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Oilseeds and Pulses in Indian Agriculture: A Review of Development Policy and Production Performance

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Abstract

Oilseeds and pulses play an important role in Indian agriculture because both are rich sources of energy and protein, essential for human diet. However, differential production performances of these crops in different phases of Indian agricultural development has been a cause of concern for planners and policy makers. The production of oilseeds exhibited a spectacular growth during the Post-Technology Mission period, while the growth scenario has been completely dissatisfactory for pulses. This study, therefore critically reviews the development policy and various measures adopted for increasing production of oilseeds, and pulses in the country. The most important issue addressed in this paper is how to sustain growth in oilseeds production and raise productivity of pulses in the changing policy regime.

The study finds that a high order of technology and yield gap exists and indicates that there is enormous scope to accelerate the pace of growth in the production of both oilseeds as well as pulses. The important factors responsible for low technology for adoption are lack of know-how, water scarcity, unremunerative prices and shortage of quality seeds. Besides, these various bio-physical and socio-economic constraints are also responsible for wide yield gaps. The study suggests for the adoption of crop and region specific strategies.

JEL Classification: ***Q13, Q16 and Q18***

Keywords : ***Oilseeds and Pulses, Production Performance; Technology Mission; Policy Imperatives for Sustainable Growth***

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1. INTRODUCTION

The vital role that the oilseeds and pulses play in the human diet need no emphasis. Oilseeds are the rich source of energy, containing twice as much energy (9 KCL/g) as carbohydrate or protein (4 KCL/g), (FAO, 1980). Pulses meet most of the protein needs of the Indian population and are also important for agriculture and livestock farming. The hay and straws of the pulses are rich in amino acids and makes a valuable cattle feed. Moreover, almost all pulses and groundnut and soyabean, among oilseeds, being leguminous plants, their cultivation improves soil fertility by fixing nitrogen into the soil. Thus, the nitrogen depleted from the soil by cereal cultivation can be replenished by proper crop rotations with pulse cultivation. That is why, oilseeds and pulses occupy an important place in the farming system of the country. They together account for about 26 per cent of the gross cropped area and contribute 20 per cent to the value of output from agriculture.

Though India is a major oilseeds and pulses growing country in the world, it has faced the problem of supply-demand gap in respect of both edible oils and pulses since the mid-seventies. The country has been importing considerable quantities of edible oils and pulses to meet the domestic demand.

Under the protectionist regime of import substitution strategy adopted since mid-eighties and followed by the constitution of the Technology Mission on Oilseeds (TMO) in May 1986, spectacular results in the production of oilseeds have been achieved. The total oilseeds production of India in 1996-97 was 24.1 million tonnes, more than double the production level of 10.8 million tonnes recorded in 1985-86. With the increase in the indigenous production of oilseeds, per capita availability of edible oils also increased from around 3.5 kg. per year to around 8 kg. per year during the corresponding period. Thus, the country achieved near self-sufficiency in the production of edible oils and its dependence on imports significantly reduced from one-third of the total demand in early eighties to less than 5 per cent since 1994-95. It was argued that, this favourable trend in oilseeds output growth deserved to be sustained in view of the relatively more income elastic demand for edible oils in India (Jhala, 1997). Unfortunately, with the opening up of the imports of edible oils under the partial trade liberalisation policy adopted in 1994, imports of edible oils increased again. There were record imports of 17 lakh tonnes in 1996-97 and between November 1998 to October 1999, imports reached 30 lakh tonnes, nearly 50 per cent more compared with 20 lakh tonnes of previous year. In value terms, it was expected to result in massive foreign exchange drain of over Rs. 7,000 crores, surpassing the record forex spending of around Rs. 6,000 crores for the earlier year (Shah, 1999). Surprisingly, the country was flooded with such massive imports when domestic supply had improved. This was a dangerous trend and it was feared that the efforts towards self-sufficiency in oilseeds production would receive a set back (Gulati, *et al*, 1996). The growth scenario was completely different for pulses. The annual production of pulses ranged between 12-14 million tonnes and virtually remained stagnant the last four decades, as there was hardly any technological breakthrough, in improving productivity of major pulse crops namely gram and tur. Consequently, per capita pulse consumption had fallen from 69 grams in 1961 to 33 grams in 1998. The quantity of pulse intake recommended by the Indian Council of Medical Research is about 70 grams per day.

Objectives of the Study

Viewed against this perspective, the present paper tries to explore the following specific objectives:

1. To review the existing studies and present the current picture of the growth performance of oilseeds and pulses;

2. To examine the regional pattern of production growth, the sources of growth and the reasons behind slow growth of these crops;

3. To assess the impact of Technology Mission on Oilseeds and Pulses (TMOP) on oilseeds growth performance and its replicability for increasing production of pulses;

4. To examine the future prospects and policy issues for these crops.

Methodology

Available data on area, production and yield of oilseeds and pulses have been examined to understand the trends in the production performance and the relative contribution of area and yield to the growth of production. The analysis covers a period beginning from the onset of the green revolution i.e. 1964-65 to 1997-98 for which final crop estimates were available. The period of study has been sub-divided into pre-and post-TMO (Technology Mission on Oilseeds and Pulses) periods i.e. 1964-65 to 1985-86 and 1986-87 to 1997-98. The analysis was also done separately for the reform period, since 1991. Regional level analysis of production trends has been included so that the concerned policy makers can use their judgement about the future trend of growth in these two important commodity groups.

Since oilseeds and pulses occupy an important position in the Indian economy, development policy and various measures adopted for these crops during different plan periods especially since the initiation of TMO were critically reviewed. Self sufficiency and allocative efficiency in the case of oilseeds economy has been a much talked about subject since the introduction of the TMO, hence, a thorough review of the available evidence was attempted.

The paper is divided into six sections. The next section discusses evolution of oilseeds development policy and its impact, especially of Technology Mission on Oilseeds. It also includes review of self-sufficiency and allocative efficiency debate on oilseeds production and more recent performance since 1994. Section 3 examines pulses development policy and growth performance of pulses before and after 1991 when pulses were included in the Technology Mission. Price support, processing and marketing aspects of oilseeds and pulses are discussed in Section 4. It is followed by a discussion on production constraints and future growth potential in Section 5. The final section summarises the major findings and policy measures.

2. EVOLUTION AND IMPACT OF OILSEEDS DEVELOPMENT POLICY

Evolution of Oilseeds Development Policy: Considering the production performance since 1951, three major phases can be identified in the output growth of the Indian oilseeds sector. The first phase from 1950-51 to 1964-65 was marked by a high growth rate of 3.55 per cent per annum. In contrast, there was a substantial decline in the growth rate (1.66 per cent) during the second phase, 1967-68 to 1980-81. This phase is called green revolution period in Indian agriculture and has been marked by considerable advances in the agricultural production due to the spread of high yielding variety technology and the range of incentive schemes and institutional supports. Agricultural production, in this period, grew at the rate of 2.38 per cent per annum, however, the production of both oilseeds and pulses was quite slow. These crops in fact (along with coarse cereals), were labeled as `slow growth crops' and their supply lagged behind demand considerably. The gap was attempted to be bridged by imports. The imports of edible oils in the early 1980s came to take almost one-third (32 per cent) of the supply and substantial amount of scarce foreign currency. The third phase began with the constitution of the Technology Mission on Oilseeds (TMO) in May 1986. Oilseeds production more than doubled since the inception of the TMO.

Policies during Sixties and Seventies: Oilseeds was considered as an important crop and increase in its production had been a critical target in each five years plan. In the Fourth Plan a target was fixed to increase oilseeds production to 10.5 million tonnes, and was proposed to intensify research in the areas of,

1. Evolution of drought resistant varieties of groundnut and mustard to be grown under rainfed condition;

2. Breeding of short duration varieties of groundnut to fit in an intensive cropping pattern and resistant to pest and tikka disease;

3. Breeding of early maturity variety of toria (mustard).

A breakthrough was achieved in castor during the Fourth Plan by the development of short duration high yielding varieties namely NPH-1 (Aruna) and GHC-3. Even then the achievement fell short of about 1 million tonne of the target and the reason for shortfall in production was the inadequate arrangements of supplying pure seeds of improved varieties. However, encouraged with a little success in the case of castor, self-sufficiency in the production of oilseeds was contemplated in the Fifth Plan. It was proposed to produce 55 million tonnes. of oilseeds over the five years period of Fifth Plan. In order to achieve this target a growth rate of 5.8 per cent per annum was envisaged with a growth of 2.4 per cent for area and 3.4 per cent for productivity. For attaining this, attention was proposed to be paid on various policies relating to pricing, localization of irrigation and other aspects of crop planning. Despite all these, oilseeds economy was characterized by sharp fluctuations in production and prices during the Fourth and the Fifth Plan. Oilseeds production fluctuated due to seasonal conditions as only 8 per cent of the total area under oilseeds could be brought under irrigation.

After Third Five Year Plan, several agricultural development programmes were started. The Council of Agricultural Research was reorganized in 1965 so as to facilitate setting up of agricultural universities. During the same period, the National Seeds Corporation of India was also set up to look into the research in the multiplication of new varieties of seeds. The high yielding varieties (HYVs) programme was taken up in late sixties with the introduction of HYV seeds of wheat. The HYV seed of rice was introduced in the early seventies. The importance of guaranteed minimum prices as an incentive to agricultural production was also recognized. A policy of support price came to be adopted with the set up of the Agricultural Prices Commission in 1965 later called Commission for Agricultural Costs and Prices (CACP). In the same year the Food Corporation of India was also established to provide all India machinery to procure, store and supply of foodgrains during shortage and price support in times of plenty.

So far as oilseeds production was concerned, till the end of Fifth Plan, it continued to present a problem of some magnitude. The oilseeds production remained low and stagnant. Most of the benefits of Intensive Agricultural Area Programme were limited to cereal crops. Among cereals, the most striking success was wheat. Very little success could be achieved in evolving HYVs of oilseeds suited to different agro-climatic conditions. This was reflected in the deceleration in the growth rates of both area as well as productivity of oilseeds between 1967-68 to 1980-81 (Acharya, 1993).

The oilseeds development policy has been critically reviewed and it was observed that shortage of certified quality seeds was due to constraints in large-scale multiplication of quality seeds (Ninan, 1989, 1995). The high overhead costs and the low priority given to oilseeds research and development in the country until the advent of TMO in 1986 were some of the reasons for the low adoption rates of improved technology. It was also noted that though irrigation was known for its yield enhancing effect, however, growth of irrigation for oilseeds had been slow. Though there were substantial yield differences between irrigated and that secured under rainfed conditions, coverage of irrigation for oilseeds in general and kharif oilseeds in particular was very low. Ninan (1993,1995) further added that risk in production and marketing of oilseeds was found to be relatively high as compared to other crops like wheat, rice and sugarcane. This was because cultivation of oilseeds in India had been largely concentrated in high-risk regions where returns on investment were low and uncertain.

Similarly, analyzing the production performance of oilseeds between 1967-68 and 1980-81, Acharya (1993, 1997) also noted that achieving food security was the top agenda of the agricultural development programme during the seventies. Hence a policy of propagating HYV seeds of cereals and use of yield raising inputs and remunerative prices for these cereals was pursued which enhanced the pay-off from these cereals relative to technologically legging oilseeds and pulses. This resulted in the diversion of the irrigated and fertile lands to wheat and paddy, and oilseeds and pulses were pushed to marginal lands. He further noted that "during the seventies, the relative price structure moved in favour of oilseeds but it could not prevent the net profitability tilting in favour of wheat and rice on account of technology induced growth of yield accompanied by supportive price policies for these cereals. Apart from the improvement in productivity and the effective price support provided to rice and wheat, it was the policy of imports of edible oils which tilted the income parity in favour of cereals" (Acharya, 1993). The imports of edible oils gradually increased from 0.86 lakh tonnes in 1971-72 to 10.74 lakh tonnes in 1980-81. The increase in imports continued till 1987-88. Augmenting domestic availability of edible oils through imports did not allow the prices of oilseeds to be competitive to cereals where both technology-based growth in productivity and increase in prices made these crops more profitable.

Besides imports, certain other measures were also adopted during the seventies to manage available supplies and to increase the production of both edible and non-edible oils. For example, a ban was put on the forward trading in oilseeds and enforced measures such as selective credit control, imposition of ceiling limit on stock holding and regulation of oil mix for manufacturing of vanaspati etc. Efforts were also directed at increasing oil supplies, through solvent extraction process and exploitation of the potential of oil from cotton seeds, rice bran and oil bearing trees of forest origin like sal, mahuva, neem, karanji etc. Discouraging the use of edible oils for non-edible purposes and expanding the cultivation of non-traditional oils such as palm oil were the other measures. Though these measures were capable of augmenting the supplies, the real solution to the mounting deficit of domestic oilseeds production lay in stepping up the output growth rates.

Oilseeds Production Programme since the Eighties

The Import Substitution Strategy: The World Bank (1999) report presents a comprehensive review of the policies governing the Indian oilseeds complex with particular focus on policies related to the external trade, government programmes to support technological change in oilseeds production and processing. It also includes discussion on domestic price and trade policies including price support and stabilization, food distribution, credit and taxation policies and the legal and regulatory environment governing movement, storage, forward and futures trading practices and the processing of oilseeds.

According to the World Bank report, India was facing a major problem of stagnant growth in oilseeds production against an ever increasing demand for edible oils since the mid-seventies. The increasing gap between demand and supply was bridged by imports with huge foreign exchange cost. According to World Bank estimates, by 1979-80, edible oil import accounted for 32 per cent of the total domestic supply. The Bank further observed that if not checked, "by 1990, filling the gap through imports would mean spending between US $ 3-4 billion (6-8 per cent of total exports) and absorbing between 8-10 per cent of total projected world exports of vegetable oils" (World Bank, 1981 cited in World Bank, 1999 p. 49). Thus, the widening gap between demand and supply became a major policy concern in the early 1980s. Inspired by the spectacular success of green revolution in the case of important cereals such as wheat and rice, the Government of India set out to attain self-sufficiency in edible oils by replacing imports with domestic production. A special thrust was given to boosting oilseeds production by providing suitable incentives and institutional supports and the rate of technology and the minimum support price programme were accorded explicit recognition as major inputs in oilseeds production. A development project for groundnut was launched in 1980-81 and for soyabean in 1981-82. Efforts were made to perfect new technologies for oilseeds and transfer these to the farmers' fields. A programme of distribution of minikits of improved seeds and fertilizers for oilseeds was taken up in the Sixth Plan period. As a result, some encouraging achievements in the production of sunflower and soyabean were recorded. The area under sunflower increased by fivefold during the Sixth Plan period. Sunflower started spreading rapidly in Karnataka and Maharashtra and to a lesser extent in Madhya Pradesh and Gujarat. The area under soyabean also increased fast in Madhya Pradesh and some bordering districts of Maharashtra. Another important development noted during the Sixth Plan was increasing popularity of summer groundnut. All these developments indicate that given a low risk environment dictated by the crop variety and agronomic factors, farmers do take up oilseeds cultivation and apply cash inputs.

Central Government Technology Support Programme: The research and development efforts were enlarged in Seventh Plan and the National Oilseeds Development Project (NODP) was launched in 1985-86 with a view to accelerating the production of four major oilseeds namely groundnut, rapeseed/mustard, soyabean and sunflower. Under this programme, seeds of HYVs, plant protection chemicals, fertilizers and rhizobium culture were made available to the growers at the subsidized rates. Along with the research and technological developments, the efforts of State Department of Agriculture, the Indian Council of Agricultural Research and State Agricultural Universities were dovetailed to demonstrate the potential of new varieties and improved techniques on farmers' fields. Initially, the efforts were concentrated in potential areas of 12 states but later, the project was extended to 180 districts of 17 states. In 1987-88, the Oilseeds Production Thrust Project (OPTP) was initiated covering 246 districts of 17 states. It was later extended to more areas.

Technology Mission on Oilseeds (TMO), 1986: As mentioned earlier the Technology Mission on Oilseeds (TMO) was constituted in May 1986. Its objective has been of attaining self-sufficiency in edible oils. Apart from generation of appropriate technology for maximizing oilseeds production and expanding it to farmers, domestic policy focus shifted towards managing price incentives. The

National Agricultural Cooperative Marketing Federation (NAFED) was made responsible for price support operations. Since market prices were always higher than the announced support prices, NAFED's intervention had no direct impact. However, the announcement of minimum support prices before sowing of crops provides guaranteed market clearance necessary for cash crops. The Mission focussed on ensuring reasonable prices to the producers through improved marketing and processing technologies. The National Dairy Development Board (NDDB) was designated as the marketing agency for procurement, buffer stock operation and distribution of edible oils. Thus, an integrated approach was adopted in 1989 to support farmers with technology inputs and remunerative price for their produce. In 1990-91, the NODP and OPTP were merged under one programme namely, Oilseeds Production Programme (OPP). Since 1992-93, the OPP has been implemented in 234 districts of 21 states. The integrated approach aimed to harness the best of production, processing, marketing and management technologies through the following four Mini Missions.

(i) **Crop Production Technology Development:** To develop improved varieties with higher yields, higher oil content, shorter growing duration, improved resistant to pest, disease and moisture stress;

(ii) **Post Harvest Technology Development:** To improve efficiency of processing through the use of modern integrated technologies and improving efficiency of ghanis and oil expeller units in private and cooperative sector. To also develop technology for minor and unconventional oil-bearing materials;

(iii) **Improved Input and Support Service Delivery:** To strengthen extension system, streamline production and distribution of seeds and supply and distribution of inputs, improve credit delivery etc.,

(iv) **Price Support and Market Development:** To create and expand integrated marketing and processing facilities in the cooperative sector, increase efficiency of procurement operations, improve price dissemination and ensure fair prices to consumers and modernize marketing facilities (storage, packaging) etc. More about the price support, marketing and processing aspects of oilseeds will be said later.

Market Intervention Operation (MIO): The integrated policy on oilseeds and edible oils of 1989 introduced additional GOI measures to restrain price instability.

These included introduction of MIO and reduction in the differentials between the open market price and the public distribution system (PDS) price. It came into force with sharp cut in the volume of edible oil imports. The MIO, implemented by NDDB from April 1989 to April 1994, was the first major attempt of the GOI to directly stabilize oilseeds and edible oil prices within a pre-determined price band. The price band policy sought to fix the procurement prices of groundnut and rapeseed-mustard at 40 per cent above the present level recommended by the Commission of Agricultural Costs and Prices. The NDDB was to achieve this by means of buffer stocking operations of seeds and edible oils from both domestic and import sources when the prices of groundnut and rapeseed-mustard went outside their prescribed price bands (Ninan, 1989).

The NDDB was allocated an initial market intervention fund of Rs. 3 million to operate the MIO. A special line of credit at concessonal rate from the Reserve Bank of India (RBI) and National bank for Agriculture and Rural Development (NABARD) was provided to finance the MIO. The NDDB also relied on canalized imports at pre-determined prices to maintain the ceiling price during the lean months and to off set possible losses on account of the MIO.

The NDDB also created the National Oil Grid and its own edible oil brand `Dhara' to assist in achieving the MIO objectives. The NDDB has, however, met with only limited success in its MIO. It had been able to contain seasonal variations of groundnut and mustard oils within prescribed price band in the initial two to three years but during 1992-93 edible oil prices soared to dizzy height. Finally, MIO ended in 1994 with considerable operating losses and controversy.

Notwithstanding the above, the study in Men (1993 cited by Ninan, 1995) indicated that because of the NDDB's market intervention operation, groundnut and mustard growers could realise an additional income of Rs. 2,300 crores in 1990-91. Within a short span of four years, the NDDB could also influence the consumer market by blending most preferred oils with refined oils, under the brand name `Dhara'. Sales of Dhara oil rose from a modest of 1,187 tonnes during 1988-89 to over 1.13 lakh tonnes during 1991-92. Dhara became popular and most sought after oil for its consistent quality, attractive prices, innovative packaging and good distribution network. Ninan (1995) mentioned that while assessing the impact of the NDDB on the oilseeds and vegetable oils market in India, one should not loose sight of the fact that the NDDB was operating in a hostile environment with the trade, industry and import lobbies, who were used to making huge profits in the past.

Partial Trade Liberalization Introduced in 1994: Until 1994, Indian oilseeds complex was operating under a virtually closed foreign trade regime. However, starting in 1994 some reforms were introduced in the import substitution strategy. It freed imports of major edible oils by putting them under OGL and reducing tariff rates. The tariff rates were further cut from 65 per cent to 20 per cent in 1996, thus for the first time, Indian oilseeds sector has been exposed to foreign competition and international price volatility. It was feared that this would slow down and even reverse the development process in oilseeds output. The cropping pattern may change again in favour of cereals (Gulati, *et al*, 1996). Whether such changes have occurred is examined while analyzing recent trends in the production of oilseeds.

The Impact of Technology Mission on Oilseeds Production: The impact of TMO on the promotion of oilseeds production has been discussed by several scholars (Shenoy, 1993; Acharya 1993, 1997; Ninan 1995). However, all these studies have analyzed data either till late eighties or early nineties. The analysis is updated in this paper that includes the recent reform period also. There are other studies also which argue that the increase in the production of oilseeds is indicative of a high degree of allocative inefficiency (Pursell and Gulati, 1993; Gulati, *et al*, 1996). The main argument against the protectionist policy is that the increase in the production has come about at the cost of cereals, pulses and cotton, where India has a comparative advantage and that the production is taking place at double the world price. For policy purposes, however, it would be useful to analyze changes in the area under different oilseed crops since the introduction of TMO and in more recent post-reform period. Such an analysis would help us to know the impact of TMO on oilseeds and pulses production in greater detail. The analysis of sources of growth and its regional pattern also forms part of this exercise. Such an analysis is supposed to help us better to understand the post-TMO growth trend and comment on the allocative efficiency debate too.

Compound Annual Growth Rates (CAGRs) of important crops and crop groups have been computed separately for pre and post TMO periods. Instead of using the original series of area, production and yield per hectare, the data have been detrended by working out three-year moving averages. Growth rates are estimated by fitting a simple trend function to the time series and the same exercise has been repeated for the state level. The statistical significance of growth rates is also indicated. The period I, from 1964-65 to 1985-86 is called as pre-TMO or green revolution period, and period II from 1986-87 to 1997-98 is known as post-TMO period.

Production in Pre-TMO Period: The pre-TMO period extending from 1964-65 to 1986-87 also represents the green revolution period. During this period, the production of oilseeds increased from an average of 7.20 million tonnes using the triennium ending 1966-67 to 11.69 million tonnes, during TE 1986-87. Similarly, the production of pulses increased from 10.24 million tonnes to 12.34 million tonnes during the same period. Against this the production of cereals almost doubled during this period from 68.39 million tonnes to 134.12 million tonnes and the production of wheat increased by four times (Table 1). Thus, both oilseeds as well as pulses grew very slowly compared to cereals. Growth in the crop production can be better explained by working out the compound annual growth rates. Therefore, the growth rates of area, production and productivity of oilseeds, pulses and other important crops are presented separately for pre-TMO period (I) and post-TMO period (II).

Between TE 1966-67 and TE 1986-87 (pre-TMO period), the production of oilseeds increased at the rate of 2.44 per cent per annum and the rate of increase in the production of pulses was only 0.63 per cent. During this period, the production of wheat and rice increased at the rate of 6.46 and 2.77 per cent per annum respectively. The increase in the annual growth rates of area and productivity of oilseeds as well as pulses was considerably low compared to the annual growth in the area and productivity of cereal crops especially wheat and rice. Here it is significant to note that whatever little increase in the production of oilseeds and pulses occurred during this period came mainly through the area expansion. However, the productivity of both oilseeds and pulses registered marginal improvement since 1980s onwards, but lagged far behind the productivity growth of wheat and rice.

Production Performance since the Inception of Technology Mission: Contrary to the pre-TMO period, the production of oilseeds recorded a spectacular growth since the inception of the Technology Mission on Oilseeds. The production of oilseeds nearly doubled from 11.70 million tonnes to 22.84 million tonnes between TE 1986-87 to TE 1997-98. However, the production of pulses also increased during this period but only marginally (Table 1). The impact of Technology Mission on the Oilseed sector can also be seen from Tables 2 and 3. Between TE 1986-87 and TE 1997-98, the share of oilseeds in the gross cropped area increased from 10.6 per cent to 14.0 per cent. This indicates a major shift in cropping pattern in favour of oilseeds. In terms of annual growth rates shown in Table 3 oilseed crops registered the fastest annual growth rate (7.48 per cent) during the post-TMO period compared to all other major crops in India. The average annual rate of growth in oilseed production was more than double the annual rate of growth of cereals (3.22 per cent) and far exceeded the annual rate of growth of wheat, rice and other crops. This recent production performance contrasts sharply with the virtual stagnation (2.44 per cent per annum) in the production growth recorded during the pre-TMO or green revolution period. It is important to note that the growth in the production of oilseeds during the post-TMO period has been contributed, almost equally, by the area expansion as well as by increase in the productivity.

Unlike oilseeds, the production scene of pulses presents a none-too-happy picture, as it has remained stagnant for the last three decades or more. The sources of spectacular increase in production of oilseeds and a near stagnancy in the production of pulses (despite inclusion of pulses in the Technology Mission in 1991) are examined below. But before that a brief discussion on the changes in the production performance of individual oilseeds and regional distribution of oilseed growth would be relevant.

Changes in the Production of Individual Oilseeds: The data related to area, production and productivity per hectare are available of nine oilseeds namely, groundnut, rapeseed-mustard, soyabean, sunflower, castorseed, sesamum, linseed, nigerseed and safflower. Production of individual oilseeds and their relative share in the total oilseeds production is presented in Table 4. Among the nine oilseeds grown in the country, the share of groundnut and rapeseed-mustard together accounted for 73.5 per cent in the total oilseeds produced during TE 1986-87. However, their share declined to 60.5 per cent during TE 1997-98. The major decline registered was in the share of groundnut. There was a marginal improvement in the share of rapeseed-mustard. Soyabean and sunflower have of late emerged as the oilseed crops having major growth potential. The castorseed also exhibited significant growth in its production. But the production of sesamum and other oilseed crops either declined or remained stagnant. Although the share of groundnut showed a decline during the post-TMO period but still it occupied the dominant position accounting for 35.1 per cent of total oilseeds production. Rapeseed-mustard still holds second rank with 25.4 per cent share but rapidly increasing share of soyabean from 8.5 to 25.0 per cent during post-TMO period brought it near to rapeseed-mustard. If this trend continues, it is likely that groundnut may soon be overtaken by either rapeseed or soyabean. Sunflower is another fast growing crop. It could also be seen from the Table 4 that 48.6 per cent of incremental oilseeds production growth has been contributed by the soyabean (42.3 per cent and sunflower (6.3 per cent). Rapeseed-mustard (27.0 per cent) and groundnut (19.8%) are other important oilseeds contributing about 95 per cent growth in the total oilseeds production. Thus, the introduction of new crops, soyabean and sunflower as well as the improvement of the production of traditional oilseeds such as groundnut and rapeseed-mustard have equally contributed to the growth in the total oilseeds production.

Regional Distribution of Oilseeds Growth: Tables 5 and 5a show statewise changes in the production of oilseeds and share of each state in the incremental product from 1986-87 to 1997-98. It can be seen that Madhya Pradesh has recorded sharpest increase in the production of oilseeds, followed by Rajasthan, Haryana and Gujarat. As a result, their share in the total oilseeds production has increased significantly. The states like Tamil Nadu, West Bengal and Andhra Pradesh have also recorded modest increase in the oilseeds production. More than fifty per cent increase in the production of oilseeds has been from two states, Madhya Pradesh and Rajasthan. Although production in other states except Orissa and Kerala has increased during the post-TMO period, the share of most of the southern and eastern states has declined. The sharpest decline has been recorded by Orissa both in its absolute production and relative share. Maharashtra, Uttar Pradesh and Punjab are other states, which show a decline in their share in the total oilseeds production despite some increase in the production in absolute terms.

The scrutiny of growth rates of area, production and yield of oilseeds for major states show that Madhya Pradesh, Rajasthan, Haryana and Andhra Pradesh have recorded higher and significant growth rates (Table 6). It can also be seen that the growth in the production of oilseeds in these states has been accounted largely for the growth of area. While growth in the oilseeds production in the states like Tamil Nadu, Gujarat and Punjab was largely accounted for improvement in the productivity. Orissa recorded higher negative growth both in area as well as productivity during the post-TMO period.

The scrutiny of details of growth rates of important oilseeds by major oilseed producing states show much larger fall in the production of groundnut (Table 7). Orissa recorded much sharper negative growth in the area of groundnut. Similarly, Maharashtra is another state recording negative growth in area under groundnut cultivation. Gujarat and Tamil Nadu recorded higher growth rates in the productivity, whereas Andhra Pradesh and Karnataka recorded growth of area under groundnut. Growth in the production of soyabean has been concentrated mainly in the states of Madhya Pradesh, Rajasthan and Gujarat and increase in the productivity has been responsible largely for higher growth in these states. Uttar Pradesh exhibits negative growth in area under soyabean.

Sunflower is another fast growing oilseed and it recorded higher growth in its production in Andhra Pradesh, Tamil Nadu, Maharashtra and Karnataka, which is largely attributed to the expansion in the area. However, the productivity growth of sunflower and soyabean was also high and significant, in these states.

Growth in the production of rapeseed-mustard provides a different pattern for pre and post-TMO periods. High production growth rates have been recorded in the states like Rajasthan, Haryana, Madhya Pradesh and Gujarat in both the pre-and post-TMO periods but productivity contributed more in the pre-TMO period whereas area expansion was largely accounted for the production growth in the post-TMO period. Thus, the spread of technological growth realised in early eighties to increasing number of growers is the characteristic feature of the rapeseed/mustard growth. High growth rates realised during the pre-TMO period in the castorseed production also continued and further consolidated during the post-TMO period. Gujarat, Rajasthan, Tamil Nadu and Andhra Pradesh recorded high and significant growth during both pre-and post-TMO periods. However, the impact of Technology Mission on the production of castor production can be seen from significantly large increase in the productivity growth in almost all major castor producing states.

The small or negative growth in the production of other minor oilseeds like sesamum, nigerseed, linseed and safflower was caused by negative growth in either area or productivity. However, inter-state difference in the productivity growth in major oilseeds is a pointer to realize further improvements, if attempts are made to tap the exploitable yield gaps. This may help to boost oilseeds production to which we would talk later in the analysis of production potential.

Decline in the Instability of Oilseed Growth: Despite differential growth across states and individual oilseeds as discussed earlier, the larger increase in the productivity per hectare and rapid diffusion of technological change to larger number of growers indicate a decline in the instability in the growth process. Oilseed production has become remarkably more stable with its rapid expansion to new areas and larger growers. It has been demonstrated by the analysis of decline in the coefficient of variation (CV) for production of important oilseeds and in their regional and seasonal production. The relevant values of CVs are presented in Table 8. The Table shows that CV of total oilseed production has steadily declined from a high of 20 per cent in 1970-77 to 18 per cent in 1981-87 and further to 5 per cent in 1989-95, (World Bank, 1999).

Increased Regional Diversification of the Production Base: Besides increasing diversification in the types of oilseeds produced in the country, the base of the output growth in the oilseeds production has also been diversified. For example, oilseeds production has shifted to the more stable producing regions such as central and western regions where CVs have been low or declining (Table 8). The relative shares of central and, to some extent western region have either increased or remained stable in the national total production of oilseeds. The increased stability in the production of individual oilseed was also indicated by the significant decline in the values of their CVs. Moreover, diversification across oilseeds and regions contributed to increased stability in the domestic supply of edible oils. The share of groundnut in total production declined from 50 per cent to 35 per cent while the shares of soyabean, sunflower increased rapidly. Rapid diffusion of rapeseeds production to larger areas and increasing number of farmers could help in retaining its larger share in the total oilseed production. The analysis further showed increased seasonal balance in the production of oilseeds. The production of rabi oilseeds increased dramatically from a third in the early seventies to 40-45 per cent in the early nineties. The increase has been reported mainly in the rabi oilseeds like sunflower, rapeseed-mustard and rabi groundnut. The increased production of oilseeds during the rabi season also contributed to greater stability in domestic output leading to stability in the domestic supply. This can contribute in two ways. First, production in each season becomes more stable as indicated by reduction in the CVs from 22 per cent to 10 per cent for rabi output. Second, kharif and rabi production increasingly compensated for each other's instability in production. The shortfall in the production of one oilseed is compensated by increase in the production of the other oilseed. This process of crop planning provides for increased overall supply stability.

Increased Irrigated Production of Oilseeds: The increase in the oilseeds production has also been accompanied by expansion in the area under irrigated oilseeds (Table 9). The area under irrigated oilseeds increased from 2.5 million hectares in 1981-82 to 6.6 million hectares in 1991-92 and further to 7.3 million hectare in 1995-96. Correspondingly, in the percentage terms irrigated area planted under oilseeds increased from 14.5 per cent to 26.1 per cent between 1981-82 to 1995-96. The increase in the irrigated cultivation of oilseeds generally would have favourable effect on production stability. Large increase in the irrigated oilseeds area in the central region (Madhya Pradesh and Rajasthan) and part of western and eastern regions (Gujarat, Haryana, Uttar Pradesh, West Bengal and Maharashtra) was accompanied by a drastic reductions in production instability (Table 8). Thus, increased irrigated production of oilseeds in major oilseeds producing states and for two important oilseeds namely groundnut and rapeseed-mustard has contributed greatly in bringing stability in the production of oilseeds. However, the tempo of bringing more area under irrigated cultivation of oilseeds seemed to have been slowed down after 1991-92 with very little growth in the area under irrigated oilseeds. Consequently, the share of oilseeds production during rabi season has marginally declined in the total oilseeds production from 40.5 per cent in 1991-92 to 39.6 per cent in 1995-96.

Sources of Growth in Oilseeds Output: We have seen earlier that oilseed crops registered the fastest growth of all major crops during the post-TMO period, and by more than doubling of oilseeds production in a short period of 10 years, India has achieved a near self-sufficiency. Improvement in regional balance and drastic drop in production instability accompanied the higher growth in the oilseed output. It was also noted that increased production of irrigated oilseeds has helped stabilize production. The sources of such a spectacular growth in the oilseeds output is discussed below.

The growth in the agricultural production is possible either through increase in the area under the crop or acceleration of crop productivity or by both. Where the scope for expansion of area is limited, acceleration in the output growth would depend on increase in the intensity of cropping as well. Between TE 1986-87 and 1997-98, the production of oilseeds in absolute terms increased by 11.15 million tonnes, and interestingly, area expansion and improvement in yield both have almost equally contributed to this spectacular growth. New crops like soyabean and sunflower contributed to about half of the incremental production of oilseeds (Table 12). Although area expansion accounted for the bulk of their output growth, productivity growth in these crops was also noteworthy. The rapeseed-mustard and groundnut, both traditional oilseeds, added 47 per cent to total oilseeds production. Even during the rapid area expansion phase rapeseed-mustard grew faster than even some of the cereal crops like wheat and rice. The increased yields of groundnut also contributed largely to its production performance. In the case of sesamum, castor and nigerseed, increase in productivity per hectare has contributed largely to their output growth. Thus, technological change, either in the form of new crops or through improved productivity of both new and traditional oilseed crops have accounted for most of the dramatic growth in oilseeds output, during the post- TMO period.

Self-Sufficiency in Oilseed Production and Allocative Efficiency: There has been considerable debate on the self-sufficiency and allocative efficiency aspects of the Indian oilseed sector. The controversy is centred on the following two aspects: (i) sources of growth of oilseed production; and (ii) whether the "Yellow Revolution" is sustainable. Acharya (1997) has summarized the debate in his recent paper, while discussing oilseeds policy. Pursell and Gulati (1993); and Gulati *et al*, (1996) in their studies argued that the increase in the production of oilseeds is indicative of a high degree of allocative inefficiency. Gulati *et al* (1996) presented percentage change between TE 1986-87 and 1993-94 for area, production and yield per hectare of oilseeds and other crop groups. It is seen that production and area under oilseeds have increased significantly during this period, while, coarse cereals have experienced a negative growth in both area and production during the same period. Thus, their main argument against the policy of encouraging the production of oilseeds is that the increase in the oilseeds production has come about at the cost of coarse cereals, pulses and cotton in which India has a comparative advantage. They also argue that the production is taking place at double the world price. Under the protectionist strategy, shielding Indian oilseed sector have shifted the allocation of resources in agriculture towards oilseed crops. Thus, achieving high price induced self-sufficiency in oilseeds production is economically costly and unlikely to be sustainable under the trade liberalization regime.

They have also estimated Nominal Protection Co-efficients (NPCs) of various commodities under importable hypotheses and NPCs above unity for important oilseeds found for soyabean, rapeseed-mustard and groundnut (see Table 6, Gulati, *et al* (1996)). According to them it has helped in bringing cropping pattern changes in favour of oilseeds which had a high degree of protection compared to cereals and pulses. In other words, these cropping patterns were not allocatively efficient from the point of view of saving or earning of foreign exchange.

On the other hand, several scholars justified the import substitution strategy on the food security ground and pointed out that there is a need to develop a comparative advantage in oilseed production through technological change (Shenoy, 1993; Acharya, 1993, 1997; Ninan; 1995; Dantwala, 1996).

Analyzing changes in area under different crops between 1984-85 and 1994-95, Acharya (1997) found that technological change in oilseed production, such as the rapid growth in the rabi oilseeds crops and non-traditional oilseeds such as soyabean and sunflower played a major role in achieving self-sufficiency. At the aggregate level, the expansion in the area under oilseeds was accompanied by an increase in the area under rice, wheat, maize and many horticultural crops. Though, there has been a considerable decline in the area under coarse cereals and a marginal decrease in the area under pulses and cotton during this period. However, the gross cropped area has also gone up during this period. An increase in the cropping intensities in most oilseed producing states also suggests that the increase in the area under oilseeds occurred mainly through the expansion of cropped area and marginal shift from low yielding coarse cereals and pulses. Acharya (1997) and Dantwala (1996) suggest that with area under low yielding coarse cereals declining and that under rice, wheat and maize increasing, fluctuations in the production of cereals has remained at a considerable level. Thus, the promotion of oilseeds production strategy has helped in promoting sustained and balanced growth of agricultural sector of the country.

Further, such shifts have taken place in those regions where irrigation facilities are inadequate and which do not have a comparative advantage in growing cereals. This argument is substantiated from the observation cited by Dantwala (1996) from the Report of the Commission for Agricultural Costs and Prices (CACP) on Price Policy for crops sown in 1994-95 season. It says: "A noteworthy feature of the oilseeds economy is that the incremental production has been contributed mostly by the states with relatively low irrigation facilities - Madhya Pradesh, Rajasthan and Karnataka. The additional area under oilseeds came mainly through the extension of cultivation to fallow lands, substitution of some low-yielding coarse cereals by oilseeds and their cultivation as a cash crop in some areas" (Government of India, 1995: p.53).

Commenting on India's lack or presence of comparative advantage in oilseed production, the World Bank report states that there were no strong evidences for or against it. While NPCs are a good measure of international price competitiveness but they are not right indicators of comparative advantage because world prices are not relevant reference point for judging the appropriateness of domestic prices or for their determination. Instead, Domestic Resource Cost (DRC) measured in the different oilseeds growing regions would be a more appropriate indicator of comparative advantage. Unfortunately, no such estimates are available for India. However, a relatively considerable growth in rabi and summer oilseeds have the advantage over other more water intensive crops because oilseeds are less water intensive crops. Thus, their growth represented an efficient use of water - a scarce resource relative to alternative crops, in which case a comparative advantage would prevail.

Similarly, a substantial growth of soyabean and sunflower and to a limited extent rapeseed-mustard caused by improvement in cropping intensity also represents an efficient use of land - a more scarce resource in agricultural production. Moreover, the increasing role of technological change in causing cropping pattern changes in favour of oilseed production by growing number of farmers, even in the absence of higher prices, again suggests the presence of a comparative advantage. Examining the above evidence, the World Bank report maintains that technological change in the growth of oilseed production and improvements in cropping intensity suggest that India's comparative advantage in oilseed production may be quite strong (World Bank, 1997).

Oilseeds Production Since 1994: Before 1994, India's oilseed sector was virtually operating under a closed trade regime. However, in March 1994, the Government of India reduced most import restrictions on vegetable oils. Imports of palmolein oils were permitted under the Open General License (OGL) with a duty rate of 65 per cent. In 1996, the new budget announced a further cut in import tariff to 20 per cent and preferential treatment of concessional tariff rates to STC and NDDB were also lifted. Commenting on the change in the oilseed trade policy Gulati *et al* (1996) pointed out that cropping pattern changes which had been moving so far in favour of oilseeds since mid-1980s, might slow down and even reverse in favour of cereals in the coming years. They argued that with the opening up of Indian economy, there was greater likelihood of increasing imports of edible oils. Under such circumstances, it would be difficult for the Indian oilseed sector to compete under open and less protected foreign trade regime. We have seen earlier that the imports of edible oils have increased during the last three years, but interestingly, it has happened along with the increase in domestic production of oilseeds. Cropping patterns demonstrated a distinct shift in favour of oilseeds throughout the post-TMO period. Between 1994-95 to 1997-98, the production of oilseeds has shown an absolute increase of 0.7 million tonne from 21.3 million tonne in 1994-95 to 22.0 million tonne in 1997-98. In 1996-97, however, the production crossed the mark of 24.0 million tonne (Table 11).

The analysis of cropping pattern changes between 1994-95 and 1997-98 also revealed a consistent improvement in the share of oilseeds in the gross cropped area. It increased from 13.4 per cent in 1994-95 to 14.0 per cent in 1997-98.

During this period, the expansion in area under oilseeds was also accompanied by absolute increase in the area under wheat and rice. However, there was a marginal decline in the area under coarse cereals and pulses. A marginal absolute decline in the area under coarse cereals and pulses, with almost stagnant share of these crops in gross cropped area, further substantiates the fact that the growth in oilseeds production might have occurred mainly through increase in the gross cropped area. Thus, the recent cropping pattern changes also indicate sustainability of "yellow revolution" even under the partial trade liberalization regime.

3. PULSES DEVELOPMENT POLICY

Recognizing the importance of pulses in Indian diet, special thrust was given on raising the production of pulses in the Fourth Plan. In 1965, an all-India coordinated pulse project was initiated to undertake a nationwide research effort. The emphasis was put on the following programmes of extension and research; (1) breeding of suitable varieties of different kinds of pulses fitting into multiple cropping or relay cropping system; (2) breeding of varieties with synchronous fruiting (especially moong and tur/arhar where picking were required; (3) breeding of disease resistant varieties, and (4) developing pesticides to prevent damage to pulses at the pod forming stage and also during the storage which was reported to be very high.

In the Fifth Plan a significant increase in the production of pulses was proposed with a target of 65 million tonnes production for the five years. These targets implied an annual growth rate of 4.0 per cent composed of area growth of the order of 1.3 per cent and productivity growth of 2.7 per cent. Although the peak production level of 14 million tonnes was reached during the plan period but it was short of the demand of pulses, which was estimated at 16 million tonnes by the end of the Fifth Plan. Finally an achievement of 11.8 million tonnes was realized against the target of 13.0 million tonnes. It was found difficult to achieve the target looking to the past performance and the limited research work done till the end of the Plan. By the end of the Fourth Plan, hardly any pulse variety could be developed, which by virtue of its maturity or non-photo sensitivity, was able to be grown in non-conventional seasons or inserted in the prevailing cropping pattern to compete with high yielding cereals or other economically dominant components of the crop rotation.

During the Fifth and the Sixth Plan periods, research on pulses continued with extension of the all-India coordinated research project. More efforts were aimed at developing varieties suitable for conditions under which cereals or millet crops give low yield and breeding of varieties suitable as catch crops to replace monsoon fallows. Identification of short duration varieties of arhar made it possible to take a crop of arhar before the rabi crop of wheat. Similarly non-photo sensitive varieties of moong, urad and Lobia could be identified which could be grown in summer in the areas left fallow. Use of fertilizers and pesticides as well as development of more effective agronomic practices were also enlarged. In addition, pulses were also included under the price support programme along with oilseeds and their prices have ruled at higher levels. But in the absence of technological breakthrough competitive to cereal crops, pulses did not experience any meaningful improvement in the production. The achievement always fell short of the targets set in plans. The review of the agricultural production situation in the Sixth Plan shows that the growth rates of area, production and yield of pulses during the period 1949-50 to 1979-80 was less than one per cent per annum. The achievements (13.0 million tonnes) also fell short of targets of 15.0 million tonnes set for Sixth Plan.

Bhalla and Tyagi (1989) attempted to analyse, for the country, the growth performance of agricultural output of important crops and crop groups for the period 1962-65, 1970-73 and 1980-83. According to them the foodgrain output as a whole registered an increase from 76.2 million tonnes during 1962-65 to 94.6 million tonnes during 1970-73 and further to 221.1 million tonnes during 1980-83. They further found that within foodgrain category crops, maximum increase took place in wheat and increase in other cereal crops was rather small. As against cereals, production of pulses registered a decline from 6.81 million tonnes during 1962-65 to 6.66 million tonnes during 1980-83 with a negative growth rate of -0.12 per cent per annum during the period.

In the case of pulse crops they found that the output of gram declined from 5.2 million tonnes in 1962-65 to 4.6 million tonnes during 1980-83. The output of tur, however, increased from 1.61 million tonnes during 1962-65 to 2.0 million tonnes during 1980-83. Nevertheless the area allocated to pulses in general and gram in particular, reported a steady decline throughout. They also found that with the spread of irrigation, cultivation of gram has given way to wheat because there has been no breakthrough in technology in the case of gram. At the all-India level, the proportion of area allocated to gram to total cropped area has declined from 6.1 to 4.5 per cent between 1962-65 to 1980-83. During this period, a large decline in the area under gram has been reported in states where irrigation increased. For example, in Haryana the proportion of area under gram declined from 33.5 to 15.1 per cent; in Punjab from 18.3 to 3.4 per cent and in Uttar Pradesh from 10.9 to 5.9 per cent. Kumar (1978) noted the elbow effect of wheat in falling production of pulses in successful green revolution states. He observed that the breakthrough via HYVs in cereals has been accompanied by a loss of acreage under pulses to cereals leading to a sharp decline in the total production of pulses.

Chopra (1982) observed a decline in the production of pulses largely affected by decrease in the area under pulse crops. This phenomenon was particularly observed after 1960-61. Chopra's study also brought out sharp contrasts in growth in the area and production of pulses grown in Rabi and kharif seasons and also among states. She found that wherever, kharif pulses were important there had been an upward trend in area and production during the period 1950-51 to 1976-77, while the opposite was the case where rabi pulses were important. She also observed a decline in the share of pulses in total cropping pattern in states where irrigation has increased.

Growth with stability and regional balance in agricultural development have been the broad objectives in the Seventh Plan and onwards. Therefore, removing imbalances in the relative growth rates of different crops especially acceleration of the growth rate in the production of pulses was recognized the most urgent requirement. The lack of technological breakthrough, inadequate plant protection measures, cultivation in marginal and non-irrigated areas under conditions of energy deprivation and lack of production oriented marketing were found to be some of the factors for slow growth in the production of pulses. In the Seventh Plan, it was proposed to introduce corrective measures and to popularize cultivation of pulses in irrigated farming system. Emphasis was also put on production of quality seeds and use of plant protection measures on area basis. A target of 16 million tonnes annual production of pulses was fixed for the Seventh Plan and the following strategy was envisaged for achieving the above target:

a. Introduction of pulses in irrigated farming system;

b. Bringing additional area under short duration varieties of moong and urad in rice fallows in rabi season and as a summer crop where irrigation facility was available;

c. Inter-cropping of arhar, moong and urad with other crops;

d. Multiplication and use of improved seeds;

e. Adoption of plant protection measures;

f. Use of fertilizers and rhizobium culture;

g. Improved post-harvest technology;

h. Remunerative prices relative to competing crops; and

i. Marketing support.

Inclusion of Pulses in the Technology Mission: Recognizing the positive role of the price policy and the yield raising technology, efforts were taken to boost the production of pulses through the interaction of both these policies, during late eighties. Keeping this in view pulses were included in the Technology Mission on Oilseeds in 1991. Since then it was known as Technology Mission on Oilseeds and Pulses. Whether the replication of mission approach for pulses could raise the rate of production of pulses is discussed.

Production of Pulses since 1990: Table 12 shows both the long-term and the short-term trends in the production of pulses. It appears that the production of pulses had marginally improved during the last three decades. Though the rate of growth of pulses production was positive and significant between 1966-67 to 1986-87, the production increased at a very slow rate (less than one per cent) during the entire green revolution period. Contrary to the oilseeds growth, the situation of growth in the production of pulses appears to have worsened after 1990-91, since the pulses were included in TMO. The production of total pulses declined marginally from 13.6 million tonnes to 13.2 million tonnes between 1990-91 and 1997-98. Almost a zero rate of growth was observed in the production of total pulses because of negative and significant growth both in area as well as yield rate (Table 12).

During the post 1990 period, some improvement was seen in the production of gram with positive significant growth caused by increase in area under the crop and its productivity. However, this positive turn around in the gram could hardly compensate the losses in the production of tur and other pulses. During this period, tur and other pulses exhibited a negative significant growth in the production. Regression in both productivity and area contributed to decline in the production of tur and other pulses.

The share of pulses in the total cropped area has also shown a steady decline since the beginning of the green revolution (Table 2). Moreover, with almost stagnant production growth, the share of pulses in the total foodgrain production also declined considerably from 13.2 per cent in 1966-67 to 6.9 per cent in 1997-98. As a result, there was a consistent decline in the per capita per day net availability of pulses, from 69 g in 1961 to 41.1 g in 1991 and further to 33.2 g in 1998. This is against a minimum daily requirement of 70 g.

The state level analysis of growth rates of area, production and yield of pulse crops, presented in Table 13, showed a significant and positive growth in the production of total pulses between 1990-91 and 1997-98 in states like Rajasthan, Madhya Pradesh, Maharashtra, Assam and Karnataka. Except in Assam and Karnataka where area growth was negative, all other states mentioned above exhibited positive and significant growth in both area as well as productivity. Positive growth in the productivity was also observed in many other states such as Punjab, Haryana, West Bengal etc. but there was a sharp decline in the production because of larger decline in the area. However, much higher rate of negative growth in the pulses production was observed in most of the traditionally pulse growing states like Uttar Pradesh, Bihar, Punjab, Haryana etc. It could also be seen from the table that these states have experienced a sharp decline in the area and production of gram (an important pulse crop grown earlier mostly in northern region).

As mentioned earlier, the expansion in the area under wheat and rice due to increased irrigation facilities caused a fall in the area under rabi pulses, especially gram. This trend seems to have continued with further negative growth in the area under gram in most northern and eastern states. However, a high order of positive and significant growth in the area in southern and central states indicates that gram is gaining ground in these states. More area allocated to gram in these states is coincided with the increase in the yield and the price of gram in these states. This resulted in change in the cropping pattern, in favour of gram. As in the case of oilseeds, the open market prices of pulses continued to remain above the minimum support price level. Thus, an improvement in the productivity might have increased competitiveness of gram with other crops.

Tur and other pulses put together accounted for about 70 per cent of area and 60 per cent of production of total pulses in India. These crops have, however, shown a negative growth in both area and productivity in most states during the post-TMO period. Increase in their production needs serious concern.

4. PRICE SUPPORT, PROCESSING AND MARKETING ASPECTS OF OILSEEDS AND PULSES

Price Support Programme: We have seen earlier that India experienced a "Yellow Revolution" between mid 1980s and early 1990s. During this period, India achieved near self-sufficiency in the production of edible oils, as the dependence on imports reduced significantly from one-third of the total demand in the past to less than five per cent in 1994-95. This happened, due to successful adoption of import substitution strategy in the oilseeds sector and adoption of new technology propagated under the Technology Mission on Oilseeds. While the new technology for oilseeds consisting of quality seeds of improved varieties, fertilizer, plants protection measures and improved agronomic practices was popularized, it was simultaneously ensured that effective price and marketing support was available to the oilseed growers. For example, between 1980-81 and 1993-94, increases in the support prices of oilseeds were more than that of other crops. The data presented in Table 14 showed that between 1980-81 and 1993-94, while the support price for paddy (common) increased by 195 percent, that for groundnut increased by 288 percent. Similarly, during this period, the support price for wheat was raised by nearly 200 percent, the increase in the support price of mustard was 230 percent. However, since 1994-95 the increase in the support prices of most of the oilseeds was lower than that of wheat, paddy, pulses and coarse cereals. Overall, oilseeds and pulses growers faced favourable price incentives throughout 1980s and in most part of 1990s.

The declaration of minimum support price well in advance of crop sowing season gives right signals to the farmers in decision making of area allocation to different crops. However, it is unlikely that prices alone i.e. without the benefit of new technology would have triggered the oilseed supply response of the order witnessed during the eighties and early nineties. Lack of any breakthrough in pulses is the case in point. Despite, a much higher increase in the support prices of pulses compared to cereals and oilseeds, the production of pulses remained almost stagnant during this period. Many scholars have been arguing that besides prices, other factors such as yield, cost of inputs, risk etc. also play an important role in cropping pattern changes. With the help of cost and return data of wheat and mustard, Acharya (1993) has shown how the price and technology together tilted the profitability in favour of oilseeds in the state like Rajasthan. His findings were that though the gross income-cost ratio for mustard was higher than that for wheat in all the years, the net return per hectare from wheat was higher than that for mustard till the mid eighties. But the ratio of net return per hectare from mustard to that for wheat increased during late eighties. This happened because of improvement in yield as well as increase in prices realized by the farmers growing mustard. This has not only compensated them for the increase in the cost of cultivation but also turned the ratio of average net return in favour of mustard.

The above example shows that the decision of the farmers to plan an area under a crop is based not only on price factor alone but the relative profitability. Since price is considered as one of the important economic forces, which determines crop pattern changes, the official approach has been a change in relative prices of different crops as the most relevant and effective remedy. However, on this issue, Dantwala (1995) has rightly contended that it is not the price but the net revenue (Income) earned from a crop that determines farmers' cropping decisions. This he calls it income terms of trade that farmers take into account while making their area allocation decisions.

The important role played by the price support incentives and the Technology Mission on Oilseeds in increasing area and production of oilseeds has also been analysed (Kelley and Rao, 1994). These researchers have examined the impact of yield and relative prices on area changes for wheat, rapeseed-mustard and gram. The results show that in the case of wheat a high growth rate in yield (3.1 per cent/year) more than offset a declining trend in real prices (-2.6 per cent), resulting a 0.4 percent growth rate in area planted to wheat. Despite a positive trend in real prices, gram experienced a drop in area (-0.9 per cent). This has happened largely because growth in yield lagged significantly behind that of other crops. Whereas, the fastest growth was registered in the area under mustard (1.8 per cent/year) due to high growth rate in yield, though there was a modest decline in real prices. This showed that lower per unit production cost and ensuring better prices can help in potential realization, though significant gains in productivity are essential.

Gulati and Kelley (1999) in their research on semi-arid tropics suggested that among oilseeds, groundnut responded to its own prices. Positive elasticity was observed in large part of the groundnut growing areas but in case of gram, positive response was found only in three crop zones and tur was non-responsive or perversely responsive in most cases. They found that evidence on own price responsiveness in case of majority of oilseeds and pulses was highly crop and region specific. They however, observed that in case of groundnut, price and non-price factors were almost equally influencive in crop zones representing about 75 per cent of groundnut growing areas, whereas, price related factors as a group dominate the effect on rapeseed-mustard, in all but one zone. On the whole, price factors such as fertilizer price, wage rate and yield are found the most consistently important price variables for these crops. While irrigation – the most important non-price factor was found consistently important in determining area changes.

It is clear from some of these studies that favourable price support environment and the technological breakthrough with higher yield and profitability under the import substitution strategy have played an important role in the doubling of oilseeds production in the country in a very short span of time. Whereas, large increase in prices, an absence of yield raising technological breakthrough for pulses failed to trigger a sustained supply response. This is one of the reasons why policy regime has succeeded in oilseeds and not in pulses. Acharya (1993) has rightly observed that increase in the production of oilseeds is the result of the dovetailing of trade policy with domestic price policy and interaction of those with technology could help in achieving the objective of evolving a production pattern consistent with the overall needs of the country.

Marketing Structure in Oilseeds: According to Gulati and Phansalkar (1994), three types of marketing channels exist in India for selling market surplus of oilseeds. They are: (1) private traders who purchase for eventual sale to private mills; (2) private traders who buy in Mandis regulated by Agricultural Produce Market Committees, for supplying to private millers; and (3) oilseeds are sold to cooperative societies for eventual processing by cooperative oil mills. Although the percentage of oilseeds flowing into each marketing channel varies from state to state, the regulated markets (mandis) serve as a major market outlet for most of the oilseeds output. There is a vast network of such mandis in India. In 1993, there were about 6792 mandis all over the country. In these mandis, agricultural produce was generally sold through auction sale and both traders and commission agents participated in trading.

Several studies are available on the effectiveness of such mandis benefiting farmers. However, the general impression is that most of these mandis have limited facilities and infrastructure to handle bulk trading in oilseeds. There is no standardized grading of products in these markets. Visual grading is generally in practice. In most cases farmers are losers. However, better access to regulated market outlets has played a critical role in the adoption of the new processing technology. It is evident from the recent expansion of large-scale modern processing facilities for soyabean and sunflower in areas where these crops are grown in large quantities. Unlike groundnut and rapeseed-mustard, soyabean and sunflower are exempt from the Small-Scale Industry (SSI) reservation policy. This policy encouraged the private sector and corporate enterprises such as ITC, Unilever etc. to offer new market outlets and services to growers. It has also helped in improving their competitiveness by raising their capacity utilization and lowering their processing costs. Although oilseed growers cooperatives have been registered in many parts of India and there were about 5513 villages growers cooperatives in 1993, associated with 8 cooperative unions in 8 states. Despite this cooperative procurement remains negligible in terms of total oilseeds production in India. Cooperative procurement is largely concentrated in two states, Gujarat and Madhya Pradesh (World Bank, 1997).

Besides, small private sector dominance and negligible cooperative purchase the other features of the oilseeds marketing structure are control on movement and storage of oilseeds and edible oils, selective credit control and ban on forward trading. In effect, such regulations increase marketing costs and adversely affect competitiveness.

Oilseed Processing Industry: World Bank (1997) report has thoroughly examined the technical and economic performance aspects of India's oilseed processing industry. According to them the industry is characterized as,

1. Fragmented and dominated by micro-scale private Ghanis.
2. The small-scale private expellers in the unorganized sector account for the bulk of India's oilseed processing.
3. There is an over capacity building causing under-utilization of processing capacities.
4. Increase in wastage due to erratic power supply is a cause for poor performance. Low agricultural yields and poor infrastructure reduces the optimal size of processing factory.
5. Crushing margins are highly volatile and exhibit negative values.
6. Government policies and regulations inhibit Indian processors coping with crushing and marketing instability.
7. Small scale industry reservations prevent factories from taking advantage of scale economies in oilseed expelling; and
8. High processing losses due to lack of vertical integration. It also contributes to significant losses in oil meal processing and quality of oil meal product.

The World Bank report showed that because of restrictions on stocking limits, on imports of oilseeds, ban on forward trading etc., the costs of processing and marketing in India turn out to be far higher than in other countries. The report finally argued for improving oilseeds marketing and processing industry for preserving gains and attaining comparative advantage in the world market.

We have seen earlier that until 1994, Indian oilseeds sector was virtually operating under closed foreign policy regime, and India's yellow revolution of mid-eighties have been largely policy induced. However, with India's signing of the Uruguay

Round of GATT in 1994, it would be difficult for Indian agriculture in future to operate in a closed economy framework.

Implementation of Uruguay Round basically means trade liberalization and lowering of protections to agricultural sector. The effect of this on the Indian agricultural economy in general and oilseeds and pulses sectors in particular are some of the important issues which have been examined by Gulati and Kelley (1999). Their analyses of the impact of policy reforms in agricultural trade and domestic marketing on cropping pattern changes and resource use efficiency, suggested that, on an average, the true economic cost of producing oilseeds at home was higher than the cost of imports with a notable exception of soyabean. They also observed that pulses also had lower economic costs than imports, indicating that pulses are also efficient import substitutes. Based on these findings, they suggested liberalization of external trade of agro-commodities and to make it more effective it must be accompanied by reforms in domestic marketing and processing sectors. According to them it is this combination which can minimize the pains of liberalization and maximize the gains. However, their policy suggestion is beset with several qualifying remarks. The policy implications discussed above are applicable only `at the margin'. A shift from one crop to another based on Resource Cost Ratios (RCRs) or protection coefficients is not the sufficient condition but there are several social, cultural, agro-climatic and infrastructural constraints under which the situation is not `either-or' but always `at the margin'. Similarly, the concept of `efficiency' measured in terms of RCR is a dynamic one, hence, it is likely that a full liberalization of agricultural trade might in the long run, adversely affect the interests of both the producers as well as the consumers. For instance, liberal imports of edible oils may leave large number of oilseed growers as losers and large quantity of export of wheat and rice may be resisted by consumers in the event of internal price rise.

It has been noted earlier that price alone does not determine the profitability of crop but factors like crop yield, cost of inputs, risk etc., also play important role in cropping pattern changes. Hence, for smooth switch from one crop to another, policy makers may have to make these crops more attractive in terms of private profit. Dantwala (1995) and Patel (1997) specified that it is not the change in barter terms of trade but the income terms of trade that farmers take into account while making their decisions in acreage allocation. Hence, a judicious measure of price and technology dovetailed to external trade policy may help in achieving the objective of evolving a production pattern consistent to the national policy of food security for the country.

Market Structure and Price Spread for Pulse: The dealers handling foodgrains also handle pulses, and the marketing arrangements for pulses are the same as for foodgrains in general. The broad marketing structure for foodgrains and pulses is as follows. The producer brings his product i.e. whole pulses to the primary wholesale markets - generally mandis regulated under the Agricultural Produce Market Committee Act. It is sold to private traders through auction sale, which goes to dal mills for processing. After processing, the product-dal (split pulse) comes to the terminal markets - mostly located in large urban centres. These are the focal points for distribution, exports and imports. The surplus areas export while deficit areas import pulses. In these markets the transactions take place between traders with or without intermediaries i.e. brokers and commission agents.

Since the market prices of pulses generally remained above the minimum support price level, not much support purchases were required, NAFED - the nodal agency for implementation of the support operations does make some commercial purchases of pulses every year but the total quantity purchased by NAFED remains always very limited. Its intervention is, therefore, inadequate to affect market behaviour. However, the declaration of minimum support price well in advance of crop sowing season gives right signals to the farmers in decision making for area allocation to different crops. The farmers look for and adopt the modern inputs and new technology for increasing the production. It also helps the farmers in minimizing price uncertainty and realizing a better price even in the years of bumper harvest.

Price Spread: The margins between the prices received by the producers and prices paid by the consumers for any agricultural commodity (the same is true for pulses) include costs of marketing and rendering marketing services such as assembling, grading, transporting, processing, wholesaling and retailing. The costs also include the market charges, sales taxes etc. These margins and costs are influenced by the performance efficiency of different marketing and processing functions, which ultimately influence the cost to the consumers. Such price differences also indicate the operational efficiency of the markets and agencies involved in the trade. Hence, in understanding the marketing margins, costs and price spread can help the policy makers to increase the operational efficiency and rationalize the margins and reduce the cost both in favour of producers as well as consumers.

For this purpose, price spreads are worked out at three stages of marketing for two important pulses namely tur and gram grown in Gujarat state. Although a number of agencies operate at different levels and in different capacities, here in this analysis prices at the following three stages, namely producer - wholesaler - retailer are marked out (Table 15).

The relationship between Farm Harvest Price (FHP) and Wholesale Price (WSP) provides an indication of the extent of the margin added in the form of sales costs and trade margins. In case of pulses, these also include processing costs, as pulses are not directly consumed but are processed before final consumption. As evident from Table 15 the ratio between FHP and WSP ranged between 55 and 64 for Tur and 70 to 76 for gram. The ratio between FHP and Retail Market Price (RMP) also ranged between 52 to 60 for tur and 65 to 72 for gram. The difference between the FHP/WSP and FHP/RMP ratios provides us with an indication of the extent of the margins of retail trader. The differences between these two ratios indicate that the retail market is more efficient compared to the wholesale market. The profit margin is higher at the wholesale level than at the retail level though it includes costs of processing.

It is also clear from the above table that difference in prices between whole (FHP) and split pulses (WSP, dal) is considerably higher for tur. It was as high as about 80 per cent in case of tur compared to about 40 per cent for gram. This indicated that the processing cost (or profit margin) was high for tur than for gram. This apart the price differentials between whole and split pulses for tur has shown an increasing trend, whereas in case of gram it has either declined or remained stable, over time.

To sum up, many scholars have been arguing that aggregate supply response to price is weak because profitability of a crop is not determined by price alone. It is the income terms of trade which include factors like productivity, cost of inputs, risk etc. in cropping pattern changes. Therefore, a proper price mechanism when backed by non-price factors such as improved marketing infrastructure and input delivery services, in a package, it works better than price incentive alone. This is being proved by the oilseeds sector growth in India with the integrated approach of TMO through four Mini Missions. Technological breakthrough has contributed equally to the output growth of oilseeds in India but still it needs significant time to happen for pulses.

5. PRODUCTION CONSTRAINTS AND DEVELOPMENT POTENTIAL

OILSEEDS

Level of Technology Adoption and Yield Gaps: Improvement in crop production technology and extension of it to the farmers' fields are the two important components of the integrated strategy of the Technology Mission on Oilseeds. The review of the past performance of the oilseed sector indicates that the contribution of improvement in yield per hectare to the growth of oilseeds production has been substantial during the post-TMO period. The rates of growth of yield of all oilseeds except safflower have been significantly higher during the post-TMO period compared to pre-TMO or green revolution years (Table 3). But, at the same time, one cannot ignore the fact that area has continued to be the major source of output growth of oilseeds in India.

It is true that because of sustained research in oilseeds, more than 240 improved cultivers of different oilseed crops of specific regional and multi-regional importance have been developed during the last two decades. These improved/hybrid varieties of seeds not only possess superior genetic yield potential but they are resistant/tolerant to one or more biotic and abiotic stresses (Singh and Dhaliwal, 1993). The International Crop Research Institute in Semi-Arid Tropics (ICRISAT) has developed groundnut variety, yielding three to five tonnes more production per hectare. This is six times the national or state average yield level (Shenoy, 1993 cited by Ninan, 1995). Moreover there are reports that the discovery of short duration, early maturing (90 days) high yielding varieties of soyabean has replaced kharif fallow in Madhya Pradesh and sunflower which has a duration of 90-100 days has replaced poor yielding sorghum and cotton areas in Maharashtra (Oblitas, 1990).

Pandey, *et al* (1993) and Acharya, (1997) reveal that returns from cultivation of oilseeds crops such as mustard, soyabean and sunflower are substantially higher than their competing crops like wheat and gram. Despite yield improvement and increase in profitability in oilseeds cultivation, still India's yield rates are lower compared to world average and much lower than yield rates reported by first three important oilseed producing countries (Tables 16 and 17). In 1996, although India had a share of 18.6 per cent in the total area under oilseeds at the world level, its share in world output was less than 10 per cent. The lower per hectare yield (almost half of the world average) was the main reason for such a paradoxical situation. India has a yield rate of 851 kg./ha. compared to 1787 kg./ha at the world level. Furthermore, in almost all major oilseeds except castor, India was lagging far behind the yield rates prevailing in first three important individual oilseed producing countries. For example, Israel and Saudi Arabia had more than four times higher yields of groundnut than India. Even much larger differences in yield rates were observed (almost 12 times) in rapeseed-mustard grown in Mexico and India. The Indian yield rates were also much lower in other oilseed crops, except castorseeds. As a result of lower growth in yields, India's position in the world area and production of most of the oilseed crops remained unchanged between 1986 and 1996.

Though some improvement in yields of castor, groundnut, safflower and sesamum could help in increasing their ranks, India still holds a very low position compared to many oilseeds producing countries. Moreover, further deterioration of India's position with respect to rapeseed-mustard and soyabean has mainly contributed to India's incremental oilseeds production during post-TMO period, which is a matter of serious concern. However, much larger yield gaps in most oilseeds prevailing in India compared to other countries indicate towards the vast yield potential existing ahead to be realized. The wide differences in oilseed yield rates across states in the country also indicates towards the vast scope existing for further improvement in yield levels of almost all oilseed crops, more specially of groundnut, rapeseed-mustard, sunflower and soyabean (Table 18).

It could be true that by adopting recommended technology, productivity per hectare and economic returns can be increased substantially in many oilseed crops grown both under irrigated and rainfed conditions. However, lower level of technology adoption and yield gaps continue to prevail (Rao, 1991; Prasad, *et al*, 1993; Chowdry, *et al* 1993; and Pandey, *et al*, 1993).

Analyzing the data pertaining to on-farm trends on groundnut, sesamum, sunflower and greengram for the period 1992-93 of Northern Telagana Zone of Andhra Pradesh, Prasad, *et al* (1993), found higher extension gap for all crops except sesamum. The study also found poor rate of technology adoption (60 to 90 per cent) for kharif groundnut. It was also low for sesamum and greengram. However, the level of technology adoption was medium to high for sunflower. Thus, there existed a lot of extension gap in the adoption of technology (Table 19). The study also reported existence of substantial attainable yield gaps in these crops. Non-availability of improved variety of seeds, inadequate technical know-how and shortage of water were reported as important reasons for non-adoption of technology. Strengthening of extension services and training of farmers were some of the measures suggested.

Rao's (1991) based on the valuable data for more than 2300 demonstrations covering diverse oilseed growing areas in the country, showed the existence of vast untapped yield potential in the oilseed crop varieties currently available (Table 20). The reported yield gaps ranged from 42 to 48 per cent for groundnut and around 90 per cent for rapeseed, safflower and irrigated castor. However, the realizable yield potential was found to be much higher for most of the crops sown in kharif such as castor, sesamum, linseed and sunflower. Interestingly, the highest yield gap was found in the cultivation of rabi/summer sunflower. Using the untapped potential yield gaps, Rao, Singh and Dhaliwal (1993), estimated yield gaps to the extent of 25, 50, 75 and 100 per cent under the currently available technologies which could augment production of oilseeds to the tune of 28.5, 57.0, 85.5 and 114.1 lakh tonnes respectively. Chowdry *et al* (1993) also reported existence of large yield gap in groundnut crop at different situations in Anantpur district of Andhra Pradesh. The magnitude of yield gap of groundnut pod between the average farmer and the research farm was 20.85 quintals/ha, between good farmer and research farm was 14.60 q/ha and between the average farmer and good farmer was 6.25 q/ha. The factor analyses contributing to yield gaps indicated that the optimum time of sowing alone could contribute to the extent of 64.3 per cent to total productivity. The authors considered poor management practices and input use responsible for wide yield gaps and non-adoption of improved technology. It was observed that 90 per cent of farmers used only local varieties, 94 per cent of them did not take any measure to control pests and diseases. Though moisture conservation is considered very important in dry farming, only 15 per cent of the farmers adopted the practice of deep tillage for moisture conservation. Shortage of capital was also reported one of the reasons for use of fertilizers by smaller proportion of farmers. Thus, most of the studies outlined existence of several productivity constraints such as unbalanced use of fertilizers, inadequate irrigation facilities, lack of capital, non-availability of improved varieties of seeds, etc.

Distribution of Quality Seeds: As stated earlier, shortage of certified/quality seeds has been reported by several studies as a major constraint in slow growth in productivity and low level of technology adoption both for oilseed as well as pulses crops. The programme of production and distribution of quality seeds has been going on since long. Between 1985-86 and 1994-95, number of improved varieties of oilseeds and pulses have been developed. The distribution of certified seeds almost doubled in case of oilseeds from 5.68 lakh quintals to 11.38 lakh quintals, and there was about 50 per cent increase in the supply of quality seeds of pulses during this period (Table 21). However, one does not know, the area to be covered by HYV seeds distributed. Ninan (1989) pointed out that the current distribution of certified/quality seeds of oilseeds was not able to meet even 10 per cent of our requirement. He also pointed out the existence of weaknesses between seed production chain as the availability of certified seeds was not commensurate with the breeder and foundation seeds produced in the country. Moreover, many of the varieties currently grown have become obsolete and are in need of being replaced.

PULSES

High Fluctuations in Production and Poor Growth in Productivity: The poor rate of growth in yield per hectare of total pulses (0.83 per cent) only and negative significant growth of yields of tur and other pulses, between 1991-98, as observed earlier indicates an absence of major breakthrough in the production of pulses.

Tuteja (1993) also revealed that no major breakthrough in the production of pulses has taken place despite the implementation of the Intensive Pulses Development Programme in the Haryana state. She also observed prevalence of low yield rates of pulses due to certain inherent problems.

The production of pulses has been fluctuating widely in the past. The role of risk in pulse production is not less and it has not been reduced even after two decades of sustained research. When weather conditions are not favourable, the coverage of area under both rabi as well as kharif pulses is affected adversely. For example, a record output of 14.3 million tonnes was achieved in 1990-91, but 1991-92 being a dry year, there was a drastic reduction in the coverage of area under pulses. As a result, production of pulses in 1991-92 came down to 12 million tonnes. Due to erratic fluctuation in rainfall there is a high variability in the production of pulses. The declining trend in the production of tur and other pulses was accompanied by increased fluctuations both in area and yield. Dixit and Kumar (1993) also revealed that too frequent, sharp and sudden fluctuations in the productivity of pulses put the crop in the category of risky activity. According to them the higher the expectation of returns, the higher will be the associated risk level, hence, only stable crops enter the activities at lower risk level, whereas risky crops get in at higher risk. This leads to the neglect of cultivation of pulses by small farmers, as their capacity to absorb shocks is low and being risk averse by nature, they avoid risky crops like pulses.

Climatic factors play an important role in yield fluctuations of pulses ()Prasad *et al* (1993) and Kumar (1978)). High temperature and moisture stress affect flower drop and bud abortion. Frost and low temperature during night cause heavy damage to rabi pulses while continuous rains invite more insects, pests and diseases. Since kharif pulses are mainly rainfed crops and rabi pulses are generally grown in areas where moisture is conserved during the monsoon (or with limited irrigation), the overall productivity of pulses is adversely affected by low or absence of rainfall in the month of September. The drought like situation also affects to a great extent, the subsequent sowing of rabi pulses such as gram and urad. The occurrence of adequate rainfall at crucial stages of riping of kharif pulses and before sowing of rabi pulses assumes greater importance as only 13 per cent of area under pulses is currently receiving assured irrigation. The importance of irrigation on the production of pulses needs no emphasis. Despite this, there has been marginal increase in the area under irrigated pulses from about 8 per cent in 1970-71 to 13 per cent by 1995-96. Lack of irrigation facilities, use of primitive techniques of production and low levels of technology adoption including the use of chemical fertilizers, improved seeds and better management practices have been identified as basic constraints hindering the growth of the production of pulses in India. [1]

The analysis of data from four agricultural censuses also showed that over the 15 years (1971-86), there has been an absolute decline in the area under pulses from 21.11 million hectares to 20.91 million hectares (Kumar, 1993). This was largely due to a sharp decline in the area under both irrigated and unirrigated pulses on large holdings and also due to a decline in the unirrigated area of medium holdings. Although there has been an increase in the relative share in the total area under pulses on smaller holdings (below 4 hectares), the same is not commensurate with the increase in their area operated and irrigation facilities available to them.

The quantity of certified/quality seeds distribution is not adequate. As against about 20 per cent share of pulses in the area under total foodgrains the improved seeds of pulses distributed was about 3.50 lakh quintal per year between 1990-91 and 1994-95, constituting only 9 per cent of total improved seeds of foodgrains distributed during this period. Drought and root diseases are the most serious constraints to higher yields of pulses (Kelley and Rao, 1994). Much, however, still needs to be done in ascertaining which on-farm constraints are limiting the adoption of new technology in the production of pulses.

6. SUMMARY OF FINDINGS AND POLICY IMPERATIVES

Oilseeds and pulses are important part of human diet because they are rich source of energy and protein. They also occupy an important place in the Indian farming system with their combined share of 26 per cent in the gross cropped area and 20 per cent share in the value of total agricultural output. Though India is a major oilseeds and pulses growing country in the world, its domestic production fell short

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[1] For more details see various papers presented in the Annual Conference Volume of Fifty Third Indian Society of Agricultural Economics, Bombay, 1993.

of the demand, and the gap has been filled, for long, by imports.

Oilseeds: The review of the past trends in the agricultural production revealed that until the introduction of the high yielding varieties (HYVs) of cereals like wheat and rice in mid-sixties, the growth performance of almost all crops (cereals, pulses and oilseeds) was more or less uniform. However, during the green revolution period, starting from mid-sixties until early eighties some changes in cropping pattern were observed leaning mostly in favour of cereal crops, especially wheat and rice. Production performance of oilseeds and pulses during this period was very poor compared to wheat and rice. As a result, oilseeds and pulses were labelled as `slow growth crops' during green revolution period. However, under the import substitution strategy adopted since early eighties and followed by the constitution of the Technology Mission on Oilseeds (TMO) in May 1986, India's oilseed sector witnessed a dramatic turn around in its fortune. The production of oilseeds increased from 10.8 million tonnes in 1985-86 to 22.0 million tonnes in 1997-98. Thus, the oilseeds production more than doubled during the last one decade reaching much nearer to 26 million tonne of edible oilseeds demand projected for 2000 A.D. by the National Commission on Agriculture in 1976. With an annual growth rate of over 7 per cent, during the post-TMO period, growth performance of oilseeds surpassed all other crops and had also been distinctly superior to its own past performance. As a result, per capita availability of edible oils increased from 5 kg./year in 1985-86 to about 8 kg./year in 1997-98. If this tempo of growth is maintained, it should not be difficult to achieve the targets of 30 and 45 million tonnes of oilseeds production set by the Planning Commission for Ninth and the Tenth Five Year Plans respectively.

Increase in both area and yield per hectare contributed significantly to this spectacular growth in oilseeds output, though the contribution of the former was greater than that of the latter. Moreover, this outstanding growth performance achieved during the post-TMO period was accompanied by increased production stability and diversified growth across oilseeds as well as across regions. Notwithstanding an exemplary progress in oilseeds production in the recent past, the basic question still remains of whether the `yellow revolution' is sustainable. More so, still higher growth in the production of oilseeds is welcomed for three reasons. One, that the demand for edible oils in future is likely to grow faster in view of increasing purchasing power of all segments of the population; two, oil meal improvement of soyabean and a number of other oilseed crops would enhance their utility as food. Similarly, increased production of oil meals of castor and rapeseed-mustard could help in meeting likely increase in domestic needs of fertilizer and animal feeds. It would also help in improving our export potential. Last but not the least, the recent oilseed growth has been limited to mostly low oil content oilseeds such as soyabean (15 per cent), rapeseed-mustard (33 per cent) etc. The high oil containing oilseeds like groundnut, sesamum, nigerseed, linseed etc. have shown either limited or negative growth in their production. However, the diversified use of oilseeds as a source of edible oils as well as food, animal feed and fertilizer would add more value to the crop production. This would also provide much needed incentive to farmers, in the form of value addition, to use more yield raising inputs in the crop production.

The success of high yielding cultivars of new crops like soyabean and sunflower and expansion of traditional oilseed crop of rapeseed-mustard to large number of growers and to different agro-climatic regions has raised hope for increasing oilseed production in future. But, land being the limited and competing resource for crop production, horizontal expansion of oilseed production, in future, has limitations. Rapid oilseeds growth in recent past, on the cost of coarse cereals has already raised serious concerns. Under such circumstances, increasing production per unit of area i.e. vertical expansion is largely the alternative available for future growth.

Several studies have shown existence of lower level of technology adoption and yield gaps; and it is true that by adopting recommended technology, productivity per hectare and economic returns can be increased substantially in many oilseed crops grown both under irrigated and rainfed conditions. Non-availability of quality seeds, lack of technical know-how and water scarcity have been identified as important reasons for non-adoption of technology and large gaps between actual and realisable yields.

India's position in the ranking of oilseeds yields in the world is very low. However, significant inter-state yield differences across states, point to the existence of large yield potential available to be tapped with improvement in the level of technology adoption and increasing irrigated area under oilseed cultivation.

We have seen that area has been the major source of output growth of oilseeds in the past and yield has played only a secondary role. Therefore, more concerted efforts are now required to increase yield levels of different oilseed crops, both in irrigated as well as rainfed areas. Though appreciable attempts have been done by the Indian Council of Agricultural Research (ICAR) in developing improved varieties of seeds, still more intensified research in the development of high yielding and drought/disease resistant seed varieties are needed. Shortage of quality seeds has been reported as major constraint for technology gap, hence, the capacity for the production of breeder and foundation seeds need to be doubled, so that the production and distribution of quality seeds can be enhanced and made available to the growers in adequate quantities. Gearing of extension machinery for popularizing the available technology should also be done with a missionary zeal.

Pulses: Unlike oilseeds, the production of pulses has remained stagnant during the last three decades. Furthermore, no positive growth was seen even after inclusion of pulses in the Technology Mission on Oilseeds, in 1991. Between 1990-91 and 1997-98, the production of total pulses grew at almost zero rate of growth. Though improvement in the production of gram was noted due to increase in its area as well as yield, but it could hardly compensate the large decline in the production of tur and other pulses, which occupied about two-third area under total pulses. The share of pulses in gross cropped area and total foodgrain production also recorded a decline during this period. As a result, per capita per day net availability of pulses declined drastically to only 33 grams in 1997-98.

Increasing production of pulses has a practical significance because they are the cheap and important source of protein for largely vegetarian Indian population. The Planning Commission has set a target of the annual production of 17 and 20 million tonnes for 9th and 10th Plan periods respectively. This is based on the premise of production growth rate of more than 3 per cent per annum. Looking to the past trends, these targets seem to be of much higher order. It would require large-scale increase in both area under pulses and their productivity levels. Recent growth experience of gram provides some hope of expanding its production further in the southern and central regions but increasing production of tur and other pulses require large scale revamping and restructuring of entire agricultural research and support services system.

The ICAR has, no doubt, been active in developing improved seed varieties of pulse crops for quite sometime, but a real breakthrough is yet to be achieved. Very little improvement in the yield rates of most of the kharif crops, as also some of the rabi pulses are the indication of slow growth in production. The existing yield levels of almost all pulse crops are considerably lower than the potential.

The role of risk in the production of pulses is not less either. Wider fluctuations in the area and yield of most of the pulses especially kharif pulses, put these crops in the category of risky business. Despite good prices, the average value productivity of pulses is lower compared to other competing crops. A marginally higher yield of pulses failed to provide sufficient attraction to farmers, more so when they have to incur additional input costs. In view of the fact that about 87 per cent of pulses are grown either in rainfed or unirrigated conditions, there is, therefore, an urgent need to give much higher priority to strengthening research in dry-farming technologies.

This is also important because no marked improvement in the development of irrigation potential is likely to happen in the near future, for two reasons. One, that the public sector investment in this sector is slackening overtime; and, two, that the problems posed by the environmentalists reduced the tempo to go ahead with the major and medium irrigation projects. In this context, augmenting water resources through watershed development and rainwater harvesting programmes assume great importance. In order to increase both production and productivity of oilseeds and pulses, watershed development and rainwater harvesting programmes in rainfed areas should be linked to the Technology Mission on Oilseeds and Pulses. This would help bringing about efficient water utilization and cultivation of high value but low water requirement crops.

Lack of irrigation facilities, use of primitive techniques of production, low level of technology adoption and poor crop management practices are the basic constraints hindering the growth of pulses in the country. And most of these problems are location/region specific, which needs specific solutions to bring about changes in the situation. More research is, therefore, required in understanding of bio-chemical basis of resistance as well as on-farm constraints limiting the adoption of new technology and in the area of studying impact of yield and relative prices on area changes.

To sum up, it is clear from the review of various studies that a high order of technology gap and yield gap exist both for oilseeds and pulses, more so for pulses. The prime factors responsible for low technology index are lack of know-how, water scarcity, non-remunerative prices and shortage of quality seeds, whereas, various bio-physical and socio-economic constraints are responsible for wide yield gaps. So far, progress has been slow in tapping yield potentials. Instead of going slow, now much intensive efforts are needed to harness untapped potentials wherever they exist. There is enormous scope to accelerate the pace of production in the growth of oilseeds and pulses through technological, institutional and policy incentives in the shape of area and crop specific strategies. Increase in production at low cost can reduce income risk. It can be achieved by containing high variability in yield rates through evolving drought and disease resistant high yielding varieties. Thus, lower per unit production costs and better prices together can help in realizing the potential yield gaps. And for that a significant gains in productivity are essential. In fact, there is a need of `yield revolution' to raise the production of both oilseeds as well as pulses. All this would undoubtedly need stepping up of investment in the crucial areas like research in dry farming technology and increasing irrigation resources.

Table 1: Changes in Crop Production (TE 1967-68 to 1997-98)(All India)

Crops	Production of Various Crops (Million Mt.)			Absolute Change (Million Mt.)		Percent Change During	
	TE 1966-1967	TE 1986-1987	TE 1997-1998	TE 1967-1987	TE 1987-1998	TE 1967-1987	TE 1987-1998
Rice	33.45	60.91	80.34	27.46	19.43	82.1	31.9
Wheat	11.32	45.15	65.78	23.81	20.63	298.9	45.7
Coarse cereals	23.62	28.07	31.42	4.45	3.35	18.8	11.9
Total cereals	**68.39**	**134.12**	**177.54**	**65.73**	**43.42**	**96.1**	**32.4**
Gram	4.54	4.96	5.56	0.42	0.60	9.3	12.1
Tur	1.58	2.43	2.32	0.85	-0.11	53.8	-4.5
Other pulses	4.11	4.95	5.35	0.84	0.40	20.4	8.1
Total pulses	**10.24**	**12.34**	**13.23**	**2.10**	**0.89**	**20.5**	**7.2**
Food grains	78.62	146.47	190.76	67.85	44.29	86.3	30.2
Groundnut	4.88	5.81	8.02	0.93	2.21	19.1	38.0
Rapeseed-	1.33	2.79	5.79	1.46	3.00	100.8	107.5
mustard	-	0.96	5.67	-	4.71	-	490.6
Soyabean	-	0.38	1.15	-	0.77	-	202.6
Sunflower	0.44	0.49	0.59	0.05	0.10	11.4	20.4
Sesamum	0.55	1.26	1.62	0.71	0.36	129.1	28.6
Other oilseeds							
Total oilseeds	**7.20**	**11.69**	**22.84**	**4.49**	**11.15**	**62.4**	**95.4**
Cotton	5.43	8.05	12.74	2.62	4.69	48.3	58.3
Sugarcane	112.87	175.69	277.96	62.82	102.27	55.7	58.2

Source: CMIE (1991), Agricultural Production in Major States: 1967-68 to 1989-90; CMIE (1999), Agriculture

Table 2: Percentage Area under Different Crops to Gross Cropped Area

Crops	TE 1966-67	TE 1986-87	TE 1990-91	TE 1997-98
Cereals	59.3	58.5	56.5	53.8
Rice	22.7	23.2	23.0	23.2
Wheat	8.2	13.1	12.8	13.9
Coarse cereals	28.3	22.2	20.7	16.8
Pulses	14.6	13.2	12.9	12.1
Gram	5.3	4.1	3.8	3.8
Tur	1.6	1.8	1.9	1.9
Other pulses	7.7	7.3	7.2	6.4
Foodgrains	73.9	71.8	69.5	65.9
Oilseeds	10.1	10.6	12.5	14.0
Groundnut	4.7	4.0	4.6	4.0
Rapeseed/Mustard	1.9	2.2	2.8	3.6
Soyabean	0.0	0.8	1.2	2.9
Sunflower	0.0	0.5	0.7	1.0
Sesamum	1.7	1.2	1.3	1.0
Linseed	1.1	0.8	0.6	0.4
Castorseed	0.3	0.4	0.4	0.4
Nigerseed	0.3	0.3	0.3	0.3
Safflower	0.2	0.5	0.4	0.4
Cotton	5.1	4.1	4.1	4.8
Sugarcane	1.6	1.7	1.9	2.2
Plantation crops	0.4	0.5	0.5	0.4
Other crops	8.9	11.4	11.6	12.7
Non foodgrains	26.1	28.2	30.5	34.1
Gross cropped area	100.0 (157.3)	100.0 (177.4)	100.0 (183.4)	100.0 (186.5)

Source: Same as in Table 1.

Note: Figures in parentheses are gross cropped area in million hectares

Table 3: All India: Compound Growth Rates of Area, Production and Yield of Important Crops

Crops	1966-67 to 1986-87			1986-87 to 1997-98			1966-67 to 1997-98		
	Area	Pro-duction	Yield	Area	Pro-duction	Yield	Area	Pro-duction	Yield
Groundnut	-0.11**	1.20*	1.31*	0.63	2.64*	2.00*	0.35*	1.67*	1.31*
Rapeseed/ Mustard	0.88**	3.02*	2.12*	5.17*	7.29*	2.01*	2.60*	5.56*	2.89*
Soyabean	22.75*	22.31*	-0.25	14.72*	19.67*	4.30*	17.70*	18.63*	0.77**
Sunflower	7.66*	5.17**	-2.25*	8.17*	12.89*	4.47*	10.55*	9.84*	-0.62***
Sesamum	-0.64*	0.94*	1.59*	.50*	0.91	2.45*	-0.55*	1.52*	2.08*
Linseed	-0.98**	0.13	1.12*	-4.07*	-2.17*	1.97*	-2.67*	-1.21*	1.50*
Castorseed	2.06*	7.02*	4.86*	2.48*	11.68*	8.98*	2.12*	6.97*	4.75*
Nigerseed	1.40*	3.02*	1.56*	0.64*	1.03	1.79**	0.77*	2.13**	1.35*
Safflower	2.90*	9.53*	6.44*	-2.95*	-0.76	2.26**	1.31*	5.12**	3.75*
Total oilseeds	**0.73***	**2.44***	**1.70***	**4.07***	**7.48***	**3.28***	**1.63***	**3.72***	**2.05***
Gram	-0.51*	-0.13	0.38	0.12	0.80*	0.69*	-0.29*	0.06	0.35*
Tur	1.11*	1.94*	0.82*	0.31**	-0.18	-0.47*	0.58*	0.68*	0.09**
Other pulses	0.61*	0.87*	0.25	-0.36*	0.25	0.59*	0.08**	0.53*	0.46*
Total pulses	**0.30***	**0.63***	**0.33**	**-0.26**	**0.88**	**1.15**	**0.06**	**0.84***	**0.78***
Rice	0.70*	2.77*	2.06*	0.25*	1.25*	1.00*	0.27*	1.25*	1.00*
Wheat	2.89*	6.46*	3.47*	0.46*	1.61*	1.14*	0.83*	2.29*	1.45*
Coarse cereals	-0.76*	1.03*	1.80*	-2.28	1.11	3.47	-1.16*	0.76*	1.94*
Total cereals	**0.47***	**3.22***	**2.74***	**-0.31**	**2.85**	**3.17**	**0.15***	**3.01***	**2.86***
Food grains	0.44*	2.95*	2.50*	-0.13*	1.16*	1.29*	0.06*	1.21*	1.16*

Source: Same as in Table 1.

Notes: Significance value * upto 1 per cent level; ** upto 5 per cent level; *** upto 10 per cent level

Table 4: Crop-wise Share in the Incremental Production of Oilseeds During TE 1986-87 to TE 1997-98

Oilseed Group/Crop	TE 1986-87		TE 1997-98		Change During TE 1986-87 to TE 1997-98		Percent Change in Production (1986-87 to 1997-98
	Million tonnes	Per cent share	Million tonnes	Per cent share	Million tonnes	Per cent Share	
Groundnut	5.81	49.6	8.02	35.1	2.2	19.8	38.0
Kharif	4.31	36.8	6.41	28.1	2.1	18.9	48.8
Rabi	1.50	12.8	1.61	7.0	0.1	0.9	6.7
Rapeseed/ Mustard	2.79	23.9	5.79	25.4	3.0	27.0	107.5
Soyabean	0.96	8.5	5.67	25.0	4.7	42.3	490.6
Sunflower	0.38	3.4	1.15	4.8	0.8	6.3	202.6
Sesamum	0.49	4.3	0.59	2.6	0.1	0.9	20.4
Other oilseeds	1.26	10.3	1.62	7.0	0.4	3.6	28.6
Total oilseeds	**11.69**	**100.0**	**22.84**	**100.0**	**11.1**	**100.0**	**95.4**
Kharif oilseeds	6.49	55.6	14.03	61.4	7.5	67.6	115.4
Rabi oilseeds	5.20	44.4	8.81	38.6	3.6	32.4	69.2

Source: CMIE (1999), Agriculture

Table 5: Statewise Share in the Incremental Production of Oilseeds During TE 1986-87 to 1997-98

Oilseed Group/Crop	Production (Lakh Tonnes)		Incremental Production		% Change in Production (1986-87 to 1997-98
	TE 1986-87	TE 1997-98	Lakh tonnes	% share	
Central Region					
Madhya Pradesh	13.10 (11.2)	52.29 (22.8)	39.19	35.3	299.2
Rajasthan	10.94 (9.4)	32.98 (14.5)	22.04	19.8	201.5
Uttar Pradesh	10.17 (8.7)	13.23 (5.8)	3.06	2.8	30.1
Western Region					
Gujarat	15.90 (13.6)	32.69 (14.3)	16.79	15.1	105.6
Maharashtra	10.69 (9.2)	12.3 (5.8)	1.54	1.4	14.4
North Eastern Region					
Haryana	2.69 (2.3)	7.36 (3.2)	4.67 (0.82)	4.2 (0.7)	173.6 (43.9)
Punjab	1.87 (1.6)	2.69 (1.2)	-	-	-
Eastern Region					
Assam	1.49 (1.3)	1.59 (0.7)	0.10	0.1	6.7
Bihar	1.19 (1.0)	1.50 (0.7)	0.31	0.3	26.1
Orissa	8.00 (6.8)	2.03 (0.9)	-5.97	-5.4	-75.0
West Bengal	2.42 (2.1)	3.91 (1.7)	1.49	1.3	61.6
Southern Region					
Andhra Pradesh	14.12 (12.1)	22.39 (9.8)	8.27	7.4	58.6
Karnataka	11.97 (10.2)	15.86 (6.9)	3.89	3.5	32.5
Tamil Nadu	9.38 (8.0)	16.63 (7.3)	7.25	6.5	77.3
Kerala	0.12 (0.1)	0.11 (0.0)	-0.01	0.0	-8.3
Other states	2.81 (2.4)	10.51 (4.6)	7.73	7.0	278.1
All India	**116.86 (100.0)**	**228.40 (100.0)**	**111.50**	**100.0**	**95.4**

Source: CMIE (1999), Agriculture. Figures in parentheses are percentage to total

Table 5a: Area, Production and Yield of Oilseeds in Major States Contributing to the Incremental Production During TE 1986-87 and TE 1997-98

Crop/State	TE 1986-87			TE 1997-98			Incremental Production TE 1986-87 to 1997-98		% Change in Production 1986-87 to 1997-98
	Area (lakh ha)	Yield (Kg/ha)	Production (lakh tonnes)	Area (lakh ha)	Yield (Kg/ha)	Production (lakh tonnes)	Lakh tonnes	% share	
Groundnut									
Gujarat	18.93	583	11.04	18.88	1076	20.31	9.27	41.9	84.0
Tamil Nadu	9.30	952	8.85	9.72	1618	15.73	6.88	31.1	77.7
A.P.	16.38	792	12.97	20.77	939	19.51	6.54	29.6	50.4
Karnataka	8.81	886	7.81	11.67	869	10.13	2.32	10.5	29.7
Maharashtra	6.85	796	5.45	5.46	1190	6.50	1.05	4.7	19.3
M.P.	2.68	646	1.73	2.53	1013	2.57	0.84	3.8	48.6
Other states	7.97	1287	10.26	5.64	972	5.48	-4.78	-21.6	-46.6
Total	70.92	819	58.11	74.67	1074	80.23	22.12	100.0	38.1
Soyabean									
M.P	10.98	691	7.59	40.99	1037	42.50	34.9	74.1	459.9
Rajasthan	0.42	762	0.32	4.64	1067	4.95	4.63	9.8	1446.9
Gujarat	0.12	332	0.04	0.10	674	0.06	0.02	0.0	50.0
U.P	1.89	772	1.46	0.49	857	0.42	-1.04	-2.2	-71.2
Other states	0.29	552	0.16	8.05	1087	8.75	8.59	18.2@	5368.8
Total	13.70	699	9.57	54.27	1044	56.68	47.11	100.0	492.3
Sunflower									
A.P.	0.47	426	0.20	2.67	670	1.79	1.59	20.7	795.0
Karnataka	4.73	457	2.16	8.77	399	3.50	1.34	17.4	62.0
Maharashtra	3.21	405	1.30	4.74	542	2.57	1.27	16.5	97.7
Tamil Nadu	0.18	611	0.11	0.26	1038	0.27	0.16	2.1	145.5
U.P	0.03	667	0.02	0.29	1310	0.38	0.36	4.7	1800.0
Other states	0.08	125	0.01	2.47	1202	2.97	2.96	38.5*	29600.0
Total	8.70	437	3.80	19.20	598	11.48	7.68	100.0	202.1
Rapeseed/Mustard									
Rajasthan	9.83	757	7.43	29.26	828	24.22	16.79	55.9	225.0
Haryana	3.10	845	2.62	5.81	1143	6.64	4.02	13.4	153.4
U.P	1.44	708	1.02	1.41	844	1.19	0.17	0.6	16.7
M.P	3.41	618	2.11	7.23	775	5.60	3.49	11.6	165.4
Gujarat	1.90	1200	2.28	3.53	1175	4.15	1.87	6.2	82.0
West Bengal	0.10	1100	0.11	0.29	1345	0.39	0.28	0.9	254.5
Other states	19.17	641	12.29	19.66	799	15.71	3.42	11.4	27.8

Total	38.95	715	27.86	67.19	862	57.90	30.04	100.0	107.8

Table 5a (Contd...)

Crop/State	TE 1986-87			TE 1997-98			Incremental Production TE 1986-87 to 1997-98		% Change in Prod-uction 1986-87 to 1997-98
	Area (lakh ha)	Yield (Kg/ ha)	Pro-duction (lakh tonnes)	Area (lakh ha)	Yield (Kg/ ha)	Pro-duc-tion (lakh tonnes	Lakh tonnes	% share	
Other Oilseeds									
Gujarat	3.70	686	2.54	6.45	1267	8.17	5.63	122.9	221.7
West Bengal	1.21	521	0.63	1.43	699	1.00	0.37	8.1	58.7
A.P.	4.98	191	0.95	4.33	252	1.09	0.14	3.1	14.7
Tamil Nadu	1.21	347	0.42	1.54	403	0.62	0.20	4.4	47.6
Karnataka	5.09	389	1.98	3.57	518	1.85	-0.13	-2.8	-6.6
Other states	40.11	273	10.97	29.08	321	9.34	-1.63	-35.6	-14.9
Total	56.30	311	17.49	46.40	476	22.07	4.58	100.0	26.2
Total Oilseeds									
M.P	25.00	524	13.10	56.70	922	52.29	39.19	35.2	299.2
Rajasthan	17.77	616	10.94	40.45	815	32.98	22.04	19.8	201.5
Gujarat	24.64	645	15.90	28.95	1129	32.69	16.79	15.1	105.6
A.P	21.83	647	14.12	27.77	806	2.39	8.27	7.4	58.6
Tamil Nadu	10.69	877	9.38	11.52	1444	16.63	7.25	6.5	77.3
Haryana	3.17	849	2.69	6.25	1178	7.36	4.67	4.2	173.6
Karnataka	18.71	640	11.97	24.60	645	15.86	3.89	3.5	32.5
U.P	19.01	535	10.17	16.98	779	13.23	3.06	2.7	30.1
Maharashtra	21.73	492	10.69	18.98	644	12.23	1.54	1.4	14.4
West Bengal	3.88	624	2.42	4.97	787	3.91	1.49	1.3	61.6
Punjab	1.95	959	1.87	2.19	1228	2.69	0.82	0.7	43.9
Orissa	10.01	799	8.00	4.19	484	2.03	-5.97	-5.4	-74.6
Other states	10.18	548	5.58	18.18	774	14.07	8.26	7.4	148.0
Total	188.6	620	116.8	261.7	873	228.4	111.5	100.0	95.4

Source: CMIE (1999) , Agriculture.

Table 6: Statewise Compound Annual Growth Rates (CAGRs) of Area, Production and Yield of Oilseeds

Region/State	CAGRs for 1966-67 to 1986-87			CAGRs for 1986-87 to 1997-98		
	Area	Production	Yield	Area	Production	Yield
Southern Region						
Andhra Pradesh	0.38	1.68*	1.30*	2.63*	4.14*	1.51*
Karnataka	2.92*	3.71*	0.76*	2.27**	3.23*	0.94**
Kerala	3.13*	-3.46*	-6.38*	-1.89*	1.14	3.03*
Tamil Nadu	0.00	-0.17	-0.31	-0.65	4.53*	5.20*
Western Region						
Gujarat	1.38*	3.44*	2.04*	3.36*	7.70*	4.20**
Maharashtra	1.50*	3.17*	1.65*	-1.52**	1.27	2.83*
North-Western Region						
Haryana	2.17*	4.93*	2.70*	7.81*	11.82*	3.72*
Punjab	-3.03*	-2.95*	0.09	1.41	5.09*	3.63*
Central Region						
Madhya Pradesh	-1.92*	4.85*	7.65*	8.47*	13.94*	3.83*
Rajasthan	1.34**	7.05*	5.63*	8.45*	10.65*	2.03*
Uttar Pradesh	-2.15*	-1.39*	0.78**	-1.07*	3.85*	4.97*
Eastern Region						
Assam	4.66*	5.10*	0.42***	-1.21*	-0.20	1.03*
Bihar	0.14	1.56*	1.41*	-1.98***	0.09	2.12*
Orissa	6.27*	8.22*	1.84*	-9.51*	-14.05*	-5.02*
West Bengal	5.31*	8.52*	3.04*	1.49**	2.41***	0.91
All India	**0.73***	**2.44***	**1.70***	**4.07***	**7.48***	**3.28***

Note: Same as in Table 1.

Table 7: Statewise Compound Annual Growth Rates (CAGRs) for Major Oilseed Crops

Crop/State	CAGRs for 1966-67 to 1986-87			CAGRs for 1986-87 to 1997-98		
	Area	Production	Yield	Area	Production	Yield
Groundnut						
A.P	0.96*	1.96*	0.96*	2.25**	3.22**	0.88***
Gujarat	0.60***	2.04**	1.44***	1.58**	5.61**	3.97
Tamil Nadu	-0.04	-0.22	-0.19	0.49	5.16*	4.53*
Karnataka	-0.12	1.86*	2.02*	1.95**	2.98*	0.65
Maharashtra	-1.60*	0.69	2.32*	-2.6**	0.63	3.32*
Orissa	9.02*	10.11*	1.00**	-14.57*	-17.64*	-3.59*
All India	-0.11***	1.20*	1.31*	0.63	2.64*	2.00*
Rapeseed-Mustard						
Rajasthan	7.86*	12.24*	3.86*	10.3*	11.22*	0.87***
U.P	-1.73*	-1.07**	0.74**	1.39*	5.25*	3.88*
Haryana	2.44*	5.52*	2.90*	7.11*	10.80*	3.53*
M.P	4.18*	8.32*	3.98*	7.34*	9.33*	1.86**
Gujarat	12.50*	18.09*	4.97*	7.39*	7.30*	-0.09
West Bengal	3.48*	7.26*	3.65*	1.48*	1.84	0.36
All India	0.88**	3.02*	2.12*	5.17*	7.29*	2.01*
Soyabean						
M.P	27.03*	24.82	-1.74*	13.69*	18.49*	4.22*
Rajasthan	10.49*	15.94*	4.66*	24.48*	28.27*	.08*
Gujarat	23.85*	28.64*	3.86*	0.34	6.75	6.38**
U.P	17.24*	16.34*	-0.58	-8.11	-7.72***	0.23
All India	22.75*	22.31*	-0.25	14.72*	19.67*	4.30*
Sunflower						
Punjab	-	-	-	4.82**	3.23*	-1.40*
A.P	-3.72	-5.33	-1.06	18.90*	24.89*	4.54*
Karnataka	16.24*	14.56	-0.77	5.73*	5.93*	0.24
Maharashtra	16.08*	16.53*	-0.21	3.81*	7.96*	3.89*
Tamil Nadu	-9.60*	-11.90*	2.64**	5.75*	12.01*	6.19*
U.P	-6.58*	-8.21*	-1.65*	28.59	4.44*	4.87*
All India	**7.66***	**5.17****	**-2.25***	**8.17***	**2.89***	**4.47***

Table 7 (Contd...)

Crop/State	CAGRs for 1966-67 to 1986-87			CAGRs for 1986-87 to 1997-98		
	Area	Production	Yield	Area	Production	Yield
Sesamum						
Gujarat	0.05	0.99	0.94	9.11	18.07*	8.22*
West Bengal	17.14*	17.44*	0.25	2.60*	3.62*	0.99
Rajasthan	-2.18*	-1.52***	0.66	1.11	9.50	9.21***
A.P	-2.59*	-3.31*	-0.64***	1.28*	5.65*	3.97**
Karnataka	4.07*	5.21*	1.11*	-2.95**	-1.30	1.88*
Tamil Nadu	0.12	0.38	0.26	-0.25	3.70*	3.85*
U.P	-2.71*	-6.21*	-3.45*	-7.24***	6.56*	14.59*
All India	-0.64*	0.94*	1.59*	-1.50***	0.91	2.45*
Castor						
Gujarat	9.46*	17.16*	7.04*	7.97*	15.35*	6.84*
Rajasthan	8.11*	7.13*	-1.22	15.75*	33.82*	16.46*
A.P	-0.33	-0.89	-0.49	-2.31**	2.01	4.34*
Tamil Nadu	2.74*	1.17*	-1.48*	6.57*	6.35*	-0.24*
Karnataka	-1.07*	2.73*	3.84*	-2.82*	-1.72	1.14
M.P	-1.04	-2.02**	-1.19*	6.48**	8.07*	1.49***
All India	2.06*	7.02*	4.86*	2.48*	11.68*	8.98*
Linseed						
M.P	0.14	-1.69	-1.83	-2.10*	-1.05	1.16***
U.P	-5.03*	-3.32*	1.92*	-5.78*	-1.69*	4.52*
West Bengal	2.41*	2.32*	-0.15	-7.99**	-8.5**	-0.75
Karnataka	0.65	-0.48	-1.12**	-6.37**	-2.66*	3.96*
A.P	-4.59*	-3.53*	0.53	0.69	3.44	2.50**
Maharashtra	1.89*	2.85*	0.94*	-5.86*	4.49*	1.48*
All India	-0.98**	0.13	1.12*	-4.07*	-2.17*	1.97**
Nigerseed						
Orissa	6.24*	7.11*	0.82***	0.47	0.87	0.40
Maharashtra	1.59*	2.73*	1.16***	-2.67*	-1.38	1.52**
Karnataka	4.32*	3.54*	-0.66*	-2.90*	-3.28*	-0.45
All India	1.40*	3.02*	1.56*	-0.64*	1.03	1.79**
Sunflower						
Karnataka	2.41*	10.78*	8.17*	-3.68*	0.32	3.49*
Maharashtra	3.46*	9.82*	6.15*	-2.73*	-0.84	1.94***
A.P	-0.79	2.32***	3.12*	-2.59	-1.05	1.43***
Orissa	2.02*	2.30**	0.22	-1.29	-0.80	0.42
All India	2.90*	9.53*	6.44*	-2.95*	-0.76	2.26**

Note: Significance value * upto 1 per cent level; ** upto 5 per cent level; *** upto 10 per cent level

Table 8: Indicator of Production Instability (Co-efficient of Variation)

	1971-77	1981-87	1988-94
Oilseeds Production			
Groundnut	0.269	0.267	0.144
Rapeseed-mustard	0.285	0.259	0.116
Soyabean	0.396	0.457	0.233
Sunflower	0.953	0.369	0.219
Others	0.183	0.242	0.121
Total oilseeds	0.203	0.185	0.049
Regional Production			
North	0.053	0.267	1.301
Center	0.214	0.259	0.105
East	0.127	0.457	0.432
West	2.450	0.369	0.468
South	0.301	0.242	0.082
Seasonal Production	**1976-82**	**1989-95**	-
Kharif	0.224	0.116	-
Rabi	0.227	0.100	-

Source: World Bank (1999) *The Indian Oilseed Complex Capturing Market Opportunities*, Allied Publications, New Delhi, p. 73.

Table 9: Irrigated Area Under Oilseeds

State	Irrigated Area in `000 Hectares			% Increase During		Irrigated Area as % of Total Cropped Area		
	1981-82	1991-92	1995-96	1982-92	1992-96	1981-82	1991-92	1995-96
Groundnut								
Andhra Pradesh	266	510	373	91.7	-26.9	18.8	20.6	16.8
Gujarat	232	164	182	-29.3	11.0	10.7	8.5	9.6
Karnataka	113	318	244	181.4	-23.3	13.1	23.8	20.5
Maharashtra	54	144	186	166.7	29.2	7.8	19.4	36.4
Rajasthan	15	67	76	346.7	13.4	9.3	27.0	35.1
Tamil Nadu	226	338	258	49.6	-23.7	26.2	30.7	27.6
All India	964	1661	1398	72.3	-15.8	13.3	19.2	18.6
Rapeseed & Mustard								
Bihar	13	33	36	153.8	9.1	17.3	31.9	33.2
Gujarat	183	329	354	79.8	7.6	93.4	83.8	46.2
Haryana	100	428	384	328.0	-10.3	49.3	67.0	66.8
Madhya Pradesh	82	274	315	234.1	15.0	28.4	45.2	45.3
Rajasthan	318	1583	1975	397.8	24.8	48.8	66.1	70.3
Uttar Pradesh	255	632	579	147.8	-8.4	57.7	48.9	52.9
West Bengal	69	322	322	366.7	-	42.3	78.2	98.3
All India	1153	3762	4135	226.3	9.9	44.9	57.4	63.2
All oilseeds	**2520**	**6600**	**7300**	**161.9**	**10.6**	**14.5**	**24.8**	**26.1**

Source: CMIE (1996), India's Agriculture Sector: A Compendium of Statistics Table 24, p. 24
CMIE (1999), Agriculture, pp. 49-50.

Table 10: Incremental Production and Sources of Growth of Oilseeds in India, TE 1997-98 Over 1986-87

Crop	Incemental Production		Source of Growth (%)		
	Lakh (Tonnes)	Per cent	Area	Yield	Inter-action
Groundnut	22.1	19.8	23.9	75.8	0.3
Rapeseed-mustard	30.0	26.9	70.9	27.6	1.5
Soyabean	47.1	42.2	74.8	21.9	3.3
Sunflower	7.7	6.9	63.4	34.7	1.9
Sesamum	1.0	0.9	-164.8	269.2	-4.4
Castor	5.0	4.5	21.2	76.9	1.9
Linseed	-0.8	-0.8	1565.9	-90.8	-1375.1
Nigerseed	0.1	0.1	62.1	173.8	-135.9
Safflower	-0.7	-0.7	388.2	-297.4	9.2
Total oilseeds	111.5	100.0	54.4	43.8	1.8

Source: Same as in Table 4.

Table 11: Changes in Area and Production of Important Crop Groups, 1994-95 to 1997-98

Crop	Area in Million Hectare				Production in Million Tonnes			
	1994-95	1995-96	1996-97	1997-98	1994-95	1995-96	1996-97	1997-98
Rice	42.8 (22.8)	42.8	43.4	43.4 (23.3)	81.8	77.0	81.7	82.3
Wheat	25.7 (13.7)	25.0	25.9	26.7 (14.3)	65.8	62.1	69.4	65.9
Coarse cereals	32.2 (17.1)	30.9	31.8	31.1 (16.7)	-	-	-	-
Total cereals	**100.7 (53.5)**	**98.7**	**101.1**	**101.2 (54.2)**	**177.5**	**168.1**	**185.2**	**179.4**
Gram	7.5 (4.0)	7.1	6.8	7.5 (4.0)	6.4	5.0	5.6	6.1
Tur	3.3 (1.7)	3.4	3.5	3.5 (1.9)	2.1	2.3	2.7	1.9
Total pulses	**23.0 (12.2)**	**22.3**	**22.4**	**22.8 (12.1)**	**14.1**	**12.3**	**14.2**	**13.1**
Groundnut	7.9 (4.2)	7.5	7.6	7.3 (3.9)	8.1	7.6	8.6	7.8
Rapeseed-Mustard	6.1 (3.2)	6.5	6.5	7.1 (3.8)	5.8	6.0	6.7	4.7
All oilseeds	**25.3 (13.4)**	**26.0**	**26.3**	**26.2 (14.0)**	**21.3**	**22.1**	**24.4**	**22.0**
Total cropped area	188.1 (100.0)	186.5 (100.0)	186.6 (100.0)	186.6 (100.0)	-	-	-	-

Source: Government of India, *Economic Survey, 1998-99*, Ministry of Finance, p. 5-16 and 5-17.
Note: Figures in parentheses are per cent to total cropped area

Table 12: Changes in Area, Production and Yield of Pulses and Other Crop Groups, 1966-67 to 1997-98

Crop/Crop Group	TE 1966-67	TE 1990-91	TE 1997-98	Annual Compound Growth Rate Between	
				1966-67 to 1986-87	1990-91 to 1997-98
Area (M.ha.)					
Gram	8.3 (36.2)	6.9 (29.1)	7.1 (31.6)	-0.51*	1.22
Tur	2.6 (11.4)	3.6 (15.2)	3.5 (15.6)	1.11*	-0.58**
Other pulses	12.0 (52.4)	13.2 (55.7)	11.9 (52.8)	0.6*	-1.87*
Total pulses	22.9 (100.0)	23.7 (100.0)	22.5 (100.0)	0.30*	-0.76*
Wheat	12.9	23.5	25.9	2.89*	1.34*
Total cereals	93.3	103.7	100.3	0.47*	-0.41*
Foodgrains	116.2	127.4	122.8	0.44*	-0.47*
Production (M.t)					
Gram	4.5 (44.1)	4.9 (36.0)	5.6 (42.4)	-0.13	3.16*
Tur	1.6 (15.7)	2.6 (19.1)	2.3 (17.4)	1.94*	-1.02
Other pulses	4.1 (42.2)	6.1 (44.9)	5.3 (40.2)	0.87*	-2.16*
Total pulses	10.2 (100.0)	13.6 (100.0)	13.2 (100.0)	0.63*	0.07
Wheat	11.3	53.0	65.8	6.46*	3.54*
Total cereals	68.4	158.8	177.6	3.22*	1.86*
Foodgrains	78.6	172.4	190.7	2.95*	1.73*
Yield (Kg./ha)					
Gram	546	707	780	0.38	1.91*
Tur	610	729	663	0.82	-0.44
Other pulses	343	463	448	0.25	-0.30
Total pulses	447	574	587	0.32	0.83**
Wheat	876	2252	2544	3.47*	2.17*
Total cereals	733	1532	1770	2.74*	2.28*
Foodgrains	677	1353	1553	2.50*	2.86*

Note: Significance value * upto 1 per cent level; ** upto 5 per cent level

Table 13: Growth Rates of Pulses, 1990-91 to 1997-98

States/ Crops	Gram			Tur			Other Pulses			Total Pulses		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
Andhra Pradesh	11.04*	15.11*	3.66**	-0.82	4.25*	5.06**	-0.69	-1.58***	-0.90	-0.07	0.55	0.62***
Assam	-	-	-	-1.72*	-1.61***	0.11	-0.28	4.20*	4.50*	-0.37	3.67*	4.06*
Bihar	-3.00*	-3.50*	-0.51	0.53	-2.43*	-2.95**	-4.10*	-4.34*	-0.25**	-6.28*	-6.73*	-0.48
Gujarat	-0.67	1.36	2.04**	0.19	0.11	-0.08	0.21	-0.32	-0.53	0.07	0.17	0.09
Haryana	-6.15*	-1.68	4.76**	-6.26*	5.64**	0.66	-3.49***	-1.79	1.77*	-6.03*	-2.11	4.17**
Himachal Pradesh	-1.63**	5.71**	7.40*	-	-	-	1.38*	-1.70	-0.18	-2.12*	-0.93	1.22
Karna-taka	9.01*	16.82**	7.16*	-3.27**	0.59	3.99	-1.46**	-0.54	0.93	-0.27	2.77*	3.05*
Kerala	-	-	-	-	-	-	-3.13*	-2.12	1.04	-3.13*	-2.12	1.04
Maha-rashtra	3.49**	4.81***	1.27	1.20*	2.75	1.53	-0.62	1.81	2.44	-0.75	2.81	2.04
Madhya Pradesh	2.50*	5.34*	2.77*	-2.51*	-5.77*	-3.38*	0.96*	2.28**	1.31	1.43*	3.17*	1.71*
Orissa	-4.01*	-5.60**	-1.66	-0.77	-3.85**	-3.11*	-16.37*	-22.26*	-7.04*	-14.16*	-18.18*	-4.68*
Punjab	-17.66*	-15.18*	3.26**	-6.00*	-5.75*	0.10	0.49	2.49**	1.87**	-5.54	-4.15**	1.48**
Rajasthan	4.02*	7.27*	2.78**	-1.76	-1.51	0.02	2.11*	1.09	-0.98	2.89*	5.04**	2.09
Tamil Nadu	3.52***	4.83**	1.59*	-5.69*	-3.53	2.14	-6.51*	-6.94*	-0.57	-6.30*	-5.94*	2.09
Uttar Pradesh	-4.42*	-4.59*	-0.12	-0.03	-2.30*	-2.46**	1.86*	2.04*	0.17	-0.86*	-1.42*	-0.56**
West Bengal	0.16	6.84**	6.66*	-6.12*	-6.61	-0.53	-6.43*	-6.24*	0.20	-5.74*	-4.70*	1.11**
All India	1.22	3.16*	1.91*	-0.58**	-1.02	-0.44	-1.87*	-2.16*	-0.30	-0.76*	0.07	0.83**

Note: Significance value * upto 1 per cent level; ** upto 5 per cent level; *** upto 10 per cent level.

Table 14: Minimum Support Prices of Agricultural Commodities

Year	Wheat	Rice	Coarse grain	Gram	Tur	Must-ard	Ground-nut	Sun-flower	Soya-bean (Black)
1980-81	117	105	105	145	190	245	206	183	183
1981-82	130	115	116	@	@	@	270	250	210
1982-83	142	122	118	@	215	@	295	250	220
1983-84	151	132	124	235	245	355	315	275	230
1984-85	152	137	130	240	275	360	340	325	240
1985-86	157	142	130	@	300	385	350	335	250
1986-87	162	146	132	260	320	400	370	350	255
1987-88	166	150	135	280	325	415	300	390	260
1988-89	183	160	145	325	360	460	430	450	275
1989-90	215	185	165	421	425	575	500	530	325
1990-91	225	205	180	450	480	600	580	600	350
1991-92	275	230	205	500	545	670	645	670	395
1992-93	330	270	240	600	640	760	750	800	475
1993-94	350	310	295	640	700	810	800	850	525
1994-95	360	340	290	670	760	830	860	900	570
1995-96	380	360	300	700	800	860	900	950	600
1996-97	475	380	310	740	840	890	920	960	620
1997-98	510	415	360	815	900	940	980	1000	670
1998-99	550	440	390	895	960	1000	1040	1060	705
Percent change in 1993-94 over 1980-81	199.1	195.2	180.9	341.4	268.4	230.6	288.3	364.5	186.9
Percent change in 1998-99 over 1993-94	57.1	41.9	32.2	39.8	37.1	23.5	30.0	24.7	34.3
Percent change in 1998-99 over 1980-81	370.1	319.0	271.4	517.2	405.3	308.2	404.9	479.2	285.2

Table 15: Relationship Between Farm Harvest Price, Wholesale Price and Retail Market Price for Tur and Gram, Gujarat State

Year	MSP	FSP (Whole) Rs./QL.	WSP (Dal) Rs./QL.	Rmp (Dal) Rs./QL.	Ratio Between		Per Cent Difference Between Fhp/Wsp
					FHP/ WSP	FHP/ RMP	
TUR							
1990-91	480	1053	1654	1737	0.64	0.60	57.1
1991-92	545	982	1733	1821	0.57	0.54	76.5
1992-93	640	1027	1696	1786	0.61	0.58	65.1
1993-94	700	1076	1785	1873	0.60	0.57	65.9
1994-95	760	1443	2438	2572	0.59	0.56	69.0
1995-96	800	1622	2932	3111	0.55	0.52	80.8
GRAM							
1990-91	450	681	973	1046	0.70	0.65	42.9
1991-92	500	674	959	1034	0.70	0.65	42.3
1992-93	600	924	1271	1347	0.73	0.69	37.5
1993-94	640	1261	1663	1760	0.76	0.72	31.9
1994-95	670	955	1336	1445	0.71	0.66	39.9
1995-96	700	946	1331	1448	0.71	0.65	40.7

Source: Government of India (1995 and 1996), Report of the Commission on Agricultural Costs and Prices on Price Policy for Crops Sown in 1994-95 and 1995-1996 Seasons.

Note: MSP = Minimum Support Price; FHP = Farm Harvest Price
WSP = Wholesale Price; RMP = Retail Market Price

Table 16: India's Position in the World in Area Production and Yield of Important Oilseed Crops

Oilseed	India's Share in the World				India's Yield in Respect to World Average (%)	
	Area		Production		1986	1996
	1986	1996	1986	1996		
Groundnut	39.6 (1)	35.6 (1)	29.8 (1)	27.4 (2)	75.1 (69)	77.0 (45)
Rapeseed-mustard	25.6 (2)	28.9 (2)	13.4 (3)	19.7 (3)	52.6 (30)	68.2 (39)
Soyabean	2.6 (5)	7.7 (5)	1.4 (5)	3.2 (5)	52.5 (45)	41.4 (63)
Sunflower	4.5 (7)	10.5 (3)	1.4 (12)	5.9 (6)	32.0 (47)	55.0 (46)
Sesamum	30.9 (1)	29.7 (1)	16.8 (1)	24.5 (1)	54.5 (65)	82.4 (43)
Castor	38.1 (1)	66.4 (1)	30.1 (1)	70.5 (1)	79.1 (28)	106.2 (5)
Linseed	28.3 (1)	34.7 (1)	12.8 (3)	14.7 (3)	66.1 (33)	40.6 (30)
Safflower	66.9 (1)	70.2 (1)	48.6 (1)	53.6 (1)	72.5 (12)	76.4 (8)
Total of 8 oilseeds	16.0	18.6	8.0	9.6	50.0	53.6

Source: Compiled from the FAO Production Yearbooks.
Note: Figures in parentheses indicate India's position in the World

Table 17: Yield Difference between India and First Three Important Oilseed Producing Countries in the World

Oilseed Crop	Country and Yield per Hectare (Kg.), 1996
Groundnut	Israel (5400), Saudi Arabia (4000), Greece (3778), India (1000)
Rapeseed-mustard	Maxico (11111), Algeria (6250), Beltak (3857), India (952)
Castorseed	Paraguay (1382), Cambodia (1091), China (1083), India (952)
Sesamum	Honduam (1267), Ethopia (1063), Central Africa (1000), India (310)
Safflower	USA (2050), China (1905), Maxico (1111), India (608)
Sunflower	Ukraine (2727), Austria (2634), Greece (2591), India (659)
Soyabean	Italy (3435), Ethopia (3068), Greece (2912), India (866)
Linseed	Canada (843), China (500), India (340)

Source: FAO (1997), *FAO Production Yearbook,* Vol. 50, 1996, Rome.

Table 18: Statewise Per hectare Yield Differentials of Important Oilseed Crops, 1995-96 (Yield in Kg./ha.)

State	Ground-nut	Sesa-mum	Rapeseed-mustard	Lin-seed	Castor	Saf-flower	Niger-seed	Soya-bean	Sun-flower
Andhra Pradesh	1100	270	-	210	270	310	-	-	720
Bihar	900	340	760	490	-	-	510	-	-
Gujarat	540	370	1150	-	1580	-	-	580	-
Haryana	810	-	1270	-	-	-	-	-	1500
Himachal Pradesh	-	270	450	330	-	-	-	-	-
Karnataka	980	460	270	270	700	660	190	690	400
Kerala	760	250	-	-	-	-	-	-	-
Madhya Pradesh	1030	250	810	280	310	290	210	1020	340
Maha-rashtra	1130	250	430	260	300	560	200	-	620
Orissa	1010	210	160	450	530	500	460	-	-
Punjab	890	380	1050	-	-	-	-	-	1540
Rajasthan	760	100	860	450	1130	-	-	940	-
Tamil Nadu	1710	380	-	-	320	-	-	-	920
Uttar Pradesh	770	130	1040	410	-	-	-	780	1210
West Bengal	1160	750	790	290	-	-	-	-	-
All India	1010	290	910	330	970	580	320	1020	610

Source: CMIE (1997), Agriculture

Table 19: Levels of Adoption of Technology for Different Crops

(Per cent)

Technology	Groundnut		Sesamum		Sunflower		Greengram
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Variety	10	13	5	10	90	95	20
Seed rate	20	30	60	70	80	90	70
Seed treatment	10	20	Nil	Nil	-	-	10
Method of sowing	10	20	Nil	5	60	70	5
Thinning	-	-	10	30	50	60	-
Gypsum application	10	30	-	-	-	-	-
Intercultural operations	40	70	Nil	20	70	80	0
Fertiliser application	40	70	Nil	30	60	80	0
Note: * Anticipated Plant protection	20	50	Nil	40	50	75	0
Post-harvest technology	-	40	60	70	70	80	-
Use of implements	20	30	Nil	Nil	30	40	0

Source: Prasad and others, (1993).

Table 20: Yield Gaps (Kg./ha) of Important Oilseed Crops

Crop	National Average (1988-89)	Mean Realis-able Yields With Improved Technology	Yield Gap	
			Kg/Ha	Per Cent Difference
Groundnut				
Kharif	948	1347	399	42.0
Rabi/summer	1463	2161	698	47.7
Rapeseed	866	1645	779	90.0
Safflower	556	1044	488	88.8
Castor (Irrigated)	1478	2818	1340	90.7
Castor (Unirrigated)	317	1093	776	244.8
Sesamum	291	625	334	114.7
Linseed	295	671	376	127.5
Nigerseed	288	422	134	46.5
Sunflower				
Rabi/summer	367	1575	1208	329.2
Kharif	376	913	577	133.5

Source: Rao, (1991). Cited by Singh and Dhaliwal, (1993).

Table 21: Number of Seed Varieties Notified and Distribution of Certified/Quality Seeds

Year	Notification of Varieties (No.)		Distribution of Certified/Quality Seeds (Qty.in lakh Quintals)	
	Oilseeds	Pulses	Oilseeds	Pulses
1985-86	-	-	5.68	2.32
1986-87	-	-	6.29	3.39
1987-88	-	-	6.54	3.46
1988-89	10	9	11.12	3.48
1989-90	9	7	8.78	3.52
1990-91	13	3	8.59	3.41
1991-92	20	20	9.66	3.29
1992-93	13	16	10.75	3.40
1993-94	12	15	11.38	3.40*
1994-95 (Upto August 1994)	7	8	8.00	3.70*

Source: Government of India, Annual Reports, 1992-93 and 1994-95, Department of Agriculture and Cooperation, Ministry of Agriculture

Note: * Anticipated

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