieties. As the seed rhizome plays an important role in case of productivity, every year farmers have to change the seed material. But, there was no seed producing agency for turmeric in the state. The certified seed had to be imported from other states such as Andhra Pradesh or Tamil Nadu and hence, the seed material become costly because of its bulkiness as a consequence, the farmers used the same seed material for several years. This may be also one of the reasons for the lower growth in the case of productivity and hence the total production over the study period. The results of the study are in line with the study conducted by Angels (2001) and Thumar *et al.* (2006) where they observed that area and production of garlic in Gujarat increased at higher rate than that of yield. Whereas, the results are on par with that of Bhowmick *et al.* (2009) where the growth in area of ginger in Assam showed negative.

5.1.3 Selected districts

It is evident from the Table 4.3 that, the growth rate in area and production of turmeric in Chamarajanagar district were found positive and significant at one per cent whereas, the growth rate of yield was found negative (-0.98%) and instability was found less in the case of productivity than that of area and production this may be due to stability in productivity *i.e.*, usage of local and low yielding varieties for cultivation due to more cost of seed rhizomes and also because of practicing traditional cultivation practices and lack of support from the departments. The expansion in area solely depends upon the local market. But Kollegal, Chamarajanagar and Gundlupet APMCs do not have infrastructural facilities compared to Erode market like, absence of warehouse facility for bulk storage of the produce, absence of large number of merchant middlemen were the possible reasons for the decline in the yield of turmeric (Lokesh and Chandrakanth, 2004).

In the case of Mysore and Bagalkot districts, the growth rate and instability in production of turmeric was found to be highest as compared to area and yield. This might be due to the prevelance of suitable and congenial environmental conditions for cultivation of turmeric in the study districts. The highest growth in the production was due to increase in area as well as productivity of turmeric. In both the districts farmers store the mother rhizome in good condition as prescribed by the scientists.

Growth rate in area (-1.26%), production (1.10%) and productivity (2.40%) of turmeric in Belgaum district was found lesser than that of Chamarajanagar, Mysore and Bagalkot districts and found non-significant. This may be due to the competition from the sugarcane crop in the district as in Belgaum district turmeric was rotated with sugarcane and also due to practicing of traditional cultivation practices, incidence of pest and disease and that lead to the stability in the productivity of turmeric. In Belgaum district the farmers use their own planting material year after year that too five to six years continuously this may lead to the decline in the yield year after year since the farmers store the planting material in traditional method (without proper treatment), which may lead to carry over of pests and diseases and also the farmers have lack of knowledge about the proper treatment.

5.1.4 Components of change in average turmeric production

The variance decomposition analysis developed by Hazell (1982) was used to examine the sources of instability by decomposing the changes in average production between the two sub periods, which was presented in Table 4.4.

In the case of Karnataka the variation in average production of turmeric was due to change in mean area (122.95%) and contribution of mean yield was negative (-22.17%). This instability was due to less fluctuation in productivity. The non-availability of assured market facility, middlemen exploitation, small quantity of output, non-availability of specific varieties and certified seeds may be the reasons for the instability in area and yield of turmeric in the second period over the first period in the state. Therefore, the future effort should be made to stabilize the area of turmeric along with increasing yield level. For this, modern technology of agriculture should be promoted, which consists of pest and disease resistant varieties. As the change in area was contributing more towards instability in turmeric production, the government has to stress more on pricing strategies, market facilities and policies, which would help in stabilizing the production, prices and would maximize profit to farmers (Angels and Hosamani, 2005).

The variation in average production of turmeric in India was due to change in mean yield (58.39%) and mean area (39.45%). The factors such as climatic change over time, infrastructure, controlled agronomic practices and plant breeding influenced the variability in turmeric yield. The yield of turmeric was mainly affected due to the succeptibility of the crop to pests, diseases and climatic factors to a considerable extent. It is a crop with high input requirements such as FYM, mulches *etc.* Intensive care was needed for the crop, and the agronomic practices play major role in deciding the yield.

So for the stable growth, the reduction in yield instability is necessary in future. Kumar and Sankaran (1998) reported that the decrease in area instability more than compensated for the marginal increase in yield instability in turmeric during the 1980's, resulting in a reduction in production instability. It was suggested that the future development programmes should envisage stabilization of yield, which would stabilize production. In order to meet the domestic and international demand, the production of turmeric is to be stable. The stability in the productivity could be achieved through investing in the development of cultivars suitable for existing agro-climatic conditions; hence, evolving the location specific varieties is necessary along with suitable scientific crop production technologies for reducing the fluctuations in turmeric production.

5.1.5 Sources of change in the variance of average turmeric production

The variance decomposition procedure developed by Hazell (1982) was used to examine the sources of change in the variance of production of turmeric during period-II over the period-I.

It could be seen from Table 4.5 that in the case of Karnataka, change in yield variance (79.95%) and change in residual (75.83%) were the major source of change in variance of turmeric production. This result was due to less fluctuation in productivity of turmeric in the state. The non-availability of assured market facility, middlemen exploitation, small quantity of output, non-availability of specific varieties and certified seeds may be the reasons for the instability in area and yield of turmeric in the second period over the first period in the state.

In the case of India as a whole also change in residual and change in yield variance were the important factors contributing for the instability in the production of turmeric in the country. The high yielding varieties, mass production, organised marketing facilities and facilities provided by Spices Board may be the possible reason for stability.

Hazell (1984) noted that changes in area variance and change in mean area, to some extent contributed to instability of total cereal production in India. This observation was in contrast to present study even though it is not a spice crop.

Thus, from the results it was evident that the production of turmeric was not stable both in Karnataka and India. The findings of the study are in line with study conducted by Kumar and Sankaran (1998) and Angels and Hosamani (2005).

5.2 Production performance of turmeric

5.2.1 General characteristics of sample farmers

The general characters of the respondents are presented in Table 4.6. In the case of age of the sample respondents Mysore district farmers were younger than that of Chamarajanagar, Belgaum and Bagalkot district farmers. In all the four districts the main occupation of them was agriculture. With respect to education level of the sample farmers, in Mysore district the more sample respondents were illiterate as well as more number of the respondents had their education up to college level and above compared to the other district sample respondents and the average size of the family of the respondents was high in the case of Chamarajanagar district. The average size of irrigated farm was high in both Belgaum and Bagalkot districts compared to Chamarajanagar and Mysore district sample farmers. This was due to the fact that in the study area water for irrigation was sufficiently available from Krishna and Ghataprabha reservoirs. It is evident from the results that the area under turmeric was more in the case of Chamarajanagar followed by Belgaum, Bagalkot and Mysore districts.

5.2.2 Cropping pattern of the sample respondents

The absolute area devoted to different crops by the sample farmers in all the four districts was ascertained for the agriculture year 2011-12. Table 4.7 indicated that in all the four districts maize was the major crop grown by the farmers during Kharif season except Chamarajanagar and Mysore districts where paddy was the major crop. Whereas, during rabi season sorghum was the major crop. In Belgaum and Bagalkot districts wheat and chickpea were the other major crops grown by the farmers during rabi season. In the case of Mysore and Chamarajanagar districts sunflower and chickpea were the other crops grown in the season. In summer season maize was again major crop grown by the farmers as the farmers got good amount of water facility during the season. With respect to area under annual crops sugarcane was the major crop compared to any other crop mainly because of prevalence of more jaggery production units, sugar factories and farmers in the study area got good returns from cultivation of sugarcane. The perennial crops grown in the study area were mango, coconut and pomegranate. Thus the cropping intensity was more in case of Bagalkot and Belgaum districts than that of Chamarajanagar and Mysore districts this may be due to the availability of more water for agriculture in those districts.

5.2.3 Labour use pattern in the production of turmeric in the selected districts

The quantity of labour used, costs involved in the different operations of turmeric production for an acre area are presented in the Tables 4.8, 4.9, 4.10 and 4.11.

The human labour use on the sample farms has been depicted in the tables revealed that turmeric is highly labour intensive crop which requires semi-skilled labour from planting till harvesting. Quantity wise the total human labour usage was higher in the case of Belgaum district (100 mandays) than that of Chamarajanagar, Mysore and Bagalkot districts whereas, cost wise it was more in the case of Mysore district (₹18065) this was mainly due to more wage rate prevailed in the district compared to other districts. In all the sample districts the major operations involved for the usage of labour were weeding, irrigation, harvesting and planting. In the sample districts, the farmers carried out weeding operations for 4-5 times due to emergence of more weeds. The frequency of irrigation was for once a week and the crop received around 40-45 irrigations during its life period. The harvesting of turmeric rhizomes involved the activities like; cutting the leaves and then digging of the rhizomes and consequently for all these operations the crop needed extensive utilization of labours. Thus, the availability of labour at reasonable wages was a prerequisite for turmeric cultivation which plays a vital role in its successful cultivation (Singh *et al.,* 2012).

The usage of bullock labour was high in the case of Mysore district (4 pair days) with a cost of ₹1848 than other districts. The bullock labour was required mainly for the seed bed preparation and intercultivation operations. The intercultivation operation needs more pair days because of infestation of more weeds in the study area.

The total machine hours used was also more in the case of Mysore district (14 hours) compared to remaining districts with a cost of ₹ 5758. The usage of machine labour was more in the case of harrowing operation, ploughing and for transportation of FYM. Better land preparation may lead to good growth of the crop so the farmers usually practice 4-5 times harrowing operations in the study area. The results of the above findings are in agreement with the results of Lokesh and Chandrakanth (2004) and Singh *et al.* (2012)

5.2.4 Input use pattern and output obtained in turmeric cultivation

Per acre utilization of different inputs and output realized by the sample farmers in the selected districts is presented in Table 4.12. The different kind of inputs utilized were planting material, human labour, bullock labour, machine labour, farm yard manure (FYM), fertilizers and plant protection chemicals.

Close observation of the table revealed that, per acre utilization of planting material was high in the case of Bagalkot district (10.40 quintal) compared to other three districts. The usage of human labour was more in the case of Belgaum district, whereas, usage of bullock labour and machine labour was more in the case of Mysore district. The Bagalkot and Chamarajanagar district farmers used more quantity of FYM than that of Mysore and Belgaum district farmers which was the major input required for turmeric growing and very scarcely available in the country. The application of FYM has favorable affect on growth and yield of turmeric. The different fertilizers used in the study area were DAP, Urea and potash among these fertilizers, DAP was used in more quantity than that of other two. The total quantity of fertilizers used was more in the case of Belgaum district than that of Chamarajanagar, Mysore and Bagalkot districts this was mainly because of availability of more irrigation in Belgaum districts than that of other districts as the usage of fertilizers is heavily depends upon the irrigation facility and also soil condition. The use of plant protection chemicals in the selected districts was more in the case of Chamarajanagar (₹ 3209) and Belgaum districts (₹ 3078) than remaining two districts mainly because of attack of more pest and diseases *viz.*, shoot borer, rhizome rot, termite leaf eating caterpillar in the districts. Finally yield levels of main product were observed to be high in the case of Bagalkot (27.72 quintals) than that of other districts and lower level of yields was observed in case of Belgaum district (25.68 quintal). This was mainly due to attack of pest and diseases in Belgaum district mainly problem of termites and rhizome rot and even though the sample farmers used more amount of fertilizers in the cultivation of turmeric but more usage may lead to the problem of leaching.

5.2.5 Cost of cultivation of turmeric

It is evident from the results presented in the Table 4.13 that, per acre average cost of cultivation of turmeric was high in the case of Belgaum district (₹ 83402) than Bagalkot (₹ 82949), Chamarajanagar (₹ 77263) and Mysore district (₹ 76985) in that, the total variable cost was ₹ 78224, ₹ 78192, ₹ 72956 and ₹ 72564 respectively, among the variable costs, cost of planting material, cost of human labour and cost of FYM were the major items in case of all the four districts. The expenditure on the planting material was found to be an important item in the total cost of cultivation of turmeric since seed material had to be properly processed by way of seed treatment. This difference in the cost of cultivation was mainly because of difference in the cost of planting material since most of the farmers in Belgaum (₹ 35564) and Bagalkot district (₹ 34031) used the seed material brought from the far away (eg., Sangli in Maharashtra state.) whereas, in the case of Chamarajanagar (₹ 29439) and Mysore district (₹ 29123), majority of the farmers used seed material from their previous crop. A few farmers purchased improved seed material from Erode market in Tamil Nadu. The cost on seed material could be reduced if the farmers would have known the technique of preserving their own seed material in better way. As turmeric is a vegetatively propagated crop, the healthy mother rhizomes can be used for planting in the next season by proper treatment and preservation. The growers expressed their fear about decreasing crop stand and gradual decreased in yield, year after year. This happened mainly because they stored the seed material by traditional method (without proper treatment), which may lead to carry over of pests and diseases. The farmers were not aware of preserving their own seed material by proper treatment.

The turmeric is more labour intensive crop as discussed earlier in case of labour utilization pattern and also the farmers used more quantity of FYM to improve the soil fertility and to get more yield since there is a better spread of younger rhizomes in the fertile soils, which the farmers were aware of (Kerutagi *et al.,* 2000). The cost involved in the usage of human labour was high in the case of Mysore district (₹ 17677) than that of other districts even though the quantity of human labour used was high in the case of Belgaum district but due to more wage rate prevailing in the Mysore district.

The results of the study are in line with the study conducted by Patil (2000) where, he found that the total cost of cultivation of turmeric was ₹ 235224.84 per hectare in Sangli district (Maharashtra) and Patil *et al.* (2004) where, the results of their study showed that the per hectare cost A, cost B, and cost C were ₹163824.31, ₹ 229098.67 and ₹ 236298.67 respectively in Sangli district of Maharashtra.

5.2.6 Cost of processing of turmeric

Harvesting of turmeric is carried out during January to March since the temperature during summer season helps in curing the crop. The curing percentage of turmeric was 20 to 22 per cent in the study area. The turmeric crop is harvested in the form of wet rhizomes which are not used for the direct consumption. It needs certain kind of farm level processing. Farm level processing starts from separation of fingers from rhizomes. It consists of curing, drying and polishing of cooked fingers. The detailed per acre cost of farm level processing of turmeric is presented in Table 4.14.

The total cost of processing of turmeric was found to be high in the case of Bagalkot district (₹ 12531) than other districts this marginal difference was mainly due to the difference in the hiring charges of the machines for processing. In the study area, for curing operation the sample farmers incurred more cost on machine labour which was more in the case of Bagalkot district. It was noticed that in the study area, majority of the farmers were practicing the scientific method and TNAU method for curing of turmeric as these methods required considerably less time as compared to the traditional method and moreover, these improved techniques also helped in perfect boiling of turmeric which turn influenced the colour and aroma of the final product. The cost on human labour was found high in the case of Belgaum district (₹1667) for curing operation than other districts. For fuel to cook the rhizomes farmers used vegetative waste from mulberry sticks, dried coconut leaves, sugarcane thrash, cotton sticks available on the farm and some of the sample farmers purchased the fuel wood for boiling purpose from other sources that is about 2.5 to 3 quintal of fuel wood was required to cook one acre rhizomes. It was noticed that the cost incurred by the sample farmers on fuel wood was more in the case of Mysore district (₹1073) this was mainly because majority of the farmers in the district purchased the wood from outside and in the case of Chamarajanagar district none of the sample farmers purchased the wood from outside they used dried vegetative parts available in their farms.

The cooked fingers are dried in the sun by spreading them in five to seven cm thick layers on low quality sarees or drying floor. A thinner layer is not desirable, as the colour of the dried product may be adversely affected. During night time, the rhizomes were heaped or covered with material which provides aeration. It may take 10-15 days for the rhizomes to become completely dry. In dying operation farmers incurred more cost on human labour as it is 10-15 days process and to some extent on purchase of sarees and drying nets which are required for drying mainly low quality sarees and drying nets, these sarees costs around ₹ 8 to 10 each and around 100 to 120 sarees were required to dry one acre of cooked rhizomes. It was noticed that in the purchase of utensils the Bagalkot and Belgaum district farmers incurred more cost compared to Chamarajanagar and Mysore districts. The main reason for this was in Chamarajanagar and Mysore districts majority of the farmers usually keep their cooked rhizomes in flore itself and hardly some of the farmers used sarees and drying nets.

Dried turmeric has a poor appearance and a rough dull outer surface with scales and root bits. The appearance is improved by smoothening and polishing the outer surface by mechanical rubbing. In the study area the dried turmeric are polished on the farm by hiring a power/manual operated rotary drum. The cost of hiring of machine for polishing of turmeric was high in the case of Chamarajanagar district since majority of the farmers used power-operated machine for which the farmers incurred ₹ 80-100 per bag.

5.2.7 Cost and returns profile of turmeric production

The detail per acre cost and returns structure in turmeric production in the selected districts are presented in Table 4.15. It could be seen from the table that, the total cost of cultivation was found high in the case of Belgaum district (₹ 83402) than that of other districts, cost of processing was found to be higher in the case of Bagalkot district (₹12531) and the total cost of marketing which includes loading, unloading, transportation and commission charges was high in the case of Chamarajanagar district (₹ 8273). This marginal difference in the cost of marketing was mainly due to the fact that, even though there is market facility in Chamarajanagar district but still some of the farmers sold their produce in the Erode market of Tamil Nadu, which constitued more transportation cost. The returns obtained from the main produce (fingers) was high in the case of Bagalkot district (₹ 142885) this was mainly due to more yield in the district and on the other hand the returns obtained from the main produce was lesser in the case of Belgaum district (₹ 122017) this was mainly because of less yield since in the district there was more problem of pests like termites and shoot borer attack and problem of rhizome rot during the agriculture year. The farmers of Bagalkot and Belgaum district got ₹ 5131 and ₹ 4764 per quintal price respectively for the main produce. They sold their produce in the Sangli market of Maharashtra as they received better price in that market and some of the farmers of both districts sold their produce to TAPCMS through market intervention scheme introduced by the government during 2012. Whereas, in the case of Chamarajanagar and Mysore districts, the farmers sold their produce in the local markets as well as in Erode market and TAPCMS.

The return obtained from the by-product was high in the case of Bagalkot district (₹ 59144) than the other districts. Thus, the gross returns realized were also high in the case of Bagalkot district (₹ 202029/acre). Whereas, the net returns realized were lower in the case of Belgaum district (₹ 72590). The B: C ratio was found to be profitable in all the four study districts. In spite of huge variable costs involved in turmeric cultivation returns were quite good which can further be increased by efficient management of farm level. The findings of the above analysis are in line with the results of Singh *et al.* (2012), Patil *et al.* (2009) and Lokesh and Chandrakanth (2004).

5.3 Resource use efficiency in turmeric production

The Cobb-Douglas production function was employed to analyze the relationship between the resources used and productivity of turmeric using the field level data of sample farmers. The total gross returns realized as the dependent variable and the cost of planting material, FYM, human labour, bullock labour, machine labour, chemical fertilizers and plant protection chemicals as independent variables for turmeric production. The results are presented in the Table 4.16.

The table clearly narrates that, the variables included in the function satisfactorily explained the variation in the dependent variable to the extent of 89.50 per cent, 92.10 per cent, 93.80 per cent and 90.10 per cent in the case of Chamarajanagar, Mysore, Bagalkot and Belgaum districts respectively. The regression equation was estimated in order to capture the nature and magnitude of the effects of the independent variables on the returns of turmeric production. The planting material was found to be positive and significant in all the selected districts except in the case of Bagalkot, which implies that, the increased usage of planting material increases the gross income. Since there is lack of availability of the quality planting material in the study area and if the improved varieties enter in the study area, farmers may use those varieties by spending more cost on that, which significantly contributes towards increased yield and thus the income.

Cost on chemical fertilizers was positive and found to be significant in the case of Chamarajanagar, Mysore and Belgaum districts and had positive impact on gross income. This revealed that application of more fertilizers may increase the yield and also gross income by supplying more nutrients to the crop. The other variable such as machine labour was positive and significant in the case of Mysore and Bagalkot districts which implied that it had positive impact on the gross returns. Since turmeric required more cost on usage of machine labour on the operations such as land preparation, transportation of FYM and most importantly in case of processing of turmeric. Bullock labour was significant only in the case of Bagalkot district, which implied a positive impact on gross income but the cost on plant protection chemicals was significant only in the case of Chamarajanagar district since the crop was attacked by more pests and diseases. The cost on human labour was significant only in the case of Belgaum district which means human labour had positive impact on gross income since the turmeric is highly labour intensive crop.

On the contrary the human labour was negative in the case of Chamarajanagar and Mysore districts, implies negative impact on the gross income this was mainly due to the fact that even though the usage of human labour was less compared to Belgaum district. The prevailing wage rate was high in those districts so the farmers must reduce some quantity of labour usage so that they can reduce the expenditure on human labour in the production of turmeric. Sharma *et al.* (2008) opined that the surplus of male and female labour in Himachal Pradesh because of small and marginal holdings and its excessive use had a non-significant effect on the production of cereals.

Similarly the expenditure on FYM was found to have a negative impact on gross returns in the case of Bagalkot district, means the farmers used excessive FYM in the district and bullock labour was negative in the case of Mysore district since the bullock wage rate was very high in the district compared to other districts.

The returns to scale (Σbi) was found to be more than unity in the case of Mysore (1.11) and Bagalkot district (1.01) indicating increasing returns to scale in the turmeric production whereas, it was less than one in the case of Chamarajanagar (0.91) and Belgaum district (0.92) implies decreasing returns to scale. This showed that an increase use of selected variables would result in more than adequate increase in the gross returns from turmeric production in the Mysore and Bagalkot districts. The results obtained in respect of human labour are in conformity with the results of Sekhon *et al.* (2010).

5.3.1 Allocative efficiency in turmeric production

The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) ratio, presented in the Table 4.17, revealed that allocative efficiency was positive and greater than unity in the case of planting material in Chamarajanagar (2.823), Mysore (3.380) and Belgaum (1.769) districts indicating that there is still scope to use planting material especially improved varieties and it was found to be less than unity in Bagalkot indicating less scope to increase the expenditure on planting material.

The ratio in the case of FYM was found to be less than unity in all the districts except in the case of Bagalkot district where it was negative (-0.113) indicating heavy and imbalanced use of FYM in all the selected districts. The human labour was negative in the case of Chamarajanagar and Mysore districts, whereas the ratio was less than unity in Bagalkot and more than unity in Belgaum district indicating excessive use of these inputs for the sole reason of increasing the gross returns. This was mainly because of more wage rate for human labour in these districts since the turmeric crop is highly labour intensive crop. Even the wage rate is quite high in the operations of processing and harvesting thus there is need of reduction in the usage of labour to maximize their profits.

Bullock labour was found to be more than unity in the case of Chamarajanagar (1.127) and Bagalkot (49.123) districts whereas, the ratio was negative in the case of Mysore and Belgaum districts indicated the excessive use of bullock labour and there was no further scope to increase the bullock labour. The ratio for machine labour was more than unity in the case of Mysore and Bagalkot districts indicating some more scope to increase these inputs and maximise the profits, the ratio was less than unity in the case of Chamarajanagar and negative in the case of Belgaum district indicating excessive utilization of machine labour in the production of turmeric.

The ratio for chemical fertilizers was greater than unity in all the sample districts indicating scope to increase the expenditure on chemical fertilizers which may lead to increase the yield and in turn gross returns of the sample farmers. In the case of plant protection chemicals also the ratio was more than one in all the districts except in the case of Bagalkot district (0.516) indicating excessive use of plant protection chemicals in the district.

Thus the returns can be increased by increasing the use of planting material, chemical fertilizers and plant protection chemicals in all the districts except in the case of Bagalkot where the returns can be maximized by increasing the usage of bullock labour, machine labour and chemical fertilizers. The profitable ratio in FYM and human labour was less than unity (except Belgaum) and negative indicating imbalanced use. The findings are in conformity with those of Anand (2011) and Dodke *et al.* (2002b) where resource use efficiency of turmeric in Chandrapur district of Maharashtra for human labour showed negative value indicated excess use.

5.3.2 Technical efficiency in turmeric production

The details relating to technical efficiency in the production of turmeric in the selected districts has been discussed under the following heads.

5.3.2.1 Timmers measure of technical efficiency in turmeric production

The technical efficiency in turmeric cultivation was worked out by using Timmer's method. The distribution of sample farmers in the selected districts according to different technical efficiency ratings for turmeric has been presented in Table 4.18. The results revealed that in all the sample districts majority of the sample farmers were operating under 90-95 per cent efficiency rating which was found high in the case of Chamarajanagar district, to some extent farmers were operating under 95-100 per cent efficiency ratings that was also found high in the case of Chamarajanagar district. On an average half of the sample farmers were operating under the efficiency ratings of less than 90 per cent.

The study revealed that majority of the farmers were operating under less than 90 per cent technical efficiency ratings, mainly due to use of traditional cultivation practices. The lack of technical knowledge about package of improved practices, low level and imbalanced use of fertilizers non-availability and high cost of recommended inputs especially labour for timely application even use of low yielding varieties might have also contributed to this phenomenon. It clearly indicates that there is a scope to improve the operation of farmers and move in to high technical efficiency level by adopting suitable cultivation practices. These findings were in line with those of Mary and John (2011) and Kulkarni (2008).

5.3.2.2 Kopp measure of technical efficiency

The technical efficiency in terms of excessive resources used by the farmers in crop production was worked out using Kopp measure of technical efficiency for turmeric. The actual and frontier use of different resources for the turmeric production are presented in Table 4.19. The table revealed that the technical inefficiency due to excessive use of resources ranged from 4.23 per cent in human labour to 126.38 per cent in plant protection chemicals in Chamarajanagar districts, 15.00 per cent in human labour to 97.54 per cent in FYM in the case of Mysore district, 11.50 per cent in machine labour to 172.47 per cent in FYM in the case of Bagalkot district. Belgaum district had shown lower level of inefficiency among the various inputs (9.63 per cent in planting material to 40.92 per cent in bullock labour). Thus the analysis of technical efficiency in turmeric production in the study area revealed that by improving the technical efficiency of the farmers, excessive expenditure on different inputs could be saved. Thereby, there will be a substantial reduction in the cost of cultivation and increase in the returns from turmeric to the farmers. The similar findings were obtained by Dodamani (2006) in case of naturally coloured cotton production under contract farming in Dharwad district of Northern Karnataka and Sharma *et al.* (2008).

5.4 Marketing performance of turmeric

The details relating to marketing of turmeric have been presented in following heads.

5.4.1 Preference of marketing channels by turmeric producers in the study area

In the first channel the producers himself bring the produce to the market place and sold through commission agents. 58.33 per cent farmers in Chamarajanagar, 22.92 per cent farmers in Mysore district, 52.08 per cent farmers in Bagalkot district and 70.83 per cent farmers in Belgaum district sold their produce through this channel and the produce ultimately reached the consumers via wholesalers and retailers (Table 4.20). Through this channel maximum quantity of turmeric was sold by the Belgaum district sample farmers compared to other three district sample farmers.

In the second channel, the producer himself sold the produce in the distant market that is, Erode market of Tamil Nadu. This channel was seen only in the case of Chamarajanagar and Mysore district. In these districts, 6 (12.50%) farmers in Chamarajanagar and 13 farmers (27.08%) in Mysore district sold their produce through this channel. The Mysore district sample farmers sold maximum quantity of the produce through this channel as they availed better price for their produce as compared to the local market price.

The third channel constituted about 20.84 per cent of farmers from Chamarjanagar district, 37.50 per cent farmers from Mysore district, 41.07 per cent farmers from Bagalkot district and 22.92 per cent of farmers from Belgaum district with respect to the sale of the produce.

In the fourth channel, the producers brought the produce to the commission agents, through which it reached the processors. In the case of Chamarajanagar district, 4 farmers (8.33%), 6 farmers (12.50%) in Mysore district, 3 farmers each (6.25%) in Bagalkot and Belgaum districts sold their produce through this channel.

5.4.2 Marketing costs incurred by the farmers under different channels

Per quintal cost incurred by sample farmers in marketing of the turmeric through channel-I and III has been narrated in Table 4.21. The marketing cost incurred varied from market to market and channel to channel. The various items of marketing cost included in channel-I (Producer to commission agents) were the cost of cleaning, packing, loading and unloading, transportation, weighment charges, miscellaneous, commission charges and in channel-III (Producer to TAPCMS) were cleaning, packing, loading and unloading, transportation and miscellaneous charges.

It could be seen from the table that, the per quintal marketing cost incurred by the sample farmers in channel-I was high in the case of Bagalkot (₹ 387) and Belgaum (₹ 359) districts than that of Chamarajanagar and Mysore districts. In this commission charges were having the major share, as farmers use to pay 2 to 3 per cent commission to the commission agents. Apart from this transportation cost was another important item of cost and it was more in the case of Bagalkot and

Belgaum districts since the farmers of these two districts sold their produce in Sangli market of Maharashtra whereas, in the case of Chamarajanagar and Mysore district farmers use to sell the produce in Chamarajanagar, Kollegal and Gundlupet markets under this channel.

In channel-III, the total marketing cost incurred by the sample farmers was high in the case of Belgaum district (₹ 195/quintal). In this channel major items of cost were transportation cost and packing cost. The transportation was found to be the major differentiating factor for the marginal difference in the cost because the farmers in Chamarajanagar, Mysore and Bagalkot districts sold their produce in their taluk TAPCMS whereas, in Belgaum district the farmers of Raibag taluk sold the produce in nearby taluk *i.e.*, Gokak TAPCMS as in Raibag TAPCMS there was no facility of trading.

Table 4.22 highlights the total marketing costs incurred by the farmers in channel-II. This channel was seen only in the case of Chamarajanagar and Mysore district where some of the sample farmers sold their produce in Erode market of Tamil Nadu state as they felt that in Erode market they could able to get better price and also some of the farmers opined that, the commission agents will provide supply of planting material and other inputs on credit basis. It could be seen from the table that, the total marketing cost incurred by the sample farmers was high in the case of Chamarajanagar district (₹ 479/quintal). The marginal difference between the costs was mainly because of storage charges as the farmers of Chamarajanagar district stored their produce with commission agents for longer time than that of Mysore district farmers due to lower price for the produce during 2011-12. The other major cost items included in the total marketing cost were, commission charges and transportation charges.

The foregoing results clearly revealed that, the marketing cost incurred by the sample farmers was more in case of channel-II followed by channel-I and channel-III. This was mainly due to the reason that, the farmers in channel-III did not incurr any cost on commission charges, weighment charges and storage charges as this channel was introduced by the government mainly to support the farmers with respect to fall in the price of the turmeric during 2011-12. Similar findings are obtained by Birari *et al.* (2006).

5.4.3 Marketing cost incurred by various market intermediaries

The marketing costs incurred by the commission agents were more in the case of Bagalkot district (₹351/quintal) followed by Belgaum, Chamarajanagar and Mysore districts (Table 4.23). The major cost items were storage loss, tax and packing charges. The storage loss accounts more in the total cost, as the commission agents lose 2- 3 per cent of the produce while handling the produce as opined by the commission agents.

Wholesaler negotiates the price between the farmer and commission agent. He incurs cost on various items like tax and market fee paid, storage loss, storage cost, transportation, labour and packing cost. The total marketing costs incurred by the wholesalers was also high in the case of Bagalkot and Belgaum districts (₹426/quintal) followed by Mysore district and Chamarajanagar district (Table 4.24). Here major items of the costs were storage loss, tax, packing cost and miscellaneous charges. The marketing cost of the wholesalers in Bagalkot and Belgaum district was same as all the sample farmers sold the produce in Sangli market and also same wholesalers were considered for eliciting the required information.

Similarly the marketing cost incurred by the retailers was more in the case of Bagalkot and Belgaum districts (₹ 358/quintal) than that of Mysore and Chamarajanagar district (Table 4.25). The major items of the costs were storage loss, packing cost, transportation cost and loading and unloading charges.

In general the marketing costs incurred by market functionaries varied between the different selected markets among different types of market functionaries. The costs incurred by wholesale traders were higher in all the markets (Table 4.25). As per the regulated market rules, the purchaser had to pay 1-2 per cent of the value of produce as tax and market fee in the case of all the selected markets. The minor differences observed between the markets were mainly due to variation in arrivals and prices. The other cost components were loading and unloading, shop rent, miscellaneous expenses and these were also fixed by the respective market committees. All the intermediaries incurred more cost on storage loss since the facility to store the produce in Chamarajanagar market was inadequate as majority of the traders opined the problem of lack of scientific storage facility and in the case of Sangli market even though there are some good facilities available for storage of turmeric, due to handling of more quantity there will be a heavy loss while storage.

5.4.4 Marketing margins and marketing efficiency under different channels of turmeric marketing

Marketing margins and their components under different channels of marketing have been presented in Table 4.26. Marketing margins measured the gap between the net price received by the producer and the ultimate price paid by the consumer. From the view point of marketing efficiency, this gap has to be reduced to the minimum. In order to protect the actual producer, a simultaneous effort has to be made to cut the costs incurred by farmers and reduce the profit margins of the market intermediaries which actually broaden the gap between the net price received by farmer and ultimate price paid by the consumer. The marketing margins differed from market to market and from channel to channel.

A clear perusal of the table revealed that the producer's share in consumer/processor rupee was more in channel-IV than channel-I which was due to presence of more number of additional market intermediaries. Producer's share in processors purchase price was fairly better in all the four selected districts under channel IV *i.e.* highest was observed in Chamarajanagar district (75.89%) followed by Mysore (74.34%), Bagalkot (74.14%) and Belgaum district (65.60%) and similarly in the case of channel-I also.

The marketing efficiency of different channels of turmeric has been worked out by Shephard's formula and it is shown in the same table. A perusal of the Table revealed that channel IV was the most efficient marketing channel as efficiency index was high in all the districts than that of channel-I. The index was found high in the case of Mysore in both the channels. Thus selling of turmeric to the processors through commission agents is said to be efficient marketing channel. The results of the study on far with the findings of Tripathi *et al.* (2006) where Producers →Small traders → Commission agents → Retailers → Consumers was found to be the efficient channel in the marketing of ginger in Meghalaya since in that channel the producers bring the produce to local market, and sold to small traders who come from the secondary markets and also due to trading of small quantity they incurred less marketing cost and Singh *et al.* (2012) identified the marketing channels for turmeric in Punjab, they found that Producer–Processor–Consumer (channel I) has been found to be the major marketing channel by which nearly 72 per cent of the turmeric is sold. In that channel, the relative share of net price received by producer in the consumer rupee has been found as 15.46 per cent, while net margin of processor has been noted as 34.10 per cent.

5.5 Pace and pattern of market arrivals and prices of turmeric

The details of pace and pattern of turmeric arrivals and prices in different markets have been presented under the following heads.

5.5.1 Trend in the arrivals of turmeric in the selected markets

The analysis of trend in arrivals of turmeric indicated a positive trend in the selected markets under the study. The arrivals had increased in all the selected markets, but the quantum of increase in arrivals varied from one market to another market.

Sangli market registered the maximum increasing trend in arrivals and the lowest trend was observed in Kollegal market (Table 4.27). Overall, in all the selected markets, arrivals of turmeric shown an increasing trend over the period studied. The increase in the arrivals of turmeric may be attributed to the increase in area under production of turmeric in these regions. Another reason for increase in arrivals in Sangli market may be that, it is major market for the turmeric. The location of Sangli market was common to both Karnataka and Maharashtra and also center place for turmeric marketing in India. On account of which the transport of turmeric to different parts of the country was convenient and adequate facilities available for storage. Thus there was assurance of arrivals and availability of turmeric throughout the year. Whereas, in Chamarajanagar, Kollegal and Gundlupet markets the trend in arrivals was low since these markets were established recently for turmeric trading and even there were no good facilities for the storage of the produce and lack of involvement of large number of traders in turmeric trading. Because of these reasons the farmers of that region sold their produce in Erode market of Tamil Nadu.

5.5.2 Trend in the prices of turmeric in the selected markets

Linear trend analysis for prices of turmeric indicated a positive trend in the selected markets. The prices of turmeric had increased over the years in the selected markets, but here also the extent of increase in prices varied from market to market.

It could be seen from the Table 4.28 that, Gundlupet market registered a highest increasing trend in the prices of turmeric over the study period (₹ 1119.28/qtl) followed by Kollegal market. This might be due to frequent movement of the commodity from one market to another market in Chamarajanagar district and also Chamarajanagar, Kollegal and Gundlupet markets were not well developed in terms of the cold storage facilities in the markets for traders. This increase in the wholesale prices might be due to technological innovations, change in input supplies, increase in money supply, increase in population and the consequent change in demand.

New York market also showed the significant increasing trend in the price of turmeric over the years (₹ 659.46/qtl/year) since it was the major commercial center in the world. The Spices Board has started supporting innovative research programmes to discover new uses of turmeric to validate their medicinal benefits. As a part of its initiative to promote export of value added products of turmeric, India has built the brand image of turmeric in USA. Moreover, inflation might also be the possible reason for the increasing trend in the prices.

The prices in Sangli market also showed the significant increasing trend (₹ 307.00/qtl) as the Sangli market was one of the famous and popular market for marketing and trade of turmeric. Moreover, the Spice and Oil Seed Exchange (Spot market) was involved in providing the platform for marketing of turmeric in Sangli market. The sale transactions were monitored through the regulated market. Hence, the prices were decided based on the supply and demand forces. The storage facilities for turmeric were provided by the Spice and Oilseed Exchange because of this the wholesale price of turmeric was stable throughout the year. There was assurance of arrivals and availability of turmeric throughout the year. Hence, the demand was not only within or around the state but also from the entire country. Moreover, inflation might alos be an important reason for the increase in the wholesale price of turmeric over the year.

Kochi market also registered significant increasing trend in the prices of turmeric over the year (₹ 231.25/qtl). In Kochi market the turmeric was mostly used for the export purpose since it has become a reference market for spices in general and for turmeric in particular from time immemorial. The alleppy finger was a famous variety of Kerala, which has been famous throughout the world because of its high curcumin content. Hence, the price of turmeric in Kochi market not only depends on the domestic market but also international markets. Moreover, the export also has to be met from the turmeric produced in the state, because of which there was increasing trend in the wholesale price of turmeric.

In the case of Erode market the wholesale price of turmeric had increased considerably (₹ 199.35/qtl). This was mainly due to the high demand for turmeric in this region, since many processing industries were located in Erode and Salem districts. The product was purchased for processing after which it was used for domestic consumption as well as for the export. The inflation was also one of the possible reasons for the increase in the wholesale prices over the years. The similar findings were obtained by Khunt *et al.* (2006) reported in Gujarat that there was increasing trend in the arrivals and prices of major vegetables over the period in most of the regulated markets, showing the scope for expansion of vegetable cultivation and Singh *et al.* (2010) in case of green chillies in Punjab.

Jayasree *et al.* (2011) opined that the domestic prices were highly influenced by other external factors such as lagged area, lagged export quantity, lagged domestic price and lagged export price, high domestic consumption and instability in area and productivity.

5.5.3 Seasonal indices of market arrivals of turmeric in the selected markets

In order to ascertain the seasonal variation in the long-run, with respect to arrivals of turmeric in the selected markets, the seasonal indices for arrivals were calculated following 12 months moving averages. The seasonal indices of monthly arrivals of turmeric in the selected markets are presented in the Table 4.29.

It could be seen from the table that higher indices of market arrivals were observed during the month of February to May in the case of Sangli market and was highest during the month of April. In the case of Chamarajanagar, Gundlupet and Kollegal markets the indices were high during the month of June. Since the harvesting of turmeric in Chamarajanagar and Mysore district start little later than that of Belgaum and Bagalkot districts, where it commence from January month itself. Another reason was since turmeric is storable commodity; farmers can sell their produce when the prices are ruling high.

5.5.4 Seasonal indices of prices of turmeric in the selected markets

The seasonal indices of monthly prices of turmeric in the selected markets were observed high in all the markets during December month except in the case of Sangli and Gundlupet market (Table 4.30). In Chamarajanagar, Kollegal, Erode, Kochi and New York markets, the highest seasonal indices for prices were observed during December whereas, in Sangli and Gundlupet markets the highest seasonal indices for prices were observed during the month of January. This may due to storable property of the commodity. The price indices were similar in the case of Chamarajanagar, Kollegal, Erode, Kochi and New York markets since the December period was lean period with respect to arrivals of the commodity in the markets as harvesting season only starts from January itself and also might be due to the demand pattern of the turmeric in international markets which may influence the price in the international market (New York) which in turn influence the price in Kochi and Erode markets. Prasad *et al.* (1998) in their study indicated that the indices of arrivals were higher while the price indices were on lower side for both bulbs and fingers during the post-harvest month of March, April, May and June in Guntur market due to the shortage of proper storage facilities at the farmer level and the growers were forced to dispose of their produce immediately after harvest which results in a lower price.

5.5.5 Cyclical variation in the market arrivals and prices of turmeric in the selected markets

Cyclical variation in the arrivals and prices was analyzed in order to know the variation in arrivals over the years. For this multiplicative model was employed (Table 4.31 and 4.32). No cyclical variation in arrivals could be derived due to very short period data availability *i.e.,* 2003-04 to 2012-13 in the case of Sangli market, 2005-06 to 2012-13 in the case of Chamarajanagar market and 2006-07 to 2012-13 in the case of Gundlupet and Kollegal markets. It can be observed only for time series data of at least 20 years but the data collected was only for limited years due to non-availability of data. The results of the study were in line with that of the study conducted by Kuldeep (2010) in the case of Mustard seed and oil in Rajasthan.

Similarly due to very short period data in the case of Chamarajanagar, Gundlupet and Kollegal markets, cyclical variations in prices of turmeric were not observed. Whereas, in the case of Sangli, Erode, Kochi and New York markets uneven cycles were being observed. These cycles represent deviations in the price levels from the average trend due to business sequences of boom and recession appear in the economy. Madan (2008) estimated business cycles for turmeric price in Erode market was five years and six years cycle in the Kochi market.

5.5.6 Forecasting of turmeric prices in the selected markets

Box-Jenkins model is concerned with fitting of a mixed Auto-Regressive Integrated Moving Average (ARIMA) to a given set of time series data. The main objective in fitting ARIMA model is to identify the stochastic process of time series and predict the future values accurately. For the present study ARIMA model was used for predicting the future prices of turmeric in the selected markets of India and international market and the results are presented as below.

Residual analysis was carried out to check the adequacy of the models. The adequacy of the model was judged based on the values of Box-Pierce Q statistics Akike Information Coefficient (AIC) and Swarz Baysian Criteria (SBC) (Been Stock and Bansali, 1981) and sum of squares of residuals. The price behaviour in the markets were tested with their AIC and SBC values to know the accuracy of the model.

ARIMA model was estimated after transforming the variables under study into stationary series through computation of either seasonal or non-seasonal or both order of differencing and finally the model (111,111) was found to be the best model for prices of turmeric in Sangli market and Erode market (010,010) in Chamarajanagar, Kollegal and Gundlupet markets (011,011) in Kochi market and (110,110) in New York market (Table 4.33), since the statistics of AIC and SBC were found to be the lowest in these models among the various models used. The values of actual and forecasted prices of turmeric in the selected markets are presented in Tables 4.34, 4.35, 4.36, 4.37, 4.38, 4.39 and 4.40.

5.5.6.1 Forecasting of turmeric prices in Sangli market

It could be seen from the Table 4.34, that there is narrow variation in between the actual and forecasted values of prices of turmeric in Sangli market and the forecasted values of prices showed a decreasing trend in the future months. The forecast price for the month of January 2013 would be around ₹ 6083 per quintal would slowly decrease in the subsequent months and reach the minimum of ₹ 4876 in September month. But, again would pick up slowly; regain the value of around ₹ 5134 in December month. Within the year fluctuations in the prices of turmeric depends on market arrivals owing to the season of production and harvesting. The heavy arrivals lead to decrease in prices. This sort of signals of prices would surely help the farmers to make proper marketing decisions. The farmers in the Sangli market area need not wait after harvest to sell their product. They should dispose off the produce as early as possible. Delay in selling will not only result in lesser price realization, but would also lead to quantity loss in the form of damage due to storage pests and diseases which ultimately result into lesser realization of sale proceeds. Therefore, farmers in these areas are to be careful while making any decision of storage because they will be running into risks. Thus the extension agency in these areas should really work hard to disseminate the price forecast information to reach the farmers to protect them from further damages.

5.5.6.2 Forecasting of turmeric prices in Chamarajanagar market

Perusal of the Table 4.35 revealed that, the forecasted price showed the increasing trend in the prices of turmeric from January 2013 (₹4633/qtl) to September 2013 (₹7386/qtl) and there after the prices would slowly decline to ₹6244 per quintal in the month of December 2013. The farmers in the Chamarajanagar market need not to think much regarding marketing of the produce. The net returns directly depend upon the waiting ability of the farmers. Hence, providing scientific storage of turmeric would be the need of the hour. It would be more advantageous to the farmers to store the produce and sell as long as the prices prevail at the time of storage well covers the cost of storage and quantity losses at the time of storage. Since the price of the turmeric would be high during September month, if farmers can hold back their produce till September they could able to get better price for their produce.

5.5.6.3 Forecasting of turmeric prices in Gundlupet market

The forecasted prices (Table 4.36) of Gundlupet market suggested that, price of turmeric would be around ₹5629 per quintal during the month of July 2013 and it may increase up to ₹7800 per quintal in the month of September 2013 and again it may decline to ₹6403 per quintal during December 2013. Since, commodity is non-perishable; the farmers can hold back the produce and release them to the markets when the prices rule high. The role of market intelligence plays a vital role in deciding about the time of sale of the commodities. Dissemination of price forecasts well in advance to the farmers, before harvesting the crop would be the key factor to help the farmers in making marketing decisions. Role of extension agencies in effective dissemination of their forecast information not only save the farmers from sale immediately after harvest, but also help them to realize better prices for their product.

5.5.6.4 Forecasting of turmeric prices in Kollegal market

The results of ex-ante and ex-post forecast of prices of turmeric in Kollegal market (Table 4.37) revealed that, there was marginal increase in the actual price of turmeric from January 2012 (₹4200/qtl) to December 2012 (₹4700/qtl) and on the contrary, the future prices showed a declining trend in the prices of turmeric from January 2013 (₹4716/qtl) to May 2013 (₹4179/qtl) and there after the prices may increase up to ₹6859/quintal during October 2013 and then it would start declining slowly. Thus it is advisable to the farmers who depend on Kollegal market for the marketing of their produce should not dispose off their produce immediately after the harvest. Thus it could be concluded that the farmers of Chamarajanagar and Mysore district should not sell their produce immediately after the harvest, if they can think of holding back the produce as long as the prices prevail at the time of storage well covers the cost of storage and quantity losses at the time of storage. Since the price of the turmeric would be high during September and October months, if farmers can hold back their produce till September they could able to get better price for their produce.

5.5.6.5 Forecasting of turmeric prices in Erode market

The forecasted values of turmeric prices in the Erode market showed the declining trend (Table 4.38). The price would decline from ₹5250 during January month and reach minimum during June month (₹4435) then it start regain. Since the price in the Erode market mainly depend on the demand from the processing units in the region as well as demand in the international market. Thus it is advisable to the farmers of Erode region that they can sell their produce during the month of August by storing the produce in better way with themselves or with the commission agents in the market yard itself. Thus if the farmers can hold back their produce till August they could able to get better price for their produce.

5.5.6.6 Forecasting of turmeric prices in Kochi market

The results of the ex-ante and ex-post forecast values for the prices of turmeric in the Kochi market are given in the Table 4.39. It is evident from the table that, there was narrow variation in the actual and future prices of turmeric in the market. The future price of turmeric would decline to ₹4261 per quintal during June 2013 from ₹4993 per quintal during January 2013 and again it may increase marginally to ₹4750 during December 2013. The price of turmeric in Kochi market highly depend upon the price behaviour of turmeric in the international market since Kochi market is a reference market for spices in general and for turmeric. Since in the international market turmeric with high curcumin content is preferred, this was more in case of 'alleppey finger' but the production and supply of this variety is confined to only part of the Kerala and Assam and even the yield levels are low in Kerala due to pest and disease problem, erratic monsoon. Thus the farmers of Kochi region can think of practicing the modern agricultural practices in the cultivation of turmeric and also storage of the commodity in scientific way till they realise better price in the market so that they could able to compete in the market in better way and realize the higher returns from the turmeric production.

5.5.6.7 Forecasting of turmeric prices in New York market

The results depicted in the Table 4.40 indicated that there was thin variation among actual and predicted prices of turmeric in the New York market. The forecasted prices showed the declining trend in the prices of turmeric as in the case of Kochi market. The future price would decline from ₹16536 per quintal during January 2013 to ₹12933 during August 2013 and it may increase marginally to ₹13664 in the month of December 2013. This fluctuation in the price might be due to the demand for turmeric in the international market, lagged area in India, lagged import quantity, lagged domestic price in India and lagged import price. Since USA imports about 90 per cent of its requirement of turmeric from India and New York is the largest commercial center in the world.

Thus there is immense scope for the development of high curcumin content varieties so that the Indian farmers can compete in the international market. Also India must take careful step with regard to export of turmeric looking towards the demand in the international market by developing better scientific storage facilities for the farmers in all the major turmeric growing states. The growers do not undertake any grading work of turmeric. There are no standards grades and grade specifications for this product. But with greater uniformity for export purposes better confidence will be created in the foreign markets. What India lacks most is a marketing strategy. Indian companies cannot spend much on market research in foreign countries due to high costs involved in such work. If some attention is paid to remove these constraints, turmeric can certainly prove a major commercial crop to add to the export earnings of the country.

5.6 Export performance of turmeric in India

Different dimensions of export of turmeric have been explained under different heads.

5.6.1 Growth rate and instability analysis of turmeric export from India

The growth rate and instability index of turmeric export in both quantity and value terms period from 1974-75 to 2010-11 is presented in Table 4.41. The results revealed that the growth rate in export of turmeric in terms of quantity was more during overall period (5.20%) than that of both post and pre-WTO periods and even value wise also the growth rate was high during overall period (13.29%) than that of post and pre-WTO periods. It implied that a higher quantity of turmeric was being exported after establishment of WTO. The main hurdle to turmeric export was the quality; if quality was maintained; the growth rate would have increased by many fold. Turmeric being a multi-use product of natural origin, it is used in many fields such as culinary, medicine, cosmetics and textiles. The growth rate of the total export value was higher due to higher growth of the export quantity of turmeric. The overall export quantity and export value of turmeric exported were significant at one per cent level. About less than 10 per cent of the turmeric produced in the country was exported. Since in the international market, the Indian turmeric varieties are very popular among the major turmeric importers. Though many specifications regarding quality control have been announced by most of the importing countries, the quantity as well as the value of turmeric export has increased due to the efforts taken by the Spices Board, which has been established by the Government of India. The Spices Board organises many export market surveys and efforts have been made to identify the export potential for turmeric export in the many countries. Many of the developed countries like the USA, the UK and Japan are taking much interest in purchasing Indian turmeric due to high degree of quality consciousness being followed by the Indian exporters.

Jyothi and Thomas (2012) emphasized the role of excellence in quality, reliability of supplies and price competitiveness in the international trade and suggested ecologically sound methods of production including post-harvest technology and maximum value addition for spices (turmeric) with particular attention to processing, packaging, transportation and marketing for boosting the turmeric exports into the international markets. The main hurdle to the export is the quality, because the processing is not done properly. For getting a good quality product, there is the need of adoption of improved technologies, such as steam boiling and mechanical drying instead of conventional cooking and sun drying. If proper processing and pre-limitation of pesticide residue is maintained, then there would be ample of scope for increasing export in the years to come.

In view of the increased global demand for organic spices, the spices board is promoting and encouraging their cultivation. In recent years, India has started producing and exporting organic turmeric as well. A new set of exporters has emerged who are promoting their exports in Europe and also there is need to develop brand image and export of spices in consumer packs. In developed countries like the USA, Europe and Japan, where the costs involved in the value added products of turmeric are very high, so Indian trade missions can play an important role in increasing the export of value added products of turmeric (Kaur *et al.,* 2004).

The instability index of export quantity of turmeric was higher in pre-WTO period (33.47%) than both overall and post-WTO periods and with regard to instability index of export value of turmeric, it was higher during post-WTO period (90.51%) than both pre-WTO and overall periods. This indicates that the export growth during post-WTO fluctuate much due to growing demand of Indian turmeric. The instability in total value of turmeric export was very high during post-WTO period compared to pre-WTO period. Moreover, there were no stiff competitors in the international market for Indian turmeric due to comparative advantage or agro-climatic advantage. This might be due to the changing demand for turmeric products in foreign countries. These results implied that there was a high instability in pre-WTO than post-WTO period. Similar results were found in study conducted by Mamatha (1995), where she estimated the growth rates of production and export of selected spices for the period from 1970-71 to 1991-92. The spices considered were pepper, chillies, turmeric and ginger and found that positive growth rate in respect of production and export of the selected spices was due to the increased domestic production and demand for these species in the international market. Similar findings were obtained by Sadeesh *et al.,* (2007) and Hema and Kumar (2007) with respect to instability of export of turmeric in terms of quantity.

5.6.2 Direction of trade of turmeric export from India

International markets for commodities are changing fast because of globalization and liberalization. The changes are continuously taking place; it would be of interest to document the changes, which perhaps aid in the export promotion policies. Though it would be difficult to pinpoint the nature of these changes and its direction, Markov chain analysis provides a probability approach in broadly unraveling the changes. Estimation of transitional probability matrix is central to Markov chain analysis. It indicates the direction of the changes, which help to decide the strategy and promotional policies to retain the sales or increase sale in a particular market.

The transitional probability matrix presented in Tables 4.42 to 4.45, depicts a broad idea of change in the direction of trade of Indian turmeric during pre-WTO and post-WTO period. The five major countries which imported Indian turmeric were: UAE, USA, UK, Iran and Japan. The export to remaining countries was pooled under the category of ‘other countries. It was seen from Table 4.42, that during pre-WTO period, ‘other countries’ were the most stable importers of Indian turmeric as they retained their original share of about 59.74 per cent from the previous year followed by UK (39.91%). USA and Japan were the most unstable importers of Indian turmeric during the pre-WTO period as both the countries did not retain any amount of their share from the previous year.

On the contrary UAE was found to be the most stable importer of Indian turmeric when we analysed the direction of trade by considering only top five countries as it retained 43.84 per cent of its share from the previous year during pre-WTO period (Table 4.43). Similarly USA and Japan were found to be unstable importers of Indian turmeric as they did not retain any amount of their share from the previous year by losing their major share to UAE.

Whereas, during post-WTO period (Table 4.44) Japan was unstable importer of Indian turmeric as it did not retain any of its original share from the previous year and it lost 87.09 per cent of its share to the UAE, followed by USA (12.91%). Hence, Japan may not be regarded as a stable importer of Indian turmeric in future. The reason may be that it imports turmeric from Burma and Thailand.

The USA was found to be one of the stable importers of Indian turmeric because it retained its original share of around 48.68 per cent over the period as the quantity imported by the USA was high. In future, its share may be reduced from the total turmeric traded from India. The countries such as China give a stiff competition to India in turmeric trade. The quantity may vary according to the ethnic Indian population and based on the medicinal requirement of turmeric in USA.

UK lost its major share of 67.60 per cent to UAE as it was the traditional importer of Indian turmeric. This retention may be because of the ethnic population as well as the preference for the natural products where the organic farming and other environment friendly activities were given first preference (Angels, 2001)

Iran is also one of the stable importer of Indian turmeric as it retained 55.57 per cent of its original share. Hence, in the future Iran will be one of the most stable importers and its growth may be higher in turmeric import from India.

The UAE has retained 35.66 per cent of its original share and it is the one of the stable importers of Indian turmeric. Being a major importer of Indian turmeric, if it loses its share, it will create a high instability in the export of turmeric from India in future.

The countries pooled under the other category retained 83.45 per cent of its original share, which implied that even though they import in smaller quantities, there was high stability, they have retained most of their original share. Hence, compared to major importing countries at present, the countries pooled under 'others category' would import more turmeric from India in near future. Between the two periods other countries retained as major markets and UAE remained as third important market in between the periods. The countries USA, Iran and UAE are emerging as important new market avenues in post-WTO period. The Iran country is also in a position to import a large quantity of turmeric. On the contrary, UK is relegated to lower place in the post-WTO period in terms of share of retention of turmeric trade.

Similarly Iran was the most stable importer of Indian turmeric during post-WTO period when we analysed the direction of trade by considering only top five countries as it retained 56.19 per cent of its share from the previous year (Table 4.45).

Thus, it was clear that the countries pooled under 'others category', UAE, UK, USA and Iran would be the stable importers of the Indian turmeric in future and Japan was least stable importers. Hence, it would be necessary to give more stress on these countries. The plans for export should be oriented towards these countries and also plans should be formulated for stabilizing the export to other countries. The reasons may be that in many areas such as, food, textiles and cosmetics, turmeric is being replaced by synthetic chemicals, as a colouring agent. In medicine, turmeric is a naturally available new material at a lower cost. As a result, the retention of its original share was increasing over the period. The other reasons were that the properties of turmeric were being explored continuously and its usage has been increasing along with the demand for fast food shops in the major importing countries. The results of the study are in line with study conducted by Angels *et.al* (2011). Mamatha (1995) assessed the direction of trade of turmeric where, the countries such as UAE (25.00%) and UK (65.00%) were the stable importers of the Indian turmeric. The countries such as Japan, USA and Iran were found to be unstable importers of Indian turmeric.

5.6.3 Projections of Indian turmeric export to major importing countries

The projection of the Indian turmeric export to different countries was computed using the transitional probability matrix and the results of actual and projected exports of Indian turmeric have been presented in Table 4.46. The table revealed that the share of USA in the turmeric import from India would be increased from 5.06 per cent in 2010-11 to 5.96 per cent in 2014-15 which was a meager growth. The Japan also showed the same result which would gain its meager share, where its per cent of share in import from India would be increased from 5.68 per cent in 2010-11 to 6.16 per cent in 2014-15.

In the case of UK, Iran, UAE and other countries, the projected market share is expected to decrease during 2010-11 to 2014-15 from 5.80 per cent to 5.26 per cent, 8.06 per cent to 8.05 per cent, 15.67 per cent to 15.58 per cent and 59.73 per cent to 59.00 per cent respectively.

Keeping in view the foregoing discussions, more stress has to be given on the countries such as UK, Iran, UAE and other countries category for maintaining present status of export and the government has to give more importance to the countries such as USA and Japan to maintain the market share in the future. A high dependence on one or two export markets will increase the trade risk in the longrun. Therefore, more importance has to be given to the minor importing countries such Bangladesh, Sri Lanka, *etc.* and appropriate export promotion strategies have to be evolved to diversify the geographical concentration. Appropriate steps and policies have to be evolved to maintain the market share of Indian turmeric. The policies have to be drawn based on the problems faced by the importing countries, so that the export of turmeric would increase in future and India may earn more foreign exchange through turmeric export.

5.6.4 Competitiveness of Indian turmeric in international market

In the era of globalization, foreign trade policies have given high importance in boosting over agricultural exports. This has resulted in cutthroat competition among world nations in the trade scenario of various commodities, and in this connection a country's exports will be decided by efficiency promotion and its price competitiveness. Under the WTO regime, the bilateral agreements between the countries as per which the trade of different items have taken place, is of not much importance. Hence, examining the export competitiveness of the commodities of interest for a country is utmost importance. In this context, the competitiveness of Indian turmeric export was examined using nominal protection coefficients (NPC). The nominal protection coefficients of turmeric were estimated for the year 1983-84 to 2012-13 under exportable hypothesis and the results of the analysis are presented in Table 4.47 and 4.48.

As shown in the Table 4.47, during both the pre and post-WTO regimes, turmeric enjoyed more export competitiveness in the international market. Further, the NPCs were declined during post-WTO regime compared to pre-WTO regime and the value of NPC under exportable hypothesis was 0.29 (Table 4.48). This infers that, this crop has tremendous export potential in the international market. In view of this, necessary R&D support, scientific processing facilities, quality promotion, cost effective production technologies *etc.*, should be given due consideration to brighten the prospects of turmeric trade in the international market. Considering the stiff competition from other major turmeric producing countries, it is essential to promote the quality of output on par with the Sanitary and Phyto-Sanitary (SPS) Standards of the importing countries. Being a traditional crop with religious importance and with a significant farming experience in turmeric cultivation over the centuries in India, it is high time for the researchers to plan for producing HYV of turmeric with desired quality attributes.

Jyothi and Thomas (2012) emphasized role of excellence in quality, reliability of supplies and price competitiveness in the international trade and suggested ecologically sound methods of production including post-harvest technology and maximum value addition for spices (turmeric) with particular attention to processing, packaging, transportation and marketing for boosting the turmeric exports into the international markets. The major challenges identified to Indian turmeric were productivity, quality and value addition challenge. So, India has to use high yielding varieties, appropriate production technologies and all the more highly conducive climate for turmeric production. Thus, in order to compete and retain India's position in the world market, the quality expectations in areas of pesticide residues, mycotoxins and microbial load should be strengthened. Global demand for value added turmeric is on the increase. Convenience in consumption is the characterization of the new market and placed enormous demand in value added turmeric. Mainly due to lack of adequate processing facilities the share of value added spices export in general and turmeric in particular from India is very less. So we have to concentrate on product diversification and value addition to be more competitive in the international market. The findings of the study are in line with Jyothi and Thomas (2012) and Siddaya and Atteri (2010).

5.7 Market integration

Spatial market integration refers to a situation in which prices of a commodity in separated markets move together and price signals and information are transmitted smoothly across the markets, hence, spatial market performance may be evaluated in terms of the relationship between the prices of spatially separated markets and spatial price behavior in the markets may be used as a measure of overall market performance. Co-integration is a two step process: first any long run equilibrium relationships between markets are established, and then a dynamic correlation model is estimated. The first step in co-integration is Augmented Dicky Fuller-Unit Root Test (ADF Test) is conducted to check the data for stationarity. On conducting ADF Test for major markets of turmeric prices, it was found that all the seven markets were in non-stationarity position with respect to price series. Hence, all markets taken in to consideration for co-integration test and they were made stationary taking first order differentiation.

In order to know the co-integration between the markets considered under study, Vector Error correction Mechanism was conducted and the results of the same are presented in Table 4.49. The co-integration coefficients were tested for the significance by comparing the 't' values with the table 't' values (1.7) and the significance was established.

Clear inspection of the table revealed that, the Chamarajanagar market price was influenced more by Kollegal market (53.15%) this may be due to the small distance between these two markets. The one month previous price of Erode market have an impact on present month price of that market, Gundlupet market, Kochi market, Kollegal and Sangli markets to the tune of 75.67 per cent, 35.81 per cent, 46.87 per cent, 37.05 per cent, and 40.85 per cent respectively. The two months lagged price of Erode market influence have more impact on the New York market prices (48.66%) followed by Kollegal and Kochi and Gundlupet market also could able affect the New York market (33.66%). The two months lagged price of the Kochi market also able to influence the prices in Erode (46.61%), Gundlupet (38.74%) and New York market price (37.77%).

One month lagged price of Kollegal market influence the price of Chamarajanagar, Erode, Kochi, present price of Kollegal and Sangli market prices to the extent of 53.15 per cent, 66.46 per cent, 50.07 per cent, 64.38 per cent and 33.43 per cent respectively and the two month lagged price of Kollegal market also influence Kochi market prices to the tune of 35.46 per cent. The two month lagged price of Sangli market could able to influence the Kochi market prices (40.75%) and it does not have any effect on the remaining markets. It is very interesting to see that, the present price of New York market was influenced alone by one month lagged price of New York market (100.75%) and to some extent Kochi market price also influenced by one month and two month lagged price of New York market price.

Though the markets were spatially separated the co-integration analysis showed the wholesale price of turmeric prevailed in these markets almost have more or less same impact on other markets except Sangli and Chamarajanagar markets which were having less impact on other markets, this may be due to the fact that the Chamarajanagar market is not well developed with respect to turmeric trading as there was no good facilities for the traders as well as farmers to store the produce for longer time and in the recent days the Karnataka government developing the market yard to create facilities to the farmers as well as it is requesting the traders from Erode market to participate in the trading activities.

Some problems exist in the marketing of turmeric in Sangli market, the spices and Oilseed Exchange was not working properly in the Sangli because of mistrust, infighting and lack of interest in futures by traders. Also the present ‘slotting fee’ required for exhibiting Indian spice was high and most of Indian exporters are reluctant to bear it for promoting their product Kaur *et al.* (2004).

It could also be concluded that the Kochi, Erode and New York markets are well co-integrated where the law of one price holds good. Since the Kochi market is reference market for spices and in general for turmeric and it sends the price signals to the rest of the markets in the country by receiving the signals from New York market and both Erode and Kochi markets are concern with export of turmeric. In the international market consumers will prefer for the turmeric with high curcumin content and those can be supplied by Kochi market since the ‘alleppy finger’ which has high curcumin content is grown only in parts of the Kerala and Assam and Erode is the only Regulated Market functioning throughout the year whereas the turmeric markets in Andhra Pradesh, Maharashtra and in other States of India are seasonal in nature.

Eventhough the markets were well co-integrated as far as the wholesale price of turmeric is concerned, the price levels followed its own trend, since it depended on the market dynamics of respective states. If we look at the wholesale price of turmeric in different domestic markets during 2012-13, Chamarajanagar (₹4107), Gundlupet (₹4518), Kollegal (₹4617), Erode (₹4678), Kochi (₹5548) and Sangli (₹5431) markets followed different prices directions for turmeric. In order to minimize this price variation there is a need to create an overall market web. In the context of safeguarding the interest of the domestic farmers on the one hand and realizing the export competitiveness for turmeric on the other, there is an immense need for strengthening the Market Intervention Schemes. Since the Kochi and New York markets were well co-integrated as expected in the current scenario of well developed market infrastructures like transport, communication facilities, it is only logical that both markets influenced each other. The above findings of the study are in line with Mamatha (1995) where she reported that there was a high integration between the domestic and international markets. When there was change in the price of turmeric in the international market, automatically the wholesale price of turmeric changed in Kochi market. Similarly, Jayasree *et al.* (2010) also showed domestic markets (Kochi) and international market (New York) for pepper were highly integrated, which was indicative of mutual influence exerted by the markets on each other.

5.8 Production and post harvest constraints in turmeric production

An opinion survey was conducted to identify the problems faced by the farmers at different stages of production and marketing of turmeric in the study area. Problems were analysed using Garrett’s Ranking Techniques and the results of the study are presented in Table 4.50 and 4.51.

5.8.1 Problems faced by the farmers in production of turmeric

The major production problems faced by the sample farmers in the production of turmeric are presented in Table 4.50. Perusal of the table revealed that in all the four selected districts the major problems opined by the farmers were pest and disease attack, non-availability of labour during the peak season, higher cost of production in turmeric and non-availability of quality planting material. That means in all the selected districts there was problem of rhizome rot, problem of termite and shoot borer, this problem was even more in the case of Chamarajanagar and Belgaum districts. This might be due to non-availability of resistant varieties in Karnataka. Even the farmers opined that, due to non-availability of suitable pesticides, lack of information about the pesticides and availability of spurious chemicals in the market were the major threats in controlling the pest and diseases attack in the area. The other problem expressed by the sample farmers was non-availability of human labour during peak season, since turmeric is highly labour intensive crop it needs more quantity of labour during planting, weeding, harvesting and processing. The farmers expressed their sadness towards the non-availability of labour during these operations. Even they are available, the labours demand more wage in the various operations of turmeric than any other crops. All these reasons and high cost of planting material lead to higher cost of production of turmeric. The results of the above findings are aligned with the findings of Rajur (2007) where he reported that 81 per cent of the farmers expressed the problem of pest and disease in chilli production in Karnataka, Karpagam (2000) reported high cost of inputs and scarcity of labour were the major problems of turmeric in Tamil Nadu and Sawant (2002).

5.8.2 Post-harvest problems faced by the farmers in turmeric production

Table 4.51 depicts the major post-harvest problems faced by the sample farmers in the study area; it is evident from the table that, in all the selected districts major post-harvest problems in the production of turmeric opined by the sample respondents were, price fluctuation, lack of remunerative price for the produce, inaccessibility to regulated market and transportation problem. During the year 2011-12 there was sharp decline in the price of the turmeric to less than ₹ 5000 from ₹ 17000 per quintal during 2010-11 mainly because of fourfold increase in the production of turmeric in all the major turmeric growing states in India but later to some extent this problem was solved by the government through market intervention scheme by announcing a price of ₹ 5000 per quintal. The other major problem expressed by the sample farmers was inaccessibility of regulated market since the roads from their villages to regulated markets were not good and morever, the regulated markets were located far away from the cities and in Karnataka there was no facility for turmeric trade due to absence of traders in the regulated markets. Recently the government has established the trading facility in Chamarajanagar market so that the farmers can sell their produce in that market and they can save transportation cost by going and selling the produce in Erode market. But in this market still there were no facilities for proper storage of turmeric and because of this some of the farmers from Chamarajanagar and Mysore districts sold their produce in Erode market of Tamil Nadu. On the other side of the state, the farmers of Belgaum and Bagalkot district were heavily dependent on Sangli market, even by incurring more transportation and commission charges.

The high commission charge, as reported by the farmers was another major problem. As per the bye laws, commission agents should get 2 per cent of the value of produce from the traders as their commission and the farmers need not have to pay anything as commission. But in reality the commission agents are receiving commission from both the farmers as well as traders. As reported by the farmers, they have paid commission which ranged from 2 to 4 per cent. This was because of linking of credit with marketing *i.e.* majority of the farmers get the credit facilities from the commission agents both in the form of cash and inputs like, seeds, fertilizers and pesticides with an agreement of selling their produce to them only.

The other post-harvest problems faced by the farmers were inadequate storage facilities, lack of processing facilities, grading facilities and involvement of large number of intermediaries. Despite of the developmental efforts taken by the Spices Board, there is no improvement in the post-harvest handling. The traditional way of preparing the produce for market led to poor quality and contamination with undesirable foreign bodies may lead to rejection of the export consignment due to high level of pesticide residue and aflatoxins in the turmeric. Similar results were obtained by Madan *et al.* (2002) in turmeric and chilli cultivation in Andhra Pradesh and Srivastava *et al.* (2012) in case of Saffron in Jammu and Kashmir.

SUMMARY AND POLICY IMPLICATIONS

India is popularly known as the “Spice Bowl of the World” as a wide variety of spices with premium quality are grown in the country since ancient times. Among the commodities that were traded during that period, spices occupied a major portion due to their superior quality and diversity which attracted foreigners to India. India has been well known for the trade since the period of exploration of sea routes, because of its various spices and superior quality. This was the key reason because of which India has invaded by the European countries and was imperialized. To such an extent India was famous for the spices.

The important varieties in India are: Alleppey Finger (Kerala) and Erode and Salem turmeric (Tamil Nadu), Rajapuri and Sangli turmeric (Maharashtra) and Nizamabad Bulb (Andhra Pradesh). In domestic and international markets Salem turmeric has established itself as the best quality and it fetches a higher price compared to the price of Erode turmeric.

In the world scenario India is the leader in terms of production, consumption and export. India accounts for 78 per cent of the total world production followed by China (8%), Myanmar (4%), Bangladesh and Nigeria (3%). After India, China is the major exporter in terms of export followed by Vietnam and Myanmar. United Arab Emirates (UAE) is the major importer accounting for 24.06 per cent of the total exports followed by United States of America (12.93%), Japan, Sri Lanka, Iran, United Kingdom and Middle Eastern countries. India contributes 70.41 per cent of world exports followed by Viet Nam (6.1%), Netherlands (3.09%), Indonesia (2.32%), Myanmar (2.16%) and China (2.02%) during 2010-11 (*UCX, 2012*).

India has 195.10 thousand hectares under turmeric cultivation with a total production of 992.90 thousand tones (2010-110). Andhra Pradesh is called the “turmeric bowl of India” as it topped both in area and production with 59475 hectares and 364044 tonnes respectively during 2009-10. Karnataka is alo one of the largest producer of turmeric in India with an area of 24912 ha and with production of 250829 tonnes in 2010-11 with a share of 25.20 per cent of India’s total production. The major districts which are producing turmeric in the state are Chamarajanagar, Mysore, Bagalkot, Belgaum and Bidar. Chamarajanagar is the leading district with an area of about 9708 ha with a production of 50808 tonnes followed by Mysore (6389 ha and 100310 tonnes), Bagalkot (4161 ha and 62898 tonnes) and Belgaum (1695 ha and 10352 tonnes).

India is the major exporter of turmeric in the world, yet there are hardly few studies throwing light on various facets of turmeric. These studies are lacking a holistic approach encompassing production, marketing, price behavior, production and post harvest constraints and export of turmeric. In the era of globalization a reassessment of supply potential, domestic and international demand scenarios and export potential become most essential. Keeping in view the above points, the present study is a modest attempt to analyse production, marketing, export potential of turmeric in Karnataka. The study will also help the planners and policy makers to frame appropriate policies related to the turmeric production, marketing and export.

6.1 Objectives

1. To estimate growth and instability in area, production and productivity of turmeric in Karnataka
2. To work out the allocative and technical efficiency in the production of turmeric
3. To work out the cost and returns in the production of turmeric
4. To identify and evaluate marketing channels for turmeric in Karnataka
5. To analyse the trend in arrivals and prices of turmeric and predict the future prices
6. To analyse the export performance of turmeric from India
7. To study the integration of important markets for turmeric
8. To enumerate production and post harvest constraints in turmeric

6.2 Methodology

Multi stage sampling technique was employed for selection of districts, taluks and villages. Karnataka state was selected as it is one of the major turmeric producing state in the country. In the first stage four districts were selected based on the highest area under turmeric cultivation *i.e.,* Chamarajanagar, Mysore, Bagalkot and Belgaum districts. In the second stage two taluks from each district were selected based on the highest area *i.e.*, Chamarajanagar and Gundlupet in Chamarajanagar district, H. D. Kote and Hunsur in Mysore district, Jamakandi and Mudhol in Bagalkot district and Gokak and Raibag in Belagum district. In the third stage two villages from each taluk were selected again based on the area under turmeric. For the selection of producers, the random sampling method was adopted and from each village twelve farmers were selected, thus the total sample size of the respondents was 192.

For the selection of markets and market intermediaries' purposive sampling technique was adopted *i.e.*, Sangli, Chamarajanagar, Gundlupet and Kollegal Markets were selected as the majority of the turmeric growers of the state were used to sell their produce in these markets. For studying the marketing aspects of turmeric from each market five retailers, five wholesalers and five commission agents were selected randomly from each market and the total sample size was 60. To evaluate the integration of major turmeric markets in India Kochi and Erode and international market New York were considered for the study.

The study utilized both primary and secondary data. The primary data relating to cost of production, price obtained by the farmers, channels followed in marketing of their produce, cost of marketing the produce were obtained from the producers to study the cost of production, cost of marketing *etc.* Similarly, the data on costs incurred by the market functionaries in the marketing of the produce, price at which the commodity was purchased and sold *etc.* were collected in order to work out the margins obtained by each of them. The time series data on area, production, productivity, arrivals, prices, exports *etc.* were obtained from secondary sources.

The study period was divided into two periods based on the policy of the government on liberalization of trade at different periods. However, for better understanding of the growth in area, production, yield and export of turemric, the overall study period (1974-75 to 2010-11) was further divided into two sub periods.

Period-I: Pre-WTO period (1974-75 to 1994-95), Period-II: Post-WTO period (1995-96 to 2010-11) and Overall Period: 1974-75 to 2010-11.

Whereas, with respect to Karnataka was concerned the period was divided as 1979-80 to 1994-95 (Pre-WTO), 1995-96 to 2010-11 (Post-WTO) and 1979-80 to 2010-11 (Overall period).

The data on prices of both domestic and international market pertaining to the period from 1983-84 to 2012-13 were considered to compute export competitiveness and from 1983-84 to 1994-95 (Pre-WTO) and 1995-96 to 2012-13 (Post-WTO) were considered to workout trade direction.

To examine the marketing performance of turmeric, data on monthly arrivals and prices for the selected markets for the period from 2003-04 to 2012-13 in the case of Sangli market, from 2005-06 to 2012-13 in the case of Chamarajanagar market, from 2006-07 to 2012-13 in the case of Gundlupet and Kollegal markets were considered based on the availability of data.

While monthly wholesale prices for the period from 2002-03 to 2012-13 in the case of Erode market and for the period from 2001-02 to 2012-13 in the case of New York and Kochi markets were considered based on the availability of data. The annual wholesale prices of turmeric for Sangli, Erode, Kochi and New York markets were collected for the period of 23 years (1990-91 to 2012-13). The primary data on cultivation of turmeric from farmers pertained to 2011-12 agricultural year.

To fulfill the specific objectives of the study, based on the nature and extent of availability of data, analytical techniques such as tabular presentation technique, growth rate analysis, instability analysis, allocative efficiency, Timmer's measure of technical efficiency, Kopp measure of technical efficiency, time series analysis, ARIMA technique, Co-integration analysis, Markov Chain analysis, NPC and Garrett ranking technique were adopted.

6.3 Findings of the study

The findings of the study are given in brief under the following heads.

6.3.1 Growth and instability in area, production and productivity of turmeric

1. During pre-WTO period the growth rates in area, production and productivity of turmeric in India were 3.45 per cent, 8.09 per cent and 4. 48 per cent respectively whereas, in the post-WTO period the growth rates of area, production and productivity of turmeric were 1.99 per cent, 3.96

per cent and 1.94 per cent and in overall period 2.65 per cent, 5.60 per cent and 2.88 per cent respectively.

2. The instability index for area during post-WTO period (7.26%) was lower compared to pre-WTO period (7.92%) and overall period (8.24%). Instability index for production of turmeric was also lower in post-WTO period (10.37%) than both pre-WTO period (18.64%) and overall period (16.52%). Similarly the instability index for yield of turmeric in post-WTO period (9.57%) was lower than both pre-WTO period (12.44%) and overall period (12.51%).
3. The growth rate of area, production and productivity of turmeric in Karnataka, during pre-WTO period were 5.26 per cent, 15.36 per cent and 9.54 per cent, whereas during post-WTO period 9.31 per cent, 11.93 per cent and 2.27 per cent and in overall period 5.92 per cent, 6.35 per cent and 0.47 per cent respectively.
4. The instability index for area during pre-WTO period (15.88%) was lower compared to post-WTO period (40.52%) and overall period (37.21%). Similarly instability index for production of turmeric was also lower in pre-WTO period (54.54%) than both post-WTO period (69.00%) and overall period (79.04%). Whereas, the instability index for yield of turmeric in post-WTO period (24.18%) was lower than both pre-WTO period (51.53%) and overall period (63.45%).
5. The growth rate in area, production and productivity in Chamarajanagar district were 13.59 per cent, 12.47 per cent and -0.98 per cent, in Mysore district were 16.66 per cent, 25.74 per cent and 7.78 per cent, in Bagalkot district 24.92 per cent, 33.70 per cent and 7.03 per cent and in Belgaum district -1.26 per cent 1.10 per cent and 2.40 per cent respectively.
6. With respect to instability index, it was found higher in production than both area and productivity in the case of all the selected districts.
7. In the case of Karnataka, the variation in average production of turmeric during the post-WTO period over the pre-WTO period was mainly due to change in mean area (122.95%) whereas, in the case of India the change in mean yield was found to be the dominant source of output growth (58.39%).
8. The major components of change in variance in turmeric production between the post-WTO period and the pre-WTO period in Karnataka and India were the yield variance (79.95%) and change in residuals (47.30%) respectively.

6.3.2 Production performance of turmeric

1. Per acre average cost of cultivation of turmeric was ₹ 77263 in Chamarajanagar district, ₹ 76985 in Mysore district, ₹ 82949 in Bagalkot district and ₹ 83402 in Belgaum district in that costs of planting material, human labour and FYM accounted for the major share in total cost of cultivation.
2. The total cost of processing and cost of marketing of turmeric were ₹ 11003 and ₹ 8273 per acre in Chamarajanagar district, ₹ 11739 and ₹ 8011 in Mysore district, ₹ 12531 and ₹ 8006 in Bagalkot district and ₹ 11123 and ₹ 7984 in Belgaum district respectively.
3. The gross returns realized by the farmers from both main product and byproduct were ₹195049 with net returns of ₹ 98511 and B: C ratio of 2.02 in Chamarajanagar district, ₹ 191909 with net returns of ₹ 95174 and B: C ratio of 1.98 in Mysore district, ₹ 202029 with net returns of ₹ 98543 and B: C ratio of 1.96 in Bagalkot district and ₹ 175099 with a net returns of ₹ 72590 and B: C ratio of 1.71 in Belgaum district.
4. The MVP: MFC ratio for chemical fertilizers and plant protection chemicals were found more than unity in the case of all four districts whereas, the ratio for planting material was also found more than unity in the case of all sample districts except Bagalkot and for bullock labor the ratio was found more than unity only in the case of Chamarajanagar and Bagalkot districts indicated underutilization of these resources.
5. In the case of all the selected districts majority of the farms achieved 90-95 per cent level of technical efficiency. The farmers growing turmeric in Chamarajanagar could save their expenditure on the usage of plant protection chemicals, in Mysore and Bagalkot district on the usage of FYM, and in Belgaum district on the usage of bullock labour.

6.3.3 Marketing performance of turmeric

1. The turmeric in the study area was marketed through four channels Producer → Commission agent → Wholesalers → Retailers →Consumer, Producer → Distant market commission agents, Producer → TAPCMS and Producer → Commission agent →Processors
2. The per quintal cost incurred by sample farmers in the marketing of turmeric through channel I and III were ₹ 343 and ₹ 158 in Chamarajanagar district, ₹ 343 and ₹ 179 in Mysore district, ₹ 387 and ₹176 in Bagalkot district and ₹ 359 and ₹ 195 in Belgaum district respectively. The total marketing cost incurred by the Chamarajanagar and Mysore district farmers in channel-III was ₹ 477 and ₹ 449 per quintal respectively.
3. The total per quintal marketing cost incurred by the commission agents in Chamarajanagar district was ₹ 304, ₹ 295 in Mysore district, ₹ 351 in Bagalkot district and ₹ 340 in Belgaum district. Wholesalers incurred ₹ 327 per quintal in the marketing of turmeric in Chamarajanagar district, ₹ 342 in Mysore district and ₹ 426 in the case of both Bagalkot and Belgaum district.
4. The retailer incurred ₹ 338 per quintal marketing cost in the case of Chamarajanagar district, ₹ 352 in the case of Mysore district and ₹ 358 in the case of both Bagalkot and Belgaum district.
5. The producer's share in consumer/processor rupee was more in channel IV than channel I and it was highest in the case of Chamarajanagar district compared to others.

6.3.4 Pace and pattern of market arrivals and prices of turmeric

1. Sangli market showed highest increasing trend in the market arrivals of turmeric every year compared to other markets whereas, the annual increase in prices of turmeric was found to be the highest in the case of Gundlupet market. In Chamarajanagar, Gundlupet and Kollegal markets the highest market arrivals was seen during the month of June whereas, in Sangli market the highest market arrivals was seen during the month of April.
2. The highest seasonal indices observed in all the markets during December month except in case of Sangli and Gundlupet market where it was found higher during the month of January and the number of cycles observed in Sangli, Erode, Kochi and New York markets 6, 7, 5, 5 and these cycles occurred for every 2.83, 2.71, 4.00 and 4.20 years respectively in prices of turmeric.
3. The forecast price in Sangli market was high for the month of January 2013, during September 2013 in Chamarajanagar and Gundlupet markets, during October 2013 in the case of Kollegal market, during January 2013 in the case of Erode, Kochi and New York markets.

6.3.5 Export performance of turmeric in India

1. The growth rate in export of turmeric in terms of quantity and value was high during overall period than that of pre and post-WTO periods. The instability index of export quantity of turmeric was higher in pre-WTO period than both post-WTO and overall periods and with regard to instability index of export value of turmeric, it was higher during post-WTO period than both pre-WTO and overall periods.
2. Results of Markov chain analysis revealed that the countries pooled under 'others category', UAE, UK and Iran would be the stable importers of the Indian turmeric in the future and countries like USA and Japan were least stable importers.
3. The projection of export quantity from 2010-11 to 2014-15 reveled that, the share of USA and Japan showed increasing trend whereas, UK, Iran, UAE and other countries showed declining trend and turmeric enjoyed more export competitiveness in the international market during both the pre and post-WTO regimes.

6.3.6 Market integration

1. The results of the co-integration analysis revealed that the Kochi, Erode and New York markets were well co-integrated where the law of one price holds well.
2. In the domestic markets, Erode, Kochi and Kollegal markets were well co-integrated.

6.3.7 Production and post harvest constraints in turmeric production

1. In all the four selected districts the major production problems opined by the farmers were pest and disease attack, non-availability of labour during the peak season, higher cost of production in turmeric and non-availability of quality planting material.

2. Major post-harvest problems in turmeric opined by the sample respondents were, higher price fluctuation, lack of remunerative price for the produce, inaccessibility to regulated market and transportation problem.

6.4 Policy implications

The policy implications emerging out of the study are outlined below in brief.

1. High priority has to be assigned to increase the production and productivity of turmeric by evolving location specific high yielding varieties of turmeric and the Karnataka State Seed Corporation and UHS, Bagalkot may take up the seed production activities of turmeric in the turmeric growing areas of the state, so that the burden of seed transport and non-availability of certified seeds would not be a problem for the farmers.
2. As the change in area and productivity were contributing more towards instability in turmeric production, the government has to stress more on pricing strategies, market facilities and policies, which would help in stabilizing the prices and would maximize profit to farmers. This is necessary to meet the increasing domestic demand on the one hand and to maintain the monopoly supply position at the international market on the other.
3. In spite of huge variable costs involved in turmeric cultivation returns were quite good and hence, the farmers need to be encouraged to take up the cultivation of this crop in large areas with a provision of financial assistance by the institutional agencies at subsidized rate of interest.
4. The technical efficiency analysis indicated that, the expenditure on the usage of various inputs can be reduced by following concerted efforts for dissemination of improved technology for a proper as well as judicious use of inputs.
5. Producer's share in consumer/processor rupee was more in channel-IV and thus there is a need to develop processing industry in the production area to enable the farmers to get remunerative price for their produce.
6. The government may take serious steps to encourage both farmers and traders for trading of the commodity in the local regulated markets by providing the infrastructural facility such as storage and transport besides disseminating information on international markets, price behaviour and other trade matters.
7. Quality of turmeric is the main hurdle to the export, and the trainings may be organized for the farmers to produce good quality turmeric. The facilities such as steam boilers and mechanical driers need to be provided by the government and spice industries to marginal and small farmers for increasing export in the years to come.
8. The result of Markov chain analysis has indicated that India is likely to lose its export markets in some of the countries like UK and Japan. Our exports are likely to be concentrated in major importing countries, Iran and UAE in the future. A high dependence on one or two export markets will increase the trade risk in the long run. Therefore, more importance has to be given to the minor importing countries such as Bangladesh, Sri Lanka, *etc.* and appropriate export promotion strategies have to be evolved to diversify the geographical concentration. Appropriate steps and policies have to be evolved to maintain the market share of Indian turmeric.
9. In order to maintain the better market integration, there is a need to establish special cells for turmeric to generate market information and market intelligence, which would provide platform for guiding the farmers in marketing their produce.
10. The major problems opined by the farmers were pest and disease attack in the production of turmeric. The prophylatic measures to protect the crop against pest and disease incidence which includes use of resistant varieties, seed and soil treatment including soil solarisation of seed beds, application of neem cake, bio control agents *etc.* In order to popularise the above techniques demonstration programmes may be taken in all the major growing districts.
11. Price stabilization measures need to be more pro-active rather than reactive, panic mechanisms. Price risk reduction measures such as providing adequate, timely dependable and farmer centric market intelligence through the collective efforts of all stake holders like farmers, traders, exporters, promotional agencies and R & D institutions assume importance in this context.

REFERENCES

Adelani Adebisi, O., Olajide Taiwo, F. B., Adeoye, I. B. and Olajide Taiwo, L. O., 2011, Analysis of production constraints facing Fadama vegetable farmers in Oyo state, Nigeria. *World J. Agric. Sci.,* **7**(2) : 189-192

Agarwal, N. L. and Singh Narendra., 2003, Cumin seed marketing in Rajasthan. *Agric. Mktg.,* **46**(1) : 36-42

Ajjan, N., Raveendran, N., Rajamani, K., Indumathi, V. M. and Vennila, A. R., 2009, Economics of cultivation and marketing of tulsi in Tamil Nadu. *Indian J. Arecanut, Spices and Medicinal Plants,* **11**(2) : 52-59

Almemaychu Amera, 2002, Production and price behaviour of potato In Karnataka State, India – An economic analysis. *Ph. D. Thesis*, Univ. Agril. Sci., Dharwad, Karnataka (India).

Anand, S. M., 2011, Performance of cotton in traditional paddy fields of Uttara Kannada district, Karnataka– An economic analysis. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Anavrat Vinod., 2010, Marketing constraints and technology needs of Nagpur Mandarin growers. *Indian J. Agril. Mktg.,* **24** (1) : 150-153.

Anchal, D. and Sharma, V. K., 2009, Price spread of litchi in Punjab, *Indian J Agril. Mktg.,* **23**(2) : 147-153.

Angles, S. and Hosamani, S. B., 2005, Instability in area, production and productivity of turmeric in selected South Indian states. *Madras Agric. J.,* **92** (4-6) : 271-278

Angles, S., 2001, Production and export of turmeric in South India – An economic analysis, M. Sc. *(Agri) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India)

Angles. S, Sundar. A. and Chinnadurai M., 2011, Impact of globalization on production and export of turmeric in India – An economic analysis. *Agric. Econ. Res. Rev.,* **24**(2) : 301-308

Ansari, M. I. and Ahmed, S. M., 2001, Time series analysis of Tea prices: An application of ARIMA modeling and co integration analysis. *Indian Econ. J.,* **48**(3) : 49-54.

Anuradha Narala and Zala, Y. C., 2010, Technical efficiency of rice farms under irrigated conditions in Central Gujarath. *Agril. Econ. Res. Rev.,* **23**(2) : 375-381

Anwarul Huq, A. S. M. and Fatimah Mohamed Arshad., 2010, Technical efficiency of chili production. *American J. Appl. Sci.,* **7**(2) : 185-190

Arulanandu, U., 2007, An econometric analysis of international and domestic trade of spices. *M. Sc. (Agri.) Thesis*, Tamil Nadu Agricultural University, Madurai.

Ashalatha., 2000, Export trade performance of Indian cashew. *M. Sc. (Agri.) Thesis.,* Univ. Agric. Sci., Bangalore.

Baharumshah Ahmed Zubaidi and Habibullah Muzafar Shah., 1994, Price efficiency in pepper markets in Malaysia : A cointegration analysis. *Indian J. Agric. Econ.,* **49**(2) : 205-215.

Bala Bru., Sharma, S. D. and Sharma, K. C., 2007, Garlic Cultivation : An emerging crop enterprise in Kullu Valley of Himachal Pradesh and its economics thereof, *Agric. Situ. India,* **63(**12) : 669-671.

Balanagamma, D., Ranganathan, C. R. and Sundaresan, R., 2000, Forecasting of agricultural scenario in Tamil Nadu – A time series analysis. *J. Indian Soc. Agric. Stat.,* **53**(3) : 273-286.

Basu, J. P. and Dinda, S., 2003, Market integration: An application of error correction model to potato market in Hoogly district, West Bengal. *Indian J. Agric. Econ.,* **58**(4) : 742-751

Beenstock, M. and Bansali, R. J., 1981, Analysis of IOWA price series by autoregressive model fitting techniques. *J. Agric. Econ.,* **31** (2) : 237-242.

Bhowmick, B. C., Baishya, A. K. and Mathews, D., 2009, Importance of ginger as a spice crop and its growth performance in Assam. *Agric. Situ. India,* **66**(1) : 9-12

Birari, K. S., Patil, M. R. and Kamble Poonam., 2006, Farm level production, processing and marketing of turmeric in Western Maharashtra. *Agric. Mktg.,* **49**(1) : 4-7

Birukal, B. Y., 2001, Statistical analysis of price and arrivals of cotton in selected regulated markets of Northern Karnataka. *M. Sc. (Agri) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India)

Bisaliah, S., 1977, Decomposition analysis of output change under new production technology in wheat farming – some implications to returns on investment. *Indian J. Agril. Econ.,***32** : 193-201.

Cheluvarangappa, T. G., 2007, Supply response and price behaviour of copra in Tumkur District, Karnataka- An economic analysis. *M. Sc. (Agri) Thesis (unpublished),* Univ. Agric. Sci., Bangalore.

Chhabi De., Singh, V. K., Baby Dey., Singh, M. K. and Nirmal De., 2012, Trends in production and export of vegetables in India. *Economic Affairs,* **57**(1) : 1

Choudhary Kuldeep., 2010, Dynamics of spot and futures market prices of mustard and its derivatives in India. *M. Sc. (Agri) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Dalawai, A., 2004, Production and marketing of cotton in Karnataka-An economic analysis. *Ph. D. Thesis*, Karnataka Univ., Dharwad, Karnataka (India).

Dhakre, D. S. and Sharma Amod., 2009, Growth and instability of ginger production in North-East : Region. *Agric. Situ. India,* **66** (8) : 463-466

Dittok, S. and Breth, S. A., 1994, Market integration : The case of dry season vegetables in Nigeria. *Issues in African Rural Develop,* **2 :** 89-101.

Dodamani, M. T., 2006, Production and value addition in naturally coloured cotton under contract farming- an economic analysis. *Ph. D Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Dodke, L. B., Kalamkar, S. S., Shende, N. V. and Deoghare, B. L., 2002a, Economics of production and marketing of turmeric. *Indian J. Agric. Mktg.,* **16**(2) : 69-72

Dodke, L. B., Kalamkar, S. S., Shende, N. V. and Deoghare, B. L., 2002b, Resource use efficiency and productivity of turmeric. *J. Soils and Crops.,* **12** (1) : 124-126

Dyammannavar, G. D., 2000, Economics of gherkin production and trade in Haveri district, Karnataka. *M. Sc. (Agri) Thesis*, Dept. of Agricultural Economics, Univ. Agric. Sci., Dharwad, Karnataka (India).

Elsamma Job and George, M. V., 2002, Technical efficiency in rice production – A frontier production function approach. *Agril. Econ. Res. Rev.,* **15**(1) : 50-55

Farrell, M. J., 1957, The measurement of production efficiency. *J. Royal Stat. Soc.,* AIZO (2) : 253-281

Ganga, G. Lal and Saran, P. L., 2007, Problems in production and marketing of henna : a study in Pali district of Rajasthan. *Haryana. J. Hortic. Sci.,* **36**(3&4) : 212-216

Ghosh Bidyut Kumar. and Kuri Pravat Kumar., 2007, Agricultural growth in West Bengal from 1970-71 to 2003-04 : A decomposition analysis. *The IUP J. Agric. Econ.,* **4**(4) : 30-46

Ghulghule, J. N., Asmatoddin, M., Thombre, A. P. amd Shinde, R. B., 2009a, Price spread in marketing of fig in Maharashtra. *The Asian J. Hortic.,* **4**(1) : 25-28

Ghulghule, J. N., Asmatoddin, M., Thombre, A. P. amd Shinde, R. B., 2009b, Resource use efficiency in fig production in Maharashtra. *The Asian J. Hortic.,* **4**(1) : 158-160

Gichangi, A., Maobe, S. N., Karanja, D., Getabu, A., Macharia, C. N., Ogecha, J. O., Nyang'au, M. K., Basweti, E. and. Kitonga, L., 2012, Assessment of production and marketing of climbing beans by smallholder farmers in Nyanza Region, Kenya. *World J. Agric. Sci.,* **8** (3) : 293-302

Govindarajan, K. and Karunakaran, K. R., 2011, Technical efficiency of paddy under different irrigation scenarios in Tamil Nadu. *Madras Agric. J.,* **98**(10-12) : 356-361

Granger, C. W. and Newbold, J., 1974, Developments in the study of co-integrated economic variables. *Oxford Bull. Econ. Stat.,* **34** (1) : 213-228.

Greene, W. H., 1980, Maximum likelihood estimates of econometric frontier functions, *J. Econ.,* **13** : 27-36.

Gupta Manoj and Sharma, K. D., 2009, Production and processing of ginger in Himachal Pradesh. *Indian J. Arecanut, Spices and Medicinal Plants,* **11**(4) : 148-155

Gupta Manoj and Sharma, K. D., 2010, Production and marketing of ginger in Himachal Pradesh. *Agric. Situ. India,* **66**(12) : 681-686

Gyan Prakash., Ram Kumar Jha and Sharma, R. C., 2006, Estimating growth rates and decomposition analysis of foodgrains production in India. *The IUP J. Agric. Econ.,* **3**(1) : 40-51

Gyati Riku., Raju, V. T., Tripathi, A. K. and Uttam Singh, N., 2011, Status of ginger with special reference to Meghalaya. *Agric. Situ. India,* **67**(11) : 655-659

Handerson, J. M and Quandt, R. E., 1971, Microeconomic Theory- A Mathematical Approach (2nd edition), McGraw Hill Company Limited, New York.

Hazell, P.B.R., 1982, Instability in Indian food grain production, Research Report 30. International Food Policy Research Institute. Washington, D.C., USA.

Hazell, P. B. R., 1984, Sources of increased instability in Indian and US cereal production. *Amer. J. Agric. Econ.,* **66**(3) : 302-311.

Hema, M. and Ranjit Kumar., 2007, Production and trade performance of major spices grown in Western Ghat region in India. *Indian J. Agril. Mktg.,* **21**(1) : 83-95

Hemanth Kumar., Devaraj and Purushottam., 2009, Trends and decomposition of lentil in India. *Agric. Situ. India,* **66**(7) : 385-388

Hiremath, V. M., 2004, Production and marketing of cotton in Karnataka – An economic analysis. *M. Sc. (Agri) Thesis*, Univ. Agric. Sci., Bangalore.

Hosamani, S. B., Hiremath, G. M. and Kulkarni, B. S., 2011, Indian pomegranate export in the Pre-WTO regime. *J. Acta Hortic.,* 890 : 602-613

Huq Anwarul, A. S. M. and Arshad Fatimah Mohamed., 2010, Technical efficiency of chili production. *American J. Appl. Sci.,* **7** (2) : 185-190.

Indira Rajaraman and Arindam Datta, 2003, Univariate forecasting of state level agricultural production. *Econ. Polit. Weekly,* May 3, **48**(1) : 1800-1803.

Jaleta Moti and Gebremedhin Berhanu., 2011, Price co-integration analyses of food crop markets : The case of wheat and teff commodities in Northern Ethiopia. *African J. Agric. Res.,* **7**(25) : 3643-3652,

Jayasree, K., Swapnam Surendran., Satheesh Babu, K. and Jesy Thomas, K., 2010, Global competitiveness and market integration of Indian pepper. *Indian J. Arecanut, Spices and Medicinal Plants,* **12**(1) : 3-6

Jayasree, K., Swapnam Surendran., Satheesh Babu, K. and Jesy Thomas, K., 2011, Price behavior in pepper : A time series approach. *Indian J. Arecanut, Spices and Medicinal Plants,* **13** (2) : 23-25

Jayesh, T., 2001, Production and export performance of pepper and cardamom in South India. – An economic analysis, *M. Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Jeromi, P. D and Ramanathan, A., 1993, World market and India : An analysis of growth and instability. *Ind. J. Agric. Econ.,* **48**(1) : 88-97.

Jose, C. T. and Jayasekhar, S., 2008, The growth trends in area, production and productivity of Arecanut in India. *Agric. Situ. India,* **65**(1) : 135-140.

Kachroo Jyoti., Arti Sharma and Kachroo Dileep., 2010, Technical efficiency of dryland and irrigated wheat based on stochastic model. *Agril. Econ. Res. Rev.,* **23**(2) : 383-390

Karpagam, C., 2000, A study on knowledge and adoption behavior of turmeric growers in Erode district of Tamil Nadu state. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Kaur Arjinder., Kiran Sethi. and Kaur Parmider., 2004, Export of turmeric : Status and prospects. *Indian. J. Agril. Mktg.,* **18**(1) : 104-114

Kaur Lavleen, Dhaliwal Tejinder., Rangi, P. S. and Singh Nirmal, 2005, An econometric analysis of tomato arrivals and prices in Punjab. *Indian J. Agric. Mktg.,* **19**(3) : 45-50.

Kerutagi, M. G., Kotikal, Y. K., Hulamani, N. C. and Hiremath, G. K., 2000, Costs and returns of turmeric in Belgaum district of Karnataka. *Karnataka J. Agric, Sci.,* **13**(1) : 209-211

Kerutagi, M. G., Ramchandra, V. A., Kunnal, L. B., Mahajanshetti, S. B. and Shirol, A. M., 2009, Marketing of sapota in Northern Karnataka. *Indian J. Agric. Mktg.,* **23** (2) : 57-63.

Khunt, K, A., Gajipara, H. M. and Vekariya, S. B., 2006, Price behaviour of major vegetables in Gujarat state. *Indian J. Agric. Mktg.,* **20**(1) : 45-48.

Kolur Anil., 2011, Market dynamics of wheat in Karnataka - An econometric approach. *M. Sc. (Agri) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Kopp, R, J., 1981, The measurement of production efficiency. *Australian J. Econ.,* **97**(3) : 457-503.

Korikantimath, V. S., Hiremath, G. M., Peter, K. V., Shripad, P. V. and Naik, A. D., 2000, Economics of mixed cropping of Byadagi chilli and cotton. *Karnataka J. Agric. Sci.,* **13**(1) : 73-78

Krishnadas, M. and Mundinamani, S. M., 2011, Changing direction of major spices exports from India. *Indian J. Arecanut, Spices and Medicinal Plants,* **13**(3) : 21-24

Krishndas, M., 2010, Production and Export Performance of Major Indian Spices - An Economic Analysis, *M. Sc. (Agri) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Kshirsagar, P, J., 2008, Production, processing and marketing of kokum (*Garcinia indica*) in Konkan region of Maharashtra– An economic analysis. *Ph. D Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Kulkarni, G. N., 2008, Economics of irrigation induced land degradation and its reclamation in Upper Krishna Project command area. *Ph. D Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Kumar, K. and Singh, H. L., 2010, Price spread in marketing of mango in Lucknow district of U. P. *Indian J. Agric. Mktg.,* **24** (2) : 50-57.

Kumar, N. A and Sankaran, P. G., 1998, Instability of turmeric production in India. *J. Spice and Aromaic Crops*, **7** (1) : 19-22

Kumar, P. and Sharma, R. K., 2003, Spatial integration and pricing efficiency at the farm level : A study of paddy in Haryana. *Indian J. Agric. Econ.,* **58**(2) : 201-217.

Kumawat, R. C. and Kumar Pradeep, 2006, An empirical analysis of market integrated of rapeseed-mustard in the state of Rajasthan. *Indian J. Agril. Mktg.,* **20** (3) : 129-134.

Kumawat, R. C. and Meena, P. C., 2005, Growth and instability in area, production and yield of major spice crops in Rajasthan vis-à-vis India. *J. Spices and Aromatic Crops,* **14**(2) : 102–111

Lakshmanachar, M. S and Velappan, E., Marketing of chillies, ginger and turmeric in India. Proceedings of the National Seminar on Chillies, Ginger and Turmeric, Hyderabad, Andhra Pradesh, India, 11-12 January 2004.

Lokesh, G, B and M, G. Chandrakanth., 2004, Economics of production, marketing and processing of turmeric in Karnataka. *Indian J. Agric. Mktg.,* **18**(2) : 32-44

Madan, M. S., 2004, Estimation of cost of cultivation in spices-vanilla. *Indian J. Arecanut, Spices and Medicinal Plants,* **6**(1) : 28-38

Madan, M. S., 2008, Changing scenario of turmeric production and marketing. *Agric. Situ. India,* **66** (4) : 193-210

Madan, M. S., Sarma, Y. R. and Nagendra. J., 2002, Spices production and prospects in Andhra Pradesh. *Indian J. Arecanut, Spices and Medicinal Plants,* **4**(1) : 42-50

Mahajan Priyanka. and Nanda Paramjit., 2011, Structural changes in commodity composition and direction of agricultural exports in India under WTO regime. *IUP J. Agric. Econ.,* July 2011

Mal Puran., Grover, R. K. and Malik, D. P., 2009, Economic analysis of safed musli in Haryana. *Indian J. Arecanut, Spices and Medicinal Plants,* **11**(1) : 1-7

Mamatha, B. G., 1995, Export trade of selected Spices in India – An economic analysis. *M. Sc. (Agri) Thesis*, Univ. Agric. Sci., Bangalore

Manasa R., 2009, Dynamics of prices and arrivals of pigeonpea in Karnataka – An econometric analysis. MBA (Agribusiness) *Thesis*, Univ. of Agric. Sci. Dharwad, Karnataka (India)

Mane, U. S., Changule, B. B., Mane, B. B., Kolekar, P. L. and Gharge, S. H., 2011, Economics of turmeric production in Sangli district of Maharashtra. *Agriculture Update,* **6** (2) : 34-37

Mary Louis, L and John Joel, A., 2010, Data envelopment analysis-An application to turmeric production in North Western region of Tamil Nadu. *Operational Research Society of India*, **47**(3) : 205–215

Mehta, R. and Srivastava Pankaj Kumar, 2000, Analysis of seasonality in prices of agricultural commodities. *Agric. Situ. India,* **5**(1) :311-323.

Mendoza, M. S. and Rosegrant, M. W., 1995 Pricing behaviour of Philippines corn markets : Implications for market efficiency. *Res. Rep. 101,* International Food Policy Research Institute, Washington, DC., USA.

Mishra, J. P., Vishwakaram, R. S. and Shri Kumar Rawat., 1999, Production and marketing of chillies. *The Bihar Jn. of Agri. Mktg.,* **7**(1) : 37-43

Mittal, V. N., 1995, Reviving ginger production in Himachal Pradesh. *Agric. Situ. India,* **52**(1) : 3-7

Mohan, H. P., 2009, Impact of IPM technology on cotton and paddy production in Haveri district- An economic analysis. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Mokashi, P. K., 2012, An economic analysis of export potential of grapes from Northern Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Moktan, M. W and Mukherjee Dhiman., 2008, Trade and marketing strategy for spice crops in Darjeeling district. *Environ. Ecol.,* **26**(3A) : 1302-1305

Murugananthi, D., Selvam, S., Raveendaran, N. and Meena, S. T., 2008, A study on the direction of trade in the Indian turmeric exports : Markov Chain approach. *The IUP J. Agric. Econ.,* **5**(4) : 20-25

Navadkar, D. S., Dorge, D. S. and Sale, D. L., 2005a, Econometric analysis of arrivals and prices of vegetables in Gultekadi regulated market, Pune. *Agril. Situat. India,* June pp. 117-120.

Navadkar, D. S., Sale, D. L. and Patil, U. D., 2005b, Marketing of vegetables grown around Pune city. *Agric. Situ. India,* **62**(3) : 259-262.

Nikhil, H. N., 2008, A study of Arecanut marketing and prices under economic liberalization in Karnataka, *M. Sc. Thesis* submitted to the Univ. Agric. Sci., Bangalore.

Pal, S. and Sirohi, A. S., 1989, Instability in Indian crop production : Its magnitude and sources. *Artha Vijnan,* **31**(3) : 241-256.

Patel, A., 2000, Market integration and pattern of market arrivals of rapeseed-mustard in Mehasana district of Gujarat. *Agric. Mrktg.,* **62** (4) : 24-29.

Patel, G. N. and Agarwal, N. L., 1994, Growth and instability in production of groundnut in Saurashtra region of Gujarath. *Agric. Situ. India,* **49(**3) : 171-175

Patil, M. R. , Borse, M. K. , Patil, S. D. and Poonam, Kamble., 2009, Economic aspects of production, processing and marketing of turmeric in western Maharashtra. *Intl. J. Agric. Sci.,* **5** (1) : 60-63

Patil, P. R., 2000, Economics of production and marketing of turmeric In Sangli district (Maharashtra). *M. Sc. (Agri.) Thesis*, Mahatma Phule Krishi Vidyapeeth, Rahuri

Patil, P. R., Lohar, N. S., Bhingardeve, S. D. and Bondar, V. S., 2004, Economics of production of turmeric in Sangli district of Western Maharashtra. *Indian J. Arecanut, Spices and Medicinal Plants,* **6**(1) : 9-12

Pawar, N. D. and Misal, D. H., 2004, Behaviour of prices and arrivals of pomegranate in Western Maharashtra. *Agric. Mrktg.,* **47**(4) : 22-24.

Pol, P. B., 2001, Economics of production and marketing of ginger in Satara district. *M. Sc. (Agri.) Thesis*, Mahatma Phule Krishi Vidyapeeth, Rahuri

Prasad, Y. E., Murthy, C. S. and Satyanarayan, G., 1998, An economic analysis of arrivals and prices of turmeric in Guntur market. *Indian J. Mktg.,* **3**(1) : 34-37

Radam Alias., Mohd Ariff Hussein., Hairuddin Mohd Amin. and Mad Nasir Shamsudin., 2007, Technical efficiency of Chinese cabbage farm in Cameron Highland Malaysia. *The IUP J. Agric. Econ.,* **4**(4) : 7-19

Rajesh, D. B., 2006, Economic evaluation of vanilla cultivation in Uttara Kannada district of Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Rajesh, S. R., 2003, Export performance of major spices in India. *M. Sc. (Agri) Thesis*, Tamil Nadu. Agric. Univ., Coimbatore.

Rajesh, S. R., 2004, Export performance of major spices in India. *Agric. Econ. Res. Rev.,* **17**(1) : 141-142

Rajur Basavaraj., 2007, Production and marketing performance of chilli in Karnataka – An economic analysis. *Ph. D Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Rajur, B. C., Patil, B. L., Kunnal, L. B. and Basavaraja, H., 2009, Market arrivals and prices of chilli in Karnataka-An economic analysis. *Agric. Situ. India,* **65**(11) : 671-674

Rao, Y. S., Lakshmanan, K., Mary Mathew. and Thomas, J., 2011, Problems faced by farmers and traders of saffron and other spices in Jammu and Kashmir. *Indian J. Arecanut, Spices and Medicinal Plants,* **13**(3) : 5-13

Ravikumar, K. N., Raju, V. T. and Sreelakshmi, K., 2001, Determinants of prices of agricultural commodities in the regulated markets of Andhra Pradesh. *Agril. Market.,* **43** (1) : 19-22.

Reddy Dilip., 2008, Futures trade, export and direction of trade in soya : An econometric analysis. *MBA (Agribusiness) Thesis,* Univ. of Agric. Sci. Dharwad, Karnataka (India).

Russell, M. P and Yaung, T., 1983, Frontier production function and measurement of technical efficiency, *J. Agric. Econ.,* 34(2) : 139-149.

Sadeesh, J., Pouchepparadjou, A., Anil Kuruvila., Rammohan, J. and Umamaheshwari, L., 2007, An economic analysis- export performance of Indian spices. *Agric. Situ. India,* **63**(10) : 593-601

Saikumar, B. C., 2005, Farming systems in the tank commands of north eastern Karnataka – An economic analysis of Jala Samvardhane Yojana Sangha managed tanks. *M. Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India)

Saini, A. S. and Bhati, S. K., 1995, Constraints of ginger marketing in Himachal Pradesh. *The Bihar J. Agric. Mktg.,* 3(2) : 117-127

Sangeeta Shroff, 2004, Marketing of onion in Maharashtra. *Indian J. Agric. Mktg.,* **4**(1) : 45-50.

Sanjay Kumar, 2003, An economic analysis of onion production in India. *M. Sc. (Agri.) Thesis,* CCS Haryana Agricultural University, Hisar.

Sarada, C. and Kalidasu Giridhar., 2008, Threats in production of coriander. *J. Spices and Aromatic Crops,* **17** (2) : 158-162

Satheesh Babu, K., Jayasree, K. and Silja Jose., 2012, Price behavior in small cardamom : An analysis. *Indian J. Arecanut, Spices and Medicinal Plants,* **14**(3) : 9-15

Sawant M. S., 2002, A study of adoption of turmeric production technology in Satara district. *M. Sc. (Agri.) Thesis*, Mahatma Phule Krishi Vidyapeeth, Rahuri.

Sekhar, C. S. C., 2012, Agricultural market integration in India : an analysis of select commodities. *Food Policy*, **37**(3) : 309-322

Sekhon, M. K., Kaur Mahal Amrith., Kaur Manjeet and Sidhu, M. S., 2010, Technical efficiency in crop production : A region wise analysis. *Agril. Econ. Res. Rev.,* **23**(2) : 367-374

Selvakumar, G., 2003, Forecasting trained agricultural manpower in Tamil Nadu. *M. Sc. (Agri.) Thesis,* Tamil Nadu Agric. Univ., Coimbatore, India.

Sharma, Amod and Kalita, D. C., 2008, Trends in area, production and productivity of major fruit crops in Jammu and Kashmir. *Agric. Situ. India,* **66**(1) : 15-17.

Sharma, R. K., Chauhan, S. K. and Gupta Sonika., 2008, Technical efficiency in North-Western Himalayan region : A study of Himachal Pradesh Agriculture. *Agril. Econ. Res. Rev.,* **21**(1) : 82-90

Shivaraja, M. B., 2012, Production and value addition to chilli in Northern Karnataka–An economic analysis. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Shivaraya Balappa, 2000, Economic performance of production, marketing and export of vegetables in North Karnataka, *Ph. D. Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Shivashankar, K., 2007, Marketing of dry chillies in Karnataka-A management appraisal. *Ph. D Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India).

Shiyani, R. L., Kakadia, B. H. and Pandya, H. R., 1999 Time Series analysis of arrivals and prices of garlic in Regulated Markets of Saurashtra. *Indian J. Agric. Mktg.,* **13**(2) : 42-43.

Shumeta Zekarias., 2010, Avocado production and marketing in Southwestern Ethiopia. *Trends Agric. Econ.,* **3**(4) : 190-206

Siddaya and Atteri, B. R, 2010, Export competitiveness of fresh fruits and vegetables under compliance. *Agric. Econ. Res. Rev.,* **23** (3) : 555 - 561.

Sing Surender., 2007, Technical efficiency of paddy cultivation : A socioeconomic analysis of Haryana state. *The IUP J. Agric. Econ.,* **4**(3) : 36-47

Singh Bhagwan., 2007, Constraints in adoption of production technologies in cumin (*Cuminum cyminum* L.*). J. Spices and Aromatic Crops,* **16** (1) : 42–45

Singh Ganganjot, S. S., Chahal and Kataria, P., 2010, A study on behavior of arrivals and prices of Green Chillies in Punjab, *Ind. J. Agric. Mktg.,* **24**(1) : 26-37.

Singh, B., Singh, V. K. and Khatkar, R. K., 1999, Marketing of tomatoes in Hoshipur districts of Punjab. *Indian J. Agril. Mktg.,* **13**(2) : 40.

Singh, J. M., Singh, Jasdev., Garg. B. R. and Kaur Baljinder (2012), Production and marketing of turmeric-A case study in Punjab. *Ind. J. Agric. Mktg.,* **26** (1) : 36-45

Sinharoy and Nair, 1994, International trade of pepper and price variations using co-integration analysis. *Indian J. Agric. Econ.,* **31**(2) : 90-98.

Sivanagaraju, P., 2006, Traditional and SRI methods of paddy cultivation – A comparative economic analysis. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).

Sridhara, J., 2010, Economics of contract farming –A case study of chilli in Bagalkot district of Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Karnataka (India).

Srivastava, J. N., Upma Dutta., Singh Brajeshwar. and Rakesh Kumar., 2012, Golden condiment saffron : production constraints, status and strategies in Jammu Kashmir. *Indian J. Arecanut, Spices and Medicinal Plants,* **14**(3) : 3-8

Subal Maibangsa., Baruah, B. P., Mercydi Maibangsa. and Mahanta, T. K., 2003, Marketing of important medicinal and aromatic plants in Assam. *Indian J. Arecanut, Spices and Medicinal Plants,* **5**(2) : 41-42

Sujatha, R. V. and Eswara Prasad, Y., 2008, Direction of trade in Indian pepper exports : a Markov Chain approach. *The IUP J. Agric. Econ.,* **5**(2) : 22-30

Taher Mohammad. and Shadmehri Ahamdi., 2008, Estimating growth rates and decomposition analysis of agricultural production in Iran (1970-2000). *Trends Agric. Econ.,* **1**(1) : 14-26

Tamil Selvan, M. and Manojkumar, K., 2003, Indian spices-challenges and opportunities. *Indian J. Arecanut, Spices and Medicinal Plants,* **5**(1) : 1-4

Tavisikonda Jyothi and Thomus Jesy, K., 2012, Global competitiveness of Indian turmeric, *Indian J. Arecanut, Spices and Medicinal Plants,* **14**(1) : 3-8

Thomas, E. K., Krishnan, S., Jesy Thomas, K. and Sreela P., 2006, Technical efficiency of vegetable production in Kerala : A frontier production function approach. *The IUP J. Agric. Econ.,* **3**(2) : 32-40

Thumar, V. M., Gajipara, H. M. and Khunt, K. A., 2006. Growth and instability in production and export marketing of garlic. *Indian J. Agril. Mktg.,* **20**(2) : 25-33

Timmer, C. P., 1971, Using a probabilistic production function to measure technical efficiency. *J. Polit. Econ.,* 79 (4) : 776-794.

Tripathi, A. K., Subhasis Mandal., Datta, K, K., and M, R. Verma., 2006, A study of ginger in Ri-Bhoi district of Meghalaya. *Indian J. Agric. Mktg.,* **20**(2) : 107-116.

Tripathi, A. K., Subhasis Mandal., Verma M, R. and Raju, V. T., 2009, Impact of training on production and marketing of ginger in Ri-Bhoi district of Meghalaya. *Indian J. Agric. Mktg.,* **23**(1) : 58-65.

Vadival. V and Madhusoodanan, K. J., 2003, Problems and prospective of garlic productivity and exports. *Indian J. Arecanut, Spices and Medicinal Plants,* **5**(3) : 89-93

Vani. A. and Krishnaiah. J., 1998 Price Integration in Marketing of Chillies : A study of Guntur market in Andhra Pradesh. *Indian J. Agric. Marktg., (Conf. Spl.).* **12** (3) : 48.

Varghese, P. K., 2007, Economics of cardamom in Kerala. *Ind. Jn. of Agri. Econ.,* **62**(1) : 99-112

Vasudev, N. and Chowdry, K. R., 1999, Marketing of tomato in Andhra Pradesh. *Indian J. Agric. Mktg.,* **13**(2) : 53.

Veeranagouda., Havaldar, Y. N., Megeri, S. N., Hosamani, S. B. and Basavaraj Banakar., 2011, Growth rate scenario of chilli in North-Karnataka. *Karnataka J. Agric. Sci.,* **24** (3) : 412.

Virender Kumar, H. R. Sharma and Kamalesh Singh, 2005, Behaviour of market arrivals and prices of selected vegetable crop : A study of four metropolitan markets. *Agric. Econ. Res. Rev.,* **80** : 271-290.

Vishal Talawar., 2010, Market dynamics and price forecasting of maize in South Karnataka – An application of GARCH model. *M. Sc. (Agri) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India)

Wadhwani, M. K. and Bhogal, T. S., 2003, Economics of production, post harvest management and price behaviour of Cole crops in Western U. P. -An empirical analysis. *Agric. Mktg.,* April-June, pp. 10-20.

Yin Runsheng and Min, R. S., 1999, Forecasting short-term timber prices with univariate ARIMA model. *J. Amer. Stat. Assoc,* **25**(1) : 154-158.

Yogisha, G. M., Karnool, N. N., Vijaya Kumar, H. S. and Basavaraja, H., 2007 Trends and seasonal variation in arrivals and prices of potato in Kolar district. *Agric. Mktg.,* **69**(4) : 26-28.

Appendix VII: Interview schedule

PRODUCTION, MARKETING AND EXPORT PERFORMANCE OF TURMERIC IN KARNATAKA: AN ECONOMIC ANALYSIS

Schedule No. :

I. GENERAL INFORMATION:

1. **Name of the respondent:**

Village: Taluk: District:

b. Occupation: Primary:

Secondary: 1.

2.

II .Family Particulars:

Sl. No	Name	Sex	Age	Education	Whether engaged in farming
1.					
2.					
3.					
4.					
5.					
6.					

III. SOCIAL STATUS

Are you a member of any social organization? Yes/No

If yes, please furnish the details as below

Name of the organization	Nature of participation			Extent of participation		
	Member	Office bearer	Distinctive features	Regular	Occasional	Never
Gram panchayat						
Co-operative society						
Taluk Panchayat						
Zilla Panchayat						
Farmers forum						
Farm youth's forum						
School chairman (SDMC)						
Irrigation societies						
Farm women's forum						
Youth club						
Any other (specify)						

IV. Land Holding (Ha):

***1-Canal; 2-Tank; 3-Open Well; 4-Tube Well; 5-Others (specify):**

Sl. No.	Particulars	Rainfed		Irrigated		Source of irrigation*
		Area	Land value/ Rent(Rs/ha)	Area	Land value/ Rent(Rs/ha)	
1.	Area owned					
2.	Leased in					
3.	Leased out					
4.	Fallow land					

V. Cropping Pattern of the Study Area

Season	Crop	Area (ha)	Rainfed/ Irrigated
Kharif	1.		
	2.		
	3.		
	4.		
	5.		
	6.		
Rabi	1.		
	2.		
	3.		
	4.		
	5.		
Summer	1.		
	2.		
	3.		
	4.		
	5.		

VI. Asset Possession:

Types of assets	Nos.	Year of purchase/ Construction	Purchase/ construction Value(Rs)	Junk value	Expected life span
Building					
(a) Farm home					
(b) Farm shed					
(c) Storage godown					
Bullock cart					
Livestock					
Tractor					
Power tiller					
Implements					
1. Pumpset					
2. Irrigation equipments					
3. Ploughs					
4. Cultivator					
5. Seed drill					
6. Intercultural implements					
7. Thresher					
8. Sprayer/duster					
9. Harrow					
10. Leveler					
11. Puddler					
12. Others					
(i)					
(ii)					
(iii)					

VII. COST OF CULTIVATION

Area (acres): Variety: HYV/Local Name: Season: *Kharif /Rabi/summer*

a. Labour required for the different operations

Particulars	No of times	Family labour				Hired labour			
		M	W	BP	ML	M	W	BP	ML
Ploughing									
Harrowing									
Transportation of FYM									
Spreading of FYM									
Seed bed preparation									
Spraying of weedicides									
Planting									
Fertilizer /organic manure application									
Hand weeding									
Inter cultivation									
Spraying PPC/Bio-pesticides									
Irrigation									
Harvesting									
Transportation									
Others									
1)									
2)									

Note: M=Men, W=Women, BP= Bullock pairs, ML=Machine labour

b. Labour charges:

Cost of hiring labour

1. Men (Rs. /day) :
2. Women (Rs. /day):
3. Bullock pair (B pair /day):
4. Machine labour (Rs/hr):

c. Input cost

Particulars	Quantity (kgs)	Price /unit	Total cost (Rs)
1. Planting material			
2. Seed treatment chemicals			
3. Fertilizers/Bio-fertilizers			
a. N			
b. P			
c. K			
d.			
4. Pesticides /Bio-pesticides			
a.			
b.			
5. Weedicides			
6. Irrigation charges			
7. Land revenue			
8. Rental value of land			
9. Others (specify)			

VIII. Cost of farm level processing

Particulars	Human labour	Machine labour	Fuel	Utensils charges
Curing				
Drying				
Polishing				
Colouring				

IX. DETAILS ON RETURNS

1. Area sown:
2. Yield/acre :
3. Price (Rs/t):

X. Particulars of the market/ marketing

1. The nearest regulated market from the village
2. Distance from the village to the market
3. Nature of the road to the market
    1. Mud road 2. Metal road
4. Whether your village is
    1. Easily accessible throughout the year
    2. Not accessible during rainy season
    3. Difficult to reach in any season
5. Mode of conveyance available to reach market from your village
    a) Bus b) Train c) bus and train
    d) Truck e) Tempo f) Bullock cart
    g) No transportation facilities
6. Have you got any conveyance of your own?
    a) Bullock cart b) Mechanized vehicle
    c) Both a and b d) No conveyance
7. Reasons for selling at a particular market
    a) Remunerative price b) Correct weight
    c) Low market charges d) Absence of middle men
    e) Spot payment f) Getting transport, storage/ loan facility
    g) Nearness h) Personal bondage
8. Do you collect price information?
    a) Daily b) More than once a weak c) Weekly
    d) Monthly e) Season wise f) Annually
9. Marketing pattern of turmeric

Month of sale	Place of sale	To whom sold	Quantity sold(qtls)	Price (Rs)	Total amount

11. Purpose of selling your produce to the above.

Sl. No.	Purpose	VM	WST	Processo r	CA	Retailer	Co-op society
1	Previous agreement						
2	Better payment						
3	Immediate cash payment						
4	Small quantity of produce						
5	Low marketing cost						
6	Social ties with intermediaries						
7	Loan facility available						
8	Input supply, seeds/fertilizers/pesticides						
9	Storage facilities						
10	Transportation facilities						
11	Correct weighment						
12	Other reason						

12. Source of price information

a) Going to market and knowing by yourself
b) Asking others who sold the produce
c) Asking people who have gone to town
d) Radio/TV/Newspapers/Commission agents/Traders/Mobiles/Others
e) Internet/Krishimaratvahini
f) Agribusiness Export Knowledge Center (UASD)

13. Do you compare the price while selling the produce, if yes

a) Within the market b) Between the market

14. Do you demand higher price from the buyers and if you feel that the price is low?

Yes/ No

15. Do you withdraw the produce from sale? Yes/No

If yes how many times and what are reasons?

a) Low price b) Buyers refusal c) Higher price expectation

16. Are you satisfied with the following facilities in the regulated market?

a) Internal road b) Auction platform

c) Storage facility d) Weighment

e) Market information f) Communication

g) Accommodation

XI. Cost incurred in marketing of turmeric (Rs/qtl or bag)

Sl. No.	Items	Cost
1	Cleaning /sorting	
2	Packing	
3	Loading	
4	Transportation	
5	Unloading	
6	Weighment	
7	Commission charges	
8	Storage charges	
9	Personal expenses	
10	Miscellaneous	
	Total	

XII. Problems faced by farmers during production, processing and marketing of turmeric

I. Production constraints

1. Non – availability of suitable varieties
2. Non – availability of quality planting material
3. Non – availability of labour during peak season
4. Non – availability of fertilizers during appropriate time

5. Pest and disease attack
    a. Non – availability of suitable pesticides
    b. Pesticides are costly
    c. Availability of spurious chemicals in the market
    d. Lack of adequate information about pesticides
        i. Time of application
        ii. Quantity of application
        iii. Whether single or mixer has to be used
        iv. Dilemma in selection of pesticides
6. Higher cost of production
7. Financial constraints
8. Lack of awareness about IPM
9. Lack of support from department

II. Marketing

1. Lack of market infrastructure
2. Lack of market information and intelligence
3. Involvement of large number of intermediaries
4. Lack of remunerative price for the produce
5. Inaccessibility to regulated market
6. Non- availability of grading facility
7. High commission charges
8. Unauthorized deduction
9. Malpractices in weighment
10. Inadequate storage facilities
11. Transportation problems
12. Lack of processing facilities
13. High price fluctuation

MARKET FUNCTIONARIES
(Retailers/Commission Agents/wholesalers)

No. ______________

I. GENERAL INFORMATION

1. Name of the respondent:

2. Location:

3. Age:

II A. Crops handled

Crop	Quantity	Price per quintal	Total value (Rs.)
Turmeric			

B. Are you dealing in commodities other than turmeric? Yes/No, If yes, what are the crops

C. Do you make outright purchase in the field and transport it on your own cost? Yes/No

III. What facilities do you provide to the producer who brings produce for sale?

Loan / Storage / Accommodation / Transportation / Advance payment / Seed/ Fertilizers /Pesticides etc.

IV. Do you give any credit facilities to the farmers who bring produce to your shop? Yes/No If Yes,

a. To how many farmers	
b. Maximum duration for which amount is advanced	
c. Amount advanced per farmer	
d. Total amount advanced	
e. Conditions for advancing loan (Security etc.)	
f. Mode of recovery followed	
g. Interest rate charged	

V. Investment made in the business

A. 1. Owned (Rs.): ______________________________ 2. Borrowed: _______________

3. Interest rate charged: ________________________

B. Investment on

i. Godowns (No. of godowns): _________________Amount (Rs. ___________)

ii. Shops (No. of shops): ______________________ Amount (Rs. ___________)

iii. Equipments (Rs.): ____________________ iv. If any: _______________

VI. 1. Do you have the knowledge of different qualities/grades/standards of different varieties of processed turmeric: little/average/perfect?

2. Do you grade the processed turmeric? Yes/ No. If yes, on what basis?

3. Do you make payment according to the grades? Yes/No

4. Methods used in fixing the prices for different grades:

5. Do you make any deductions for more moisture content/any other foreign matter? Yes/No

VII. 1. Do you regularly collect the market information?

i. Local market: Yes/No ii. Other markets: Yes/No

2. If yes, source of information about market situation: Personal visit/ neighbors/newspapers/radio/Telephone/any other source

VIII. Do you have shop owned/rented?

1. If rented, what is the rent per year: ___________ 2. License fee

3. Tax paid: _________ (basis of taxes: ______________________________)

4. Maintenance cost: ____________ 5. Insurance: _____________

6. Any other costs (specify):___________________________

IX. 1. Distance of your shop from the market place: _____________

2. Place of arrivals of processed turmeric: _________________

3. Distance of the village: ______________________

X. Do you sell the dry turmeric to the wholesaler/retailer?

If yes, to how many wholesalers/retailers? _______________

XI. At present what problems (or inconveniences) you are facing in processed turmeric marketing

1. _________________ 2. _________________

3. _________________ 4. _________________

XII. What is your opinion regarding regulation in processed turmeric trading:

Necessary/ Unnecessary (State reasons)

XIII. Dry Turmeric transactions

A. Purchase activity

Crop	From whom purchased	From where	When purchased	No. of sellers buyers present	Method of purchase	Quantity purchased	Price		Market fee
							Per unit	Total value	
Turmeric									

B. Selling activity

Crop	To whom sold	Method of sale	Qty sold	Sale price		Commission		Qty sold	Value (Rs.)	Wastage	
				Per unit	Total value	Rate	Total			Qty	Value
Turmeric											

XVI. Trade directions

A. Quantity purchased from different places

Crop	Place	Qty purchased	Price per qtl.	Distance (km)	Transportation cost		Handling charges	Other charges
					Per km	Total value		
Turmeric								

Crop	Place	Qty sold	Price per qtl	Distance (Km)	Transportation cost		Handling charges	Other charges
					Per km	Total value		
Turmeric								

B. Quantity sold to different places

XVII. Retail transactions

1. Quantity purchased: ________________________
2. Average purchase price: ____________________
3. Quantity sold: ____________________________
4. Average sale price: _________________________
5. Quantity wastage: __________________________
6. Wastage value: ____________________________
7. Cost incurred: _____________________________
8. License fee: _______________________________

a. Transportation cost: _________________________
b. Bagging cost: _____________________________
c. Labour cost: ______________________________
d. Any other cost: ____________________________

9. Capital invested: --

PRODUCTION, MARKETING AND EXPORT PERFORMANCE OF TURMERIC IN KARNATAKA: AN ECONOMIC ANALYSIS

VINOD R. NAIK **2013** **Dr. S. B. HOSAMANI**

Major Advisor

ABSTRACT

The focus of the study was on the production, marketing and export performance of turmeric in Karnataka. Field level data were elicited for the agriculture year 2011-12 through personal interview method. The time series data on area, production, productivity, arrivals, prices, exports etc. were obtained from secondary sources.

The growths in area, production and productivity were found to be higher during pre-WTO period in the case of India as a whole. Whereas, the instability indices for area, production and productivity of turmeric were lower during post-WTO period. The variation in average production of turmeric during the post-WTO period over the pre-WTO period was mainly due to change in mean area (122.95%) and change in mean yield (58.39%) in the case of Karnataka and India respectively. Per acre average cost of cultivation of turmeric was found to be high in the case of Belgaum district (₹ 83402) and B: C ratio was found to be higher in the case of Chamarajanagar district (2.02). The MVP: MFC ratio for chemical fertilizers and plant protection chemicals were found more than unity in the case of all four districts. In the case of all the selected districts majority of the farms achieved 90-95 per cent level of technical efficiency. The producer's share in consumer/processor rupee was more in channel-IV than channel-I and it was the highest in the case of Chamarajanagar district compared to others. The growth rate in export of turmeric in terms of quantity and value was high during overall period than that of pre and post-WTO periods. Results of Markov chain analysis revealed that the countries pooled under 'others category', UAE, UK and Iran would be the stable importers of the Indian turmeric in the future. The results of the co-integration analysis revealed that the Kochi, Erode and New York markets were well co-integrated. In all the four selected districts the major problems faced by the farmers were pest and disease attack and higher price fluctuations.