

**CHANGES IN OILSEED ECONOMY OF KARNATAKA:
PRE AND POST-WTO ANALYSIS**

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I. INTRODUCTION

Agriculture continues to be the most important sector of Indian economy accounting for 22 per cent of the country's Gross National Product and the livelihood of more than two thirds of population. As the economy grows, the scope of agricultural economy also expands horizontally and vertically. By and large agriculture makes three kinds of contribution to the economic growth of a nation viz., the factor contribution, the production contribution and market contribution.

For the past several decades the rate of growth in India's food production (2.60%) exceeded the population growth rate (2.1%). As a result of concerted efforts, the country in the mid sixties experienced a major breakthrough in its food production, which has been regarded as the Green Revolution. The success of the new farm technology has enabled India to increase the production of food grains and with this breakthrough, the country has been able to attain its food self-sufficiency from an almost continuous dependence on food imports till as late as the early seventies. The food production has increased from a mere 52 million tonnes in 1950 to 212 million tonnes in 2003-04.

Thus the overall performance of Indian agriculture in the last five decades has been remarkable. However, the progress shown in the production of different crops and regions has been neither consistent nor balanced. The new farm technology has brought in regional disparities. For instance, the regions like the Punjab plains have witnessed a tremendous upsurge in crop production, while the other regions especially the dry tracts do not bear any comparison. Structurally too, the impact of the Green Revolution has not been uniform. Rice, wheat and a few other annual crops registered a spectacular production performance, while in the case of coarse grains, pulses and oilseeds such a phenomenon was not forthcoming.

1.1 THE OILSEEDS SECTOR IN INDIAN ECONOMY

Oilseeds form one of the important groups of cash crops in Indian agriculture. They are the most important sources of supply of edible oils in the country. Indian vegetable oil economy is the fourth largest in the world next only to USA, China and Brazil accounting for about 14 per cent of world's oilseed area and 7 per cent of world's production. However, the productivity in India was only 986 kg/ha (2003) as compared to the world average of 1777 kg/ha (2003). In the domestic agriculture sector, oilseeds occupy a distinct position after cereals sharing 13 per cent of the country's gross cropped area and accounting for nearly 3 per cent of the gross national product and 10 per cent of the value of all agricultural products (Oilseeds Situation, 2005). The oilseed sector has been playing major role in not only reducing the gap in domestic demand and supply but also earning valuable foreign exchange from its by products (Virupakshappa and Kiresur, 1998). India ranks first in castor and safflower production and it is the second largest producer of groundnut and sesame and ranks third in linseed and rapeseed, fifth and ninth in soybean and sunflower, respectively. India is blessed with diverse agro-ecological conditions ideally suited for growing nine annual oilseed crops viz., groundnut, rapeseed-mustard, sunflower, sesame, soybean, safflower, castor, linseed and Niger; two perennial oilseed crops (coconut and oil palm) besides secondary oil crops such as maize and cotton. In addition to the above, more than 100 tree species of forest origin which have the potential to yield about one million tonnes of vegetable oil are grown in the country. The major annual oilseed crops growing states are Madhya Pradesh (22.2%), Gujarat (12.6%), Rajasthan (13.6%), Maharashtra (11.8%), Andhra Pradesh (10.7%), Karnataka (9.4%), Tamil nadu (3.1%) and Uttar Pradesh (4.8%). Punjab, Uttaranchal, Chhattisgarh, Haryana, Himachal Pradesh, Bihar, Jammu and Kashmir, West Bengal, Orissa, Kerala and Northeastern states are covering remaining 11.6 per cent of oilseed growing area. Gujarat (22.4%) tops the list of major annual oilseed producing state followed by Madhya Pradesh (22.5%), Rajasthan (15.8 %), Maharashtra (11.7%), Andhra pradesh (6.4%), Karnataka (4.1%), Tamil Nadu (4%) and Uttar Pradesh (3.7%). In India, groundnut ranks first contributing 32.4 per cent of the total output followed by soybean (31.1%), rapeseed & mustard (24.5%) and the other six oilseed crops (12%).

The oilseed scenario in the country has undergone a sea change in the last twenty years. India has emerged from a net importer of edible oil in 1980's to a net exporter status during the early 1990's. Again it has become a net importer accounting for more than 40 per cent of annual edible oil needs. The major contributors for the spectacular success during early 1990's were the oilseed production technology, the expansion in cultivated area, the price support policy and the institutional support, particularly the formation of Technology Mission on Oilseeds (TMO) in 1986 (Hegde and Kiresur, 1999). The strategy under Technology Mission on Oilseeds catalyzed increased production of oilseeds resulting in "Yellow Revolution" in the country. The increase in production of different oilseeds during the period 1985-86 to 1994-95 was spectacular; 26.96 per cent in the groundnut, 111.50 per cent in rapeseed-mustard, 420.5 per cent in soybean and 74.12 per cent in the total oilseed crops. India's total oilseed production was stood at 27.43 Mt during 2005-06. Exports of oil cakes/extractions increased from mere Rs. 62 crores in 1985-86 to Rs. 3157 crores in 1996-97. However, total oil cake export during 2004-05 was Rs. 3101 crores. So, far more than 300 improved varieties and hybrids in oilseed crops have been released for cultivation. The growth rate registered for nine oilseeds during 1949-50 to 2003-04 in respect of area, production and productivity are 1.17, 3.11 and 1.5 respectively. India, as the world's third largest consumer of vegetable oil after China and EU, has seen per capita consumption increase from 4 Kg per annum to 10 Kg per annum in the past four decades though much lower than most of the developed countries. India's vegetable oil consumption for 2004-05 is forecast at a record 11.8 Mt, up from the previous record of 11.5 Mt in 2003-04. The domestic availability of vegetable oils has shot up to 7.7 million tonnes (2003-04), which is more than double of that in 1980-81 (2.8 million tonnes).

Groundnut

Groundnut is the leading oilseeds crop of the country. However area under groundnut showed a declining trend in the decade of 1990's. In 1991-92, the area under groundnut cultivation was 86.68 lakh hectares, which declined to 62.38 lakh hectares in 2001-02. In the drought year of 2002-03, the groundnut area had shrunk to 59.54 lakh hectares. Like soybean, this crop is also being grown in the rainfed areas and its production is dependent upon monsoon. In 2001-02, groundnut production was 70.28 lakh tonnes (*kharif* 56.2 lakh tonnes and *rabi* 14.05 lakh tonnes), which declined to 43.63 lakh tonnes (*kharif* 32.4 lakh tonnes and *rabi* 11.2 lakh tonnes) in 2002-03. The decline was about 38 percent. However, the favourable monsoon in 2003 helped to increase the groundnut production to 84.8 lakh tonnes (*kharif* 71.3 lakh tonnes and *rabi* 13.5 lakh tonnes), that is, an increase of about 94 percent from last year. Apart from the dependence on rains, the crop is facing low and stagnant yield. Though India is second largest producer of groundnut in the world, in terms of productivity its level is less than half of that in several countries. There has been virtually no breakthrough in seed technology, which is a major challenge before the ICAR-SAU system and also to TMOP. Further, the crop often gets affected by aflatoxin, which adversely impacts its export prospects. However, during 2003-04, sizeable export of groundnut took place. The exports became possible because of lower than expected production of groundnut in Senegal and Argentina. The re-emergence of India in export market is a healthy development, in spite of the fact that quality issues had acted as trade barriers in the past. In any case, the aflatoxin issue needs to be addressed by educating farmers, processors and exporters. Research on aflatoxin related issues need to be encouraged. The niche has been made in the export market, which needs to be sustained.

Sunflower

The sunflower seed crop is grown in *kharif* as well as in *rabi* season. The area under this crop, which was 21.14 lakh hectares in 1991-92, increased to 26.68 lakh hectares in 1993-94, but decreased to 10.74 lakh hectares in 2000-01. However, the area again increased to 11.77 and 16.38 lakh hectares in 2001-02 and 2002-03, respectively. Accordingly, the production of sunflower seeds increased or decreased with the change in area coverage. The production of *kharif* sunflower seeds increased from 1.6 lakh tonnes in 2001-02 to 2.8 lakh tonnes in 2002-03. Although 2002-03 was a drought year, the production has increased mainly due to increase in area coverage. In 2003-04, the *kharif* production was estimated at 3.00 lakh tonnes, that is, an increase of 7 per cent over the previous year's level.

The average yield of sunflower seed in the country was as low as 550 kg per hectare in 2002-03. In the major sunflower seed growing states like Andhra Pradesh, Karnataka and Maharashtra, which occupied about 96 per cent of the total area covered, the yield was only 663, 463 and 494 kg per hectare respectively. In the states of Punjab and Uttar Pradesh, area coverage under sunflower seed was low, but the yields were as high as 1560 kg and 1667 kg per hectare respectively. While possibility of extending the area under sunflower seed in Punjab and Uttar Pradesh should be explored with an integrated support system (including development of processing units, price support as well as marketing arrangements), the states having low yield should strive to achieve the productivity level of Punjab and Uttar Pradesh.

1.2 SIGNIFICANCE OF THE INTERNATIONAL TRADE

When a country specializes in the production of a few goods due to international trade, it exports commodities, which it produces cheaply in exchange for what others can produce at a lower cost. It gains from trade and there is increase in national income, which in turn, raises the level of output and the growth rate of the economy. Thus the higher level of output through trade tends to break the vicious circle of poverty and promotes economic development. International trade widens the market and increases the inducement to invest income and saving through more efficient allocation. Thus international trade promotes the economic development of the nation. India has comparative advantage in agriculture, so that there is considerable scope for raising farm income and employment by stepping up agro based exports. Economic integration and trade liberalization will have great impact on the national economy in general and agricultural sector in particular. This will be good opportunity to expand markets and receive modern and advanced technologies from developed countries.

1.3 TRADE LIBERALIZATION AND WTO

Indian agriculture is undergoing a perceptible structural transformation due to economic reforms. The decade of 1990s witnessed two very significant developments that have had profound impact on agricultural trade. The first development relates to liberalization of the economy initiated since 1991. The second development was the free trade regime following Uruguay Round Agreement and formation of World Trade Organization (WTO).

The economic environment for trade in agricultural commodities is changing fast in the wake of implementation of WTO agreements. The most critical factor here to the challenges will be exporting capability of the country in a highly competitive environment, when every country is desperately struggling to export something of the other. For, India, to capture a large share of world market for manufactured goods is not easy task, in a world where, every country is desperately trying to do so. In addition, the majority of industrialized nations are already far ahead in technologies in many manufactured products.

India has a unique opportunity to substantially increase its exports of agricultural products particularly in the free trade regime under World Trade Organization (WTO).

With the implementation of the provisions of Agreement on Agriculture (AoA) by the member of WTO, the international trade opportunities are expected to change as trade barriers are reduced and free trade takes place. These changes will also ensure that competitiveness of countries in individual product or commodities will play a major role in the international trade.

STATE

Karnataka, India's eighth largest states out of 28 states has a population of about 53 million. It accounts for 5.89 per cent of India's land and 5.30 per cent of India's population. It contributes 5.50 per cent of India's GDP. Karnataka is one of India's fastest growing states. It has a prominent position in the agricultural economy of India. Its agricultural sector grew at an average rate of 4 per cent compared to all India average of 3.60 per cent.

Karnataka is endowed with varied agro-ecological, agro-climate, biodiversity, soils and climate conditions across the state. Its economy, particularly agricultural economy is experiencing significant changes for the past three decades. Agriculture sector in the state registered a growth of 3.37 per cent during the period 1980-98. Its contribution to the SDP in the eighties was 40.70 per cent but over years the contribution is declining. It was 28.20 per cent during 1997-98. Despite declines in its contribution to SDP, it still continues to be the major sector in terms of its contribution to employment creation, export earnings and supply of raw materials to various industries in the state.

A large proportion of the cultivated area in the state is devoted to the production of principles crops. They are paddy, maize, red gram, groundnut, cotton etc. Of the total cultivated area of the state, about 33 per cent is covered by cereals, 42 per cent by pulses, 19 per cent by oil seeds and 6 per cent by commercial crops.

Karnataka is one of the major oilseeds producing state in the country accounting for 9.72 per cent of the total area under oilseeds and 7.03 per cent of the national production in the year 2003-04. Important oilseeds grown in the state are groundnut, sunflower, safflower, sesame, castor, linseed, soyabean, mustard and nigerseed. Total area under oilseeds in the state was 2606 thousand hectares during 2003-04. This accounts for 21 per cent of the total cropped area in the state during the same period. It was observed that 73 per cent of the total irrigated area was under food crops and only 15.6 per cent was under oilseeds. From this 18.7 per cent and 20.7 per cent of the total area respectively for groundnut and sunflower was irrigated. But in the case of soyabean 50 per cent of the area was under irrigation in the year mentioned above. For rapeseed-mustard the level of irrigation was only 10 per cent and in all other oilseed crops it was less than 2 per cent. This shows that oilseed crops in the state are mainly grown under rainfed conditions.

1.4 SIGNIFICANCE OF THE STUDY

Implication of WTO has brought a change in the Indian economy as a whole and agriculture sector in particular. Liberalization of the Indian economy has provided enormous opportunities for agricultural exports. To step up the rate of growth of exports, the Government of India has embarked upon a major programme of macro economic stabilization and structural adjustment through new trade and industrial policies. In effect to bring it in line with the equilibrium in order to improve the country's international competitiveness. In this context, it is important to understand the global competitiveness of various agricultural commodities produced in the state.

Therefore, the present study intends to analyze the global competitiveness of oilseeds and their economies of production over a period of time in Karnataka. In this study, an attempt has been made to estimate NPC, DRC, direction of trade and supply response of groundnut and sunflower. The findings of the study will help the planners and the policy makers to formulate appropriate agricultural development, export and stabilization policies for the state as a whole.

1.5 OBJECTIVES OF THE STUDY

Against this background, the present study is an attempt to analyze the competitiveness of Karnataka's oilseed economy in the wake of globalization.

The specific objectives of the present study are:

1. To study the changes in the economy of groundnut and sunflower production during pre and post WTO period.
2. To analyze the supply response of groundnut and sunflower production in Karnataka.
3. To analyze the trends in direction of trade of groundnut and sunflower.

4. To study the relationship between international prices and domestic prices of groundnut and sunflower.

1.6 PRESENTATION OF THE STUDY

The entire study has been divided into six chapters.

In the introductory chapter, the problem has been presented against the background of the brief history of agriculture, oilseeds sector in Indian economy, brief description about selected crops, significance of international trade, trade liberalization and WTO. The specific objectives of the study have been indicated in this chapter. Chapter II deals with review of research studies, which have a bearing on the objectives of the present study. Chapter III describes the main features of the state, the source of data and the statistical tools and techniques with the aid of which data have been analyzed and interpreted. The next chapter is devoted to the presentation and interpretation of results in the form of tables and graphs. Here, a very brief indication of major findings has been given. Chapter V concentrates on the discussion about the results of the study vis-a-vis the findings of others. The main findings of the study have been summarized and presented along with the policy implications in chapter VI. The last chapter gives a list of references used for the study.

1.7 LIMITATIONS OF THE STUDY

- ◆ From the results obtained for two sub-periods (pre-WTO and post-WTO), one can not say the change occurred between two periods is only because of establishment of WTO. There also some other factors which influences the change.
- ◆ Calculation of shadow price while constructing policy analysis matrix was very difficult task for social scientists. So, some proxy calculations were done.
- ◆ While calculating growth rate for unit price, the current price was considered instead of constant price.
- ◆ The data relating to only oilseeds export were considered, ignoring export of oil meals and other byproducts.

II. REVIEW OF LITERATURE

A review of past research helps in identifying the conceptual and methodological issues relevant to the study. This will enable the researcher to collect relevant data and subject them to sound reasoning and meaningful interpretation. This chapter attempts a brief review of the relevant research literature related to the present study. Keeping in view, the objectives of the study, reviews are presented under the following headings.

- 2.1 Studies related to growth
- 2.2 Studies related to changes in economics of production.
- 2.3 Studies related to supply response analysis
- 2.4 Studies related to direction of trade
- 2.5 Studies related to export competitiveness and comparative advantages and
- 2.6 Studies related to market integration.

2.1 STUDIES RELATED TO GROWTH

Chengappa (1982) studied the growth rates of area, production and productivity of coffee in India. Linear model of the type $Y_t = a + b_t$ and exponential model of the type $Y_t = a b^t$ were used to work out the growth rates. The exponential function indicated a good fit and obtained an annual compound growth rate in production of 5.68 per cent for Arabica and 7.4 per cent for Robusta. The combined growth rate was 6.1 per cent per annum.

Nair and Gopinath (1982) estimated the trends in respect of area, production and productivity of coconut in Kerala across districts during the sixties and seventies. Area under coconut was found to be rapidly expanding during sixties and the first half of the seventies. However, the production of nuts started declining by early 1970s. By comparing the yield performance over the period of Alappuzha district, situated at the heart of the coconut root (wilt) disease belt and other districts, he repudiated the oft-repeated villainous portrayal of the root (wilt) disease in the coconut economy of the state.

Dass *et al.* (1985) analyzed the trends in coffee exports in relation to general exports from India for the period 1956-57 to 1982-83. The annual compound growth rates of exports in general had failed during the period 1972-73 to 1982-83 in spite of buoyant world demand and high domestic production. The shares of coffee exports in total exports, in value terms, had increased in the period 1956-57 to 1971-72 and 1972-73 to 1982-83. However, unit values, quality and export values recorded chronic instability during the same period.

Prakash (1986) analyzed the growth rates in production, consumption, exports and imports of Indian coffee. He used a modified exponential growth function of the form $\text{Log } Y_e = a + bt + et^2$, where growth is $b+2ct$. He indicated that the growth rate in production of Indian coffee increased consistently and recorded a compound growth rate of 4.51 per cent per annum during 1962-63 to 1981-82. The consumption growth recorded was 1.69 per cent per annum for the same period. Exports, however, had registered a significant increase during the study period, which recorded a compound growth rate of 6.94 per cent per annum.

Achoth *et al.* (1988) analyzed the data to document changes that had occurred in pulse production in Karnataka and to identify the important components of variability during and after the green revolution. The study revealed that production of pulses in Karnataka had registered a significant increase during the decade following the green revolution period. This increase was contributed by the increase in production in Gulbarga district. The instability for the state as a whole had increased in the decade after the green revolution. Most of this instability was contributed by minor pulse growing districts. The instability induced by changes

in the area variances was the single largest component, which increased instability of pulse production in the state.

Gemtesa (1991) compared the performance of Ethiopian coffee exports during the pre-revolution and post-revolution periods. The exponential growth model of the form $Y_t = ab^t e^u$ was employed. The results showed that the export growth in the pre-revolution period was lower (1.51 per cent) when compared to the post-revolution period (1.77 per cent).

Jain and Singh (1991) estimated the growth rates for different Pulse crops in Punjab during the pre-and post-green revolution phase to examine whether the new cereal technology had got diffused to Pulses. During the pre-green revolution period area, yield and production of total Pulses registered a positive but non-significant growth rates indicating stagnation. Whereas, in the second period all the three variables gave negative growth rates which were significant in the case of area and production, denoting deceleration. Continuous substitution of area under pulses with HYV cereal crops was the main reason for the desperate performance of pulses in the post-green revolution period.

Krishnan *et al.* (1991) worked out trends in growth rates of area, production and productivity of major crops in Kerala for the period 1970-71 to 1986-87 and compared them with the corresponding trends at the all-India level. Negative growth rates of output were registered by four out of the ten crops studied *viz.*, rice, tapioca, arecanut and coconut. Growth rates of production were positive and significant for only two crops namely, dry ginger and rubber. Negative and significant growth rates of area of rice and tapioca indicated a shift in cropping pattern in favour of cash/plantation crops.

Veena (1992) analyzed the growth of Indian coffee exports for the period 1965 to 1990 using an exponential function of the form $Y = a b^t$. She found that exports of plantation type of coffee exhibited a compound growth of 3.6 per cent per annum while Arabica grew at a growth rate of 3.0 percent. Robusta exports registered a marked compound growth rate of 10 per cent per annum.

Tripathy and Gowda (1993) used exponential functions to estimate and compare the district wise compound growth rates of area; yield and production of groundnut in Orissa during the seventies (1970-71 to 1979-80) and the eighties (1980-81 to 1989-90). The structural change in the growth pattern between the decades was examined employing a Chow's test. Despite negative growth rates of yield in both decades, growth rate of production had been impressive, which increased from 4.56 per cent per annum in the seventies to 7.87 per cent in the eighties mainly because of high growth rate in area increase. The structural change in the growth function, especially that of yield and production in almost all the districts covered was apparent from the significant 'F' values obtained in the Chow's test.

Vani and Vyasulu (1996) studied the growth rates for three important cereals crops in Karnataka, namely rice, jowar and ragi in the three sub- periods 1955-56 to 1964-65, 1965-66 to 1979-80 and 1980-81 to 1989-90. The results indicated that in the case of rice there was a positive growth rate in the production and yield over the entire period and a negative growth rate in area. In case of ragi, the growth rate of production was higher than that of rice. A positive growth rate in area and production over the entire period with the highest growth in the second sub period was reported. In the case of jowar, there was a high growth rate in area and production in most of the districts. Productivity in most of the districts was high in the second period compared to the first and third sub periods.

Pervez (2001) analyzed the growth in area, production and yield in the major crops of Pakistan for a period 1970-71 (period I) to 1984-85 (period II). The study revealed that the increase in crop production was contributed largely by area than by productivity in Punjab and Sindhu during period I. Sindhu region recorded a higher growth in area, production and yield as compared to Punjab in period II. It was also observed that Punjab recorded a low degree of instability in growth rates in most of the crops as compared to Sindhu region in period II.

Varghese (2004) worked out the trend in area, production and productivity of cardamom in Kerala for a period from 1970-71 to 2002-03 using semi-logarithmic growth

equation. The area under cardamom registered a negative percentage annual trend growth rate of -1.216 which is statistically significant. The output grows at an average annual trend growth rate of 4.14 per cent and yields Registered an average annual growth rate of 5.51-oer cent.

Lathika and Kumar Ajit (2005), analysed the Growth trends in Area, Production and Productivity of coconut in India of all the coconut producing states/union territories for which the period has been divided into two sub-periods as phase I(1951 to 1995) and phase II(1996 to 2002).

2.2 STUDIES RELATED TO CHANGES IN ECONOMICS OF PRODUCTION

Bisaliah (1977) decomposed the yield difference between the two wheat production technologies in Punjab into its constituent sources. He found that improved production technology contributed 15 per cent of the total change in output (40.50 per cent). The increased use of inputs under Mexican wheat contributed about 25.50 per cent to the total difference in output. Among the different inputs the contribution of fertilizer, capital and labour was 15, eight and two per cent, respectively.

Basavaraja, (1980) studied the economics of producing hybrid and local tomato varieties in Bangalore district. The total cost of cultivation per hectare for hybrid tomato was twice that of local tomato. Labour was a major item of input accounting for 29 per cent and 37 per cent of the cost respectively, for hybrid and local tomato. The gross returns and net returns over the cost C for hybrid tomato were 2.5 times greater than those of local tomato, indicating higher profitability of hybrid tomato over the local tomato.

Prasad *et al* (1983) in their study of benefit cost appraisal of rainfed ground nut in chittoor district of Andhra Pradesh estimated cost A, cost B, and cost C, per hectare as Rs. 1,389.63 Rs. 1,732.15 and Rs. 1,861.45 respectively. The per hectare gross returns and net returns over the cost C were Rs. 2,055.10 and Rs. 193.65 respectively. in cost A the major item of cost was seed which constituted 25.53 per cent in cost C . The low net farm income of Rs. 193.65 was mainly due to low yield of crop during 1980-81, which was considered to be bad agricultural year for rainfed crops.

Russel and Young (1983) measured the technical inefficiency of Northwest England farm using the frontier production function analysis. Kopp and Timmer measure of efficiency index worked out to 0.72 and 0.73 respectively. A slightly lower Kopp measure of technical efficiency was attributed to mild decreasing returns to scale observed on the sample farms. Further majority (75 per cent) of the sample farmers achieved more than 64 per cent efficiency, while one-third sample farms operated at higher (more than 75 per cent) efficiency level.

Kalirajan (1984) examined the importance of efficient use of technology in achieving the higher production using the stochastic production function. The results indicated a wide variation in technical efficiency among the sample farmers. Deficient extension system was identified as an important factor causing the variation

Singh and Atibhudhi (1985) studied the economics of pulse cultivation in Cuttack and concluded that cost of production per hectare in small and large farms was Rs. 616.13 and Rs. 704.68 respectively and cost of production per quintal of pulse was Rs. 148.46 and Rs. 138.44 in small and large farms respectively. The average cost of production per quintal of pulse was Rs.144.54. the average yield in the case of small farms was 4.15 quintals and in case of large farms, it was 5.09 quintals. The gross income per hectare for small and large farms worked out to Rs. 1,351.25 and Rs. 1,612.37 respectively. The net incomes for the corresponding farm size s were Rs. 735.12 and Rs. 907.69 respectively.

Srikantha Murthy (1986) in his study on resource productivity in agriculture in Bangalore district observed that cost of cultivation of paddy per acre was highest for marginal

farmers and lowest for large farmers. Thus, the existence of scale of economics was noticed in the cultivation of paddy. In the analysis of cost of cultivation of ragi he found that marginal farmers incurred highest cost per acre, followed by small and large farmers. But the results did not indicate economics of scale, as the cost of production of ragi per quintal was highest for small farmers followed by marginal and large farmers.

Lohar (1987) studied the economics and marketing of hybrid tomatoes in sattara district (Maharashtra state). He found that the per hectare cost of cultivation of hybrid tomato was Rs. 54,698. He observed that the cost of marketing also was very expensive (Rs. 28,297.71 per hectare) and it accounted for nearly 52 per cent of the total cost and consumed almost 25 per cent of the gross income. Further, he noticed that rental value of land, manures and fertilizers, human labour; other expenses (such as bamboo sutali for tying the bamboo) and plant protection charges were the major cost items and accounted for 33 per cent of the total cost. The per quintal cost of production worked out of Rs. 74.09 .of the total marketing cost incurred by the producers 55.31 per cent was towards transport charges. 40.95 per cent towards wooden boxes, 1.02 per cent for sutali and 0.87 per cent of bamboo boxes .the per quintal marketing costs was Rs. 38.33 .the gross profit realised from the sale of 738.20 quintals of hybrid tomatoes was Rs. .1,15,903.11 and thus, the net return, after deducting the cost of cultivation and marketing worked out to Rs.32, 902.40 per hectare.

Karisomansgoudar (1990) studied the economics of production and marketing of rainfed onion in Gadag taluk of Dharwad district. He found out that the total cost of production of rainfed onion was Rs. 2,777.43 for small producers and Rs. 3,788.63 for large producers. In onion production, human labour was a major cost item and accounted for 40.14 per cent for small producers and 30.06 per cent of total cost of cultivation for 16.28 per cent and 29.97 per cent for small and large producers, respectively .the net returns obtained by small producers was lower (Rs. 3,647.07) when compared to large producers (Rs. 5,317.27) per acre. Cost of production per quintal was Rs.86.54 for small and Rs. 96.78 for large producers.

Nanjareddy *et al.* (1990) studied the economics of producing hybrid and local tomato varieties from the data for 1988-89, in Bangalore district. They found that most of the inputs used the cultivation of hybrid tomatoes were higher than those of local varieties except seeds and bullock labour. Their average total variable cost per acre in the case of hybrid tomato (Rs. 14,006.55) was about 250 per cent higher than that of local varieties (Rs.4, 109.63). The average labour required per acre in the case of hybrid tomato (313.21 mandays) was about 180 per cent higher than that of local variety (112.55 mandays) .the total cost of production of hybrid tomatoes (Rs. 23,364) per acre was about 290 per cent higher than that of local tomato (Rs. 7,894.42). Yield and gross income per acre of hybrid tomatoes was (259.92 qtl and Rs. .45,778.22) about 225 per cent and 400 per cent higher than that of local variety (79.40 qtl. and Rs. 9,131). The net gain per acre from the production of hybrid tomatoes over local tomatoes was Rs.21, 181.64.

Umesh and Bisaliah (1991) compared the relative efficiency of different varieties of groundnut over the seasons and regions in Karnataka using frontier profit function. Both TMV-2 and SP-I varieties recorded a higher level of efficiency. Sample farmers of Chitradurga district showed higher efficiency during both kharif and summer when compared to their counterparts in Dharwad district. Among different production inputs labour was used more efficiently. However, between the seasons its efficiency was higher during Kharif season.

Jayaram *et al.* (1992) studied the technical efficiency in rice cultivation in Mandya district of Karnataka. The results of the frontier production analysis revealed that relatively higher level of output efficiency was observed on both small (97.54 per cent) and large (97.60 per cent) sample farms. In contrast, the input use was highly inefficient. The efficiency indices obtained through the Kopp measure indicated that a majority (72 per cent) of small farms operated at an efficiency level of more than 75 per cent and about 46 per cent of large farms used inputs at the rate of 86 per cent and above efficiency level. Further, the actual and frontier use of input showed that all the factors were excessively used than frontier usage by both the category of sample farmers.

Kautala (1993) used the stochastic model to study technical efficiency of wheat farms in Karnal district of Haryana. The estimated mean technical efficiency was 0.7636, which implied that the actual output of wheat on an average was 23.64 per cent less than the frontier output. Further, with the idealistic environment of production technologies the discrepancies between actual and frontier output could be minimized.

Parikh and Shah (1994) tried to measure technical efficiency, using a translog frontier production function on cross-sectional data from 397 farms in the Northwest Frontier Province of Pakistan. The estimated farm level technical efficiency was found to be dependent upon levels of credit, education, farmers' age and the extent of land fragmentation. Lack of education, restricted credit and fragmented holdings were found to be the causes of inefficiency.

Panda (1996) examined the nature of technical and allocative efficiency of sericulture farms in Tamil Nadu state. A sample of 120 sericulture farmers from 12 villages in two districts; Dharmapuri and Dindigal were selected. A Cobb-Douglas type of production function was estimated using ordinary least squares. Production function analysis revealed the scope for increasing cocoon productivity through increased use of disease free layings, better silkworm germplasm and efficient use of labour. Farm-specific technical efficiency and input-specific allocative efficiency exhibited scope for minimizing inefficiency. One of the major constraints to sericulture development was inadequate trained manpower. To improve productivity and efficiency, extension support in mulberry cultivation and silkworm rearing technology were recommended to be strengthened with the development of infrastructure facilities.

Xiaosing and Scott (1998) in their study on efficiency and technical progress in traditional and modern agriculture used a stochastic production and cost frontier to derive technical, allocative and economic efficiency of Chinese conventional and hybrid rice production. The results revealed significant differences in traditional and hybrid rice production. However, the significant regional efficiency

Hazarika and Subramanian (1999) estimated technical efficiency in tea using stochastic frontier production function in Assam. It was observed that the farm specific technical efficiency varied between 0.64 and 0.99 with a mean technical efficiency of 0.88. It was found that 29.41 per cent of the total farms that operated large estates belonged to the most efficient category (96 to 99 per cent) and 8.82 per cent in the least efficient group (64 to 70 per cent). Similarly in small and medium sectors 15.15 per cent were highly efficient and 3.03 per cent least efficient.

Munir *et al.* (1999) made use of a stochastic Cobb-Douglas production frontier to estimate the farm level technical efficiency of rice farms in Punjab, Pakistan, using data collected for the crop year 1996-97. The average technical efficiency of the sampled farms was estimated to be 85 per cent, with a minimum of 57 per cent and a maximum of 96 per cent. The results further showed that the visits of agricultural extension agents to the farm or farmers' visits to extension offices, and the availability of agricultural credit played a significant role in improving technical efficiency. More experienced (aged) and educated farmers also realized high productive efficiency and thus output.

Mythili and Shanmugam (2000) estimated the technical inefficiency of individual farmers using an unbalanced panel data of 234 rice farms in Tamil Nadu. The maximum likelihood method was used to estimate the frontier function. It was found that technical efficiency varied widely (ranging from 46.5 per cent to 96.7 per cent) across sample farms and is time invariant. The mean technical efficiency was computed as 82 per cent, which indicates scope for raising output without additional resources. The gap between realized and potential yield highlighted the need for improving farm level extension services

Abay *et al.* (2004) analyzed the efficiency of input use in tobacco production in Turkey with respect to sustainability. The provinces in the Aegean, Northwestern, Eastern-Southeastern Anatolian and Black Sea regions were considered. Face-to-face interviews were carried out with 300 farmers from the provinces. Data Envelopment Analysis (DEA)

calculated efficiency measures of tobacco farms in each region. The average technical efficiency score for all regions was found to be 0.456, implying that the same level of production per plot can be obtained even if the inputs used for tobacco production are decreased by 54.4 per cent. The results also indicated a strong positive relationship between the efficiency of input use and the sustainability of agriculture.

Reddy and Sen (2004) revealed the existence of technical inefficiency in production of rice in the Zone command area of Bihar. Technical inefficiency of the individual farms was estimated through stochastic frontier production function analysis. It was found that technical inefficiency of sample farms ranged between 6.67 and 66.42 per cent with an average of 25.55 per cent. Technical inefficiency in the production of rice was negatively related to farm size, education of the farmer, experience, extension contacts and percentage of good land and positively related with age and fragmentation of land.

Madan Lal Gurjar and Varghese (2005) studied the temporal changes in the economic parameters on major rabi crops like wheat, barley, gram, rapeseed and mustard in the state of Rajasthan. The study showed that the total cost of cultivation of wheat has gone up from Rs. 3321.60 in 1981-82 to 17607.57 per hectare in 1999-2000 depicting an increase by 5.3 times during the period of nineteen years. Among operational cost items, family labour recorded maximum share in the increase in cost of cultivation over time. The cost of cultivation of barley increased from Rs. 2681.13 in 1981-82 to Rs. 14820.5 per hectare in 1999-2000 showing an increase of 5.52 times during a period of nineteen years.

2.3 STUDIES RELATED TO SUPPLY RESPONSE ANALYSIS

Basavaraja (1982) felt that it would be better to estimate both acreage and yield responses with a view to properly gauging the impact of price and non-price variables on the supply of cotton in Karnataka State. He estimated production response in addition to area and yield responses for the purpose of comparison.

Bhowmick and Ahamed (1993) studied the supply response of major oilseed crops in Assam for the period 1972-73 to 1988-1989. The results showed that increase in oilseeds production had been related to increased acreage rather than intensification of production.

Deshpande (1994) in his study on supply response of chilli in Karnataka State for the period 1969-70 to 1990-91, concluded that the increase in the total output of chilli in the state was the result of shifting land from other crops rather than by increasing the yield of the crop.

Kumar and Rosegrant (1997) worked on the dynamic supply analysis of cereals with an intention to separate the output decision in to area and yield per hectare decisions. They assumed that the farmer first decides on area allocation among the crops and then the intensity of inputs used and hence yield.

Singh (1998) approximated the output decisions of farmers in terms of area under the crop rather than its yield while studying supply response of oilseeds in Uttar Pradesh. According to him this is because the area enjoyed by the crops can be considered as a barometer of the farmers land allocation decision. Further, the area allocation under a crop is a function of several endogenous factors, whereas, the yield is influenced by several exogenous factors. But, Singh also believed that the farmers could keep area constant and increase output by varying yield level.

Gajja *et al.* (1983) found that decisions regarding area allocation for groundnut in Rajasthan corresponded strongly with the harvest price lagged by one year. They concluded that price behaviour was a decisive factor for area allocation for groundnuts in conjunction with such factor as its own productivity performance, prices of competing crops and rainfall patterns in Rajasthan.

Naik and Patnaik (1984) opined that, in Orissa most potato growers tended to sell potatoes just after harvest due to lack of adequate storage facilities and to meet urgent cash

requirements. The harvest price had therefore an explanatory significance in a study of price impacts on area allocation and output. The result of the study revealed that output and area under potatoes were dependent upon the harvest price of potatoes lagged by one year in this area.

Mahajanshetti (1987) studied the supply response of jowar in Karnataka. He used the area under competing crops of jowar to deflate the relative price factors and incorporated this relative price of jowar into the area, yield and production response models.

Janaiah *et al.* (1991) while studying the farm supply response of cotton in Andhra Pradesh for the period 1956-57 to 85-86, used both the farm harvest price of cotton and its competing crop (chillies). The results revealed that the previous year's price had exerted significant positive influence on current area in the state as a whole and its regions except in Rayalaseema, whereas the price of competing crop (chillies) in Rayalaseema region and the state as a whole was observed to have negative relationship with current year's area.

Tripathy and Gowda (1993) by making use of one year lagged harvest price in their model to study the area response of groundnut in Orissa obtained a positive and significant impact of harvest price on the area under groundnut. The short-run elasticity was 0.334 while the corresponding long-run elasticity turned to be 0.3619.

Monthly groundnut wholesale price data for all districts of Orissa state (India) for the period 1974-90 were collected and used in the analysis of groundnut prices in Orissa market and its impact on area and production by Mohanty (1995). The findings revealed that both monthly and annual wholesale prices of groundnut vary significantly in most districts as well as at the state level. A significant relationship between groundnut price and groundnut area and production was observed.

Omezzine (1996) studied the winter tomato farmers' response in Tunisia. The adaptive expectation geometric distributed-lag model was used to test farmers' reaction to expected prices of inputs and outputs as well as to other determinants of supply. Results indicated that farmers reaction to the price they expect depends on previous years prices.

Dhindsa and Sharma (1997) had used lagged relative price to study the supply response of prices in Punjab state and arrived at non-significant negative impact of the variable on area under gram in two regions and the state as a whole. They contend that the non-significant impact of relative price variable would show that the farmers in various regions of Punjab did not take into consideration the changes in relative price of the crop (gram) while allocating area under this crop.

Mesfin Arega (2000) studied the supply response of maize in Karnataka. The study was carried out mainly to evaluate the impact of relative price and selected non-price factors and to analyse the short and long run price elasticities. The results indicated that relative price factor had positive and significant bearing on hectareage of maize in none of the selected districts but at the state level. Districts *viz.*, Belgaum and Bijapur evidenced significant negative impact of price on hectareage of maize.

Chandrasekhara Rao (2004) worked out the aggregate agricultural supply response in Andhra Pradesh. The study revealed that partial regression coefficients of terms of trade with respect to aggregate agricultural output, crop, food grain and non-food grain are not statistically significant and they are positive. Thus it can be concluded that the response of agricultural output (includes livestock, crop, food grain and non-food grain output) to changes in terms of trade is positive and non-significant.

Suleiman Abrar *et al.* (2004) explained the crop level supply response by region wise in Ethiopia. The results showed that the output prices are clearly an important part of the incentive structure, but non-prices factors are the binding constraints. This is most apparent in the relatively non-commercial Northern highlands where these factors are far more important in affecting production and resource use than price incentives.

2.4 STUDIES RELATED TO DIRECTION OF TRADE

Konandreal and Hurtado (1978) analysed the trade flows in the international wheat market for the period 1951-56 to 1969-74. They attempted to explain the export performance of major wheat exports and analysed the evolution of trade patterns over time. They concluded that the exporter who failed to concentrate their marketing efforts in fast growing markets performed poorly, whereas others that enjoyed a preferential treatments on major markets and or managed to overcome trade barriers in fast growing markets performed quite well.

Atkin and Blanford (1982) studied structural changes in import market share for apples in United Kingdom. The changes in composition of United Kingdom Apple import during the period 1963-74 were analysed using a first order markovian model. The study indicated that changes in market share has been systematic, stable and of long duration. The estimated transitional probability matrix could explain the nature of change by indicating the relative competitive strength of different exporters. The large increase in France's market share was examined and estimated derived on the effect of United Kingdom membership of the E. C. for the year 1978-79. The results showed that E. C. membership increased French market share in the United Kingdom market by more than 26 per cent points and decreased the share of Australia and South Africa by 18 and 10 per cent points respectively.

Libbin (1982) conducted a study to predict farm numbers in the USA by size class. Values of size classes were chosen to represent size classes of farms, ranches and non-land based of farming operations. A series of USDA indices were chosen for explanatory variable in the Markov analysis. Approximately 30 combinations of 9 different indices were applied to the Markov model. Model results indicated that the historical decline in the farm numbers would continue to a level of about 2 million farms by 1990. The farm number projections were closely tied to growth of remaining farms. The primary factors causing or allowing farms to grow in size included increased price for inputs and increased productivity of own labour. The results also revealed a continuing trend towards fewer large farms.

Erthridge *et al.* (1983) analysed the changes in the structure of the Texas high plains cotton ginning industry. Using Markov chain procedures future industry structure was made under conditions of transition probabilities. All projections showed declining number of active ginning firms with large decline in number of small firms and increasing number of large finns.

Mellor (1984) made an attempt to introduce the Markov chain as a mechanistic model of behaviour in an agricultural setting. The concept of time varying transitional probabilities was introduced as a feasible alternative to the standard stationary assumptions. The results supported the view that the basic model was simple and also benefited from the introduction of explanatory variables influencing the transition probabilities. He also cautioned that neglect of important variables could lead to undesirable consequences, when such models were used for forecasting support.

Edwards *et al.* (1985) applied Markov analysis to study the changing distribution of farms by size. They had applied a model to the longitudinal data set for 1974-78 from the census of agriculture. The model predicted reasonably well for the actual change during 1978-82. The results indicated that the future distribution of farms by acres per farm would be more like the present then the present was like the past.

Srivastava and Ahmad (1986) analysed the direction of exports from India for the period 1960-61 to 1983-84, the countries such as USA, former USSR, UK, Japan and erst while West Gennany had greater share in India's export and import trade. India's exports to the above mentioned five major trading countries declined over the period of study. UK no more remained in the principal destination of Indian trade as it was in the pre-independence period. In 1983-84 USA emerged as one of our major trading partners.

Disney *et al.* (1988) conducted a study for analyzing the structure of the pig meat production industry in the south Atlantic census division. The finding of the study indicated

that both total farm numbers and the size distribution of pig meat farms were highly sensitive to the future pig maize price ratio. The set of models presented provided a tool that could be used to evaluate the effects of reduction in maize price support programs on pig meat farm distributions as both maize and pig producers were allowed time to adjust production, the long term relationships was more difficult to determine.

Jaikumar (1990) analysed the country wise foreign exchange utilization by the silk sector. Developed markets like West Germany, USA, Japan, France and UK accounted for bulk of India's exports. Among the traditional markets UAB, Singapore and South Korea dominated. However, ten markets accounted for bulk of India's silk exports taking over 75 per cent of the total export sales of Indian silk products to various countries in 1988-89.

Gemtessa (1991) analysed the direction of trade using Markov model. The share of Ethiopian coffee exports in USA drastically declined during 1979-89. However West German markets indicated to be the potential market for Ethiopian coffee. Further, the loss in the market share of Ethiopian coffee in USA France, USSR and other countries was diverted to West Germany's market. It was also projected that the market share of Ethiopian coffee export to West-Germany market would increase to 32 per cent by 2000 A.D. mainly because of West-Germany's preference for Ethiopian mild coffee.

Veena (1992) analysed the direction of trade of Indian coffee exports using Markov chain model. It was observed that India could not retain its previous market share of USA, Netherlands, Yugoslavia and other importers. However, the actual quantity exported to all these countries had increased which was due to increased quantity of Indian coffee exports. India retained its market share to former West Germany, erstwhile USSR and Italy.

Lakshminarayana (1993) studied the direction of Indian silk exports by employing first order Markov process. The major importing countries considered for the analysis were the USA, West Germany, UK, France, Italy and Japan. The exports to the USA were stable and would remain highly loyal to Indian silk. The probability of export to the UK, West Germany and Japan switching over to the USA was unity implying that entire quantity of exports to these countries would drift to the USA over the period of time.

Jeromi and Ramanathan (1993) noticed significant changes in direction of pepper exports from India for the period of 1975-90. It was observed that nearly 44 per cent of India's exports were directed to former USSR, which constituted about 82 per cent of the total imports of that country. On the other hand India not only failed to increase its exports to USA in tandem with increased consumption in that country but also could not sustain the quantity exported in the past years. Instability in exports was low in case of former USSR, Italy and Canada and higher for Poland, USA and Czechoslovakia.

Jalajakshi (1994) studied the pattern of Indian shrimp exports between two periods: period I covering 1970-80 and period II covering 1980-90. The export of frozen shrimp to Japan and USA and EEC were stabilized during the period II over the period I. There was high variation in with respect of shrimp export to USA and EEC countries because of the preference of cold water shrimps in these countries.

Nagaraja (1997) analysed the direction of trade of the Indian Horticultural Commodity exports by employing a first order Markov process, which helps in identifying the gains and losses in export value. It revealed that the other fresh fruits, vegetable and processed fruits and vegetables retained their share of onion and garlic respectively. Where as grapes, onion and mango juice sustained their original share of 59.8 per cent and 19.4 per cent respectively.

Srinivasamurthy and Subramaniam (1999) analysed the direction of onion trade by using Markov chain model during the year 1980-81 to 1994-95. The major among importers of Indian onion over a period of time was Malaysia which was having a transfer probability of 0.6459 from Saudi Arabia and 0.3488 from UAE, in addition to having high probability of retention of its own share. On the other hand, Saudi Arabia, which was having zero probability of retention of own share of fresh onion, was likely to gain to some extent from

Bangladesh and other countries.

Mahesh (2000) studied the structural changes in exports of Indian tea for the period 1979-80 to 1998-99 by employing the first order Markov model. The probability matrix indicate that the countries like UK, USSR, ARE, Iran, UAE, Saudi Arabia and other importing countries like Germany, Poland and USA could not retain their share of Indian tea imports.

Mahadeviah (2001) estimated the transitional probability matrix for Indian cotton exports for the period I (1981-87 to 1990-91) and period II (1991-92 to 1998-99). He concluded that China was the only stable country among the major importers of Indian cotton s reflected by the high probability of retention which increased form 8 per cent in period I to 32 per cent in period II. The major gainers among the importers of Indian cotton in the period II over period I were China, Japan, Indonesia and other countries.

2.5 STUDIES RELATED TO EXPORT COMPETITIVENESS AND COMPARATIVE ADVANTAGES

While analyzing the export growth prices of turmeric in India, Ravindran and Aiyasamy (1982) indicated that the cyclical pattern of variations in prices revealed that the length of the export price cycle varied three to seven years. The export prices were studied for their relation with the domestic prices. The coefficient of correlation was 0.9473 and this close movement of export and domestic prices of turmeric explained the poor variation in the value of the variable R_t (ratio of export price P_e to domestic price P_d in year t) and consequently the correlation of export price of turmeric with its domestic prices. This indicated that the export price was exposed to international trade fluctuations.

Anderson and Ahn (1984) examined the protection policy and changing advantage in Korean agriculture from the mid 1960s. The domestic resource cost methodology was used to measure the foreign exchange earnings foregone by keeping resources in rice production. They concluded that agricultural protection is unlikely to continue to achieve its objective of slowing the decline in food self-sufficiency and helping farmers keep pace with urban incomes unless it was increased continually.

Borsen *et al* (1984) analyzed the relationship among weekly prices at Rotterdam, Netherlands of rice imported in to Europe from the United States, Thailand and Argentina. A theoretical model of price determination was developed to explain the hypothesized direction of dynamic influence. Causality tests among the price series were applied. The dynamics of price relationships were then analyzed using dynamic multipliers. Argentinean and the US prices were found to move together. These two prices responded quickly (one to two weeks) to changes in Thailand prices. Thai prices were found to react slowly (taking 10 to 20 weeks) to changes in Argentinean and US prices.

Senur (1985) studied the protectionist rice price policy in Panama where the domestic price was well above the world market level. Although the producers were benefited by this policy, it imposed significant drain on consumers' income, increased Government expenditures and affected economic efficiency. The policy recommendation was to bring domestic prices in line with the international level.

Mishra (1986) evaluated protection versus under pricing of agriculture in India for two major cereal wheat and rice from 1955 to 1980. Nominal protection indices (NRD and NPC) were estimated for six time points at each quinquennium. Besides showing changes over time in the levels of protection or exploitation, the aim was to see whether some comparative statements vis-à-vis industrialized and industrializing countries could also be made.

Canosanz (1987) discussed the impact of highly protectionist agricultural policies of developed countries upon the Colombian economy. International protection combines with the removal of protection from imports via policies biased towards consumer's competition within the country were displacing production from areas where it had real comparative advantage. This led to imports of wheat and substitution of local products like maize and rice.

Gulati (1987) attempted to quantify the degree of distortion in the trade pricing policies with regard to Indian seed cotton (kappas) during 1980s. The region and variety specific structure of incentives for cotton was estimated by adopting a standard methodology covering four major varieties of cotton, which dominate the cultivating regions of Maharashtra, Punjab, Gujarat and Andhra Pradesh. The results in general indicated a situation of dis-protection for the Indian cotton cultivators and suggested that Indian cotton is an efficient export crop as well as an efficient import substitute.

Whitton (1987) reviewed the export policies of six major cotton-producing countries by dividing them as those likely to subsidize cotton and those potentially taxing it. China and USSR, the largest cotton producers in the world, were found to pursue policies of both subsidization and taxation. None of the other countries found offering direct producer payments but all had some input subsidization. Producer's subsidy equivalents for India and Pakistan did not indicate subsidized cotton in either country. Negative taxes on producers, resulting from export control, substantially exceeded net transfer to producers from subsidized inputs.

Gulati *et al* (1990) studied the effective incentives for wheat cultivators in India by selecting four wheat-growing states (Haryana, Madhya Pradesh, Punjab and Uttar Pradesh) under importable hypothesis. The NPCs for four states averaged for the period 1980-81 through 1986-87 were found to be 0.84, 0.75, 0.85 and 0.77 in the case of Haryana, Madhya Pradesh, Punjab and Uttar Pradesh respectively. These results indicated that wheat cultivators in India had been taxed on pricing front compared with imports. But under export competition hypothesis only one state namely, Punjab was taken for calculation of NPCs. It averaged 1.34, which implies that cultivators in Punjab state were protected.

Gulati (1990a) determined the degree of distortion in the trade pricing policies with regard to Indian rice during the 1980s. Six rice-growing states (Andhra Pradesh, Bihar, Madhya Pradesh, Orissa, Punjab, and Uttar Pradesh) were selected under importable hypothesis and Punjab was selected for exportable hypothesis where it was deemed to compete with Thai rice. Under importable hypothesis, the results showed that the rice cultivators were taxed on the pricing front and under exportable hypothesis. Punjab rice cultivator seemed to have acquired protection only during 1985-86 and 1986-87, but the average situations for 1980's remained taxed.

Gulati (1990b) worked out the protection coefficients for groundnut in India by selecting three different groundnut growing states under both import and export competition hypotheses. Domestic price of groundnut was about 50 per cent more than import price, which implied that groundnut received a significant degree of protection from the existing policies under import competition hypothesis. The NPCs of Gujarat, Andhra Pradesh and Tamil Nadu were 1.47, 1.50, 1.53 under import competition hypothesis and 1.87, 1.96 and 1.95 under export competition hypothesis respectively, indicating the level of incentives were significantly higher under export competition hypothesis than under import competition hypothesis. Indian export of groundnuts to hard currency areas had been a limited one in the 1980s.

Valdes *et al* (1990) studied agricultural pricing policies in Chile for the 24- year period, 1960-84. Five products namely milk, beef, wheat, apples and grapes were examined for their protection. The study found wide variations in direct, normal and effective rates of protection for the products examined. There was consistent nominal protection for milk production. Nominal protection of wheat production was positive while apples and grapes experienced positive protection before 1975 and has a much greater impact on the structure of incentives than did agricultural policies.

Gulati (1994) in their study of export competitiveness of selected agricultural commodities identified the constraints in the export of fresh fruits, vegetables and processed fruits and vegetables. Canalization of onion through NAFED has led to loss of share in export market because of intervention of NAFED, whenever there is escalation of price in the domestic market. The infrastructure for storage, transport, internal as well as international was largely inadequate. The interest on export finance was high (13 per cent) and it should be

brought down to nine per cent per annum. Institutions such as farmers-exporters co-operatives like Maha grapes and Maha mango was considered most useful in the export promotion of fruits and vegetables. This is essential to ensure good quality product as well as remunerative returns to the farmers.

Rao (1995) analyzed the export competitiveness of Indian onions in major markets using constant market share model over a period, 1979-82 to 1989- 92. The importing countries for analysis were Malaysia, Singapore, Srilanka, UAE and the rest of the importing countries grouped as others. Onion exports to Malaysia were fairly competitive where in 26 per cent of total change in exports was due to competitiveness of our exports in that market. The UAE was the only country where India's onions were not at all competitive. Regarding onion exports to the world as a whole, only one per cent of the total change in exports was found to be due to competitive effect.

In the study involving estimation of nominal protection coefficients (NPCs) for DCH-32 seed cotton in Karnataka for the period 1983-84 through 1991-92 under both exportable and importable hypothesis, Umapathi *et al* (1995) indicated an overall situation of disprotection to the cotton cultivators of the area studied. The NPCs were found to be much below unity and implied that DCH-32 seed cotton would be an efficient export crop as well as an efficient import substitute, but for the barriers that delink the domestic market from the world market.

Reddy *et al* (1998) analyzed export competitiveness of groundnut with particular reference to Karnataka using nominal protection coefficient technique under importable and exportable hypotheses. Results of the study showed that groundnut had been receiving significant protection by then existing policies as indicated by coefficients greater than unity. Thus groundnut is neither an efficient import substitute nor an exportable commodity, which should be a cause for concern as it is widely grown in dry land areas, where alternative profitable crops are few.

Ravi and Reddy (1998) examined the export competitiveness of selected agricultural commodities with particular reference to Karnataka using nominal protection coefficient technique. Among the six commodities studied, Karnataka lacked comparative advantage in most of the crops except cotton. The exports potential of jowar, maize, and groundnut and sunflower were significantly low. Even though, Karnataka was the leading coffee exporting state, in recent times, domestic market found to be more favourable compared to the export market. Unlike cereals and oilseeds, Karnataka had an absolute advantage in case of cotton export.

Jha (2000) expressed that India had comparative advantage in producing large number of agricultural commodities due to lower resource costs. The comparative advantage is high for commercial crops like, cotton, tobacco, jute, spices tea and coffee. The country has also advantage in producing labour intensive crops like, rice. The country has, however, no comparative advantage in producing coarse cereals like maize and sorghum. In Wheat, the country was at the margin.

Mahesh (2000) studied the export competitiveness of Indian tea by estimating the NPC and DRC under both importable and exportable hypotheses during the year 1998-99. The results revealed that, under importable hypothesis the NPC and DRC were 0.71 and 0.66, respectively. The NPC was below unity, which indicated that the domestic tea is an effective import substitute, where as the DRC was also less than one implying that the tea growers spend less than a rupee equivalent of foreign exchange on the production. Hence, it is profitable to use non-tradable inputs in the production of tea in India. Under exportable hypothesis, the NPC and DRC were 0.98 and 0.93 respectively. The NPC was less than unity which reveals that tea is competitive in the international market and it represents an effective export commodity where as DRC was also less than one implying its export competitiveness in the international market.

Sudha (2000) worked out the DRC for rose cultivated in 38 hi-tech rose units located in Bangalore urban and Bangalore rural districts of Karnataka and adjoining Dharmapuri districts of TamilNadu during 1997-98. The results revealed that the DRC for the industry as

a whole was 0.52, which reveals a high export competitiveness of hi-tech rose in the study area. The DRC ratio suggested the efficient use of resources by the rose cultivating hi-tech units. It was inferred that as long as the price of output and the proportion of the traded components of inputs remain at the present level, it is highly competitive to produce rose for export purposes.

2.6 STUDIES RELATED TO MARKET INTEGRATION

Gupta and Mueller (1982) analyzed the pricing efficiency in spatial markets. They suggested a technique for analyzing the price relationship between regional markets, which avoids the ambiguity of the correlation coefficient. The method was based on Fama's concept of pricing efficiency and consists of tests based on Granger's causality. The method was applied to price series from three regional markets of slaughter hogs in West Germany

Lundahl and Peterson (1982) studied the market integration for major food grains for the period of 1969-74. The number of markets for each product considered was 19 for rice, eight for grain millet, 20 for grain corn, 11 for ground corn and 15 for seed beans. Monthly price series were detrended and the residuals were correlated. The results showed that there was not high correlation between the residuals. For all the food grains, there was a tendency for the correlation to be full towards the end of each year.

Raveendran and Aiyaswamy (1982) while analyzing export growth and export prices of turmeric from India observed cyclical pattern of variations in prices. The length of the export price cycle varied from three to seven years. The export prices were studied for their relation with the domestic prices. The coefficient of correlation between the two was 0.9473. The high correlation in export and domestic prices of turmeric explained little variation in value of the variable R_t (ratio between price P_e to domestic price P_d in the year t , i.e., $(P_e / P_d)_t$) and consequently its non significant influence on export trade. The very high correlation of export price of turmeric with its domestic prices obviously confirmed the vulnerability of the latter to international price fluctuations.

Spriggs *et al* (1982) studied the relationship between Canadian and US wheat prices. Their finding was that the US wheat prices led Canadian wheat prices. The lack of any significant price relationship indicated the effectiveness of US Government's export subsidy program. They also indicated that Granger's causality seemed to have a positive feature for detecting the price leadership.

Ward (1982) measured the linkage among retail, wholesale and shipping point prices for a select group of fresh vegetables using Wolffrans asymmetric model. Price transmission measurements were made for a subset of fresh vegetables. The results showed that the wholesale markets formed basic mode of pricing. Both the retail and shipping point prices generally lagged behind wholesale price changes. The evidence clearly showed that wholesale price increases were not totally reflected at the retail levels, whereas retail prices tend to

adjust to lower wholesale prices. In contrast, the shipping point prices reflected to a greater extent the wholesale price decreases as compared to price increases.

Brorsen *et al* (1984) illustrated the use of univariate and multivariate time series analysis in the investigation of dynamic relationships among selected weekly import prices of rice in the European Economic Community (EEC). EEC imported rice from US, Thailand and Argentina. The results showed that Argentinean and US prices moved together. These two prices were influenced by the European market and react quickly to changes in Thailand prices. Thailand prices responded slowly to US and Argentinean prices.

Arshad and Ahaffak (1990) made use of Ravallion's regression model to study the integration of palm oil market in Peninsular Malaysia. The crude palm oil market was observed to be spatially price efficient. The high integration of the crude palm oil markets was not surprising in view of the efficient and adequate infrastructure facilities available. The

standardization of crude palm oil futures contract made the product homogenous leading to efficient price discovery thereby enhancing pricing efficiency.

Gemtessa (1991) analyzed the integration of Ethiopian coffee prices with the world prices using the correlation coefficient. The correlation coefficient for the monthly average prices secured at domestic and world markets for 12 months lag was calculated. The bivariate correlation coefficient of the two market prices revealed that they move together in the same direction. The lagged cross correlations of domestic prices and world prices also revealed that they move together in the same direction. The lagged cross-correlations of domestic prices and world prices of coffee for the period 1979-80 to 1987-88 indicated that the world prices of coffee had a stronger influence on the domestic prices than the domestic prices had on the world prices of coffee.

Baharumshah and Habibullah (1994) employed the cointegration technique to analyze the long run relationship among pepper prices in six different markets of Malaysia. The co-integration technique was applied to weekly pepper prices for the period 1986-91. The empirical findings of the study indicated that regional pepper markets in Malaysia were highly co integrated and prices of pepper tended to move uniformly across spatial markets indicating competitive pricing behaviour.

Sinharoy and Nair (1994) using the co-integration approach analyzed the pepper price variations in the world market. It was observed that due to open trade status of pepper, its prices had moved synchronously, indicating integration of the world-pepper market. It was pointed out that due to the oligopolistic nature of the world market for pepper; its prices did not deviate much. The domestic supply variables were found to be responsive to the international market conditions.

Behura and Pradhan (1998) used bivariate price series correlation and Engle-Granger test to analyze the market integration for Orissa marine fish markets. The bivariate correlation coefficients for six selected market pairs ranged between 0.60 and 0.85. The test statistic obtained for all the pair wise markets were found to be less than the asymptotic critical value even at 10 per cent level excepting that of Cuttack-Paradip pair. Thus the marine fish markets in the state were assumed to be not integrated and hence quite uncompetitive. This was mainly attributed to poor infrastructure facilities at landing centers as well as the terminal secondary markets.

Bhatta and Bhat (1998) studied the extent of price relationship for areca nut between selected markets of Mangalore and Sira using the correlation coefficient method. The results revealed that the Mangalore market was more efficient than Sira market. The commercial nature of the crop and its diversified market conduct was clear from the fact that there was a direct relationship between the supply and price.

Ghosh (2000) investigated intra-state spatial integration of rice markets in India. This study used ML method of co-integration. Intra-state regional integration of rice markets was evaluated by testing the long run linear relationship between the prices of the state-specific variety of rice quoted in spatially separated locations in four selected states. The cointegration results for Uttar Pradesh indicated that the regional markets are integrated to such an extent that the Law of one price (LOP) holds for III / IV ARWA variety of rice. However, no evidence was found in favour of the LOP for the coarse or common variety of rice marketed in Bihar, Orissa and West Bengal, even though the regional rice markets were found to be integrated. The results pertaining to inter-state regional integration of rice markets represented by four market centers chosen from the four selected states revealed that even though the markets are integrated, the LOP does not hold.

Kumar (2000) analyzed the relationship between prices of rice in domestic market (New Delhi) with major rice markets of the world *viz.*, Bangalore and Houston (USA) by using the co integration approach. The results clearly revealed that all the price series were not stationary and were not integrated in the long run.

III. METHODOLOGY

A systematic designing of the study is sine-qua-non for any scientific enquiry. This chapter presents a brief description of study area, the database and analytical tools and techniques used in the study under the following headings.

- 3.1 Description of the study region
- 3.2 Database
- 3.3 Analytical tools and techniques
- 3.4 Terms and concepts

3.1 DESCRIPTION OF THE STUDY REGION

3.1.1 Geographical location

The Karnataka state confined roughly within $11^{\circ} 35'$ North and $18^{\circ}30'$ North latitudes and $74^{\circ} 5'$ East and $78^{\circ} 35'$ East longitude, is situated on a tableland where Western and Eastern Ghat ranges coverage into the Nilgiri hill complex. It is located in the Western part of the Deccan Peninsular region of India. The state is bounded by Maharashtra and Goa states in the North and Northwest; by the Arabian Sea in the West; by Kerala and Tamilnadu States in the South and by the state of Andhra Pradesh in the East. The state extends to about 750 Km from North to South and about 400Km from East to West. Karnataka's total land area is 1,91,791 Sq.Km. It accounts for 5.83 per cent of the total area of the country (32.88 lakh Sq.Km) and ranks sixth among major states of the country in terms of size.

3.1.2 Demographic Characteristics

The total population of the state according to the 1991 census was 449.7 lakhs. It was 5.3 per cent of the all India population of 8,443 lakhs. The annual rate of population growth between 1951 and 1991 was 2.1 per cent. Between 1981-1991, the population of the state increased by 20.65 per cent as against an increase of 23.57 per cent at the national level. The density of population as per 1991 census was 235 persons per square km, which was lower than all India density of 257. About 69 per cent of the population is in rural areas and the remaining 31 per cent is urban population. The literacy rate as per 1991 census was 56 per cent.

3.1.3 Physiography

Physiographically Karnataka state forms part of two well-defined macro regions of Indian Union; the Deccan plateau and the Coastal Plains and Islands.

The state has four physiographic regions as given below.

1. Northern Karnataka Plateau: It comprises of the districts of Belgaum, Bidar, Bijapur, Bagalkot and Gulbarga. It represents a monotonous treeless extensive landscape with a general elevation of 300 to 600 meters from the mean sea level.
2. Central Karnataka Plateau: It covers the districts of Bellary, Chikmagalur, Chitradurga, Davanagere, Dharwad, Gadag, Haveri, Raichur, Koppal and Shimoga. It represents the transitional surface between the Northern Karnataka plateau of Deccan Trap and Southern Karnataka Plateau with relatively higher surface. The general elevation varies between 450 and 700 meters. This region represents the area of Tungabhadra basin.

3. Southern Karnataka Plateau: It covers the districts of Bangalore, Bangalore Rural, Hassan, Kodagu, Kolar, Mandya, Mysore, Chamarajanagar and Tumkur. This region largely covers the area of the Cauvery river basin lying in Karnataka. The general elevation of the region varies from 600 to 900 meters.
4. Karnataka Coastal Region: It extends between the Western Ghats edge of the Karnataka Plateau in the east and the Arabian Sea in the West and covers Dakshina Kannada, Udupi and Uttara Kannada districts. The Northern parts of the Ghats are of lower elevation (450-600 meters) as compared to Southern parts (900 to 1500 meters).

3.1.3.1 Rainfall

The annual rainfall in the state varies roughly from 50 to 350 cm. The Southwest monsoon is the principal rainy season during which the state receives 80 per cent of its rainfall. Rainfall in the winter season (January to February) is less than one per cent of the annual total. In hot weather season (March to May) it is about seven per cent and in the post-monsoon season it is about 12 per cent.

3.1.3.2 Temperature

The ideal temperature prevalent through out the state facilitates year round cropping if water is available. However, certain adjustments in the nature of crops to suit the local temperature regimes during different parts of the year are essential to ensure satisfactory yield of crops. The state has pleasant and moderate climate with a maximum temperature up to 40^o C over the Northeastern part of the state. The average humidity in the state is 60 per cent.

3.1.4 Soils

Karnataka state represents a wide variety of geological, climatic, vegetative and physiographic features, which have influenced soil formation and thus given rise to various types of soils. Accordingly, different soils have distinct morphological and physico-chemical properties that have a bearing on plant growth and have influenced the cropping pattern, giving a unique status to the state. A scientific knowledge of soils is a pre-requisite to understand the local ecology and useful in planning for agricultural development.

The extent of coverage of different types of soils is as follows;

- 1) Shallow black soils (1.3%)
- 2) Medium black soils (20.34%)
- 3) Deep black soils (10.25%)
- 4) Red sandy soils (29/27%)
- 5) Mixed red and black soils (11.82%)
- 6) Red loamy soils (15.14%)
- 7) Laterite soils and laterite gravelly soils
- 8) Coastal alluvial soils (2.58%)

3.1.5 Climate

The state enjoys three main types of climate. The state has been divided in to three subdivisions namely; (i) Coastal Karnataka, (ii) North interior Karnataka and (iii) South interior Karnataka.

The tropical monsoon climate covers the entire coastal belt and adjoining areas. The climate or weather in this region is hot with excessive rainfall during monsoon season. The Southern half of the state experiences seasonally hot dry tropical savanna climate while most of the northern half experiences hot semi arid tropical steppe type of climate.

3.1.6 Cropping Pattern

The agriculture in the state is largely rainfed resulting in the productivity fluctuations across the state. The major crops grown in the state are grouped as cereals, pulses, oilseeds and cash crops. Out of the total gross cropped area, 33 per cent of the area is under cereals, 42 per cent is under pulses, 19 per cent is under oilseeds and 6 per cent by commercial crops.

Ragi (finger millet), paddy, maize, and jowar (sorghum) occupy about 80 per cent of the area under cereals. Red gram (tur) and Bengal gram are the major pulse crops, which account for about 4.5 per cent of the area under pulses. Groundnut and sunflower are the important oilseed crops that occupy about 80 per cent of the area under oilseeds. Cotton occupies about 75 per cent of the area under the cash crop.

3.2 DATA BASE

Data for the study were collected from various published sources. Time series secondary data on the area, yield and production of selected crops (groundnut and sunflower) were obtained from the publications of Center for Monitoring Indian Economy (CMIE), Pvt. Ltd. Mumbai. The data covered a period of 20 years from 1985-86 to 2004-05. The Data's for cost of cultivation of groundnut and sunflower were collected from 'Farm Management cell', Department of Agriculture, Government of Karnataka. Data on destination wise exports were obtained from "Monthly Statistics of Foreign Trade of India", published by Directorate General Commercial Intelligence and Statistics, Kolkata. International reference price of the crops under study were collected from the various issues of FAO production yearbook. The maritime freight rates for groundnut and sunflower were obtained from FAO Trade Year Book (2004). Information on domestic prices of the selected crops and other agricultural statistics were compiled from various issues of "Karnataka at a Glance", and "Karnataka's Economy in Brief" published by Directorate of Economics and Statistics, Bangalore.

3.3 ANALYTICAL TOOLS AND TECHNIQUES

The methods and tools of analysis employed in the present study are elaborated under the following headings;

3.3.1 Growth functions

3.3.2 Tabular analysis

3.3.3 Supply response model

3.3.4 Markov chain analysis

3.3.5 Policy analysis matrix

3.3.6 Co integration analysis.

3.3.1 Growth Model

The growth in area, production, productivity, quantity exported and export value were analyzed using the exponential growth function of the form

$$Y = a b t e \dots\dots\dots(1)$$

Where,

Y = Dependent variable for which growth rate is estimated

a = Intercept

b = Regression coefficient

t = Time variable

e =Error term

The compound growth rate was obtained from the logarithmic form of the equation as below

$\ln y = \ln a + t \ln b$

The per cent compound growth rate (g) was derived using the relationship

$g = (\text{Anti ln of } b - 1) \times 100$

3.3.2 Tabular analysis

To study the changes in cost and return structure over a period of time for the selected crops (groundnut and sunflower). The cost of cultivation data on *kharif* groundnut crop was collected for 20 years. The entire period was divided into two sub-periods viz., Pre-WTO (1984-85 to 1994-95) and Post-WTO (1995-96 to 2004-05) and average cost and returns were worked out for two sub-periods separately and compared.

3.3.3 Supply response model

To analyse the supply response of groundnut and sunflower the following area and yield response models were used.

3.3.3.1 Area Response Model

$$A_t = a_0 + a_1 P_{t-1} + a_2 A_{t-1} + a_3 Y_{t-1} + a_4 R_t + D$$

Where,

A_t = Area under the crop in period 't'

P_{t-1} = Crop price in time period 't-1'

A_{t-1} = Area under the crop in period 't-1'

Y_{t-1} = Yield of the crop in period 't-1'

R_t =Pre sowing period rainfall for period 't'

D = Dummy variable 'WTO'.

3.3.3.2 Yield response model

$$Y_t = a_0 + a_1 P_{t-1} + a_2 Y_{t-1} + a_3 R_t + a_4 F_t + D$$

Where,

Y_t = Crop yield for the time period 't'

P_{t-1} = Crop price in time period 't-1'

Y_{t-1} = Yield of the crop in period 't-1'

R_t = Actual rainfall in the sowing period

F_t = Quantity of fertilizer used in the time period 't'

3.3.3.3 Coefficient of rigidity

$$(1 - \gamma)^N = 0.05 \quad \dots\dots\dots (1)$$

Taking logarithm on both sides, equation becomes;

$$N \log (1-\gamma) = \log 0.05$$
$$N = \frac{\log 0.05}{\log (1-\gamma)} \quad \dots\dots\dots(2)$$

'N' indicates number of years required for adjusting 95 per cent of changes in the dependent variable. It is the ratio of the probability level to the coefficient of adjustment subtracted from unity, both expressed in logarithmic forms.

For area adjustment model;

$$N = \frac{\log 0.05}{\log (1 - \text{coefficient of area adjustment})}$$

For yield adjustment model;

$$N = \frac{\log 0.05}{\log (1 - \text{coefficient of yield adjustment})}$$

3.3.4 Markov chain analysis

The structural change in exports was examined using the Markov chain model. Central to the Markov chain model is the transitional probability matrix 'P'. The elements P_{ij} of this matrix indicate the probability that export will switch from country 'i' to country 'j' over time. The diagonal element P_{ij} where $i=j$, measures the probability of the country to retain its market share. In other words, as examination of the diagonal elements of the transitional probability matrix indicates the loyalty of importing country to a particular country's exports.

In the context of the current application, structural change was treated as a random process in which five importing countries were considered for both the oilseeds (groundnut and sunflower) The average export of the selected crops from India amongst importing countries in any period depends only on the export in the previous period and this dependence is same among all the periods. This is algebraically expressed as,

$$E_{jt} = \sum_{i=1}^n (E_{it-1})P_{ij} + e_{jt}$$

Where,

E_{jt} = exports from India to the j^{th} country in the year t

E_{it-1} = export of the i^{th} country during the year $t-1$

P_{ij} = the probability that export will shift from i^{th} country to j^{th} country

e_{jt} = the error term which is statistically independent of E_{it-1}

n = the number of importing countries

The probabilities P_{ij} , which can be arranged in a $(c \times n)$ matrix, have the following properties.

$$0 \leq P_{ij} \leq 1$$

n

$$\sum_{i=1}^n P_{ij} = 1, \text{ for all } i$$

Thus, the expected export share of country during period ' t ' is obtained by multiplying the exports to these countries in the previous period ($t-1$) with the transitional probability matrix. The probability matrix was estimated for both pre and post WTO periods separately.

Thus, transitional probability matrix is estimated in the linear programming (LP) framework by a method referred to as minimization of Mean Absolute Deviation (MAD).

$$\text{Min, } OP^* + I e$$

Subject to

$$X P^* + V = Y$$

$$G P^* = 1$$

$$P^* \geq 0$$

Where,

P^* is a vector of the probabilities P_{ij}

O is the vector of zeros

I is an appropriately dimensional vectors of areas

e is the vector of absolute errors

Y is the proportion of exports to each country.

X is a block diagonal matrix of lagged values of Y

V is the vector of errors

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

3.3.5 Policy analysis matrix

The PAM is essentially a double accounting technique that summarizes budgetary information for farm and post farm activities. While simple to use, it is theoretically rigorous and derived from social cost-benefit analysis and international trade theory economics. The basic in using the PAM method are identifying the commodity system, assembling

representative budgets for each activity in the system, calculating social values, aggregating the budgetary data into a matrix, analyzing the matrix and simulating policy changes. The method rests upon the familiar identity: profit = Revenue – costs, for reasons that will soon be apparent costs are divided into those inputs that are traded on international markets (fertilizer, pesticides, hybrid seeds) and those domestic factors (labour, land, and capital), which are not traded internationally. This gives us the following profit identity.

$$\text{Revenue} - \text{Cost of tradable inputs} - \text{costs of domestic factors} = \text{profit}$$

PAM is measured in two types of prices: private and social, which are defined clearly in the contest of working with a PAM.

Private values are prices at which we observe goods and services actually being exchanged and those which we have used in our budgets- the price of the crop, the cost of seed, fertilizer, farm yard manure, pesticides and going wage rates. These are also called market or financial prices. Social values are the prices, which would prevail in the absence of any policy distortion (such as taxes and or subsidies) or market failure (such as monopolies). They reflect the value to the society as a whole rather than to private individuals, and are the values used in economic analysis when the objective is to maximize national income. These are sometimes called shadow prices, efficiency values, or opportunity costs.

The determination of the social value is one of the main tasks of the economists, since these values offer the best indication of optimizing income and social welfare. For internationally traded goods, we use world price[free on board (FOB) for exports and cost insurance and freight (CIF) for imports. And in case of domestic factors, which are not traded in international markets, figuring out social price is difficulty and one way to do so involves mentally subtracting the effects of the policy. The social costs have been calculated using Value Marginal Product approach, which uses factor share (Si) of various inputs (Xi) together with mean values of the inputs and outputs (Y) and prices (Pi). The computation of social costs of inputs is as follows.

$$P_{xi} = [(S_i/X_i) * Y] P_y$$

Once all private values have been matched with their social equivalents, we arrive at two identities:

$$\text{Private revenue} - \text{Private cost of tradable inputs} - \text{Private cost of domestic factors} = \text{Private profit}$$

$$\text{Social revenue} - \text{Social cost of tradable inputs} - \text{Social cost of domestic factors} = \text{Social profit.}$$

The Policy Analysis Matrix

	Revenues	Cost of tradeable inputs	Cost of domestic factors	Profits
Private values	A	B	C	D
Social values	E	F	G	H
Divergence	I	J	K	L

From the table A-B-C=D, E-F-G=H, A-E=I, and so on. An important thing to keep in mind of a given commodity system, the costs and profit represent an aggregate for all activities from farm to wholesale. For revenues, A is wholesale price, and E is the world price of the comparable product in the comparable location.

From this table several useful values appears, Private profit (D) is the aggregate measure of net returns of all activities in the system and a high value would suggest a system that is competitive from a financial point of view. In other words, profit being generated for the participants in that system. A negative value would be strong indication that the system is unsustainable, since there are no incentives for individuals firms or farmers to participate and they would leave to the industry. In contrast, social profit (H) represents the foreign exchange saved by reducing imports or earned by expanding exports of a unit of this commodity. A positive value means that the is adding to national income, while a negative suggests that the country as a whole would be better off in terms of national growth by not producing this commodity. As such, it is an indication of international comparative advantage.

Cell L is the difference between D and H, and thus describes the value of the resource going in to (if positive) or coming out of (if negative) the commodity system from the economy as a whole.

Nominal Protection Coefficient (NPC)

Nominal Protection Coefficient is a straightforward measure of competitiveness. It is calculated as ratio between the domestic price to the international price of a comparable grade of commodity, adjusted for all transfer costs such as freight, insurance, handling costs, margins, losses etc.

Symbolically,

$$\text{NPC} = \frac{\text{PD}}{\text{PR}}$$

Where,

NPC = Nominal protection coefficient

PD = Domestic price of the commodity in question

PR = World reference price of the commodity in question

A decision criterion is, if NPC is less than one, then the commodity is competitive (under importable hypothesis it is considered as 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).

Nominal protection coefficient of tradable outputs and tradable inputs was estimated as,

NPC on tradable goods = A/B.

Domestic Resource Coefficient (DRC)

The DRC ratio also measures the relative efficiency of domestic production in terms of its international cost competitiveness. The DRC coefficient compares the opportunity costs of using domestic primary resource- land, labour and capital and traded inputs in domestic production to the value added by that production at border price.

$$\text{DRC} = \frac{a_{ij}v_j}{(P_i^b - a_{ij}P_i^b)}$$

Where, a_{ij} ($j=k+1$ to n) is the technical coefficient (input use per unit of output) for domestic resource (non-tradable intermediary input) I in the production output v_j and I is the shadow price of such an input. When DRC ratio is lower than one, domestic production is efficient and internationally competitive because the opportunity cost of spent domestic resource is smaller than the net foreign exchanged gained in exports or saved by substituting

for imports. A DRC ratio less than one is thus taken as an indicator of long run comparative advantage. The opposite is true when DRC ratio is larger than 1.

The PAM matrix to determine the level of comparative advantage of crop production was analyzed. The non-tradable inputs considered are labour (human and bullock), FYM, rental value of land, as these are not traded internationally. The tradable inputs are the hybrid seed, fertilizer, and pesticides. The social cost have been calculated using Marginal Value Product approach that uses factor shares (Si) of various inputs (Xi) together with the mean value of inputs and output (Y) and price (Py). The computation of social cost of input is as follows

$$P_{xi} = \{ (S_i/X_i) * Y \} * P_y$$

The import and export parity price was calculated as given in the Table 3.1 and 3.2. Trade competitiveness of selected crops was estimated under two distinct hypotheses. i) The importable hypothesis and ii) the exportable hypothesis.

3.3.6 Co integration analysis

The market integration concept explains the relationship between the prices in two markets that are spatially or temporally separated. If two markets are perfectly competitive and well integrated spatially and temporally, the correlation coefficient between pair of such time series data on prices will be equal to unity. Any slack in the market integration is indicated by the correlation coefficient that is lower than unity.

Markets, which are, spatially price efficient rules out the possibility of profits through arbitrage, as the profits gradually get absorbed because of competition. If two regions are engaged in trade of a commodity, the Law of One Price (LOP) that the price of the commodity should be the same after the necessary adjustment are made for the transfer cost and if necessary the exchange rate. In the present case, co integration analysis was employed to study the nature of relationship between domestic and international prices.

Co-integration is regarded as the empirical counterpart of the theoretical notion of a long run or equilibrium relationship between two or more variables. In the context of the present application, the aim was to examine whether the Law of One Price existed for selected oilseed crops (groundnut and sunflower).

The starting point of testing the Law of One Price was the determination of the order of integration of the price series. If the series is stationary it meant that the series has basic statistical properties implying that it is invariant with respect to time. Thus, it has constant mean, a constant finite variance and covariance between observations, which depend only upon their distance apart in time.

$$P_t = P + e_t \dots\dots\dots(a)$$

Where, P_t is the observed value of the series at the time 't' and e_t , a random disturbance term. The series P_t is said to be stationary, expressed as $I(0)$.but, often price series tend to display increase or decrease which violet the above condition. In this case, successive differencing reduces the series to stationary, thus,

$$P_t - P_{t-1} = e_t \dots\dots\dots(b)$$

$$P_t = P_{t-1} + e_t$$

A series, which becomes stationary after first differencing is said to be integrated of order one and it is expressed as $I(1)$. Generally, a series may have to be difference d times to become stationary in which case it is termed as $I(d)$. a major difference between $I(0)$ and $I(1)$ series is that the $I(0)$ series has a finite mean and variance, while in $I(1)$ series, these magnitude do not exist.

Consider the price of selected oilseed crops in two markets India (Karnataka) and US at time t as $P1t$ and $P2t$ where, $P1t$ refers to the price in Indian (Karnataka's) market and $P2t$ refers to the price in US market at time t . Given this, the following three situations can be identified.

Case (A): Both the price series having the order of stationarity equal to zero

$P1t \sim I(0)$ and $P2t \sim I(1)$. In this case, the mean and the variance exist. This in turn implies that the LOP holds on a long run relationship as both price fluctuate around their mean. Difference in their mean is possible reflecting the fixed component such as middleman's profit and other factors. In such a situation, it is valid to regress $P1t$ on $P2t$ and test the restriction that the slope coefficient equals one and the intercept term equals zero.

Case (B): Both the price series having the same order of stationarity, but greater than zero.

$P1t \sim I(d)$, $P2t \sim I(d)$, $d > 0$. In this case both price series have the same order of integration, which is greater than zero. Hence, additional information is needed to examine the validity of LOP. Such information is obtained from the theory of co integration. Which states that even though same explosive pattern characteristics both price yet there must exist a parameter, which brings them together in the long run so that their linear combination is of a lower order of integration than the original series. In such case $P1t$ and $P2t$ form co integrated system.

Case(C): Both the price series having different order of stationarity.

$P1t \sim I(d)$, $P2t \sim I(b)$, $d \neq b$. in this case, prices have different order of integration and the LOP does not hold because at least one of either $P1t$ or $P2t$ will exhibit explosiveness. This can be understood if, $P1t$ is $I(0)$ and $P2t$ contains an explosive component which cannot be explained by $P1t$ alone.

In general, to determine whether $P1t$ and $P2t$ are co integrated, the following regression is employed.

$$P1t = a + bP2t + et \dots \dots \dots (c)$$

Where, 'a' and 'b' are the parameters to be estimated. If et is integrated by the order b ($b > d$), $P1t$ and $P2t$ are said to be c integrated. When $b=0$, the LOP holds since both prices move together in the long run. In particular, the LOP postulates that the co integration parameter $b=1$. Thus co integration test is transformed into a stationarity test of difference between the two price series.

Let $P1t$ and $P2t$ denote (non-stationary) price of selected cereals in India and US market respectively. Central to LOP, $P1t$ and $P2t$ form a co integration system.

Let $P1t = bP2t + et$ be the c integration regression where, b represents the co integration parameter, it is interpreted as the long run counterpart of the association between the two price series. Expressing $P2t$ in terms of $P1t$ as

$$P2t = P1t \dots \dots \dots (d)$$

And substituting it in the co integration regression yields,

$$P1t = P2t + et \dots \dots \dots (e)$$

This has the co integration parameter of the one thus a stationarity test of et itself is a sufficient test of co integration which can be expressed as

$$Et = P1t - bP2t \dots \dots \dots (f)$$

To determine the order in integration, the following procedure referred as the Dicky-Fuller test was employed which was based on the regression.

$$\nabla z = a + az_{t-1} + et \dots \dots \dots (g)$$

Where, z denotes the variable being tested and denoted the difference e operator, i.e.,

$$\nabla z = z_t - z_{t-1} \dots \dots \dots (h)$$

Where a and b are parameters to be estimated.

The hypothesis tested is

Ho; Zt is not I(0) against

H1: Zt is I(0)

Ho is rejected if the estimates of b are negative and significantly different from zero.

The analysis of stationarity is carried out for the price series Indian and US markets for the selected oilseed crops. Further, the order of stationarity within each market was examined by calculating

$$P1 = P1_t - P1_{t-1} \dots \dots \dots (i)$$

Co-integration between prices was done by regressing the annual average market prices of selected oilseed crops in India on the USA market price and then by examining the residuals for stationarity and also examining the difference between the two price series for stationarity.

3.4 TERMS AND CONCEPTS

3.4.1 Specification of Variables used in the Supply response model

The price and non-price variables selected for the study are defined as under.

Price variable (P_t)

Price is one of important variable, which influences the production decisions of the farmers. The question of which price specifications (prices) would effectively enter the resource allocation decision-making process of farmer to the various production channels is crucial in comprehending the supply-price relations. Farmers usually sell their produce in wholesale markets. The same procedures were followed in the case of oilseed crops (groundnut and sunflower) also. Therefore, in the present study it was proposed to use annual average wholesale prices of the selected crops (groundnut and sunflower).

Lagged yield (Y_{t-1})

In the previous supply response studies lagged yield received due importance. This was because, the previous years yield were assumed to influence the decision of the producers regarding resource allocation. In this study too, it is believed that farmers favorably react to the previous years yield levels in allocating the land and non-land inputs.

Lagged area (A_{t-1})

In this study it was assumed that previous years area allocation also influences the producers decision in allocating area for the current year crops. Farmers calculate their expected production and yield by looking into the previous years area and production. Hence

it is believed that farmers favorably react to the previous years area allocated, while allocating the land and non-land inputs for the current year.

Rainfall (R_t)

It was not the total annual rainfall that was important, but the rainfall received during the pre sowing months is relevant. This was so because, it was felt that favourable moisture conditions during sowing time would encourage farmers to bring more area under cultivation of the crop in question. Therefore, the average rainfall received in the three-pre sowing months (April, May and June) is used in the area response model as a proxy for weather factor.

For yield response model, the rainfall received during the crop period was used.

Fertilizers (F_t)

This variable indicates the quantity of fertilizer used for the selected crops over the period of time.

Dummy variable (WTO)

In addition to the above price and non-price variables, implementation of WTO was considered as an explanatory variable in the present study. This variable was included in the study mainly because to know the impact of WTO on the area and yield levels of the selected oilseed crops (groundnut and sunflower).

3.4.2 Terms used in the Policy analysis matrix

Nominal protection coefficient (NPC)

NPC is the ratio of domestic price to the world reference price (border price) adjusted for transfer costs. Commodities with ratios in excess of one are protected, while the commodities with ratios less than one are disprotected by the policy regime in relation to the situation that would prevail under free trade.

Domestic Resource Cost (DRC)

DRC is defined as the value of domestic resources, required to save or to earn a unit of foreign exchange through the production or export of the commodity. It is the cost of foreign exchange saved by reducing the import of goods or the value of foreign exchange earned from export of goods. DRC can be interpreted as ratio between the cost of dollar saved or earned through domestic production.

3.4.3 Terms used in co-integration analysis

Market integration

The market integration concept explains the relationship between the prices in the two markets that are spatially separated. When markets are integrated, it implies that the markets operate in unison as a single market system.

Table 3.1: International reference price (Exportable hypothesis)

Sl. No.	Particulars	Unit
1	Whole sale price (at domestic market)	Rs./Qtl.
2	Marketing margins	Rs./Qtl. 5% of domestic price
3	Transport cost (up to domestic market)	Rs./Qtl.
4	C &F Handling charges	Rs./Qtl.
5	Wharfage charges	Rs./Qtl.
6	Service charges	Rs./Qtl.
7	Service tax	Rs./Qtl.
8	Insurance	Rs./Qtl.
9	Freight charges to out side port	Rs./Qtl.
10	Domestic reference price	Rs./Qtl. (Add 1 to 9)
11	FOB price at out side market	US \$ / Mt
12	Exchange market	1 \$ = Mt
13	International Reference Price	Rs./Qtl (1*2) / 10
14	Nominal Protection Coefficients	10 /13

Table 3.2: Estimation of international reference price under importable hypothesis

Sl. No.	Particulars	Unit
1	FOB (Free on Board price) out side port	US \$ /Mt
2	Insurance	US \$ /Mt 1% of FOB
3	Freight charges (up to domestic port)	US \$ /Mt
4	Custom cess	US \$ /Mt 5% of FOB
5	Exchange rate	1 \$ = Rs.
6	CIF (Cost Insurance Freight) at port	Rs./Qtl. (1+2+3+4)*5 10
7	Import Duty	Rs./Qtl.
8	Transport cost (up to domestic market)	Rs./Qtl.
9	C & F Handling charges	Rs./Qtl.
10	Wharfage charges	Rs./Qtl.
11	Service charges	Rs./Qtl.
12	Service tax	Rs./Qtl.
13	Reference Price	Rs./Qtl. (add 6 to 12 items)

IV. RESULTS

Keeping in view of the objectives of the study, the data collected from different sources were analyzed employing appropriate techniques. The results of the analysis are presented under the following heads.

- 4.1 Growth in area, production and yield of major oilseeds.
- 4.2 Growth in exports
- 4.3 Changes in economics of production
- 4.4 Supply response of major oilseed crops
- 4.5 Direction of trade
- 4.6 Trade competitiveness of selected oilseed crops
- 4.7 Relationship between domestic market price and world market prices of selected oilseed crops.

4.1 GROWTH RATES OF AREA, PRODUCTION AND YIELD OF MAJOR OILSEEDS

Compound growth rates in area, production and yield of groundnut and sunflower were worked out for the state as well as for the nation. The growth rates were worked out for two sub periods; namely, Pre WTO period (1985 to 1994) and Post WTO period (1995 to 2004) as well for the overall study period. The results of growth analysis are presented below.

4.1.1 Groundnut

The compound growth rates of area, production and productivity of groundnut in Karnataka and in India are furnished in Table 4.1. The area augmented from 0.83 million hectares in 1985-86 to 1.2 million hectares in 1999-2000, thereafter decreased slightly and it was stood at 0.82 million hectares in 2004-05 (Appendix I) with a growth rate of 0.17 per cent during the overall period. The production of groundnut has shown lot of fluctuations and it was stood at 0.57 (Appendix I) and 0.47 million hectares respectively during 1985-86 and 2004-05 with a growth rate of 0.63 per cent for the overall period. The similar situation was observed in the case of yield also, and yield growth rate was found to be at 0.46 per cent for the overall period.

Growth in area, production and productivity in the pre WTO period is exactly opposite to that of post WTO period. The performance of the crop in the post WTO period was dismal with negative trends. But in pre WTO period area, production and yield grew at 1.17, 2.4, and 1.22 per cent respectively showing less impressive growth.

Growth performance of groundnut crop in India was debilitating. The compound growth rates of area, production and productivity of groundnut in India are also presented in Table 4.1. During the overall study period groundnut area, production as well yield has shown lot of fluctuations and it ranges between 0.59 million hectares to 0.87 million hectares, 0.41 million tones to 0.96 million tones and 694 kg per hectare to 1364 kg per hectare respectively (Appendix II).

During the entire period, performance of area and production was dismal with negative trends, but yield has shown positive growth at 0.45 per cent. A comparison of two periods revealed that growth in area, production and yield in pre and post WTO period were almost opposite to each other. The performance in area, production and yield of the crop

Table 4.1: Growth in area, production and productivity of groundnut during pre and post-WTO period

Description	Karnataka		India	
	Coefficient	Growth rate (percentage)	Coefficient	Growth rate (percentage)
Pre WTO period:				
Area (000 ha)	0.0116* (0.0030)	1.17	0.0105* (0.0033)	1.05
Production (000 tonnes)	0.0237* (0.0052)	2.40	0.0181* (0.0077)	1.83
Yield (kg/ha)	0.0121** (0.0057)	1.22	0.0076 (0.0059)	0.76
Post WTO period:				
Area (000 ha)	-0.0134 (0.0057)	-1.34	-0.0139 (0.0014)	-1.38
Production (000 tonnes)	-0.0251 (0.0139)	-2.48	-0.0161 (0.0109)	-1.60
Yield (kg/ha)	-0.0117 (0.0091)	-1.16	-0.0022 (0.0103)	-0.22
Overall period:				
Area (000 ha)	0.0017 (0.0021)	0.17	-0.0047 (0.0017)	-0.47
Production (000 tonnes)	0.0063*** (0.0046)	0.63	-0.0002 (0.0037)	-0.02
Yield (kg/ha)	0.0046*** (0.0029)	0.46	0.0045*** (0.0028)	0.45

Note: Figures in the parentheses indicate standard error

Pre WTO period: 1985-1994

Post WTO period: 1995-2004

Overall period: 1985-2004

*, **, *** denote significant at 1, 5 and 10 percent respectively

Table 4.2: Growth in area, production and productivity of sunflower during pre and post WTO period

Description	Karnataka		India	
	Coefficient	Growth rate (percentage)	Coefficient	Growth rate (percentage)
Pre WTO period:				
Area (000 ha)	0.0558* (0.0134)	5.73	0.0560* (0.0086)	5.76
Production (000 tonnes)	0.0478* (0.150)	4.89	0.0707* (0.0123)	7.32
Yield (kg/ha)	-0.0080 (0.0084)	-0.80	0.0147*** (0.0084)	1.49
Post WTO period:				
Area (000 ha)	-0.0085 (0.0148)	-0.85	-0.0145 (0.0093)	-1.44
Production (000 tonnes)	-0.0015 (0.0126)	-0.15	-0.0229 (0.0099)	-2.26
Yield (kg/ha)	0.0070 (0.0080)	0.71	-0.0083 (0.0034)	-0.83
Overall period:				
Area (000 ha)	0.0074 (0.0064)	0.74	0.0114** (0.0052)	1.15
Production (000 tonnes)	0.0058 (0.0059)	0.58	0.0174* (0.0067)	1.75
Yield (kg/ha)	-0.0015 (0.0029)	-0.15	0.0060** (0.0026)	0.60

Note: Figures in the parentheses indicate standard error

Pre WTO period: 1985-1994

Post WTO period: 1995-2004

Overall period: 1985-2004

*, **, *** denote significant at 1, 5 and 10 percent respectively

during pre WTO period was less impressive with a growth rate of 1.05, 1.83 and 0.76 per cent respectively whereas performance of the crop with respect to area, production and yield was debilitating with negative trends in the post WTO period.

4.1.2. Sunflower

Result presented in Table 4.2 on growth rates of area, production and productivity of sunflower in Karnataka revealed that, sunflower area in Karnataka has grown from 0.44 million hectares in 1985-86 to 1.12 million hectares in 2004-05 (Appendix III). The area had grown at the rate of 0.74 per cent during the overall period. Production of sunflower has shown lesser growth compare to area. Production has grown from 0.24 million tones in 1985-86 to 0.42 million tones in 2004-05 (Appendix III), with a growth rate of 0.58 per cent for the overall period. The yield growth was dismal for the entire period. Yield has declined from 554 kg per hectare in 1985-86 to 375 kg per hectare in 2004-05 (Appendix III), with a negative growth of -0.15 per cent.

The performance of area and production was quite impressive in pre WTO period. The area and production had grown at 5.7 and 4.9 per cent respectively during pre WTO period. Yield has declined substantially during pre WTO period with a negative growth rate of -0.8 per cent.

The performance of area and production of sunflower during post WTO period was debilitating with negative trends, however yield has shown improvement over previous period with a positive growth rate of 0.71 per cent.

The compound growth rates of area, production and productivity of sunflower in India are also presented in Table 4.2. During the overall period, sunflower area in India increased from 0.83 million hectares to 2 million hectares (Appendix IV) with a compound growth rate of 1.15 per cent. Production had increased at the rate of 1.75 per cent from 0.43 million tones to 0.99 million tones (Appendix IV). Yield has grown at the rate of 0.6 per cent for the overall period.

Growth in area, production and yield was impressive in pre WTO period with a growth rate of 5.76, 7.32 and 1.49 per cent respectively. The performance of the crop was debilitating with negative trends during post WTO period.

4.2 GROWTH OF EXPORTS

Compound growth rates of quantity, value and unit price of exports of groundnut and sunflower for the country were estimated for the three periods using exponential growth function. Growth rates for unit price is calculated based on current price and the results are presented below.

4.2.1. Groundnut

Growth rates of India's destination wise quantity, value and price of groundnut exports are presented in Table 4.3. Table revealed that growth of India's destination wise export of groundnut was decelerating over the years.

The analysis of export trends of groundnut from 1985-86 to 2004-05 showed that quantity of groundnut export has grown annually at a compound growth rate of 9.52 per cent whereas value of groundnut exported has grown at much higher rate of 13.13 per cent. The export of groundnut is mainly concentrated in Asian countries.

In pre WTO period, the growth of groundnut exports was more impressive and it had grown at compound growth rate of 10.82 per cent. The stable markets in this period were Indonesia, Malaysia, Philippines and U.K. The quantity exported to Indonesia increased at a rate of 57 per cent whereas value realized increased at a rate of 30 per cent. Next major export destination was Malaysia to which export registered annual growth rates of 37.6 per cent and 17 per cent respectively for quantity and value. The quantity exported to Philippines

Table 4.3: Growth in export of groundnut from India to different countries

Description	Quantity (tonnes)		Value (million Rs.)		Price (Rs./qtl.)	
	Coefficient	Growth rate (percentage)	Coefficient	Growth rate (percentage)	Coefficient	Growth rate (percentage)
Pre WTO period:						
Indonesia	0.4505* (0.1587)	56.90	0.2638* (0.0853)	30.19	0.0048* (0.0052)	0.49
Malaysia	0.3190* (0.1157)	37.58	0.1562* (0.0509)	16.91	0.0041* (0.0006)	0.41
U.K.	0.2399 (0.1757)	27.11	0.2238** (0.1038)	25.09	0.0045* (0.0007)	0.45
Philippines	0.2657** (0.1395)	30.43	0.1375* (0.0552)	14.74	0.00008 (0.00008)	0.008
Srilanka	0.1360* (0.0506)	14.57	-0.0422 (0.0192)	-4.13	0.0054* (0.0008)	0.54
Others	0.1454 (0.2004)	15.65	0.1223 (0.1113)	13.00	0.0052* (0.0006)	0.52
Total	0.1028*** (0.0882)	10.82	0.1513*** (0.0871)	16.34	0.0071* (0.0007)	0.71
Post WTO period:						
Indonesia	0.0069 (0.0268)	0.69	0.0179 (0.0257)	1.81	0.0027* (0.0008)	0.27
Malaysia	0.0918* (0.0281)	9.60	0.1073* (0.0199)	11.33	0.0023 (0.0009)*	0.23
U.K.	-0.0499 (0.0366)	-4.87	-0.0441 (0.0345)	-4.31	0.0022** (0.0012)	0.22
Philippines	0.0341 (0.0716)	3.47	0.0198 (0.0397)	2.00	0.0023* (0.0009)	0.23
Srilanka	0.0412*** (0.0230)	4.20	0.0438*** (0.0272)	4.48	0.0025** (0.0011)	0.252
Others	-0.0142 (0.0325)	-1.40	2.8413 (0.0023)	0.23	0.0027* (0.0009)	0.275
Total	0.0075 (0.0230)	0.75	3.3580 (0.0191)	1.93	0.0042* (0.0011)	0.421
Overall period						
Indonesia	0.3017* (0.0469)	35.21	0.2134* (0.0273)	23.79	0.0095 (0.0027)*	0.96
Malaysia	0.2841* (0.0328)	32.86	0.1988* (0.0160)	21.99	0.0015 (0.0014)	0.159
U.K.	0.1397* (0.0458)	14.99	0.1404* (0.0309)	15.07	0.0012 (0.0022)	0.122
Philippines	0.2459* (0.0413)	27.87	0.1593* (0.0205)	17.27	0.0023 (0.00005)	-0.00
Srilanka	0.2489* (0.0259)	28.26	0.1217* (0.0188)	12.95	0.0021 (0.0042)	0.22
Others	0.1011** (0.0488)	10.64	0.0929* (0.0287)	9.73	0.0044* (0.0016)	0.44
Total	0.0909* (0.0226)	9.52	0.1234* (0.0232)	13.13	0.0074* (0.0025)	0.74

Note: Figures in the parentheses indicate standard error

Pre WTO period: 1985-1994; Post WTO period: 1995-2004

Overall period: 1985-2004

*, **, *** denote significant at 1, 5 and 10 percent respectively

Table 4.4: Growth in export of sunflower from India to different countries

Description	Quantity (tonnes)		Value (million Rs.)		Price (Rs./qtl.)	
	Coefficient	Growth rate (percentage)	Coefficient	Growth rate (percentage)	Coefficient	Growth rate (percentage)
Pre WTO period						
Poland	0.0541 (0.1478)	5.55	0.0081 (0.0222)	0.82	0.0022* (0.0007)	0.22
Netherland	-0.0130 (0.0561)	-1.29	0.0297 (0.1411)	3.01	-0.000007 (0.00008)	-0.007
German republic	-0.0219 (0.0184)	-2.17	-0.0203 (0.0170)	-2.01	-0.000007 (0.00005)	-0.007
U.K.	0.0151 (0.0127)	1.53	0.0216 (0.0182)	2.19	-0.000008 (0.00007)	-0.008
U.S.A.	0.0000 (0.0000)	0.00	0.0000 (0.0000)	0.00	0.0000 (0.0000)	0.000
Others	-0.0324 (0.1165)	-3.18	-0.0760 (0.0627)	-7.32	0.00006 (0.00006)	-0.0069
Total	-0.0045 (0.1727)	-0.45	0.0136 (0.1637)	-1.35	-0.0001 (0.00007)	-0.011
Post WTO period						
Poland	0.1529*** (0.0962)	16.52	0.0082 (0.0165)	0.82	0.0064 (0.0175)	0.64
Netherland	0.0211 (0.0316)	2.13	0.0287 (0.0291)	2.91	-0.00005 (0.00004)	-0.0052
German republic	0.2252* (0.0962)	25.25	0.1623* (0.0575)	17.62	0.00003 (0.00003)	-0.0036
U.K.	0.3055* (0.1180)	35.73	0.1284 (0.1313)	13.70	-0.00004 (0.00003)	-0.0045
U.S.A.	0.0976 (0.1500)	10.25	-0.0449 (0.1276)	-4.40	-	0
Others	0.0812** (0.0395)	8.46	0.0793** (0.0387)	8.25	-0.0003 (0.00003)	-0.0038
Total	0.0629* (0.0252)	6.49	0.0716* (0.0300)	7.42	-0.00004 (0.00004)	-0.0049
Overall period						
Poland	0.0521 (0.0421)	5.35	-0.0003 (0.0066)	-0.03	0.0008* (0.0004)	0.0811
Netherland	0.2286* (0.0356)	25.68	0.1381* (0.0370)	14.81	0.00001* (0.0001)	0.002
German republic	0.1976* (0.0307)	21.85	0.0771* (0.0180)	8.01	0.0015** (0.007)	0.153
U.K.	0.1229* (0.0334)	13.07	0.0067 (0.0330)	0.67	0.0010** (0.0005)	0.101
U.S.A.	0.0692** (0.0355)	7.16	-0.0173 (0.0298)	-1.71	0.0002 (0.0004)	0.025
Others	0.1651* (0.0357)	17.95	0.0703* (0.0220)	7.29	-0.00007 (0.0002)	-0.008
Total	0.0112 (0.0673)	1.13	0.1494* (0.0427)	16.11	-0.0016* (0.0003)	0.162

Note: Figures in the parentheses indicate standard error
Pre WTO period: 1985-1994; Post WTO period: 1995-2004
Overall period: 1985-2004
*, **, *** denote significant at 1, 5 and 10 percent respectively

had registered annual growth rate of 30.4 per cent whereas value growth rate was realized at 14.7 per cent. The quantity exported to U. K. grew at the rate of 27.10 per cent and value received increased at 25 per cent for the same period. The total price growth was found to be significant during pre WTO period and it was stood at 0.71 per cent.

In the post WTO period, export growth performance of groundnut was debilitating with a compound growth rate of 0.75 per cent for quantity and 1.93 per cent for value. The only stable market in this period was Malaysia to which export registered annual growth rate of 9.6 per cent and 11.3 per cent respectively for quantity and value. In this period both quantity and value exported to U.K. showed negative growth rate (4.87 and 4.31 per cent respectively), whereas only quantity exported to other countries showed negative growth rate (1.4 per cent). The total price growth was found to be significant and it was stood at 0.74 per cent during this period.

4.2.2 Sunflower

Growth rates of India's destination wise quantity, value and price of sunflower exports are presented in Table 4.4. Sunflower exports from India had increased steadily during the last decade.

Analysis of export trends of sunflower from 1985-86 to 2004-05 showed that quantity of sunflower exported increased annually at a lesser compound growth rate of 1.13 per cent, whereas the value of sunflower exported increased at a much higher rate of 16.11 per cent. The export of sunflower is mainly concentrated to European countries.

In pre WTO period, export growth performance of sunflower was debilitating with negative trends. The stable markets in this period were Poland and U.K. the quantity exported to Poland was increased at a rate of 5.6 per cent whereas value realized was only 0.82 per cent. Next major destination for sunflower export was U.K to which export registered annual growth rates of only 1.53 per cent for quantity and much higher (2.2 per cent) for value. The total price growth in this period was negative, non-significant and decelerating.

In post WTO period, the growth of sunflower exports was more impressive and it had grown at compound growth rate of 6.5 per cent for quantity and 7.4 per cent for value. The stable markets in this period were U.K., German Republic and Poland. The quantity exported to U.K. increased at a rate of 35.7 per cent whereas value realized increased at a rate of 13.7 per cent. Next major export destination was German Republic to which export registered annual growth rates of 25.3 per cent and 17.6 per cent respectively for quantity and value. The quantity exported to Poland had registered annual growth rate of 16.5 per cent whereas value growth rate was only 0.82 per cent. The total price growth in this period was found to be significant and it was stood at 0.162 per cent.

4.3 CHANGES IN ECONOMICS OF OILSEED PRODUCTION

4.3.1 Changes in economics of production of groundnut:

Structural changes in costs are due to changes in quantity and quality of inputs associated with the technological process and also due to their prices. The changes in relative shares of operational costs and also fixed costs, which are generally imputed value of farmer's own resources, have important implications for capital formation and income distribution in the agriculture sector.

The result in Table 4.5 shows the structural changes in the cost of cultivation of groundnut in Karnataka. The total cost of cultivation of groundnut has gone up from Rs 3689.8 per ha in pre WTO period to Rs 10329.9 per hectare in post WTO period, depicting an increase by 1.8 times. The increase has occurred in all major items of cost like human labour, bullock labour, seed, fertilizers and manures. The cost of human labour as a whole has increased at a faster rate. Among the operational cost items, human labour recorded the maximum share in the increase in cost of cultivation over time.

Table 4.5: Average cost structure and changes in cost of cultivation of groundnut in Karnataka during pre and post WTO period

(Rs./ha)

	Pre WTO period		Post WTO period		Change in post WTO period over pre WTO period		
	Value	Percentage to total	Value	Percentage to total	Value	Per cent to total	Percentage change in value
	1	2	3	4	5 = (3-1)/1 × 100	6	7
A. Operational costs							
1. Fertilizers	218.3	6.0	732.6	6.7	514.3	7.7	235.6
2. Pesticides: Dusts	126.0	8.1	55.8	0.4	-70.2	1.1	-55.7
Liquid							
3. Seed	738.6	16.0	2049.0	20.7	1310.4	19.7	177.4
4. Manures	177.9	3.9	712.8	6.4	534.9	8.1	300.7
5. Human labour	930.3	21.1	2340.4	23.1	1410.1	21.2	151.6
6. Bullock labour	428.3	11.6	1588.5	15.3	1160.2	17.5	270.9
7. Repair charges	12.3	0.6	78.3	0.6	66.0	1.0	537.1
8. Miscellaneous expenses	12.7	0.5	85.3	0.6	72.5	1.1	569.1
9. Total variable cost (I)	2645.3	70.3	7642.6	73.9	4997.3	75.3	188.9
B. Fixed costs							
1. Interest on investment	14.2	0.5	35.1	0.3	20.9	0.3	147.4
2. Land revenue and taxes	6.8	0.3	9.5	0.1	2.7	0.1	39.0
3. Interest on working capital	198.4	4.8	573.2	5.5	374.8	5.6	188.9
4. Depreciation charges	31.8	1.0	96.4	0.9	64.6	1.0	203.3
5. Risk premium	377.1	10.2	1222.9	11.8	845.8	12.7	224.3
6. Managerial cost	185.0	6.4	250.0	2.6	65.0	1.0	35.1
7. Rental value	231.3	6.1	498.2	6.2	266.9	4.0	115.4
Total fixed cost (II)	1044.5	29.7	2687.2	26.1	1642.7	24.7	157.3
Total cost (I+II)	3689.8	100.0	10329.9	100.0	6640.1	100.0	180.0

Pre WTO period: 1985-86 to 1994-95

Post WTO period: 1995-96 to 2004-05

Table 4.6: Changes in economics of groundnut cultivation in Karnataka during pre and post WTO period

Sl. No.	Particulars	Pre WTO period	Post WTO period	Percentage change from pre WTO period to post WTO period
		1	2	3 = (2-1)/100 × 100
(A)	Quantity of Inputs			
1.	Seed (Kg/ha)	57.9	90.6	56.5
2.	Fertilizers (Kg/ha)	49.0	44.8	-8.6
3.	Manures (tonnes/ha)	1.8	2.4	33.3
4.	Human labour (Man days)	67.4	68.3	1.33
5.	Bullock labour (Pair days)	12.9	15.5	20.1
6.	Pesticides			
i	Dust (Kg/ha)	3.1	17.9	477.4
ii	Liquid (lit/ha)	0.7	0.1	-85.7
(B)	Prices of inputs			
1.	Seed (Rs./kg)	12.8	22.6	76.6
2.	Fertilizers (Rs./kg)	4.45	16.4	268.5
3.	Manure (Rs./ton)	98.93	296	199.2
4.	Human labour (Rs./man day)	13.81	34.3	148.3
5.	Bullock labour (Rs./pair day)	33.23	102.2	207.6
6.	P.P. Dust (Rs./kg)	33.45	3.1	-90.7
(C)	Yield (qtl/ha)			
1.	Main product	6.1	7.2	18.0
2.	By-product	7.3	10.8	48.0
(D)	Market prices of output (Rs./qtl)			
1.	Prices of main product	917.5	1568.4	70.9
2.	Prices of by-product	39.79	87.3	119.4
3.	Gross return	957.29	1655.7	72.95
4.	Cost of production	619.0	1406.2	127.2
5.	B:C Ratio per qtl	1.54	1.17	
(E)	Value of output (Rs./ha)			
1.	Value of main product	5596.75	11292.48	101.76
2.	Value of by-product	290.47	942.84	224.59
3.	Gross return	5887.22	12235.32	107.82
4.	B:C Ratio per ha	1.59	1.18	

Out of the total increase of Rs 6640.1 in the cost of cultivation per hectare, the operational cost items contributed about 75.3 per cent and the remaining 24.7 per cent by the fixed cost items. In the operational cost items, human labour (21.2%), seeds (19.7%) and bullock labour (17.5%) were recorded maximum share in the increase in cost.

The relative shares of different inputs in the cost of cultivation of groundnut at two points of time are also given in Table 4.5. The share of operational cost has remained at 73.9 per cent in post WTO period which was little higher than 70.3 per cent in the pre WTO period. But within the operational costs, there was no much deviations in the share of inputs; except in the case of pesticides when compared within two periods. Share of pesticide has decreased drastically from 8.1 per cent in pre WTO period to 0.4 per cent in post WTO period, depicting the lesser use of pesticides for groundnut crop in the later period compared to the previous period.

The extent of change in physical inputs and their prices along with changes in physical output and their prices and gross returns for groundnut over time is given in Table 4.6. When the extent of change in physical input over time for groundnut is compared with the change in cost, it could be concluded that the increase in the labour cost is entirely due to change in wage rate. The positive change in cost of seed is attributable to substantial increase in physical seed rate and large increase in the prices of the seed over time. Similarly, the change in cost of manure for groundnut is due to physical quantity of manure used for the crop as well as its prices over the years. The decline in the share of pesticide is due to drastic decline in the use of pesticides for the groundnut crop in the later period. The gross return from the crop has recorded an increase of 156.1 per cent during the period of twenty years (1984-85 to 2004-05). The increase in gross return from groundnut is attributable to the increase in the main and by-product of groundnut as well as increase in their prices over the years. It is worth mentioning that the rate of increase in the prices of main product and by-product of groundnut has been much higher compared to the increase in the physical yield of main product and by-product. The cost of production of groundnut has increased from Rs 619 per quintal in pre WTO period to Rs 1406.2 per quintal in post WTO period, while the cost of production has recorded an increase of 127.2 per cent during twenty years.

4.3.2 Changes in economics of production of sunflower

The results in the Table 4.7 show the structural changes in the cost of cultivation of sunflower in Karnataka. The total cost of cultivation per hectare of sunflower went from Rs 2267.5 in pre WTO period to Rs 6581.2 in post WTO period, showing an increase by 1.9 times during the last twenty years. The increase in cost of cultivation has occurred in all major items of cost such as human labour, bullock labour, manures, seeds and fertilizers. The cost of bullock labour as a whole has increased at a faster rate. Among the operational cost items, bullock labour recorded the maximum share in the increase in cost of cultivation over time.

Out of the total increase of Rs 4313.8 in the cost of cultivation per hectare, the operational cost items contributed about 63.5 per cent and the remaining 36.5 per cent by the fixed cost items. In the operational cost items, bullock labour (17%), human labour (15.3%) and seed (9.3%) were recorded maximum share in the increase in cost. Out of total fixed cost items, risk premium (11%) and rental value of land (8%) were found to increase over time.

The relative shares of different inputs in the cost of cultivation of sunflower at two points of time are also given in the Table 4.7. The share of operational cost has remained at 68.3 per cent in post WTO period, which was slightly lesser than 70.4 per cent in the pre WTO period. But within the operational costs, there was no much deviation in the share of inputs; except in the case of pesticides and miscellaneous expenses when compared within two periods. The share of pesticide has increased from 0.4 per cent in pre WTO period to 0.9 per cent in post WTO period, depicting slightly higher use of pesticides for sunflower crop in the later period compared to previous period.

Table 4.7: Average cost structure and changes in cost of cultivation of Sunflower in Karnataka during pre and post WTO period

	Pre WTO period		Post WTO period		Change in post WTO period over pre WTO period		
	Value	Percentage to total	Value	Percentage to total	Value	Per cent to total	Percentage change in value
	1	2	3	4	5 = $\frac{(3-1)}{1} \times 100$	6	7
A. Operational costs							
1. Fertilizers	221.3	8.7	584.4	9.2	363.1	8.4	164.1
2. Pesticides: Dusts	9.5	0.4	89.2	0.9	79.7	1.8	840.8
Liquid							
3. Seed	276.5	11.5	675.6	11.8	399.1	9.3	144.4
4. Manures	81.5	4.4	473.9	6.6	392.4	9.1	481.5
5. Human labour	627.5	27.4	1285.6	20.6	658.1	15.3	104.9
6. Bullock labour	364.5	16.7	1096.4	17.3	731.9	17.0	200.8
7. Repair charges	11.9	0.6	45.4	0.7	33.5	0.8	280.7
8. Miscellaneous expenses	11.6	0.7	77.5	1.1	65.9	1.5	570.7
Total variable cost (I)	1604.1	70.4	4343.1	68.3	2739.0	63.5	170.7
B. Fixed costs							
1. Interest on investment	14.0	0.7	27.6	0.6	13.7	0.3	97.8
2. Land revenue and taxes	4.2	0.2	60.5	0.4	56.3	1.3	1333.8
3. Interest on working capital	116.2	5.0	272.6	4.8	156.3	3.6	134.5
4. Depreciation charges	37.8	1.7	110.3	1.4	72.5	1.7	191.5
5. Risk premium	229.7	9.8	699.7	11.0	470.0	10.9	204.6
6. Managerial cost	137.5	7.2	375.5	5.5	238.0	5.5	173.1
7. Rental value	123.8	5.0	691.9	8.0	568.2	13.2	459.1
Total fixed cost (II)	663.3	29.6	2238.1	31.7	1574.9	36.5	237.4
Total cost (I+II)	2267.5	100.0	6581.2	100.0	4313.8	100.0	190.2

Pre WTO period: 1985-86 to 1994-95
 Post WTO period: 1995-96 to 2004-05

Table 4.8: Changes in economics of sunflower cultivation in Karnataka during pre and post WTO period

SI No	Particulars	Pre WTO period	Post WTO period	Percentage from pre WTO period to post WTO period
		1	2	3 = (2-1)/100 × 100
(A)	Quantity of Inputs			
1.	Seed (Kg/ha)	10.1	6.2	-38.6
2.	Fertilizers (Kg/ha)	32.3	41.9	29.7
3.	Manures (tonnes/ha)	3.9	1.1	-71.8
4.	Human labour (Man days)	47.9	36.5	-23.8
5.	Bullock labour (Pair days)	12.7	10.7	-15.7
6.	Pesticides			
i	Dust (Kg/ha)	0.9	0.24	-73.3
ii	Liquid (lit/ha)	0.02	0.16	700
(B)	Prices of inputs			
1.	Seed (Rs./kg)	27.3	109.33	300.5
2.	Fertilizers (Rs./kg)	6.9	13.95	102.2
3.	Manure (Rs./ton)	21.0	445.35	2020.7
4.	Human labour (Rs./man day)	13.1	35.27	169.2
5.	Bullock labour (Rs./pair day)	28.8	102.4	255.6
6.	P.P. Dust (Rs./kg)	10.1	221.92	2097.2
(C)	Yield (qtl/ha)			
1.	Main product	2.76	5.9	113.8
2.	By-product	0.85	0.0	-100.0
(D)	Market prices of output (Rs./qtl)			
1.	Prices of main product	936.7	1252.2	33.68
2.	Prices of by-product	7.2	0.0	-100.0
3.	Gross return	943.9	1252.2	32.66
4.	Cost of production	717.8	1115.5	55.4
5.	B:C ratio per qtl	1.31	1.12	
(E)	Value of output (Rs./ha)			
1.	Value of main product	2585.3	7387.9	185.76
2.	Value of by-product	6.12	0.0	-100.0
3.	Gross return	2591.41	7387.9	185.1
4.	B:C ratio per ha	1.14	1.12	

The extent of change in physical inputs and their prices along with changes in physical output and their prices and gross returns for the sunflower over time is given in Table 4.8.

It is remarkable to note that the seed rate in physical terms has come down drastically for sunflower crop over the years. Therefore even though there was increase in prices of seed, a negative change in cost of seed was found for the crop. The similar situations were found for all other inputs also except in the case of fertilizers. As far as fertilizers are concerned, the positive change in the cost of cultivation of sunflower was mainly due to the increase in physical quantity of fertilizers applied for the crop.

The gross return from the crop has recorded a increase of 185 per cent during the period of twenty years. The increase in the gross return from the sunflower is attributable to increase in the main product as well as increase in the prices of main product over the years. The cost of production of sunflower has increased from Rs 717.8 per quintal in pre WTO period to Rs 1115.5 per quintal in post WTO period, while the cost of production has recorded an increase of 55.4 per cent during twenty years.

4.4 SUPPLY RESPONSE ANALYSIS

In order to evaluate the producer's response towards price and non-price factors, it was envisaged to study the response in terms of area, yield and production. Since production is a product of yield and area, as such two response functions were considered and the results of which are presented in the following Tables.

4.4.1 Area Response Analysis

4.4.1.1 Groundnut

The area under groundnut is expressed as a function of lagged area, lagged yield, lagged price, rainfall and the dummy variable (WTO) factor. The regression coefficients and elasticities of these explanatory variables are presented in the Tables 4.9 and 4.10.

The Table 4.9 reveals that R^2 was high indicating; the variables included in the model explained most of the variations in the area under groundnut crop. The R^2 explains nearly 75 per cent of the variation. The coefficient of adjustment for the area of groundnut was 0.5618.

The area under groundnut lagged one year was found to be an important variable affecting the farmer's decisions on the hectareage allocation. The coefficient was positive and statistically significant at 5 per cent level of probability for the state as a whole.

The non-price elasticity for the lagged area was calculated for both short run and long run (Table 4.10). It was found that long run elasticity was more than the short run elasticity.

The yield of groundnut lagged one year was also found to be an important variable affecting the farmer's response to area allocation. The coefficient was positive and statistically significant at 5 per cent level of probability for the state as a whole (Table 4.9).

The non-price elasticity for the lagged yield was calculated for both short run and long run (Table 4.10). Table reveals that long run elasticity was more than short run elasticity indicating that the hectareage adjustment would takes place in the long run.

The regression coefficient of lagged price was positive and found to be non significant for the crop in the state as a whole (Table 4.9). Thus indicates the farmer's hectareage allocation of the crop was not influenced by the previous years price of the output.

Table 4.9: Area response of groundnut in Karnataka over a period of time (1984-85 to 2004-05)

Sl. No.	Particulars	Co-efficient
1.	Functional form	Log-linear
2.	Adjusted coefficient of determination (R^2)	0.5618
3.	Co-efficient of determination (R^2)	0.7500
4.	Constant (a_0)	0.6665
5.	Area under the crop (A_{t-1})	0.4971** (0.2752)
6.	Yield of the crop (Y_{t-1})	0.2061** (0.1884)
7.	Crop price (P_{t-1})	0.0363 (0.0937)
8.	Pre sowing rainfall (R_t)	0.2837** (0.2261)
9.	Dummy variable (D)	-0.0152 (0.0338)

Note: Figures in the parenthesis indicate the standard error

** Significant at 5 per cent level of probability

Table 4.10: Estimated price and non-price elasticities of area of groundnut

Sl. No.	Particulars	SRE	LRE
1.	Lagged area	0.4971	0.9884
2.	Lagged yield	0.2061	0.2596
3.	Lagged price	0.0363	0.0376
4.	Rainfall	0.2837	0.3960

Note: SRE – Short run elasticity and LRE – Long run elasticity.

The coefficient of rainfall was observed to be positive and significant at 5 per cent level of probability for the groundnut crop, which implies that area allocation was dependent on pre sowing rainfall.

It can be seen from the Table 4.10 that, the short run and long run elasticity of rainfall variable was positive and thus indicates the variable 'Pre sowing rainfall' influenced the farmer's decision regarding area allocation of the groundnut crop. It was also found that the long run elasticity was greater than the short run elasticity.

The coefficient of Dummy variable i.e. WTO factor was observed to be negative and non significant for the groundnut crop in the Karnataka state as a whole, indicating the farmer's area allocation decision was not influenced by the WTO factor (Table 4.9).

The coefficient of rigidity, which indicates the number of years required for 95 per cent of adjustment in area, was calculated and presented in the Table 4.17.

The Table reveals that, for the Karnataka state as a whole the coefficient of rigidity was 4 for the groundnut crop indicating that the groundnut growers in the state would take 4 years to adjust their area under the crop to the desired level.

4.4.1.2 Sunflower

The area under the sunflower was expressed as a function of lagged area, lagged yield, lagged price, rainfall and dummy variable (WTO) factor. The regression coefficients and elasticities of these explanatory variables are presented in the Tables 4.11 and 4.12.

The Table 4.11 reveals that the R^2 was high indicating the variables included in the model explained most of the variations in the area under sunflower crop. R^2 explains nearly 80 per cent of the variations. The coefficient of adjustment for area of sunflower was 0.6601.

The variables area, price and rainfall lagged one year were found to be the important variables affecting the farmer's decision on the hectareage allocation of the crop. The coefficients were found to be positive and statistically significant at 5, 5, 10 per cent levels of probability respectively for the state as a whole.

The price and non-price elasticities were calculated for both short run and long run (Table 4.12). It was found that long run elasticities were more than short run elasticities.

The regression coefficient of the lagged yield was positive and found to be non significant for the crop in the state as a whole, indicating the hectareage allocation of sunflower crop was not influenced by the previous years yield of the crop (Table 4.11).

The non-price elasticity for the lagged yield was positive and also long run elasticity was more than the short run elasticity (Table 4.12).

The coefficient of Dummy variable i. e. WTO factor was observed to be negative and non significant for the sunflower crop in Karnataka state as a whole, indicated that the farmer's area allocation decision was not influenced by the WTO factor (Table 4.11).

The coefficient of rigidity, which indicates the number of years required for 95 per cent of adjustment in area, was calculated and presented in Table 4.17.

The Table reveals that, for the Karnataka state as a whole the coefficient of rigidity was 2.7 for the sunflower crop indicating sunflower growers in the state would take 2.7 years to adjust their area to the desired level.

Table 4.11: Area response of sunflower in Karnataka over a period of time (1984-85 to 2004-05)

Sl. No.	Particulars	Co-efficient
1.	Functional form	Log-linear
2.	Adjusted coefficient of determination (R^2)	— 0.6601
3.	Co-efficient of determination (R^2)	0.8125
4.	Constant (a_0)	5.1600
5.	Area under the crop (A_{t-1})	0.3518** (0.2122)
6.	Yield of the crop (Y_{t-1})	0.4681 (0.3867)
7.	Crop price (P_{t-1})	0.4706** (0.2767)
8.	Pre sowing rainfall (R_t)	0.3257*** (0.1051)
9.	Dummy variable (D)	-0.2839 (0.1060)

Note: Figures in the parenthesis indicate the standard error
 ** Significant at 5 per cent level of probability
 *** Significant at 10 per cent level of probability

Table 4.12: Estimated price and non-price elasticities of area of sunflower

Sl. No.	Particulars	SRE	LRE
1.	Lagged area	0.3518	0.5427
2.	Lagged yield	0.4681	0.8800
3.	Lagged price	0.4706	0.8889
4.	Rainfall	0.3257	0.4830

Note: SRE – Short run elasticity and LRE – Long run elasticity

Table 4.13: Yield response of groundnut in Karnataka over a period of time (1984-85 to 2004-05)

Sl. No.	Particulars	Co-efficient
1.	Functional form	Log-linear
2.	Adjusted coefficient of determination (R^2)	—
3.	Co-efficient of determination (R^2)	0.7740
4.	Constant (a_0)	1.6837
5.	Yield of the crop (Y_{t-1})	0.2869** (0.2332)
6.	Crop price (P_{t-1})	0.1554** (0.1343)
7.	Rainfall during current season (R_t)	0.4050** (0.2987)
8.	Fertilizer (F_t)	-0.0686 (0.0591)
9.	Dummy variable (D)	-0.03877 (0.04898)

Note: Figures in the parenthesis indicate the standard error

** Significant at 5 per cent level of probability

Table 4.14: Estimated price and non-price elasticities of yield of Groundnut

Sl. No.	Particulars	SRE	LRE
1.	Lagged yield	0.2869	0.4023
2.	Lagged price	0.1554	0.1839
3.	Rainfall	0.4050	0.6806
4.	Fertilizer	-0.0686	-0.0641

Note: SRE – Short run elasticity and LRE – Long run elasticity

4.4.2 Yield Response Analysis

4.4.2.1 Groundnut

With the view of estimating the response of producer's in terms of yield towards price and non price factors, the actual yield of groundnut in the current year is expressed as a function of lagged yield, lagged price, rainfall, fertilizer and Dummy variable. The regression coefficients and elasticities of these explanatory variables are presented in the Tables 4.13 and 4.14.

Table 4.13 reveals that R^2 was high, indicating the variables included in the model explained most of the variations in the yield of groundnut crop. The R^2 explains nearly 80 per cent of the variation. The coefficient of adjustment for the yield of groundnut was found to be 0.5992.

Table reveals that the price coefficient of the groundnut lagged one year was positive and significant at 5 per cent level of probability, indicating that the yield of the groundnut crop was influenced by the previous year's price of the output.

Yield lagged one year was also found to be the variable affecting the yield levels of the groundnut crop in the state. The coefficient was positive and significant at 5 per cent level of probability.

Rainfall was observed to be another important variable besides price and lagged yield, affecting the yield of the groundnut in the state. The coefficient was positive and significant at 5 per cent level of probability, indicating rainfall during current season affects the yield of the crop.

The coefficient of fertilizer was negative and non significant which implies that yield is not dependent on the fertilizer usage for the groundnut crop in the state.

The price and non-price elasticities were calculated for both short run and long run and presented in Table 4.14. It was found that in all cases except fertilizer, the short run and long run elasticities were positive and also the long run elasticities were more than short run elasticities.

The coefficient of Dummy variable i.e. WTO factor was observed to be negative and non significant for the groundnut crop in the state, indicating WTO factor not influences the yield of the groundnut crop in the state (Table 4.13).

The coefficient of rigidity, which indicates the number of years required for 95 per cent of adjustment in yield, was calculated and presented in the Table 4.17.

It is evident from the Table that the number of years taken for yield adjustment was 3 for the groundnut crop, which implies that the groundnut growers in the state would take 3 years to adjust their yield to the desired level.

A comparison of area adjustment with yield adjustment indicates that, yield adjustment is quicker than the area adjustment for the groundnut crop.

4.4.2.2 Sunflower

With the view of estimating the response of producers in terms of yield towards price and non price factors, the actual yield of sunflower in the current year is expressed as a function of lagged yield, lagged price, rainfall, fertilizer and Dummy variable (WTO). The regression coefficients and elasticities of these explanatory variables are presented in Tables 4.15 and 4.16.

Table 4.15: Yield response of sunflower in Karnataka over a period of time (1984-85 to 2004-05)

Sl. No.	Particulars	Co-efficient
1.	Functional form	Log-linear
2.	Adjusted coefficient of determination (R^2)	0.6020
3.	Co-efficient of determination (R^2)	0.7928
4.	Constant (a_0)	1.2439
5.	Yield of the crop (Y_{t-1})	0.3852*** (0.2070)
6.	Crop price (P_{t-1})	0.4734*** (0.2657)
7.	Rainfall during current season (R_t)	0.3478*** (0.3507)
8.	Fertilizer (F_t)	-0.0546 (0.1055)
9.	Dummy variable (D)	-0.1588 (0.0840)

Note: Figures in the parenthesis indicate the standard error
 *** Significant at 10 per cent level of probability

Table 4.16: Estimated price and non-price elasticities of yield of sunflower

Sl. No.	Particulars	SRE	LRE
1.	Lagged yield	0.3852	0.6265
2.	Lagged price	0.4734	0.8989
3.	Rainfall	0.3478	0.5332
4.	Fertilizers	-0.0546	-0.0517

Note: SRE – Short run elasticity and LRE – Long run elasticity

Table 4.17: Co-efficient of rigidity for area and yield adjustment of Groundnut and sunflower

Particulars	Number of years taken for 95% adjustment in area and yield	
	Groundnut	Sunflower
Area	4	2.7
Yield	3	3

Results revealed that R^2 was high, indicating the variables included in the model has explained most of the variations in the yield of the sunflower crop. The R^2 explains nearly 80 per cent of the variation. The coefficient of adjustment for the yield of sunflower was found to be 0.6020.

The Table reveals that the yield coefficient of the sunflower lagged one year was positive and significant at 10 per cent level of probability, indicating that the yield of the sunflower crop was influenced by the previous year yield of the crop.

The price lagged one year was also found to be the variable affecting the yield level of sunflower crop in the state. The coefficient of lagged price was 0.4734 and significant at 10 per cent level of probability.

Rainfall was observed to be another important variable besides yield and lagged price, affecting the yield of the sunflower crop in the state. The coefficient was 0.3478 and significant at 10 per cent level of probability, indicating rainfall during the current season affects the yield of the crop in the state.

The coefficient of fertilizer was negative and non significant which implies that yield is not dependent on the fertilizer usage for the sunflower crop.

The price and non-price elasticities were calculated for both short run and long run and are presented in the Table 4.16. It was found that in all cases except fertilizer, the short run and long run elasticities were positive and also the long run elasticities were more than the short run elasticities for the sunflower crop in the state as a whole.

The coefficient of Dummy variable i.e. WTO factor was found to be negative and non-significant for the sunflower crop, indicating the WTO factor has not influenced the yield of the sunflower crop in the state (Table 4.15).

The coefficient of rigidity, which indicates the number of years required for 95 per cent of adjustment in yield, were calculated and presented in the Table 4.17.

It is evident from the Table that the number of years taken for yield adjustment was 3 for the sunflower crop, indicating the sunflower growers in the state would take 3 years to adjust their yield to the desired level.

A comparison of area adjustment with the yield adjustment indicates that, area adjustment is quicker than the yield adjustment for the sunflower crop in the state.

4.5 DIRECTION OF TRADE AND CHANGING PATTERN OF EXPORTS

The proportions in the exports of Indian groundnut and sunflower to different countries over a period of time and changing pattern of trade were analyzed by employing first order Markov Model. This was achieved by examining the gains and losses in the export share of Indian groundnut and sunflower by the major importing countries.

The transitional probability matrix was estimated for groundnut and sunflower exports from India. The study was divided into two periods, the first period extended from 1985-86 to 1994-95 was termed as pre WTO period and the second from 1995-96 to 2004-05 was designated as post WTO period. Since the sunflower export from India in pre WTO period was negligible, the period considered for the sunflower crop was only the post WTO period.

The major importing countries considered for the analysis of trade in Indian groundnut were Indonesia, Malaysia, U.K., Philippines and Sri Lanka with the remaining importing countries together grouped as 'Others'. The countries considered for sunflower were Poland, Netherland, German Republic, U.K. and U.S.A. with the remaining importing countries together grouped as 'Others'.

The probability of retaining the previous period market share is interpreted by studying the diagonal and off diagonal elements of transitional probability matrix. The diagonal elements indicate retention; column elements indicate gain and row elements represents loss of country's share during previous years.

4.5.1 Export trade pattern during pre WTO period (1985-86 to 1994-95)

4.5.1.1 Groundnut

The transitional probability matrix presented in Table 4.18 gives a broad indication of changes in direction of trade of Indian groundnut export over a period of ten years.

Indonesia had a very high retention of 0.852, which is reinforced by very high probability of transfer from Malaysia (1.000) and moderate probability of transfer from U.K. (0.037). But there was a tendency to loose its market share to Malaysia (0.081), Philippines (0.065) and Sri Lanka (0.001).

Other importers also had a fairly high retention of 0.727. Which was further reinforced by very high probability of transfer from U.K. (0.947) but in turn there was a moderate probability of loosing their market share of 0.273 to U.K.

U.K. had low probability of retention of 0.014. It gained by Philippines (1.000) and 'Others' (0.273). U.K. experienced very high transfer probability of 0.947 to other countries and moderate transfer probabilities of 0.002 and 0.037 respectively for Malaysia and Indonesia.

Malaysia, Philippines and Sri Lanka were not stable markets for Indian groundnut export. Malaysia had lost its share (1.000) to Indonesia but in turn it also gained Indonesia's market share of 0.081. Malaysia experienced very high transfer probability from Sri Lanka (1.000) and low transfer probability from U.K. (0.002). Philippines had lost its share Of 1.000 to U.K., however it had gained a little share of 0.065 from Malaysia. Sri Lanka had lost its entire share of 1.000 to Malaysia and gained very less share of 0.001 from Indonesia.

Table 4.18: Transition probability matrix for groundnut during pre WTO period (1984-85 to 1994-95)

	Indonesia	Malaysia	UK	Philippines	Sri Lanka	Others
Indonesia	0.852	0.081	0.000	0.065	0.001	0.000
Malaysia	1.000	0.000	0.000	0.000	0.000	0.000
UK	0.037	0.002	0.014	0.000	0.000	0.947
Philippines	0.000	0.000	1.000	0.000	0.000	0.000
Sri Lanka	0.000	1.000	0.000	0.000	0.000	0.000
Others	0.000	0.000	0.273	0.000	0.000	0.727

4.5.2 Export trade pattern during post WTO period (1995-96 to 2004-05)

4.5.2.1 Groundnut

The transitional probability matrix presented in Table 4.19 gives broad indications of the changes of direction of trade of Indian groundnut export over a period of ten years.

Indonesia has indeed been a rapidly growing market for Indian groundnut (0.867). The high retention of this market was further reinforced by high probability of transfer from the U.K. (0.643) and moderate transfer from others (0.170); however, there were small probabilities of loss to Philippines (0.067) and U.K. (0.066).

Malaysia had a fairly high retention of 0.711, which reinforced by very high probability of transfer from Philippines (1.000), Sri Lanka (0.266) and moderately from others (0.045). But there was tendency to loose its market share to U.K. (0.057), Philippines (0.137), Sri Lanka (0.008) and others (0.087).

Other importers also had reasonable probability of retention of 0.653 and the transfer from Sri Lanka (0.637) and Malaysia (0.087) further strengthened this. However, there were small probabilities of loss to Sri Lanka (0.042), Philippines (0.034), U.K. (0.055), Malaysia (0.045) and others (0.170).

U.K. had moderate probability of retention of 0.356. It gained by 'Other countries', Malaysia and Indonesia share by 0.055, 0.057 and 0.066 respectively. U.K. experienced high transfer probabilities of 0.643 to Indonesia and 0.170 to other countries.

Philippines and Sri Lanka were not a stable markets for Indian groundnut exports. Philippines had lost its share (1.000) to Malaysia but in turn it also gained Malaysia's market share of 0.137 and Indonesia's market share of 0.067.

Sri Lanka had lost its share 0.266 to Malaysia and 0.097 to Philippines; however it had gained a little share from Malaysia (0.008).

4.5.2.2 Sunflower

The transitional probability matrix presented in Table 4.20 gives broad indications of changes in direction of trade of Indian sunflower export over a period of ten years.

Netherland has indeed been a rapidly growing market for Indian sunflower (0.679) and the transfer from German Republic (0.478) and U.K. (0.364) further strengthened this. However there was considerable probability of loss to 'other countries' (0.320).

U.K. had a fairly high retention of 0.635, which reinforced by moderate probability of transfer from German Republic (0.076). But there was a tendency to loose its big market share of 0.364 to Netherland.

German Republic also had reasonable probability of retention of 0.207, which was further reinforced by very high probability of transfer from 'Other countries' (0.855). But there was a tendency to loose its big market share to Netherland (0.478), U.K. (0.076), U.S.A. (0.056) and 'Others' (0.182).

Other countries had a moderate probability of retention of 0.052. They gained by U.S.A. (1.000), German Republic (0.182) and Netherland (0.320). Other countries experienced high transfer probability of 0.855 to German Republic and moderate transfer probability of 0.093 to Poland.

Poland and U.S.A. were not stable markets for Indian sunflower export. Poland had lost its share (1.000) to U.S.A., however it had gained a little share of (0.093) from 'Other countries'.

U.S.A. had lost its share (1.000) to other countries, but in turn it had gained a market share of 1.000 from Poland and 0.056 from German Republic.

4.6 TRADE COMPETITIVENESS

In order to determine the export competitiveness of Indian oilseeds in the world market, Nominal protection coefficients (NPC's) and Domestic resource cost (DRC's) were estimated for the period 1985-86 to 2004-05.

The whole study period was divided into two sub periods i.e. 1985-86 to 1994-95 (Pre WTO period) and 1995-96 to 2004-05 (Post WTO period). The average NPC's and DRC's were computed for the two sub periods to understand clearly the impact of WTO on the export competitiveness of Indian oilseeds.

4.6.1 Trade competitiveness of groundnut

The results of computations of NPC's and DRC's under exportable hypothesis for the groundnut crop were presented in the Table 4.21. Groundnut shows a clear cut competitive disadvantage in the pre WTO period, because NPC and DRC's are more than one. The average NPC and DRC during the pre WTO period were found to be 1.5 and 1.06 respectively. But in the post WTO period, the competitiveness has increased as evident from the NPC and DRC which turned out be less than one.(0.68 and 0.46 respectively). Under the importable hypothesis also similar results were obtained. (Tables 4.24 and 4.25).

Table 4.20: Transition probability matrix for sunflower during post WTO period (1995-96 to 2004-05)

	Poland	Netherlands	German REP	U.K.	U.S.A.	Others
Poland	0.000	0.000	0.000	0.000	1.000	0.000
Netherlands	0.000	0.679	0.000	0.000	0.000	0.320
German REP	0.000	0.478	0.207	0.076	0.056	0.182
U.K.	0.000	0.364	0.000	0.635	0.000	0.000
U.S.A.	0.000	0.000	0.000	0.000	0.000	1.000
Others	0.093	0.000	0.855	0.000	0.000	0.052

Table 4.21: Trade competitiveness of groundnut under exportable hypothesis

Year	NPC	DRC
1985-86	1.46	1.09
1986-87	1.58	0.97
1987-88	1.44	1.31
1988-89	1.80	1.01
1989-90	1.76	1.05
1990-91	1.76	1.24
1991-92	1.56	1.23
1992-93	1.26	0.80
1993-94	1.22	1.15
1994-95	1.15	0.79
Average*	1.50	1.06
1995-96	0.97	0.72
1996-97	1.04	0.60
1997-98	0.76	0.42
1998-99	0.73	0.51
1999-00	0.63	0.49
2000-01	0.67	0.56
2001-02	0.46	0.42
2002-03	0.60	0.24
2003-04	0.49	0.27
2004-05	0.47	0.40
Average**	0.68	0.46
Average***	1.09	0.76

Note: * Average of 1984-85 to 1994-95.

** Average of 1995-96 to 2004-05

*** Overall Average (1984-85 to 2004-05)

Table 4.22: Calculation of Nominal protection coefficients (NPC) for groundnut under exportable hypothesis during pre WTO period

Particulars	Place	Unit	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	94-95
Wholesale price in Karnataka		Rs/Qtl	550	568.23	620	634.13	720.2	890.6	1010.1	1250.6	1480.6	1450.8
Transport cost	Chennai	Rs/Qtl	27.75	29	29	29.65	29.8	30	31.6	31.75	32	32
Marketing margin at 5%.		Rs/Qtl	27.50	28.41	31.00	37.71	36.01	44.53	50.50	62.53	74.03	72.54
C&F handling charges		Rs/Qtl	14	14.2	14.5	15.6	16	17.2	18	21	22.75	23.8
Wharfage charges		Rs/Qtl	3.15	3.5	3.6	4	4	5	5.45	5.8	6	6.1
Service charges		Rs/Qtl	2	2	2.3	2.45	2.5	2.7	2.9	3	3	3.25
Service tax		Rs/Qtl	0.16	0.16	0.18	0.2	0.2	0.22	0.23	0.24	0.24	0.26
Equals FOB price at	Chennai	Rs/Qtl	624.56	645.50	700.58	717.74	808.71	990.25	1118.74	1374.92	1618.62	1588.75
Plus freight from India to Rotterdam		Rs/Qtl	24.04	21.47	23.64	32.96	41.04	59.11	54.54	66.24	86.59	88.77
Plus insurance at 1% of the price		Rs/Qtl	6.25	6.46	7.01	7.18	8.09	9.90	11.19	13.75	16.19	15.89
Equals landed price		Rs/Qtl	654.85	673.43	731.23	757.87	857.84	1059.26	1184.47	1454.91	1721.40	1693.41
FOB price	Rotterdam	\$/Qtl	37.8	34.8	39.78	32.39	33.6	36.1	42.2	47.06	48.77	47.1
Exchange rate		\$/Rs	11.89	12.24	12.78	12.97	14.48	16.65	17.94	24.47	28.96	31.4
FOB price	Rotterdam	Rs/Qtl	449.44	425.95	508.39	420.10	486.53	601.07	757.07	1151.56	1412.38	1478.9
NPC			1.46	1.58	1.44	1.80	1.76	1.76	1.56	1.26	1.22	1.15
NPC Aggregate pre WTO period			1.5									

Note: C & F charges include empty container lift on charges, container yard to CFS, container transportation, cargo container stuffing charges, Customs and port sundries, documentation charges.

Wharfage charges - Ship landing charges.

Table 4.23: Calculation of Nominal protection coefficients (NPC) for groundnut under exportable hypothesis during post WTO period

Particulars	Place	Unit	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	04-05
Wholesale price in Karnataka		Rs/Qtl	1354	1441.57	1649.69	1546.24	1375.31	1342.49	1499	1756	1820	1900
Transport cost	Chennai	Rs/Qtl	33.2	33.65	33.75	34	34	34.5	35	34.4	35.5	36.5
Marketing margin at 5%.		Rs/Qtl	67.7	72.08	82.48	77.31	68.77	67.12	74.95	87.80	91.00	95.00
C&F handling charges		Rs/Qtl	25	27	27.5	28	30	30	31	32.1	29	31.5
Wharfage charges		Rs/Qtl	6.25	6.4	7	7	7.25	7.25	7.5	7.25	6.5	7.5
Service charges		Rs/Qtl	3.45	3.65	3.8	3.9	4	4	3.9	4.5	4.2	4.1
Service tax		Rs/Qtl	0.28	0.29	0.3	0.31	0.32	0.32	0.28	0.32	0.3	0.33
Equals FOB price at	Chennai	Rs/Qtl	1489.88	1584.64	1804.52	1696.76	1519.65	1485.68	1651.63	1922.37	1986.50	2074.9
Plus freight from India to Rotterdam		Rs/Qtl	60.11	72.65	66.08	45.84	49.28	40.83	49.64	57.4	55.2	62.06
Plus insurance at 1% of the price		Rs/Qtl	14.9	15.85	18.05	16.97	15.20	14.86	16.52	19.22	19.87	20.75
Equals landed price		Rs/Qtl	1564.89	1673.13	1888.65	1759.57	1584.12	1541.37	1717.79	1998.99	2061.57	2157.7
FOB price	Rotterdam	\$/Qtl	51.35	48.02	69.74	64.51	59.45	53.32	78.78	67.22	88.48	101.53
Exchange rate		\$/Rs	31.39	33.4	35.47	37.12	42.08	43.28	47.76	49.38	47.45	45.56
FOB price	Rotterdam	Rs/Qtl	1611.88	1603.87	2473.68	2394.61	2501.66	2307.69	3762.65	3319.37	4198.17	4625.6
NPC			0.97	1.04	0.76	0.73	0.63	0.67	0.46	0.60	0.49	0.47
NPC Aggregate post WTO period			0.68									

Note: C & F charges include empty container lift on charges, container yard to CFS, container transportation, cargo container stuffing charges, Customs and port sundries, documentation charges

Wharfage charges - Ship landing charges.

Table 4.24: Calculation of Nominal protection coefficients (NPC) for groundnut under importable hypothesis during pre WTO Period

Particulars	Place	Unit	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	94-95
FOB price Rotterdam		\$/Qtl	37.80	34.80	39.78	32.39	33.6	36.10	42.20	47.06	48.77	47.10
Plus freight from Rotterdam to India		\$/Qtl	2.02	1.75	1.85	2.54	2.83	3.55	3.04	2.71	2.99	2.83
Plus insurance at 1% of the price		\$/Qtl	0.38	0.35	0.40	0.32	0.34	0.36	0.42	0.47	0.49	0.47
Plus Customcess 5% on FOB value.		\$/Qtl	1.89	1.74	1.99	1.62	1.68	1.81	2.11	2.35	2.44	2.36
Equals CIF price		\$/Qtl	42.09	38.64	44.02	36.87	38.45	41.82	47.77	52.59	54.69	52.76
Exchange rate		1\$=Rs	11.89	12.24	12.78	12.97	14.48	16.65	17.94	24.47	28.96	31.4
Equals CIF price		Rs/Qtl	500.43	472.93	562.53	478.25	556.70	696.24	857.03	1286.97	1583.71	1656.5
Import duty		Rs/Qtl	0	0	0	0	0	0	0	0	0	0
Transport cost	Chennai	Rs/Qtl	27.75	29	29	29.65	29.8	30	31.6	31.75	32	32
C&F handling charges		Rs/Qtl	14	14.2	14.5	15.6	16	17.2	18	21	22.75	23.8
Wharfage charges		Rs/Qtl	3.15	3.5	3.6	4	4	5	5.45	5.8	6	6.1
Service charges		Rs/Qtl	2	2	2.3	2.45	2.5	2.7	2.9	3	3	3.25
Service tax		Rs/Qtl	0.16	0.16	0.18	0.2	0.2	0.22	0.23	0.24	0.24	0.26
Equals landed cost Bangalore		Rs/Qtl	547.49	521.79	612.11	530.15	609.20	751.36	915.21	1348.76	1647.81	1721.9
Reference price		Rs/Qtl	547.49	521.79	612.11	530.15	609.20	751.36	915.21	1348.76	1647.81	1721.9
Domestic price	Karnataka	Rs/Qtl	550	568.23	620	634.13	720.2	890.6	1010.06	1250.6	1480.6	1450.8
NPC			1.00	1.09	1.01	1.20	1.18	1.19	1.10	0.93	0.90	0.84
NPC Aggregate pre WTO period			1.04									

Note: C & F charges include empty container lift on charges, container yard to CFS, container transportation, cargo container stuffing charges, Customs and port sundries, documentation charges.

Wharfage charges - Ship landing charges.

Table 4.25: Calculation of Nominal protection coefficients (NPC) for groundnut under importable hypothesis during post WTO Period

Particulars	Place	Unit	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	04-05
FOB price Rotterdam		\$/Qtl	51.35	48.02	69.74	64.51	59.45	53.32	78.78	67.22	88.48	101.53
Plus freight from Rotterdam to India		\$/Qtl	1.92	2.18	1.86	1.24	1.17	0.94	1.3	1.86	1.4	1.6
Plus insurance at 1% of the price		\$/Qtl	0.51	0.48	0.70	0.65	0.59	0.53	0.79	0.67	0.88	1.02
Plus Customcess 5% on FOB value.		\$/Qtl	2.57	2.40	3.49	3.23	2.97	2.67	3.94	3.36	4.42	5.08
Equals CIF price		\$/Qtl	56.35	53.08	75.78	69.62	64.19	57.46	84.81	73.11	95.18	109.22
Exchange rate		1\$=Rs	31.39	33.4	35.47	37.12	42.08	43.28	47.76	49.38	47.45	45.56
Equals CIF price		Rs/Qtl	1768.86	1772.91	2688.07	2584.32	2700.99	2486.83	4050.5	3610.38	4516.49	4976.0
Import duty		Rs/Qtl	0	564.54	870.79	842.87	880.56	812.3	845.24	846.03	834.53	841.93
Transport cost	Chennai	Rs/Qtl	33.2	33.65	33.75	34	34	34.5	35	34.4	35.5	36.5
C&F handling charges		Rs/Qtl	25	27	27.5	28	30	30	31	32.1	29	31.5
Wharfage charges		Rs/Qtl	6.25	6.4	7	7	7.25	7.25	7.5	7.25	6.5	7.5
Service charges		Rs/Qtl	3.45	3.65	3.8	3.9	4	4	3.9	4.5	4.2	4.1
Service tax		Rs/Qtl	0.28	0.29	0.3	0.31	0.32	0.32	0.28	0.32	0.3	0.33
Equals landed cost Bangalore		Rs/Qtl	1837.04	2408.44	3631.21	3500.4	3657.12	3375.24	4973.42	4534.98	5426.52	5897.9
Reference price		Rs/Qtl	1837.04	2408.44	3631.21	3500.4	3657.12	3375.24	4973.42	4534.98	5426.52	5897.9
Domestic price	Karnataka	Rs/Qtl	1354	1441.57	1649.69	1546.24	1375.31	1342.49	1499	1756	1820	1900
NPC			0.74	0.60	0.45	0.44	0.38	0.40	0.30	0.39	0.34	0.33
NPC Aggregate post WTO period			0.44									

Note: C & F charges include empty container lift on charges, container yard to CFS, container transportation, cargo container stuffing charges, Customs and port sundries, documentation charges

Wharfage charges - Ship landing charges

4.6.2 Trade competitiveness of sunflower

The results of computation of NPC's and DRC's under exportable hypothesis for the sunflower crop were presented in the Table 4.26. The table reveals that during pre WTO period; average NPC and DRC for the sunflower crop were found to be 1.62 and 1.48 respectively, depicting the competitive disadvantage of Indian sunflower in the world market. But in the post WTO period; the competitiveness has increased as evident from the NPC and DRC, which turned out to be less than one. (0.73 and 0.90 respectively). The NPC was less than unity indicated that sunflower is only marginally competitive in the international market and it represents an effective export commodity, where as DRC was also less than one indicated that sunflower growers have to spend less than Rupee one to earn one rupee equivalent of foreign exchange. It indicated that Indian sunflower exports are competitive in nature during post WTO period. Under importable hypothesis also similar results were obtained (Table 4.29 and 4.30).

4.7 INTEGRATION OF DOMESTIC MARKET PRICES AND WORLD MARKET PRICES OF SELECTED OILSEED CROPS

The integration of domestic market with the international market was assed by using co-integration approach. This technique is an empirical means to test the theoretical long run equilibrium relation between two economic time series data.

In the present context, the co-integration analysis was employed to examine whether the Karnataka's oilseed (groundnut and sunflower) market is integrated with the world major oilseed market (Rotterdam). The integration of these markets was studied by testing whether the law of one price holds in these representative markets. The data on the annual average prices of groundnut and sunflower in the above mentioned markets for the period 1985-86 to 2004-05 were used for analysis.

The analysis was carried out in two stages. First stage involves the verification of stationarity of the price series. The annual price series of domestic and international markets are verified for stationarity in terms of Augmented Dickey Fuller (ADF) unit root test. The results of the test are presented in the Table 4.31.

International market price series were found to be stationary at the second difference for selected crops (groundnut and sunflower), implying integration of 'Order 2'. Domestic market price series for groundnut was found to be stationary at the second difference, implying integration of 'Order 2', where as for sunflower it found to be stationary at the third difference implying integration of 'Order 3'.

The second stage involves the verification of long run synchronous movements of domestic and international market prices. To test co-integration between price series, Augmented Dickey Fuller (ADF) test was used. Table 4.32 summarizes the results of the co-integration tests. The critical values for ADF statistics for testing hypothesis to co integrate the domestic and international market price series at 10 per cent level is greater than -2.57.

It is evident from the Table that the domestic and international price series of groundnut and sunflower are co-integrated.

Table 4.26: Trade competitiveness of sunflower under exportable hypothesis

Year	NPC	DRC
1985-86	1.66	3.13
1986-87	1.54	2.18
1987-88	1.82	2.86
1988-89	1.80	1.47
1989-90	1.79	2.06
1990-91	1.93	1.34
1991-92	1.82	1.62
1992-93	1.55	1.04
1993-94	1.10	0.75
1994-95	1.17	0.98
Average*	1.62	1.48
1995-96	1.06	0.96
1996-97	1.14	1.81
1997-98	1.02	0.94
1998-99	1.03	1.11
1999-00	1.02	1.12
2000-01	1.00	0.52
2001-02	0.72	0.71
2002-03	0.76	1.05
2003-04	0.74	1.04
2004-05	0.85	0.74
Average**	0.94	0.90
Average***	1.28	1.19

Note: * Average of 1984-85 to 1994-95.

** Average of 1995-96 to 2004-05

*** Overall Average (1984-85 to 2004-05).

Table 4.27: Calculation of Nominal protection coefficients (NPC) for sunflower under exportable hypothesis during pre WTO period

Particulars	Place	Unit	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	94-95
Wholesale price in Karnataka		Rs/Qtl	402.2	425.6	380.8	525.6	565.4	750.2	812.4	850.6	929.91	1213
Transport cost	Chennai	Rs/Qtl	27.75	29	29	29.65	29.8	30	31.6	31.75	32	32
Marketing margin at 5%.		Rs/Qtl	20.11	21.28	19.04	26.28	28.27	37.51	40.62	42.53	46.50	60.65
C&F handling charges		Rs/Qtl	14	14.2	14.5	15.6	16	17.2	18	21	22.75	23.8
Wharfage charges		Rs/Qtl	3.15	3.5	3.6	4	4	5	5.45	5.8	6	6.1
Service charges		Rs/Qtl	2	2	2.3	2.45	2.5	2.7	2.9	3	3	3.25
Service tax		Rs/Qtl	0.16	0.16	0.18	0.2	0.2	0.22	0.23	0.24	0.24	0.26
Equals FOB price at	Chennai	Rs/Qtl	469.37	495.74	449.42	603.78	646.17	842.83	911.20	954.92	1040.40	1339.1
Plus freight from India to Rotterdam		Rs/Qtl	24.04	21.47	23.64	32.96	41.04	59.11	54.54	66.24	86.59	88.77
Plus insurance at 1% of the price		Rs/Qtl	4.69	4.96	4.49	6.04	6.46	8.43	9.11	9.55	10.40	13.39
Equals landed price		Rs/Qtl	498.10	522.17	477.55	642.78	693.67	910.37	974.85	1030.71	1137.39	1441.2
FOB price	Rotterdam	\$/Qtl	25.2	27.7	20.5	27.6	26.7	27.3	29.9	27.1	31.7	30.9
Exchange rate		\$/Rs	11.89	12.24	12.78	12.97	14.48	16.65	17.94	24.47	28.96	31.4
FOB price	Rotterdam	Rs/Qtl	299.63	339.05	261.99	357.97	386.62	454.55	536.41	663.14	918.03	970.26
NPC			1.66	1.54	1.82	1.80	1.79	2.00	1.82	1.55	1.24	1.49
NPC Aggregate pre WTO period			1.67									

Note: C & F charges include empty container lift on charges, container yard to CFS, container transportation, cargo container stuffing charges, Customs and port sundries, documentation charges.

Wharfage charges - Ship landing charges.

Table 4.28: Calculation of Nominal protection coefficients (NPC) for sunflower under exportable hypothesis during post WTO period

Particulars	Place	Unit	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	04-05
Wholesale price in Karnataka		Rs/Qtl	860	802	932	820	750	790	820	896	950	1020
Transport cost	Chennai	Rs/Qtl	33.2	33.65	33.75	34	34	34.5	35	34.4	35.5	36.5
Marketing margin at 5%.		Rs/Qtl	60.96	60.95	58.488	62.84	59.30	59.45	66.10	75.65	88.05	90
C&F handling charges		Rs/Qtl	25	27	27.5	28	30	30	31	32.1	29	31.5
Wharfage charges		Rs/Qtl	6.25	6.4	7	7	7.25	7.25	7.5	7.25	6.5	7.5
Service charges		Rs/Qtl	3.45	3.65	3.8	3.9	4	4	3.9	4.5	4.2	4.1
Service tax		Rs/Qtl	0.28	0.29	0.3	0.31	0.32	0.32	0.28	0.32	0.3	0.33
Equals FOB price at	Chennai	Rs/Qtl	1348.38	1351	1300.6	1392.92	1320.85	1324.54	1465.55	1667.22	1924.55	1969.9
Plus freight from India to Rotterdam		Rs/Qtl	60.11	72.65	66.08	45.84	49.28	40.83	49.64	57.4	55.2	62.06
Plus insurance at 1% of the price		Rs/Qtl	13.48	13.51	13.01	13.93	13.21	13.25	14.66	16.67	19.25	19.7
Equals landed price		Rs/Qtl	1421.98	1437.16	1379.68	1452.69	1383.34	1378.62	1529.84	741.29	1999.00	2051.7
FOB price	Rotterdam	\$/Qtl	31.2	26.6	30.9	25.7	21.4	21.9	28.7	28.6	32.1	31.3
Exchange rate		\$/Rs	31.39	33.4	35.47	37.12	42.08	43.28	47.76	49.38	47.45	45.56
FOB price	Rotterdam	Rs/Qtl	979.37	888.44	1096.02	953.98	900.51	947.83	1370.71	1412.27	1523.15	1426.1
NPC			1.06	1.04	1.03	1.04	1.02	1.01	0.73	0.77	0.75	0.86
NPC Aggregate post WTO period			0.94									

Note: C & F charges include empty container lift on charges, container yard to CFS, container transportation, cargo container stuffing charges, Customs and port sundries, documentation charges.

Wharfage charges - Ship landing charges

Table 4.29: Calculation of Nominal protection coefficients (NPC) for sunflower under importable hypothesis during pre WTO Period

Particulars	Place	Unit	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	94-95
FOB price	Rotterdam	\$/Qtl	25.2	27.7	20.5	27.6	26.7	27.3	29.9	27.1	31.7	30.9
Plus freight from Rotterdam to India		\$/Qtl	2.02	1.75	1.85	2.54	2.83	3.55	3.04	2.71	2.99	2.83
Plus insurance at 1% of the price		\$/Qtl	0.25	0.28	0.21	0.28	0.27	0.27	0.30	0.27	0.32	0.31
Plus Customcess 5% on FOB value.		\$/Qtl	1.26	1.39	1.03	1.38	1.34	1.37	1.50	1.36	1.59	1.55
Equals CIF price		\$/Qtl	28.73	31.11	23.58	31.80	31.13	32.49	34.73	31.44	36.59	35.58
Exchange rate		1\$=Rs	11.89	12.24	12.78	12.97	14.48	16.65	17.94	24.47	28.96	31.4
Equals CIF price		Rs/Qtl	341.62	380.81	301.35	412.39	450.79	540.93	623.13	769.24	1059.70	1117.34
Import duty		Rs/Qtl	0	0	0	0	0	0	0	0	0	0
Transport cost	Chennai	Rs/Qtl	27.75	29	29	29.65	29.8	30	31.6	31.75	32	32
C&F handling charges		Rs/Qtl	14	14.2	14.5	15.6	16	17.2	18	21	22.75	23.8
Wharfage charges		Rs/Qtl	3.15	3.5	3.6	4	4	5	5.45	5.8	6	6.1
Service charges		Rs/Qtl	2	2	2.3	2.45	2.5	2.7	2.9	3	3	3.25
Service tax		Rs/Qtl	0.16	0.16	0.18	0.2	0.2	0.22	0.23	0.24	0.24	0.26
Equals landed cost	Bangalore	Rs/Qtl	388.68	429.67	350.93	464.29	503.29	596.05	681.31	831.03	1123.69	1182.7
Reference price		Rs/Qtl	388.68	429.67	350.93	464.29	503.29	596.05	681.31	831.03	1123.69	1182.7
Domestic price	Karnataka	Rs/Qtl	402.2	425.6	380.8	525.6	565.4	750.2	812.4	850.6	929.91	1213
NPC			1.03	0.99	1.09	1.13	1.12	1.26	1.19	1.02	0.83	1.03
NPC Aggregate pre WTO period			1.07									

Note: C & F charges include empty container lift on charges, container yard to CFS, container transportation, cargo container stuffing charges, Customs and port sundries, documentation charges.

Wharfage charges - Ship landing charges.

Table 4.30: Calculation of Nominal protection coefficients (NPC) for sunflower under importable hypothesis during post WTO Period

Particulars	Place	Unit	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	04-05
FOB price	Rotterdam	\$/Qtl	31.2	26.6	30.9	25.7	21.4	21.9	28.7	28.6	32.1	31.3
Plus freight from Rotterdam to India		\$/Qtl	1.92	2.18	1.86	1.24	1.17	0.94	1.3	1.86	1.4	1.6
Plus insurance at 1% of the price		\$/Qtl	0.31	0.27	0.31	0.26	0.21	0.22	0.29	0.29	0.32	0.31
Plus Customcess 5% on FOB value.		\$/Qtl	1.56	1.33	1.55	1.29	1.07	1.10	1.44	1.43	1.61	1.57
Equals CIF price		\$/Qtl	34.99	30.38	34.61	28.48	23.85	24.15	31.72	32.18	35.43	34.78
Exchange rate		1\$=Rs	31.39	33.4	35.47	37.12	42.08	43.28	47.76	49.38	47.45	45.56
Equals CIF price		Rs/Qtl	1098.40	1014.56	1227.76	1057.25	1003.78	1045.39	1515.04	1588.85	1680.96	1584.4
Import duty		Rs/Qtl	0	564.54	870.79	842.87	880.56	812.3	845.24	846.03	834.53	841.93
Transport cost	Chennai	Rs/Qtl	33.2	33.65	33.79	34	34	34.5	35	34.4	35.5	36.5
C&F handling charges		Rs/Qtl	25	27	27.5	28	30	30	31	32.1	29	31.5
Wharfage charges		Rs/Qtl	6.25	6.4	7	7	7.25	7.25	7.5	7.25	6.5	7.5
Service charges		Rs/Qtl	3.45	3.65	3.8	3.9	4	4	3.9	4.5	4.2	4.1
Service tax		Rs/Qtl	0.28	0.29	0.3	0.31	0.32	0.32	0.28	0.32	0.3	0.33
Equals landed cost	Bangalore	Rs/Qtl	1166.58	1650.09	2170.9	1973.33	1959.91	1933.76	2437.97	2513.46	2590.99	2506.4
Reference price		Rs/Qtl	1166.58	1650.09	2170.9	1973.33	1959.91	1933.76	2437.97	2513.46	2590.99	2506.4
Domestic price	Karnataka	Rs/Qtl	1219.24	1219.06	1169.76	1256.87	1185.98	1189.02	1321.78	1513	1761	1800
NPC			1.05	0.74	0.54	0.64	0.61	0.61	0.54	0.60	0.68	0.72
NPC Aggregate post WTO period			0.67									

Note: C & F charges include empty container lift on charges, container yard to CFS, container transportation, cargo container stuffing charges, Customs and port sundries, documentation charges

Wharfage charges - Ship landing charges.

Table 4.31: Dickey-fuller test for stationarity of price series of groundnut and sunflower (1985-86 to 2004-05)

Sl. No.	Price series	Order of integration	Augmented Dickey Fuller (ADF) value	Dickey fuller 10% critical value
1	Groundnut			
a	Domestic Market	2	-4.2599	-2.57
b	International market	2	-5.1193	-2.57
2	Sunflower			
a	Domestic Market	3	-3.6500	-2.57
b	International market	2	-3.0599	-2.57

Note: Domestic market: Karnataka
International market: Rotterdam

Table 4.32: Dickey-fuller test for cointegration of domestic prices (Karnataka) with international prices (Rotterdam) of groundnut and sunflower

Sl. No.	Country	Augmented Dickey Fuller (ADF) value	Dickey fuller 10% critical value
1	Groundnut		
	Domestic-International Market	-2.9090	-2.57
2	Sunflower		
	Domestic-International Market	-2.8532	-2.57

V. DISCUSSION

The results of the study presented in the previous chapter are discussed in this chapter under the following headings.

- 5.1 Growth in area, production and yield of major oilseeds
- 5.2 Growth in exports
- 5.3 Changes in economics of major oilseed production
- 5.4 Supply response of major oilseed crops.
- 5.5 Direction of trade
- 5.6 Trade competitiveness of selected oilseed crops.
- 5.7 Relationship between domestic market price and world reference prices of selected oilseed crops.

5.1 GROWTH IN AREA, PRODUCTION AND YIELD OF MAJOR OILSEEDS

The globalized trade environment has put a greater onus on the countries to be competitive in their trade endeavours. In order to derive the maximum benefits from the new world trade environment, it is essential to properly assess the available export surpluses of various commodities in the country and to give greater emphasis to production strategy for the commodities for which the country has greater comparative advantage. Hence growth in area, production and productivity of the important oilseed crops of the state as well as nation was assessed.

5.1.1 Groundnut

In India groundnut is dominant oilseed crop among nine major oilseeds, accounting for 39 per cent of the oilseed output. Gujrat, Andhra Pradesh, Tamil Nadu, Maharashtra and Karnataka are the major producers of the groundnut in the country accounting for more than 80 per cent of production. Groundnut being an important crop of the state covers about 44 per cent of the area under oilseeds. The overall performance of groundnut is not encouraging as the modest growth in production in the state is mainly due to area expansion. The productivity growth showed a decreasing trend (Table 4.1). The performance of groundnut production was impressive in the pre WTO period, mainly because high growth in area. However yield showed decelerating growth during this period. In the post WTO period area, production and productivity showed dismal growth with negative trends. The overall production performance of groundnut crop in the country was decelerating. There was negative growth of area expansion during post WTO period. The negative growth in production was mainly due to decline in yield level. The growth in area, production and productivity was impressive in the pre WTO period. The increase in production was due to growth in both area and yield. The post WTO period was marked by stagnation and negative growth in yield, area and production respectively. The decrease in production was due to shrinkage in area as well the yield level.

A relatively better performance of groundnut crop in the pre WTO period might be due to expansion in area, availability of improved oilseed production technology and its adoption, remunerative support prices and institutional support, particularly establishment of Technology Mission on Oilseeds (TMO) in 1986 as suggested by Hegde (2004). But the production started declining after the establishment of WTO due to decrease in area under cultivation, which could be attributed to import of edible oils and relatively stagnant real prices of groundnut. These factors acted as disincentives to the producers to expand area under the

crop (Deshpande, 2004). Currently India is the largest importer of edible oil in the world and more than 40 per cent of domestic demand is met through imports (Chand *et al.*, 2004). All these factors resulted in stagnation in domestic groundnut production in recent years, which could be partly attributed to WTO obligations.

5.1.2 Sunflower

Sunflower has become another important oilseed crop in the recent years. Karnataka, Maharashtra and Andhra Pradesh are the major producers of sunflower. Karnataka is the largest producer of sunflower in India and it produces nearly half of the total production in the country. Out of total area of 2000 thousand hectares, Karnataka has recorded 1125 thousand-hectares area under sunflower in the country during the year 2003-04. As far as production is concerned; out of total production of 992 thousand tonnes, Karnataka has recorded 422 thousand tonnes during the year 2003-04. However, productivity in Karnataka was very low (375 kg/ha) as compare to the average productivity of India (496 kg/ha) during the year 2003-04. Punjab has recorded the highest productivity level of 1700 kg/ha during 2003-04.

The overall performance of sunflower is not encouraging in Karnataka state as the modest growth in production is mainly due to area expansion. The productivity growth showed negative trend (Table 4.2). The performance of sunflower production was impressive in the pre WTO period, mainly because high growth in area. However yield showed dismal growth with negative trend. In the post WTO period, area and production has showed dismal growth with negative trend. However yield levels has showed little improvement during this period. The yield of oilseeds such as sunflower, which are affected by the vagaries of monsoon can be doubled with good irrigation (Virupakshappa and Kiresur, 1997). The overall production performance of sunflower crop in the country has shown impressive growth. There was negative growth of area expansion during post WTO period. The negative growth in production was mainly due to substantial decline in the yield levels. The growth in area, production and productivity was impressive in pre WTO period. Yield levels has showed improvement in this period, mainly because of growth in production was much more than the growth in the area under the crop. A relatively better performance of sunflower crop in the pre WTO period might be due to expansion in area, availability of improved oilseed production technology and its adoption, remunerative support prices and institutional support, particularly establishment of Technology Mission on Oilseeds (TMO) in 1986 as suggested by Hegde (2004). Post WTO period was marked by stagnation and negative growth in production, area as well yield of the crop. The decrease in production was mainly due to shrinkage in area as well the yield levels.

5.2 GROWTH IN EXPORTS

The principal demand factors influencing exports are the magnitude of economic activity in the rest of the world and the international prices (unit values). Exports are also influenced by the competitiveness of goods in the world market. Growth of exports over the years has been discussed for the selected crops.

5.2.1 Groundnut

In the pre WTO period, groundnut exports were impressive. Exports increased mainly due to increased production (efforts of Technology Mission on Oilseeds and market intervention operations of NDDB), also rise in the world market prices. India's major export destinations are Indonesia, Malaysia, Philippines and U.K. However, India's destination wise exports were decelerating over the years. The major reason for this could be stagnation in the domestic production in recent years, which in turn might be due to increased import of edible oil and stagnant real prices of groundnut. Further, accelerated castor oil exports as it is slowly replacing groundnut area (Chand *et al.*, 2004). In order to gain from the market access, instead of exporting kernels India should strive to export value added products.

5.2.2 Sunflower

In pre WTO period, sunflower exports were debilitating with negative trends. During this period, sunflower exports from India were erratic. Poland and German Republic were found to be the major destinations for Indian sunflower during this period. Exports of sunflower during this period were negligible. But during post WTO period, sunflower exports from India has picked up momentum and impressive growth was found in this period. U.K., German Republic and Poland were found to be the major destinations for Indian sunflower during this period. India has become the regular exporter of sunflower, only after 1990's. Thus a relatively more impressive growth was found only after pre WTO period. However the overall growth of sunflower exports from India was also not encouraging. In the post WTO period, the growth in value realized was more than growth in quantity exported which was mainly attributed to growth in prices.

5.3 CHANGES IN ECONOMICS OF MAJOR OILSEED PRODUCTION

The competitiveness and comparative advantages of Kharief oilseed crops in terms of cost of cultivation, the cost structure and changes in cost over time for groundnut and sunflower were studied separately for pre WTO and post WTO period. The results of the study are discussed for the selected crops.

5.3.1 Groundnut

The results of the study reveal that, the increase in cost has occurred in all major inputs like, human labour, bullock labour, seed, fertilizers and manures (Table 4.5). The major contributing factors for the change in operational cost were increase in wage rate, increase in quantity and prices of fertilizers, increase in prices of seed and substitution of bullock labour by machine labour in recent years (Table 4.6).

The cost of human labour as a whole has increased at a faster rate. Among operational cost items, human labour recorded maximum share in the increase in cost of cultivation over time. The positive change in human labour is mainly due to the increase in wage rate over time, which was supported by the results of Kiresur *et al.* (1994). The positive increase in cost of groundnut seed over the years is mainly due to increase in prices of seed followed by substantial increase in physical quantity of seed being used for groundnut cultivation. As far as large increase in cost of manure is concerned, it was mainly due to increase in prices of manures. The gross return from groundnut has recorded an increase of 156.1 per cent during post WTO period as compared to pre WTO period. The increase in gross return from groundnut is attributed to the increase in the quantities of output and also increases in prices of main product.

5.3.2 Sunflower

The results of the study reveals that, the increase in cost has occurred in all major inputs like human labour, bullock labour, seed, fertilizers and manures (Table 4.7). The major contributing factors for the change in operational cost were; increase in wage rate, increase in quantity and prices of fertilizers, increase in prices of seed and increase in the cost of bullock labour (since bullock labour has been substituted by machine labour) (Table 4.8).

The cost of bullock labour as a whole has increased at a faster rate, attributed to replacement of bullock labour by machine labour. The positive change in human labour is mainly due to the increase in wage rate over time. The positive increase in cost of sunflower seed over the years is mainly attributed to substantial increase in the prices of seed even though there was substantial decrease in the physical quantity of seed used for sunflower cultivation. As far as high increase in the cost of manure is concerned, it was mainly due to the prices of manure. Even though the quantity of manure used for sunflower cultivation has substantially declined, the price of manure has doubled. The positive change in the cost of

fertilizer was mainly due to the increases in prices of fertilizer followed by enhanced use of fertilizer in physical terms for the sunflower cultivation. The gross return from sunflower has recorded an increase of 185 per cent during post WTO period as compared to pre WTO period. The increase in gross return from sunflower is attributed to increase in quantities of output and also increase in the prices of main product.

5.4 SUPPLY RESPONSE OF MAJOR OILSEED CROPS

The results of the two supply functions viz., area response analysis and yield response analysis presented in the previous chapter are discussed in detail in this chapter.

5.4.1 Area response Analysis

5.4.1.1 Groundnut

The high R^2 value indicated the fact that the variables included in the area response model were capable of explaining nearly 75 per cent of variation in the state for groundnut crop. While the coefficient of lagged area turned out to be significant at 0.05 level of probability. Thus significantly influencing the farmer's decision regarding area allocation of groundnut in the state (Table 4.9). The coefficient of adjustment of area was little high indicating less time required for area adjustment.

Rainfall has a very strong positive influence on the area planted under groundnut, and associated long run elasticity was also high (Table 4.10). Rainfall appears to be the single most important factor determining area response and second most important factor determining yield response (Sunil Kanwar 2004). Pre sowing rainfall coefficient was 0.2837 and is significant at 0.05 level of probability. It indicates that for every growing region if pre-sowing rainfall is good, on an average 0.2837 hectare of groundnut area can be increased under cultivation.

The lagged yield coefficient was 0.2061 and is significant at 0.05 level of probability. It indicates that for every reason if the previous years yield was good, on an average 0.21 hectares of groundnut area can be increased under cultivation.

The Dummy variable (WTO) coefficient was negative and non significant to area response of groundnut. Thus indicates area allocation of groundnut crop was not influenced by the WTO factor.

The area allocate for groundnut in the previous year, pre sowing rainfall and lagged yield were the determinants of area allocation of the current year groundnut crop in the state. With these factors at work, the area adjustment would take a fairly shorter period extending up to four years.

5.4.1.2 Sunflower

The high R^2 value indicated the fact that the variables included in the area response model were capable of explaining about 80 per cent of the variation in the state for the sunflower crop. While the coefficient of lagged price turned out to be significant at 0.05 level of probability (Table 4.11).

It was observed that for every one-rupee increase in the lagged price per quintal of sunflower, the sunflower growers in the state would bring additional 0.47 hectares of sunflower under cultivation. This shows that the farmer's were responsive to the prices in terms of area.

The coefficient of adjustment of area was little high for the sunflower crop, indicating that less time required for area adjustment. This is true to some extent because, the farmer's can bring more area under cultivation of sunflower in response to price stimuli.

The elasticity of price was worked out (Table 4.12). It was found that long run elasticity was more than short run elasticity. In the long run, elasticity was 0.8889, which indicates that by and large the sunflower growers in the state would bring 0.89 per cent of additional area under the crop for every one per cent increased in the lagged price.

Rainfall has a very strong positive influence on the area planted under sunflower, and associated long run elasticity was also high. Rainfall appears to be the single most important factor determining area response and the second most important factor determining yield response (Sunil Kanwar 2004). In other words, even after several decades of initiating massive irrigation projects, the state agriculture continues to be weather dependent. The pre sowing rainfall coefficient was 0.3257 and is significant at 0.10 level of probability. Thus indicates for every growing region in the state, if the pre sowing rainfall is good, on an average 0.33 hectares of sunflower area can be increased under cultivation.

The coefficient of lagged area turned out to be significant at 0.05 levels of probability. Thus significantly influence the farmer's decision regarding area allocation of sunflower in the state (Table 4.11). With the inclusion of this variable, the R^2 value has improved considerably.

The Dummy variable (WTO) coefficient was negative and non significant to area response of sunflower. Thus indicates the area allocation of sunflower crop was not influenced by the WTO factor.

The lagged price, the area allocated for sunflower in the previous year and pre sowing rainfall were the determinants of the area allocation of the current year sunflower crop in the state. With these factors at work, the area adjustment would take shorter period extending up to 2.7 years.

5.4.2 Yield response Analysis

5.4.2.1 Groundnut

Yield variations were explained to an extent of 77.40 per cent with the inclusion of the variables such as lagged yield, lagged price, rainfall, fertilizer and WTO dummy.

The coefficient of yield adjustment was relatively higher indicating the yield adjustment will be made in the short run itself. This has been supported by the coefficient of rigidity indicating less number of years being required for yield adjustment (Table 4.17). Yield adjustment will be made in a relatively short period of 3 years.

The variables, which affect the yield levels of groundnut crop in the state were, rainfall, lagged yield and lagged price in that order.

In the present study, rainfall has positive influence on the yield levels of groundnut and associated long run elasticity was also high (Table 4.14). Thus it clearly indicates that the rainfall during the current season has strong influence on the yield levels of groundnut in the state as a whole. Rainfall turns out to be an important factor determining the variations in the yield over time, although decidedly not so important as it is in determining crop area (Sunil Kanwar 2004).

Yield lagged by one year also emerged an important variable affecting the yield of groundnut in the state. Thus the previous year yield levels influence the current year yield of the crop i.e. if the previous year yield was good, induces the farmer's to take more care to the crops, which in turn influences the yield levels of the crop in the current year.

The coefficient of lagged price was positive and significant at 0.05 level of probability, which is turned out to be a significant variable in determining the yield of the groundnut in the state. This might be possible because farmers would take more care to the crop if the previous years prices were encouraging. Thus yield may increase.

The coefficient of fertilizer was negative and non-significant which indicates, farmers will not use much of fertilizers or yield was not much depends up on the fertilizers.

The coefficient of Dummy variable (WTO) was negative and non significant to yield response of the groundnut. Thus indicates yield levels of groundnut was not influenced by WTO factor.

Thus it can be concluded that rainfall, previous years yield level and previous year prices of output were the main factors influencing the yield of current year groundnut crop in the state.

5.4.2.2 Sunflower

Yield variations were explained to an extent of 79.28 per cent with the inclusion of the variables such as lagged yield, lagged price, rainfall, fertilizer and WTO Dummy.

The coefficient of yield adjustment was relatively higher indicating; the yield adjustment will be made in short run itself. This has been supported by the coefficient of rigidity indicating less number of years being required for yield adjustment (Table 4.17). Yield adjustment will be made in a relatively shorter period of 3 years.

The variables, which affect the yield levels of the sunflower crop in the state, were lagged price, lagged yield and rainfall in that order.

The coefficient of lagged price was positive and significant at 0.10 level of probability and is turned out to be a most significant variable in determining the yield of sunflower in the state.

Similarly the yield lagged one year as well as the rainfall variables were significantly influenced the yield of sunflower crop in the state.

The coefficient of fertilizer was negative and non significant which indicates that the farmers will not use much of fertilizers or the yield was not much dependent on the fertilizer usage.

The coefficient of Dummy variable (WTO) was negative and non significant to yield response of sunflower. Thus indicates yield level of sunflower was not influenced by WTO factor.

Thus it can be concluded that the previous years price, previous years yield and rainfall were the main factors influencing the yield of current year sunflower crop in the state.

5.5 DIRECTION OF TRADE

The finite Markov chain process, which is a stochastic process was used in the analysis of economic variables for which particular time order data are available. Hence the changes in the exports of selected crops to different countries after economic reforms were analyzed using this tool. It captures the net effect of switching pattern of export trade over a period of time. This was achieved by examining gains and losses in the export share of selected crops by major importing countries.

5.5.1 Export trade pattern during pre WTO period (1985-86 to 1994-95)

5.5.1.1 Groundnut

During this period, Indonesia has emerged as major market for Indian groundnut exports. The high probability of transfer from Malaysia further reinforces its stability. However there are small probabilities of loss to Malaysia, Philippines and Srilanka. 'Other importers' also had a fairly high retention of 0.727. Which was further reinforced by very high probability

of transfer from U.K. (0.947). U.K. had low probability of retention of 0.014. It gained by Philippines (1.000) and Others (0.273). U.K. experienced very high transfer probability of 0.947 to 'other countries'. Malaysia, Philippines and Srilanka were not a stable markets for Indian groundnut export during this period.

5.5.2 Export trade pattern during post WTO period (1995-96 to 2004-05)

5.5.2.1 Groundnut

In this period also Indonesia has indeed been a rapidly growing market for Indian groundnut (0.867). The high retention of this market was further reinforced by high probability of transfer from the U.K. (0.643). However, there were small probabilities of loss to Philippines (0.067) and U.K. (0.066). Malaysia had a fairly high retention of 0.711, which reinforced by very high probability of transfer from Philippines (1.000). 'Other importers' also had reasonable probability of retention of 0.653. U.K. had moderate probability of retention of 0.356. U.K. experienced high transfer probabilities of 0.643 to Indonesia and 0.170 to other countries. Philippines and Srilanka were not a stable markets for Indian groundnut exports in this period.

5.5.2.2 Sunflower

During this period Netherland has indeed been a rapidly growing market for Indian sunflower (0.679) and the transfer from German Republic (0.478) and U.K. (0.364) further strengthened this. U.K. had a fairly high retention of 0.635 in this period. German Republic also had reasonable probability of retention of 0.207, which was further reinforced by very high probability of transfer from 'Other countries' (0.855). Other countries had a moderate probability of retention of 0.052. They gained by U.S.A. (1.000), German Republic (0.182) and Netherland (0.320). Other countries experienced high transfer probability of 0.855 to German Republic. Poland and U.S.A. were not a stable markets for Indian sunflower export during this period.

5.6 TRADE COMPETITIVENESS OF SELECTED OILSEED CROPS

In order to derive maximum benefits from the new world trade environment, India need to give greater emphasis to production strategy with respect to the commodities for which the country has greater comparative advantage. A country's performance in the international market depends largely on its export competitiveness. Assuming identical quality of domestic and foreign products the export competitiveness signifies a situation when the difference between the domestic supply price and international price is expressed in domestic prices net of freight, transport and related costs involved in taking produce from exporting country to the importing country. In other words, a unit of a commodity fetches a price, which is considerably higher than for what it is sold in the domestic market. There are two main kinds of measures, which have been widely used to reveal trade competitiveness. These are Nominal Protection Coefficients (NPC) and Domestic Resource Cost (DRC). The NPC measures are used to find the level of protection or dis-protection and level of government intervention in different commodities. While Domestic Resource Cost (DRC) has been generally used to measure efficiency and comparative advantage in production vis-a-vis export or import of various commodities. Trade competitiveness has been estimated for selected commodities of the state based on both importable and exportable hypotheses. The results are discussed as below.

5.6.1 Trade competitiveness of Groundnut

Groundnut showed a clear-cut competitive disadvantage in the pre WTO period because NPC and DRC were more than one. NPC was more than unity in the pre WTO period indicating that the domestic prices of groundnuts were more than import prices, which signify that groundnut, received a significant protection from the state. The level of DRCs showed that costs involved in import of groundnut was lesser than the value of domestic

resources used in producing one-hectare of groundnut area. These results support the findings of Ravi and Reddy (1998) and Reddy *et al.*, (1998).

In the post WTO period, the competitiveness of groundnut improved significantly as supported by the estimates of NPC and DRC, which turned out to be less than one. However results are in contradiction with the results of Reddy *et al.*, (1998), Ravi and Reddy (1998) and Gulati (2002). Under exportable hypothesis it is assumed that Indian groundnut would compete with US groundnut in Europe (Rotterdam). The NPC's were above unity in the pre WTO period that means groundnut was not an efficient export crop. But during post WTO the magnitude of state subsidy in the form of fertilizer subsidy has come down drastically due to decontrol of phosphatic fertilizers and real prices of groundnut by and large have remained constant during this period. Perhaps these factors might be rendering groundnut competitive internationally in the post WTO period.

5.6.2 Trade competitiveness of sunflower

Sunflower also showed a clear-cut competitive disadvantage in the pre WTO period because NPC and DRC were more than one. NPC was more than unity in the pre WTO period indicating that the domestic prices of sunflower were more than import prices, which signify that sunflower, received a significant protection from the state. The level of DRCs showed that costs involved in import of sunflower was lesser than the value of domestic resources used in producing one-hectare of sunflower area. These results support the findings of Ravi and Reddy (1998) and Reddy *et al.*, (1998).

In the post WTO period, the competitiveness of sunflower improved significantly as supported by the estimates of NPC and DRC, which turned out to be less than one. However results are in contradiction with the results of Reddy *et al.*, (1998), Ravi and Reddy (1998) and Gulati (2002). Under exportable hypothesis it is assumed that Indian sunflower would compete with US sunflower in Europe (Rotterdam). The NPC's were above unity in the pre WTO period that means sunflower was not an efficient export crop.

5.7 INTEGRATION OF DOMESTIC MARKET PRICE AND WORLD REFERENCE PRICES OF SELECTED OILSEED CROPS

In order to verify the integration between domestic and world prices the co integration tests were used. Markets are said to be integrated when prices are determined interdependently. This has been generally assumed to mean that the price changes in one market are fully transmitted to other markets. The results of the co integration tests showed integration between domestic and world prices. That means there exists the long run equilibrium relationship between domestic and international markets. Probable reason for this could be high imports of edible oil, which is more than 40 per cent of the annual domestic demand for edible oils (Hegde, 2004).

VI. SUMMARY AND POLICY IMPLICATIONS

This chapter summarises the findings of the investigation and suggest appropriate policy measure.

India holds a premier position in the world not only in terms of rich diversity of oil crops but also in terms of area as well. Oilseeds occupy an important position in the Indian economy as they account for 10.14 per cent of the gross cropped area and contribute more than 58 per cent to the Gross National Product (GNP). In the domestic agriculture sector, oilseeds occupy a distinct position after food grains contributing 14 per cent of the country's gross cropped area. Although, India has the largest cultivated area under oilseeds in the world, the current consumption level of crucial nutrient such as oils and fats are below the minimum nutritional requirements. The situation has forced the government to resort to large-scale import of edible oils to bridge the gap. Considering the sizeable drain on foreign exchange caused by edible oil imports to meet domestic requirements, the efforts towards achieving self-sufficiency assumes great significance. Towards achieving self sufficiency in oilseeds and in view of the heavy strain on balance of payments, Government of India appointed in May 1986, Technology Mission on Oilseeds which has been implementing an integrated policy on oilseeds with a four pronged strategy to improve oilseed crop technology to improve post harvest technology to strengthen services to farmers and to ensure remunerative prices to the farmers. As a result of concerted efforts of Technology Mission on Oilseeds, there has been a phenomenal increase in the oilseeds production during past few years. However, as a high percentage of cultivated area under oilseeds in the country still depends on rainfall, the oilseed production fluctuates from year to year.

Economic integration and trade liberalization will have great impacts on the national economy in general and agricultural sector in particular. With the implementation of the Agreement on Agriculture (AoA) by the members of WTO, the international trade opportunities are expected to change as trade barriers are reduced and free trade take place. These changes will also ensure that competitiveness of countries in individual product or commodities will play a major role in the international trade. Therefore we need to find out not only the extent to which we are export competitive but also import competitive once the agreement is implemented and whether India can protect its major agricultural commodity sectors.

Karnataka is one of the major oilseeds producing states in the country accounting for 9.72 per cent of the total area under oilseeds and 7.03 per cent of the national production in the year 2003-04. Important oilseeds grown in the state are groundnut, sunflower, safflower, sesame, castor, linseed, soyabean, mustard and nigerseed. Total area under oilseeds in the state was 2606 thousand hectares during 2003-04. This accounts for 21 per cent of the total cropped area in the state during the same period. It was observed that 73 per cent of the total irrigated area was under food crops and only 15.6 per cent was under oilseeds. From this 18.7 per cent and 20.7 per cent of the total area respectively for groundnut and sunflower was irrigated. But in the case of soybean 50 per cent of the area was under irrigation in the year mentioned above. For rapeseed-mustard the level of irrigation was only 10 per cent and in all other oilseed crops it was less than 2 per cent. This shows that oilseed crops in the state are mainly grown under rainfed conditions.

Against this background, the present study is an attempt to analyze the competitiveness of Karnataka's oilseed economy in the wake of globalization.

The specific objectives of the present study are;

1. To study the changes in the economy of groundnut and sunflower production during pre and post WTO period.
2. To analyze the supply response of groundnut and sunflower production in Karnataka.
3. To analyze the trends in direction of trade of groundnut and sunflower.

4. To study the relationship between international prices and domestic prices of groundnut and sunflower.

Data for the study were collected from various published sources. Time series secondary data on the area, yield and production of selected crops (groundnut and sunflower) were obtained from the publications of Center for Monitoring Indian Economy (CMIE), Pvt. Ltd. Mumbai. The data covered for a period of 20 years from 1985-86 to 2004-05. The Data for cost of cultivation of groundnut and sunflower were collected from 'Farm Management cell', Department of Agriculture, Government of Karnataka. Data on destination wise exports were obtained from "Monthly Statistics of Foreign Trade of India", published by Directorate General of Commercial Intelligence and Statistics, Kolkata. International reference price of the crops under study were collected from the various issues of FAO production yearbook. The maritime freight rates for wheat were obtained from FAO Trade Year Book (2004). Information on domestic prices of the selected crops and other agricultural statistics were compiled from various issues of "Karnataka at a Glance", and "Karnataka's Economy in Brief" published by Directorate of Economics and Statistics, Bangalore.

The growth in area, production, productivity, quantity exported and export value were analyzed using the exponential growth function. To know the changes in economics of production simple tabular analysis was used. To analyze the supply response of selected crops, a simple area and yield adjustment models were used. The structural change in direction of exports was examined using Markov chain model. To examine spatial integration between domestic and international markets for selected crops, the co-integration test was employed. In order to assess the competitiveness of the selected crops, Policy analysis matrix approach was used.

The results of the study are summarized and presented below.

Growth in area, production and yield of selected crops

The performance of groundnut with respect to area, production and yield in Karnataka was impressive as compare to overall Indian performance for the reference period. The performance of the crop in the post WTO period was dismal with negative trends. However, during pre WTO period, even though the growth was less, a positive growth was observed. Overall performance of groundnut crop in India was debilitating.

The growth performance with respect to area, production and yield of sunflower in Karnataka was less impressive as compared to the overall growth performance of sunflower in India. Even though Karnataka is the largest producer of sunflower. The yield levels of sunflower in Karnataka are very less as compared to the other states.

Growth in exports

The quantity and value wise growth of groundnut export from India was impressive in pre WTO period. During post WTO period, less growth was observed. However, overall export growth performance of groundnut was quite encouraging. Indonesia, Malaysia, Srilanka and Philippines were the major destination for Indian groundnut.

The quantity and value wise growth of sunflower export from India was impressive in post WTO period as compare to pre WTO period, since India has become the regular exporter of sunflower only after 1990's. U.K., German Republic and Poland were the major destination for Indian sunflower.

Changes in economics of production

Structural changes in costs are due to changes in quantity and quality of inputs associated with the technological process and also due to their prices. The changes in relative shares of operational costs and also fixed costs, which are generally imputed value of

farmer's own resources and will have important implications for capital formation and income distribution in the agriculture sector.

The total cost of cultivation of groundnut has gone up from Rs. 3689.8 per ha in pre WTO period to Rs. 10329.9 per hectare in post WTO period. This shows an increase of 1.8 times. The increase has occurred in all major items of cost like human labour, bullock labour, seed, fertilizers and manures. The cost of human labour as a whole has increased at a faster rate. The increase in gross return from groundnut is attributable to the increase in the main and by-product of groundnut as well as increase in their prices over the years.

The total cost of cultivation per hectare of sunflower went from Rs. 2267.5 in pre WTO period to Rs. 6581.2 in post WTO period, showing an increase by 1.9 times during the last twenty years. The increase in cost of cultivation has occurred in all major items of cost such as human labour, bullock labour, manures, seeds and fertilizers. The cost of bullock labour as a whole has increased at a faster rate. The increase in the gross return from the sunflower is attributable to increase in the main product as well as increase in the prices of main product over the years.

Supply response analysis

The area allocation decision of groundnut and sunflower crops in Karnataka state were determined by the lagged area, lagged yield, lagged price and rainfall. The Dummy variable that is WTO factor was negative and non-significant to the area allocation for the selected crops. The coefficients of area adjustment were little high for the both crops indicating less time required for area adjustment. This has been supported by coefficient of rigidity that is found to be 4 and 2.7 respectively for groundnut and sunflower crops, indicating area adjustment will take place in fairly short period. The area model used was found to be significant as the variables used in the model explained around 80 per cent of the variation in the area.

The productivity of selected crops was influenced by lagged yield, lagged price and rainfall. The Dummy variable that is WTO factor was negative and non-significant to the yield levels for the selected crops. The coefficients of yield adjustment were little high for the both crops indicating less time required for yield adjustment. This has been supported by coefficient of rigidity that is 3 each for groundnut and sunflower crops, indicating yield adjustment will take place in fairly short period. The yield adjustment model used found to be significant as the variables used in the model explained around 80 per cent of the variation in the area.

Direction of trade

In pre WTO period, Indonesia and U.K. were found to be major importer of Indian groundnuts. Indonesia had a very high retention as found in the transitional probability matrix that is 0.852. U.K. had low probability of retention that is 0.014. Other importers also had a fairly high retention that is 0.727. Malaysia, Philippines and Srilanka were not stable markets for Indian groundnut export.

In post WTO period, Indonesia, Malaysia and U.K. were found to be the major importer of Indian groundnuts. Indonesia has indeed been a rapidly growing market for Indian groundnut (0.867). Malaysia had a fairly high retention of 0.711. U.K. had moderate probability of retention of 0.356. Other importers also had reasonable probability of retention of 0.653. Philippines and Srilanka were not a stable markets for Indian groundnut exports.

In post WTO period, Netherland, U.K. and German republic were found to be the major importer of Indian sunflower. Netherland has indeed been a rapidly growing market for Indian sunflower (0.679). U.K. had a fairly high retention of 0.635. German Republic also had reasonable probability of retention of 0.207. Other countries had low probability of retention of 0.052. Poland and U.S.A. were not stable markets for Indian sunflower export.

Trade competitiveness

Selected crops (groundnut and sunflower) showed a clear-cut competitive disadvantage in the pre WTO period because NPC, and DRC were more than one. But in the post WTO period, the competitiveness had increased which is evident from less than unity values of NPC and DRC. Under the importable hypothesis also similar results were found.

Integration of domestic market price and world

Market prices of crops

In the case of selected crops (groundnut and sunflower) the co integration tests showed that there is integration between domestic and world prices. That means there exists the long run equilibrium relationship between domestic and international markets.

POLICY IMPLICATIONS

1. It was observed that the yield levels of groundnut in the state as a whole were declining over time and that of sunflower too was not encouraging. Hence, there is an immediate need to take appropriate yield raising measures for sustained production of oilseeds in the state.
2. The study has provided enough evidence that the area allocation decisions in respect of oilseed crops have been governed by their relative profitability, indicating that price factors are more important than non-price factors. Hence, the ongoing price policy should be directed towards assuring appropriate remunerative prices to oilseed producers in the state.
3. The results of Markov Chain analysis have indicated that our exports of groundnut were mainly concentrated in Indonesia and Malaysia. A high dependence on one or two export markets would increase the trade risk in long-run specially if these countries also set high standards for maximum permissible level of aflatoxin. Hence, appropriate export promotion strategies are to be evolved to diversify the geographical concentration.
4. Karnataka enjoys export competitiveness in both groundnut and sunflower, hence all efforts should be made to increase the production and productivity of these oilseed crops. State should encourage enhancing the export of groundnut and sunflower.
5. It was revealed that groundnut and sunflower prices in the domestic and international market are integrated. This implies that domestic market is responsive to changes in the international market prices and producers would benefit from the increases in the international market prices. However, this benefit has not been fully exploited by the farmers because we are not self sufficient in edible oils. Self sufficiency can be achieved by evolving high yielding varieties and providing improved technologies to the producers. So, government should come out with appropriate policy to overcome this problem.

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APPENDIX

Appendix I: Area, production and productivity of groundnut crop in Karnataka from 1985-2004

Year	Area ha) (000	Production (000 tones)	Yield (kg/ha)
1985-86	834.8	575.3	688
1986-87	871.0	488.0	660
1987-88	863.5	470.5	545
1988-89	862.4	603.3	708
1989-90	1045.7	654.3	626
1990-91	1001.0	671.1	670
1991-92	1015.3	578.9	570
1992-93	1091.4	761.2	688
1993-94	1045.2	826.7	791
1994-95	986.4	809.6	822
1995-96	960.5	661.6	688
1996-97	1191.9	1138.7	966
1997-98	1100.3	916.6	833
1998-99	1040.4	706.6	679
1999-00	1230.0	1182.1	968
2000-01	1120.4	788.6	686
2001-02	1063.4	1081.1	1017
2002-03	864.7	586.7	686
2003-04	843.9	539.0	639
2004-05	822.0	479.0	683

Appendix II: Area, production and productivity of groundnut crop in India from 1985-2004

Year	Area (000 ha)	Production (000 tones)	Yield (kg/ha)
1985-86	7168.0	6436.9	898
1986-87	7124.8	5121.3	719
1987-88	6982.1	6876.4	842
1988-89	6844.0	5853.6	855
1989-90	8629.0	9668.0	1132
1990-91	8710.0	8100.0	930
1991-92	8309.0	7610.0	904
1992-93	8667.9	7080.0	818
1993-94	8166.4	8660.0	1048
1994-95	8321.7	7830.0	841
1995-96	7848.6	8061.6	1027
1996-97	7524.0	7578.4	1007
1997-98	7596.4	8642.9	1138
1998-99	7088.2	7370.0	1040
1999-00	7396.0	8981.6	1214
2000-01	6867.3	5258.1	766
2001-02	6733.4	6410.0	962
2002-03	6240.0	7027.0	1126
2003-04	6936.6	4121.1	694
2004-05	5998.0	8182.0	1364

Appendix III: Area, production and productivity of sunflower crop in Karnataka from 1985 2004

Year	Area ha) (000	Production tones) (000	Yield (kg/ha)
1985-86	445.0	246.5	554
1986-87	376.0	155.1	412
1987-88	597.8	285.6	478
1988-89	1056.6	320.5	303
1989-90	490.5	158.4	323
1990-91	580.6	235.1	405
1991-92	895.9	382.2	427
1992-93	1191.2	508.4	427
1993-94	1068.5	424.6	397
1994-95	1469.3	554.3	377
1995-96	907.3	372.6	411
1996-97	954.8	346.9	363
1997-98	881.1	361.5	410
1998-99	928.5	258.1	278
1999-00	833.4	264.0	317
2000-01	494.1	200.7	406
2001-02	477.8	231.0	484
2002-03	584.3	262.4	449
2003-04	876.6	374.0	427
2004-05	1125.0	422.0	375

Appendix IV: Area, production and productivity of sunflower crop in India from 1985-2004

Year	Area ha) (000	Production (000 tones)	Yield (kg/ha)
1985-86	834.6	439.8	527
1986-87	751.6	280.9	374
1987-88	1022.5	419.9	411
1988-89	1651.3	635.3	385
1989-90	1104.0	370.0	335
1990-91	1192.0	631.0	529
1991-92	1632.8	873.0	535
1992-93	2113.8	1194.0	565
1993-94	2085.3	1181.7	570
1994-95	2667.8	1348.2	505
1995-96	1997.3	1217.8	610
1996-97	2121.1	1258.0	593
1997-98	1995.1	1250.0	626
1998-99	1743.4	885.0	508
1999-00	1824.7	950.0	520
2000-01	1288.1	693.6	538
2001-02	1334.6	650.0	487
2002-03	1196.5	679.0	570
2003-04	1638.4	873.0	533
2004-05	2000.0	992.0	496

CHANGES IN OILSEED ECONOMY OF KARNATAKA : PRE AND POST-WTO ANALYSIS

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ABSTRACT

The present study intends to analyze the global competitiveness of oilseeds (groundnut and sunflower) and their economics of production over the period of time in Karnataka. In this study, an attempt has been made to estimate NPC, DRC, direction of trade, integration between domestic and international prices and supply response of groundnut and sunflower. The findings of the study will help the planners and the policy makers to formulate appropriate agricultural development, export and stabilization policies for the state as a whole.

Data for the study were collected from various published sources. Techniques used for the analysis were, Growth functions, Supply response model, Markov chain analysis, Policy analysis matrix and Co-integration analysis.

The performance of groundnut with respect to area, production and yield in Karnataka was impressive as compare to overall Indian performance for the reference period. It is reverse in case of sunflower. Structural changes in costs are due to changes in quantity and quality of inputs associated with the technological process and also due to their prices. The area allocation decision of groundnut and sunflower crops in the Karnataka state were determined by the lagged area, lagged yield, lagged price and rainfall. The productivity of selected crops was influenced by lagged yield, lagged price and rainfall. The Dummy variable that is WTO factor was negative and non-significant to the both area and yield levels for the selected crops. Indonesia and U.K. and Malaysia were found to be major importer of Indian groundnuts where as Netherland, U.K. and German republics were found to be the major importer of Indian sunflower. Selected crops showed a clear-cut competitive disadvantage in the pre WTO period. But in the post WTO period, the competitiveness had increased. The co-integration tests showed that there is integration between domestic and world prices of selected crops.