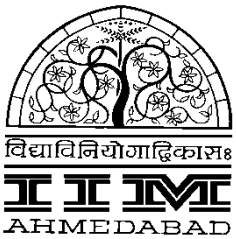
Final Report

Problems and Prospects of Oilseeds Production in India

Vijay Paul Sharma



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Vijay Paul Sharma

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Chapter 1

Introduction

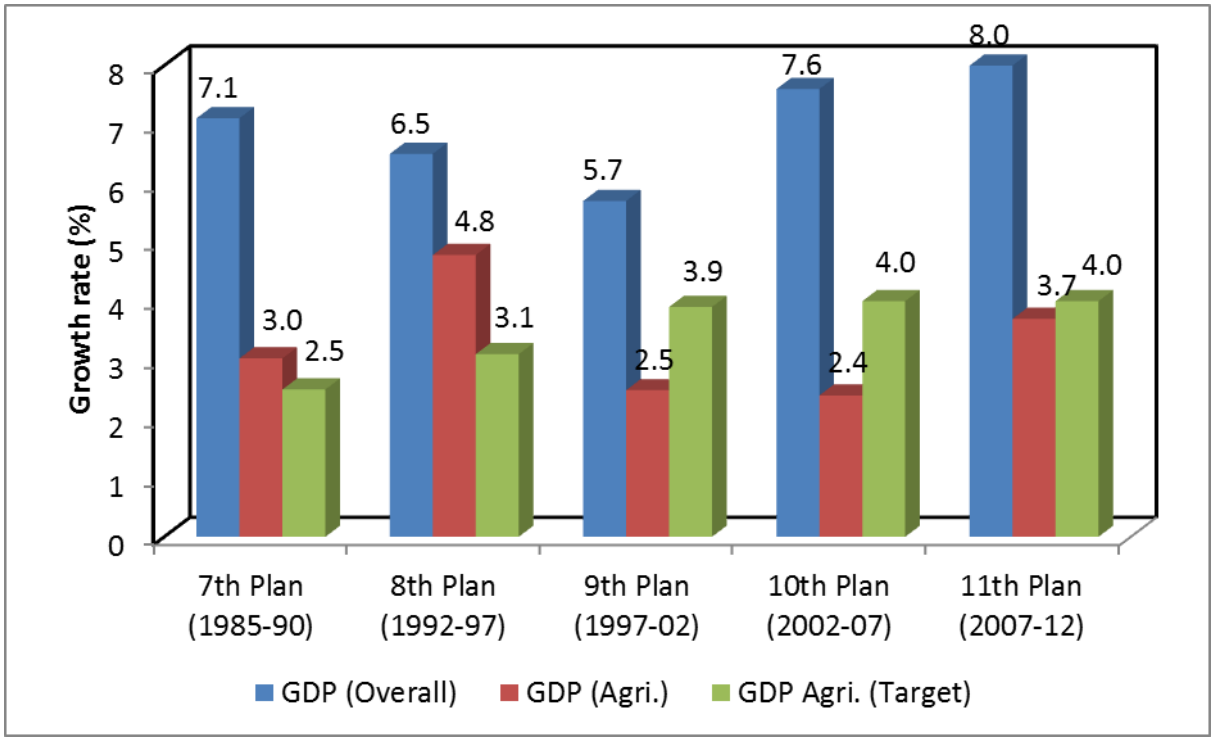
Role and Importance of Agriculture in the Indian Economy

Although agriculture contributed only 13.7 per cent (at constant 2004-05 prices) of India's Gross Domestic Product (GDP) in 2012-13, its importance in the country's socio-economic development goes well beyond this indicator as almost half of workforce (48.9%) is employed in agriculture (CSO, 2013 and GoI 2013). About 69 percent of the people live in rural areas, a large number of whom (216.5 million) are poor and mainly depend on agriculture for their livelihoods. About half of male workers and nearly 75 percent of the female workers in rural areas are engaged in agriculture (GoI, 2013a; GoI, 2013b).

The contribution of agricultural sector to GDP has continued to decline over the years while that of other sectors (particularly services) has increased. In 1971-72, agriculture and allied sectors contributed about 41 per cent of the GDP, which fell to 28.2 per cent and 13.7 per cent (at 2004-05 prices) in 1993-94 and 2012-13, respectively (CSO, 2013). The pace of structural transformation has accelerated in the post-reforms period. However, decline in the share of agricultural workers in total workers has been slower as compared to the decline in the share of agriculture in GDP. For example, between 1993-94 and 2009-10, there was more than 13.5 percentage point decline in the share of agriculture in GDP, while the decline in the share of agriculture in employment was only 8.8 percentage points. As a result, the labour productivity in agriculture has increased marginally, while for non-agricultural workers, it has increased rapidly. The value added per agricultural worker increased by 18.3% (from Rs. 17698 in 1993-94 to Rs. 20397 in 2004-05) compared with 51.7 per cent increase (from Rs. 58096 in 1993-94 to Rs. 88128 in 2004-05) in case of non-agricultural worker. Moreover, the gap between agriculture and non-agriculture GDP has increased significantly in the post-reforms period leading to an increasing disparity between rural and urban areas. The agricultural sector grew at an annual average rate of 4.8 per cent as compared to 6.5 per cent in overall GDP in the eighth plan (a gap of 1.7%) and the gap

between agriculture and overall GDP growth rate widened during the ninth (3.2%) and tenth plan (5.2%) but slightly declined during the eleventh plan (4.4%) due to good performance by Indian agricultural sector (Figure 1).

Figure 1.1: Comparative growth in GDP (overall) and GDP (agriculture) during different Plan periods in India



Source: GoI (2012)

The introduction of high-yielding varieties (HYV) technology (commonly known as Green Revolution) in mid-1960s yielded spectacular results and the production of food grains increased from about 83.4 million tonnes in the triennium ending (TE) 1964-65 to 104.4 million tonnes in TE 1971-72 (GoI, 2013). Subsequently, India, which was threatened by hunger and high dependence on imports as late as in mid-1960s, became one of the largest producers of many agricultural commodities such as rice, wheat, pulses, fruits and vegetables, etc., thus being self-sufficient in staple foods. The sharp increase in foodgrains production during the period of 1970s (CAGR of 2.8% per annum) and 1980s (CAGR of 3% per annum) enabled the country to achieve self-sufficiency in foodgrains. However, foodgrains production received a setback during the 1990s and growth rate decelerated to 1.9 percent but agricultural growth picked up during the 2000s and foodgrains production growth rate was about 2.6 per cent, primarily driven by productivity improvement, during the period 2001-02 to 2011-12.

Importance of Oilseeds in Indian Agriculture

Indian agriculture has made considerable progress, particularly in respect of food crops such as wheat and rice in irrigated areas; however, performance has not been so good in case of other crops particularly oilseeds, pulses, and coarse cereals. Therefore, after achieving self-sufficiency in foodgrains the government is focusing attention on these agricultural commodities. The oilseed sector has been an important area of concern and interventions for Indian policy makers in the post-reforms period when India became one of the largest importers of edible oils in the world, importing about half of domestic requirement in the 1990s.

On the oilseeds map of the world, India occupies a prominent position, both in regard to acreage and production. India is the 4th largest edible oil economy in the world and contributes about 10 per cent of the world oilseeds production, 6-7% of the global production of vegetable oil, and nearly 7 percent of protein meal. This sector also has an important place in the Indian agricultural sector covering an area of about 26.5 million hectares, with total production of over 29 million tonnes in the triennium ending 2011-12 (GOI, 2013). This constitutes about 14.8 per cent of the gross cropped area in the country. The oilseeds accounted for about 9.8 per cent (at 2004-05 prices) of the total value of output from agriculture in TE 2011-12 (CSO, 2013).

A wide range of oilseed crops is produced in different agro-climatic regions of the country. Three main oilseeds namely, groundnut, soybean, and rapeseed-mustard accounted for over 88 per cent of total oilseeds output during the TE2011-12. Soybean is the most important crop with an estimated production of 11.6 million tonnes in TE2011-12 grown mainly in Madhya Pradesh, Maharashtra, and Rajasthan accounting for more than 95 per cent of total production. The second most important oilseed crop is rapeseed-mustard (7.1 million tonnes) mainly grown in Rajasthan, Madhya Pradesh, Haryana, Uttar Pradesh, West Bengal and Gujarat with an estimated share of about 93 per cent in total production in the country. Groundnut, which was the largest oilseed crop in the 1990s, lost its share and is now 3rd important oilseed with an average production of 6.9 million tonnes in TE2011-12 and grown in Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan, Karnataka and Maharashtra with a combined share of about 91 per cent in total groundnut production in the country.

Other important edible oilseeds are sesamum, sunflower and safflower. Apart from West Bengal (21.3%) and Rajasthan (21.2%), Madhya Pradesh (16.8%) and Gujarat (14.1%) are other major sesamum producing states in the country. Karnataka (37.3%), Andhra Pradesh (27.2%) and Maharashtra (14.6%) account for about 80 percent of total sunflower production in the country, but production of sunflower has remained more or less constant with high variability during the last one and half decade. Safflower production has witnessed a steady decline and Maharashtra (54.7%), Karnataka (27.9%), and Gujarat (12.7%) are major producers with a share of over 95 percent in total production.

Programmes and Policies Governing Edible Oilseeds and Oils

India was a net exporter of oilseeds, meals, extractions and edible oils till 1960s but with stagnation in production and increasing demand for edible oils, India became net importer of edible oils by late-1970s. By the mid-1980s, edible oils was the largest import item, constituting about 30 per cent of the total imports, next only to petroleum products despite the fact that India had the world's second largest area under oilseeds. Government decided to achieve self-sufficiency in edible oilseeds through various policy and technological interventions by 1990s. The initial strategy to overcome stagnant oilseed production was to promote new technologies in oilseed production and processing through Centrally Sponsored Schemes. The National Oilseed Development Project (NODP) was initiated in 1984-85 and launched in 1985-86 by reorienting various centrally sponsored schemes for oilseeds development. Government of India launched Technology Mission on Oilseeds in May 1986 to increase oilseeds production in the country and achieve self-sufficiency in edible oils. In 1991-92, in view of the potential of oil palm in the country, Oil Palm Development Programme (OPDP) was launched under the "Technology Mission on Oilseeds and Pulses" with a focus on area expansion in Andhra Pradesh, Karnataka, Tamil Nadu, Orissa, Gujarat and Goa. During the Tenth Plan, Integrated Scheme on Oilseeds, Pulses, Oil Palm and Maize (ISOPOM) was implemented by converging earlier schemes like Oilseeds Production Programme (OPP), Oil Palm Development Programme (OPDP), National Pulses Development Programme (NPDP) and Accelerated Maize Development Programme (AMDP). From April 2010, pulses component of ISOPOM has been merged with Natural Food Security Mission (NFSM) to intensify efforts for production of pulses.

As a result of these policy and technological interventions initiatives, production of oilseeds increased significantly during mid-1980s to early-1990s. Between TE1985-86 and TE1993-94, production of oilseeds increased from 12.1 million tonnes to over 20 million tonnes, largely due to improved yields. Average yields increased from 644 kg/ha to 772 kg/ha during the corresponding period. Increase in area also contributed to higher production of oilseeds in the country. Area planted to all oilseeds increased from 18.9 million hectares in TE1985-86 to about 26 million hectares in TE1993-94. However, in pursuance of the policy of liberalization and globalization in the early-1990s, there were progressive changes in the trade policy in respect of edible oils. Imports of edible oils were liberalized by moving edible oils from negative list of imports and canalization to open general license (OGL). With decanalization and placing imports of edible oils under OGL in 1994-95 with reduction in import duty, imports of edible oils particularly palm oil and soybean oil increased substantially. Due to opening up of domestic markets and lack of appropriate technologies, the production of oilseeds in the country remained stagnant at about 20 million tonnes during the 1990s but increased during the recent years and reached a level of about 26.5 million tonnes in TE2011-12. The annual compound growth rate in oilseeds production was negative (-1.96%) between 1994-95 and 2000-01 but improved significantly (4.9%) during the 2000s. The average productivity has increased from 859 kg/ha in TE2001-02 to 1096 kg/ha in TE2011-12. The productivity witnessed a growth rate of 3.1 per cent while oilseeds acreage increased at the rate of 1.8 per cent during 2001-02 to 2011-12. However, the productivity levels of oilseeds in the country are still very low compared to the world average and other countries. The yields remain low largely on account of dependence on dryland farming. The production of oilseeds has not been able to keep pace with the rising demand for edible oils, which necessitated import of edible oils and today India imports about half of its edible oil requirement.

In the last three decades, oilseeds production recorded the highest growth rate (5.8%) during the 1980s, followed by 2000s (4.9%) and the lowest (0.6%) during the 1990s. During the 1980s, area expansion and productivity improvement were major drivers, area contributing about 52 per cent to increased production and contribution of yield was about 48 percent. In contrast during the 2000s, yield improvement contributed about 63 per cent to increase in production and contribution of area expansion was 37 per cent. However, during the decade of nineties, area under oilseeds recorded a negative growth rate (-0.9%)

while productivity improved marginally (1.4%). Since the area available for cultivation is limited, and in fact shrinking, production increase must come mainly from increased yield per unit of land.

Production of oilseeds and oils has not kept pace with increasing demand for edible oils and this widening demand-supply gap has necessitated imports of edible oils. The edible oils are the single largest agricultural product being imported in the country with an estimated share of about 53 percent in total agricultural imports during the TE2011-12. Dependence on imports has increased from less than 5 per cent in the early-1990s to over 55 per cent in the recent years and is a matter of concern.

Given the competing demands on agricultural land from various crops and enterprises, the production of oilseeds can be increased only if productivity is improved significantly and farmers get remunerative and attractive prices and assured market access. However, farmers face various constraints in oilseeds production. Most of the oilseeds are grown under rainfed conditions, and only 25 percent of area under oilseeds is irrigated. Several biotic, abiotic, technological, institutional, and socio-economic constraints also inhibit exploitation of the yield potential of crops and need to be addressed. Taking into account the changing policy environment, increasing demand, slow growth in domestic production and rising imports, the study attempts to analyze performance and potential of Indian oilseeds sector, identify major problems/constraints facing the sector and suggest options for increasing oilseeds production and productivity in the country.

Objectives

The specific objectives of the study are:

1. To examine trends and pattern of growth of different edible oilseeds over time and across states and identify the sources of growth in edible oilseeds output in India, and
2. To identify major constraints in the edible oilseeds cultivation and suggest policy options to increase oilseeds production and productivity in the country.

Organization of the Study

The study is organized into ten chapters. Chapter 1 provides an overview of role and importance of agriculture and oilseeds in the Indian economy, introduces the problem

statement and describes the specific problems addressed in the study. Chapter 2 presents the methodology and procedures used for data collection and analysis. In the following chapter (Chapter 3), the issue of cropping pattern changes during the last three decades and factors underlying these changes at the all-India level as well as for major states over the period 1981-82 to 2011-12 are discussed. This chapter presents the current status and growth behaviour of major edible oilseed crops in terms of area, production, and yield across different states of India during the post-reforms period. The next few chapters (chapters 4-9) discuss performance, recent trends, prospects and constraints involved in the cultivation of major edible oilseed crops. Chapter 4 provides an overview of recent trends, prospects and constraints in soybean cultivation. Trends in growth behaviour of rapeseed-mustard in terms of area, production, and yield in major producing states during the last three decades and constraints faced by farmers in rapeseed-mustard cultivation and suggestions for improving production are discussed in Chapter 5. Chapter 6 contains an analysis of performance of groundnut and problems encountered in groundnut production in major producing states. The issues related to cultivation of sunflower are discussed in Chapter 7. In Chapter 8, we analyze the performance of sesamum and examine various factors affecting sesamum cultivation in the country. Performance of safflower is discussed in Chapter 9. Main findings of the study, conclusions, and policy implications are discussed in the last chapter.

Chapter 2

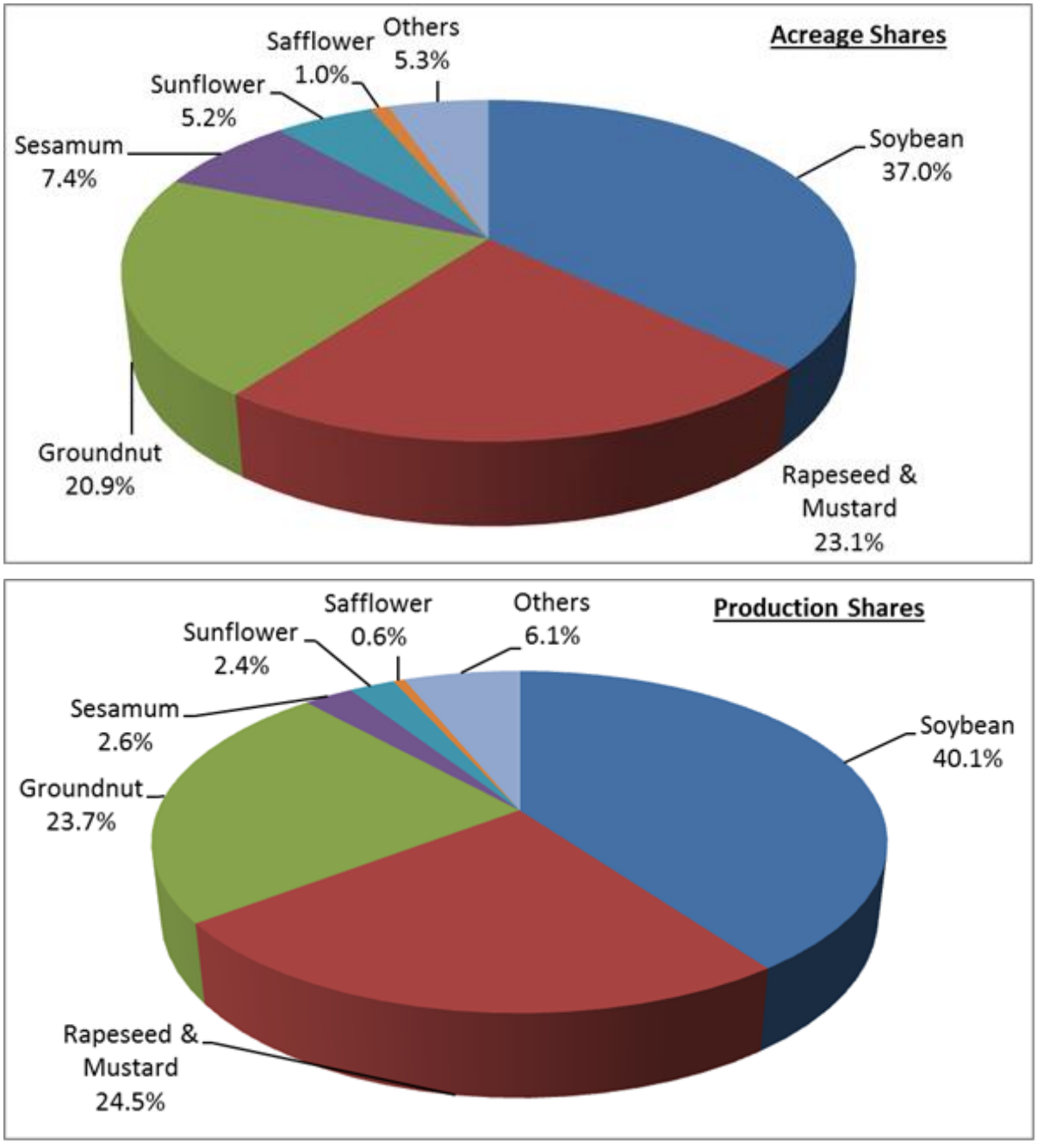
Coverage, Sampling Design and Methodology

This study is based on both primary and secondary data pertaining to major edible oilseeds, namely soybean, groundnut, rapeseed-mustard, sesamum and sunflower, grown in the country. In order to provide an overview of oilseed economy of the country, secondary data related to area, production and productivity of major oilseeds have been collected from different published sources such as State-wise Area, Production and Yields Statistics, Agricultural Statistics at a Glance, Land Use Statistics at a Glance, Report on Price Policy for Kharif and Rabi Crops, etc. published by Ministry of Agriculture, Government of India. Besides oilseeds, information on other major crops was also collected. In order to study the growth trends and patterns, the study analyzed a disaggregated time series data for major oilseeds and foodgrains in important states and the country. In order to identify major constraints in edible oilseeds production in the country, primary data from the households growing oilseeds in selected states were collected. The data on the socio-economic profile, operational holding, cropping pattern, area, production and yield of oilseeds and their cultivation aspects, sources of inputs, extension support, credit, marketing, processing and value addition aspects, major constraints in cultivation of oilseeds, etc. were collected from oilseed producers in selected states.

Coverage and Sampling Design

Multi-stage stratified sampling method was used with major states producing selected edible oilseeds as strata and districts, blocks, villages and households as primary, secondary, tertiary and ultimate units of sample, respectively. Figure 2.1 shows the share of major edible oilseeds in total area and production of oilseeds in the country during the TE2011-12. The study covered five major oilseeds, soybean, rapeseed-mustard, groundnut, sesamum and sunflower, which account for over 90 per cent of total acreage and production of nine oilseeds in the country.

Figure 2.1: Share of major oilseeds in total acreage and production of oilseeds in India: TE2011-12



Source: GoI (2013c)

In the next stage, about 2-3 states were selected with a significant share in production/acreage of respective oilseeds as well as having the potential for additional production. The shares of major states in total production of selected oilseeds as well as in total acreage are given in Tables 2.1 and 2.2. Based on production/acreage shares, we selected Madhya Pradesh and Maharashtra for soybean, Rajasthan, Madhya Pradesh and

Uttar Pradesh for rapeseed-mustard, Gujarat and Andhra Pradesh for groundnut, West Bengal for sesame and Karnataka and Andhra Pradesh for sunflower crop.

Table 2.1: Share of major states in oilseeds production in India: TE2011-12

Oilseed	***Major Producers***
Soybean	Madhya Pradesh (55.4%), Maharashtra (30.0%), Rajasthan (9.8%), Others (4.8%)
Rapeseed-Mustard	Rajasthan (46.2%), Haryana (12.2%), Madhya Pradesh (12.0%), Uttar Pradesh (11.8%), West Bengal (5.6%), Gujarat (4.9%), Others (7.3%)
Groundnut	Gujarat (38.0%), Andhra Pradesh (16%), Tamil Nadu (13.8%), Rajasthan (8.9%), Karnataka (8.4%), Maharashtra (5.7%), Others (9.3%)
Sesamum	West Bengal (21.3%), Rajasthan (21.2%), Madhya Pradesh (16.8%), Gujarat (14.1%), Uttar Pradesh (7.6%), Andhra Pradesh (2.9%), Others (11.1%)
Sunflower	Karnataka (37.3%), Andhra Pradesh (27.2%), Maharashtra (14.6%), Punjab (4.4%), Bihar (3.9%), Haryana (3.0%), Others (9.5%)

Source: GoI (2013c)

Table 2.2: Share of major states in total area under oilseeds in India: TE2011-12

Oilseed	***Major States***
Soybean	Madhya Pradesh (56.3%), Maharashtra (29.7%), Rajasthan (8.3%), Others (5.7%)
Rapeseed & Mustard	Rajasthan (46.2%), Madhya Pradesh (12.6%), Uttar Pradesh (10.1%), Haryana (8.4%), West Bengal (6.7%), Gujarat (3.5%), Others (12.4%)
Groundnut	Gujarat (32.0%), Andhra Pradesh (25.5%), Karnataka (14.1%), Rajasthan (7.6%), Tamil Nadu (7.1%), Maharashtra (5.9%), Others (7.7%)
Sesamum	Rajasthan (28.0%), Uttar Pradesh (17.1%), Madhya Pradesh (13.3%), Gujarat (12.8%), West Bengal (9.3%), Andhra Pradesh (4.8%), Others (14.7%)
Sunflower	Karnataka (50.5%), Andhra Pradesh (23.4%), Maharashtra (16.7%), Bihar (1.7%), Punjab (1.6%), Haryana (1.1%), Others (5.0%)

Source: GoI (2013c)

From each selected state, 2-3 districts were selected on the basis of joint consideration of the area sown under selected oilseed crop and the productivity level of the crop. The selection of districts was based on association between acreage and yield as per the classification presented in Table 2.3.

Table 2.3: Criteria for selection of districts

Yield / Area	*High*	*Low*
High	High Area – High Yield (HH)	High Area – Low Yield (HL)
Low	Low Area – High Yield (LH)	Low Area – Low Yield (LL)

All districts were categorized into four groups, such as high area-high yield (HH), high area-low yield (HL), low area-high yield (LH), and low area-low yield (LL). Since HH, HL and LH categories of districts have the potential for further increase in production of crops, it was decided to select one district each from these three categories for household survey. The state-wise distribution of selected districts is given in Table 2.4.

Table 2.4: List of selected districts

Oilseed	***Selected State***	***Selected Districts***
Soybean	Madhya Pradesh	Chhindwara, Narsingpur, Khandwa
	Maharashtra	Amravati, Kolhapur
Rapeseed & Mustard	Rajasthan	Bharatpur, Kota, Tonk
	Madhya Pradesh	Mandla, Chhatarpur, Morena
	Uttar Pradesh	Agra, Etah, Lakhimpur
Groundnut	Gujarat	Junagadh, Rajkot, Porbandar
	Andhra Pradesh	Mahaboobnagar, Srikakulam, Anantapur
Sesamum	West Bengal	Nadia, North 24 Parganas, Bankura
Sunflower	Karnataka	Bagalkot, Belgaum, Bijapur, Shimoga
	Andhra Pradesh	Kurnool, Prakasam and West Godavari

Source: Field Survey.

At the next stage, a list of major oilseed producing talukas/blocks in each selected district was prepared, and an appropriate number of talukas/blocks were selected for the study. From each selected taluka/block an appropriate number of villages were selected for the household survey. Finally, from each selected village, an appropriate number of farmers growing oilseeds and representing different farm categories (Marginal 0-1 ha, Small 1-2 ha, Medium 2-10 ha; Large >10 ha) were selected based on probability proportional to size

distribution at district/taluka level and with a condition that in each district a sufficient number of households in each category was obtained. The final sample consisted of 30 districts, and about 2000 households spread over eight states. Table 2.5 presents the details of various categories of households selected from various states for the selected oilseed. The reference year of the study for the household survey was 2011-12. The household data were collected by participating Agro-Economic Research Centres/Units from selected states (Table 2.6).

Conceptual Framework and Theoretical Model of the Study

As discussed earlier, the main objectives of the study were (i) to examine spatial and temporal trends and patterns of growth of important edible oilseeds and sources of growth in edible oilseeds output; and (ii) to identify major constraints in edible oilseed cultivation and suggest policy options to increase oilseeds production and productivity in the country.

Table 2.5: List of selected crops, states and farm category-wise sample size

Oilseed	***Selected State***	***Marginal***	***Small***	***Medium***	***Large***	***Total***
Soybean	Madhya Pradesh	62	47	93	38	240
	Maharashtra	110	70	69	1	250
	Total	***172***	***117***	***162***	***39***	***490***
Rapeseed & Mustard	Rajasthan	19	38	116	27	200
	Madhya Pradesh	23	34	46	17	120
	Uttar Pradesh	55	68	61	12	196
	Total	***97***	***140***	***223***	***56***	***316***
Groundnut	Gujarat	15	66	161	8	250
	Andhra Pradesh	31	78	130	11	250
	Total	***46***	***144***	***291***	***19***	***470***
Sesamum	West Bengal	**165**	**43**	**42**	**-**	**250**
Sunflower	Karnataka	72	110	66	72	320
	Andhra Pradesh	9	37	91	13	150
	Total	***81***	***147***	***157***	***85***	***470***

Source: Field Survey.

Table 2.6: List of Participating Agro-Economic Research Centres/Units in the Study/Field Survey

Oilseed	***Selected States***	**Participating AERCs**
Soybean	Madhya Pradesh	Agro-Economic Research Centre, J. N. Krishi Vishwa Vidyalaya, Jabalpur
	Maharashtra	Gokhale Institute of Politics & Economics, Pune
Rapeseed & Mustard	Rajasthan	Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar (Gujarat)
	Madhya Pradesh	Agro-Economic Research Centre, J. N. Krishi Vishwa Vidyalaya, Jabalpur
	Uttar Pradesh	Agro-Economic Research Centre, University of Allahabad, Allahabad
Groundnut	Gujarat	Agro-Economic Research Centre, Vallabh Vidyanagar (Gujarat)
	Andhra Pradesh	Agro-Economic Research Centre, Andhra University, Visakhapatnam, A.P.
Sesamum	West Bengal	Agro-Economic Research Centre, Visva-Bharati, Santiniketan (WB)
Sunflower	Karnataka	Agricultural Development and Rural Transformation Centre (ADRTC), Institute for Social and Economic Change (ISEC), Bangalore
	Andhra Pradesh	Agro-Economic Research Centre, Andhra University, Visakhapatnam, A.P.

In order to meet the first two objectives of the study, secondary data on state-wise area, production, and yield of major edible oilseed crops/crop groups, irrigated area under oilseeds, farm-harvest prices of selected oilseeds and competing crops, etc. were analysed using compound annual growth rates (CAGR), averages, coefficient of variations, etc. The analysis on trends and patterns of growth of different edible oilseeds over time and across states was done for the last three decades with a special focus on post-reforms period. To measure the relative contribution of area and yield towards the total output change, decomposition analysis was used. The analysis helped in identifying the sources of growth in

output by decomposing the changes in production into three effects, i.e., area effect, yield effect and interaction effect. The decomposition analysis was carried out on the major oilseeds mainly for the following three periods, i.e., Period I (TE1983-84 to TE1993-94) Period II (TE1993-94 to TE 2003-04) and Period III (TE2003-04 to TE2011-12). During Period I, the expansion of area under oilseeds was encouraged by introduction of Technology Mission on Oilseeds (TMO) in 1986 by Government of India. During Period II, opening up of imports of edible oils as part of economic reforms and signatory to WTO had considerable impact on domestic production and consumption pattern of major oilseeds in the country. Phase III witnessed a revival in oilseeds production and reached a record level of 32.5 million tonnes in 2010-11. In order to measure the relative contribution of area and yield towards total output change, component analysis model has been used. The quantity of output of a crop i (Q_i) is the product of yield (Y_i) and acreage allocated to its production (A_i). Decomposition can thus take the following approximate form:

$$\Delta Q_i \cong A_i \Delta Y_i + Y_i \Delta A_i$$

The decomposition reveals the relative contribution of changes in acreage and changes in yield to the overall change in the quantity of output. This is a policy-relevant issue to the extent that acreage and yield changes reflect government interventions in the sector. However, the decomposition formula stated above is an approximation of the actual change in output in which the interaction between the sources of change is not accounted. In order to capture this interaction effect, we used the following formula:

$$Q_n - Q_0 = A_0 (Y_n - Y_0) + Y_0 (A_n - A_0) + (A_n - A_0)(Y_n - Y_0)$$

$$\Delta P = \quad A_0 \Delta Y \quad + \quad Y_0 \Delta A \quad + \quad \Delta A \, \Delta Y$$

Change in production = Yield effect + Area effect + Interaction effect

Where,

Q_n = Production in the current year

Q_0 = Production in the base year

A_n = Acreage in the current year

A_0 = Acreage in the base year

Y_n = Yield in the current year

Y_0 = Yield in the base year

ΔQ = Change in production (Q_n-Q_0)

ΔY= Change in yield (Y_n-Y_0)

ΔA = Change in area (A_n-A_0)

Identification and Prioritization of Major Constraints Faced by Oilseeds Producers

Household data were collected through direct interviews with the respondents conducted by the staff of participating centres/units using a pre-tested questionnaire. Most questions were close-ended with predetermined response options among which respondents could choose. Therefore, the households chose more than one answer, and it gave multiple responses. Descriptive statistics showing key features of the selected indicators relating to land use and cropping pattern, oilseeds production, productivity, profitability and marketing, was carried out. For questions with more than one response, multiple response frequencies were used, and percentages of valid cases (less or more than 100 per cent) were reported.

The yield gap and production potential of major oilseeds were also estimated to assess the scope for increasing its production. The yield gap analysis was conducted to ascertain the gap between the potential yield and actual yield, and between experimental yield and actual yield. Three types of yield gaps have been calculated, yield gap-I (often known as technology gap) measures the gap between the experimental yield and potential yield, whereas yield gap-II measures the gap between the actual yield and potential yield. The yield gap-III, also known as extension gap, measures the gap between the experimental yield and actual yield.

The productivity level of edible oilseeds is relatively low, due to various technological, institutional, infrastructure and socio-economic constraints or a combination of these factors. The major limiting factors as perceived by the selected households in the selected states was identified and prioritized. In order to identify and prioritize major constraints facing oilseeds production, appropriate analytical techniques were used in the study. Each household was asked to rank major constraints affecting their oilseed crop. The responses of the sample farmers on the extent of severity of various constraints faced by them have been ranked by using ordinal scores from 4 to 1 (Severe=4, Moderate=3, Minor=2, Not important=1). The major constraints considered for the study were technological (non-availability of suitable varieties, poor crop germination, lack of irrigation facilities, weeds

infestation etc.), agro-climatic factors (drought at critical stages of crop growth, excessive rains, extreme variations in temperature etc.), economic and institutional (high-input cost on diesel, fertilizers, agrochemicals, shortage of human labour, low and fluctuating prices, problem of timely availability of seed, non-availability of other inputs, lack/poor extension services etc.), and post-harvest, marketing and value addition (availability of marketing infrastructures and transportation facilities, high transportation costs, exploitation by market intermediaries etc.).

Chapter 3
Overview of Oilseeds Sector: Current Status and Growth Behaviour

The agricultural policy in India has evolved from a focus on achieving self-sufficiency in crop production in general and foodgrains in particular and food security concerns to enhancing the competitiveness of the Indian agriculture and diversification of agriculture. Policy support for agricultural markets, inputs and services, technology, product price support, institutions and infrastructure has led to an increase in area, production, and yield of foodgrains and other agricultural commodities. India became self-sufficient, and in fact witnessed surplus in foodgrains in the late-1980s. However, this 'policy support' neglected some of the crops and regions, and India became a net importer of some agricultural commodities, such as edible oils and pulses. However, the liberalization of the economy led to some shift in acreage under foodgrains to non-foodgrains, particularly high-value crops/enterprises such as fruits, vegetables, fibers, etc. and policy support was provided to encourage farmers to diversify their cropping pattern towards high-value crops.

Cropping pattern changes are the result of farmers' decision about allocation of land to various crops, which is dependent on net returns and risks associated with the individual crop and competing crops. However, there are other factors which influence area allocation decisions such as availability of seeds and other production inputs, irrigation, access to input and output markets, access to credit and other services, product price support policy, input subsidies and agro-climatic factors such as soil type, temperature, rainfall distribution, etc. Significant changes in cropping pattern have taken place during the last four decades. After the introduction of high yielding varieties of rice and wheat in the mid-1960s (Green Revolution), area under wheat and rice expanded significantly while area under coarse cereals and pulses declined. The area, production and productivity of oilseeds also remained stagnant during the decades of sixties and seventies.

Concerned with stagnating production of oilseeds in the country, government of India launched the "Technology Mission on Oilseeds" in the mid-80s, which led to a significant increase in area and production of oilseeds. However, during the 1990s there have been

some shifts in area allocation among different crops/crop groups due to the opening-up of the agricultural sector and changing food habits. In this chapter, we examine the cropping pattern changes over the last four decades and identify important factors influencing those changes in the country.

Crop Pattern Shifts in Major Crops and Crop Groups (1970-2010)

The temporal analysis of changes in crop pattern has been done both at the national and state level. For present study, crop pattern changes at all India level are evaluated by considering the area share of major crops and crop groups at five time points capturing, respectively, the triennium ending (TE) averages of area in 1973-74, 1983-84, 1993-94, 2001-02 and 2010-11. These time points have been selected so as to capture different stages in the development of Indian agriculture. The TE1973-74 attempts to capture the initial impact of green revolution technology in Punjab, Haryana and Western Uttar Pradesh. The second point, TE1983-84 represents an extension of new technology to rice, and to the southern region. The triennium of 1990-93 captures the results of maturing off and spread of the green revolution to eastern and central parts of the country. This period is also characterized by a number of policy changes including the launching of the Technology Mission on Oilseeds (TMO) as well as price support and stabilization policies for oilseed crops. It was during the eighties that crops like oilseeds and other commercial crops started gaining importance and replaced coarse cereals in the central region. The triennium 1999-2001 represents post-liberalization period and tries to capture the impact of economic reforms on Indian agriculture at the national as well as state levels as this period witnessed a deceleration in public investment in agriculture. The last TE2010-11 represents a period of high growth recovery of agriculture and introduction of Bt cotton, hybrid maize and a favourable pricing policy.

Crop area changes at all-India level are analyzed for major crop/crop groups, namely, rice, wheat, coarse cereals, pulses, total foodgrains, groundnut, rapeseed-mustard, soybean, sunflower, total oilseeds, cotton, sugarcane and fruits and vegetables. For each crop/crop group, area shifts are examined, both in absolute and relative terms, for the trienniums ending: 1973-74, 1983-84, 1993-94, 2001-02 and 2010-11 (Table 3.1).

The table shows that the area under cereals remained relatively constant at national level at about 100 million ha between TE1973-74 and 2010-11 but in terms of its share in gross

cropped area (GCA), there was a decline from 60.7 to 51.7 per cent. However, some dramatic changes have taken place among different cereals. For example, area under rice and wheat increased significantly between TE 1973-74 and TE2001-02, by about 7.5 million ha. While the share of wheat in GCA increased from 11.5 to 14.2 per cent, in the case of rice its share rose from 22.7 to 24 per cent during the same time period. During the last decade, however, rice acreage declined by about one million ha while wheat area increased by over 2 million ha. The share of maize, which remained almost stable at 3.5 per cent during the 1970s, 1980s and 1990s, increased and reached a level of 4.2 per cent in TE2010-11. The share of other coarse cereals declined from 23.1 to about 10 per cent of GCA during the last four decades. The expansion in area under rice and wheat has taken place mainly because of an increase in irrigation facilities, use of high yielding varieties of seeds, assured price support and market. Other coarse cereals suffered the most, as area declined by about 16 million ha between TE1973-74 and 2010-11.

The area under pulses decreased by about one million ha during 1980s and 1990s but increased by about 2 million ha during the last decade. However, the relative share declined from 13.4 in early-1970s to 11.9 per cent in TE2001-02 but increased (12.4%) during the last decade. The area under oilseeds increased significantly from 18.5 million ha in TE1983-84 to 26 million ha in TE1993-94, mainly due to the implementation of TMOP in 1986 but declined by about 0.8 million ha during 1990s. The oilseeds acreage however, recorded an increase during the last decade due to an increase in support prices. Rapeseed-mustard and soybean in particular witnessed an impressive increase in the acreage. Soybean acreage, which was less than half a million ha in 1970-72, increased to 9.6 million ha in TE2010-11, and its share increased from negligible to about 4.9 per cent of GCA. Rapeseed-mustard acreage rose by over 2 million ha during the last four decades. Groundnut, which was the most important oilseeds crop during the 1970s, 1980s, and 1990s, lost its acreage, more so during the last decade mainly due to the introduction of Bt. cotton. Other edible oilseeds like safflower, sunflower and sesamum have lost acreage, as well as their share in gross cropped area. The area under fruits and vegetables increased from 3.7 million ha in early-1970s to 9.8 million ha in TE2010-11, and its share almost doubled during the period. The area under cotton, which remained constant at around 7.5-8.0 million ha witnessed an increase of around 1.3 million ha during the last decade and reached a level of 10.1 million ha during TE2010-11.

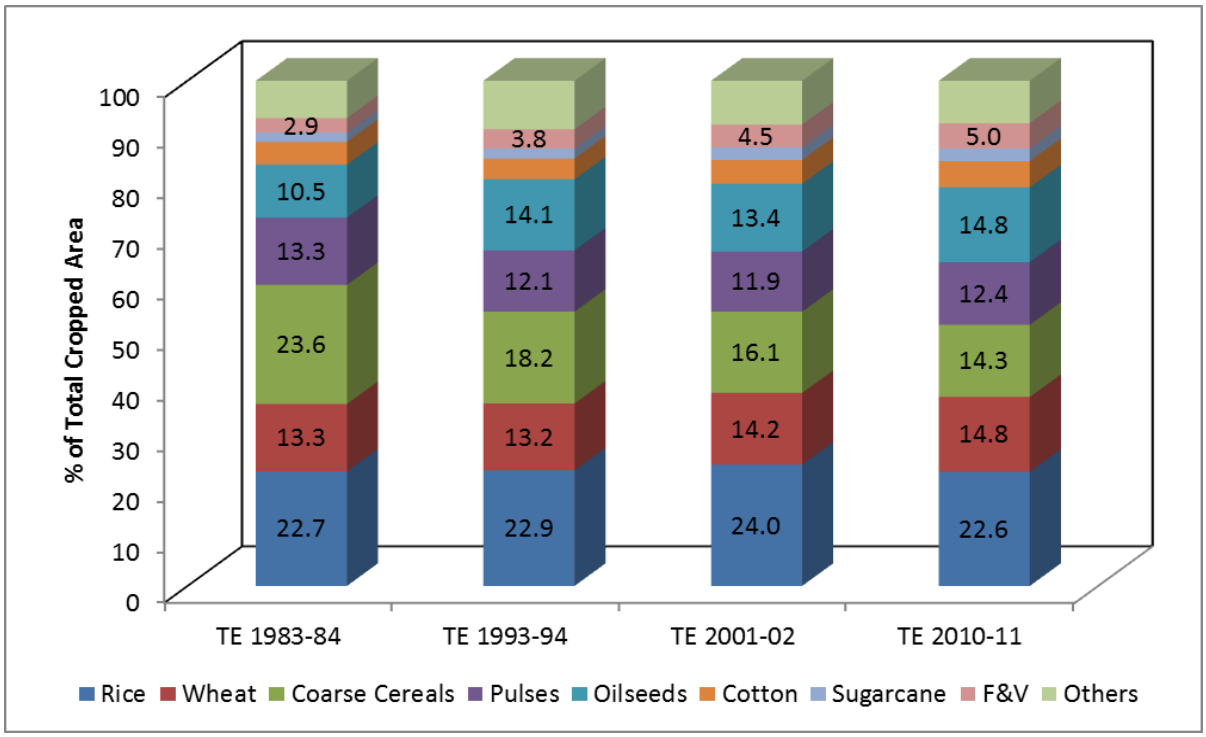
Table 3.1: Total cropped area under selected crops in India: TE1973-74 to TE 2010-11

Crop/Crop Group	*TE 1973-74*	*TE 1983-84*	*TE 1993-94*	*TE 2001-02*	*TE 2010-11*
	Area (million ha)				
Rice	37.6	40.1	42.3	45.0	43.9
Wheat	19.1	23.5	24.3	26.6	28.8
Maize	5.8	5.8	5.9	6.7	8.2
Other coarse cereals	38.2	35.7	27.7	23.4	19.7
Total cereals	100.7	105.1	100.2	101.6	100.6
Total pulses	22.2	23.4	22.4	22.2	24.0
Total foodgrains	122.8	128.5	122.6	123.9	124.6
Groundnut	7.2	7.4	8.4	6.7	5.8
Rapeseed-mustard	3.5	4.0	6.4	4.9	5.6
Sesame	2.4	2.3	2.3	1.8	2.1
Safflower	0.5	0.8	0.7	0.4	0.3
Soybean	-	0.7	3.8	6.3	9.6
Sunflower	0.2	0.5	2.3	1.2	1.4
Other oilseeds	2.9	2.6	2.2	3.9	4.1
Total oilseeds	16.7	18.5	26.0	25.2	28.9
Cotton	7.7	7.9	7.5	8.8	10.1
Sugarcane	2.5	3.2	3.6	4.7	4.9
Fruits & Vegetables	3.7	5.1	7.0	8.4	9.8
Total cropped area	165.7	176.4	184.8	187.3	194.4
	Share (%) in Total Cropped Area				
Rice	22.7	22.7	22.9	24.0	22.6
Wheat	11.5	13.3	13.2	14.2	14.8
Maize	3.5	3.3	3.2	3.6	4.2
Other coarse cereals	23.1	20.3	15.0	12.5	10.1
Total cereals	60.7	59.6	54.2	54.3	51.7
Total pulses	13.4	13.3	12.1	11.9	12.4
Total foodgrains	74.1	72.8	66.3	66.1	64.1
Groundnut	4.3	4.2	4.5	3.6	3.0
Rapeseed-mustard	2.1	2.3	3.4	2.6	2.9
Sesame	1.4	1.3	1.2	0.9	1.1

Safflower	0.3	0.4	0.4	0.2	0.1
Soybean	-	0.4	2.0	3.4	4.9
Sunflower	0.1	0.3	1.2	0.6	0.7
Other oilseeds	1.8	1.5	1.2	2.1	2.1
Total oilseeds	10.0	10.5	14.1	13.4	14.8
Cotton	4.6	4.5	4.1	4.7	5.2
Sugarcane	1.5	1.8	2.0	2.5	2.5
Fruits & Vegetables	2.2	2.9	3.8	4.5	5.0

Source: GoI (2013d)

Figure 3.1: Changing shares of major crops/crop groups in total cropped area in India: TE1983-84 to TE2010-11



Source: GoI (2013d)

Area Expansion and Crop Intensification

Decomposition of expansion in total cropped area (TCA) during TE1973-74 and 2010-11 shows that there was a marginal increase in the net sown area (NSA) during the 1970s and 1980s while during the 1990s and 2000s, the NSA declined. Net irrigated area addition varied from 9.5 million ha during the 1980s to 6.1 million ha during the 1990s. Like irrigation expansion, increased cropping intensity (represented by difference in TCA and NSA) was a major source of growth in TCA (Table 3.2). Therefore, most of the growth in TCA can be

attributed to crop intensification. The expansion in TCA during the 1990s and 2000s was solely from crop intensification and contribution of area expansion was negative. The contribution of crop intensification to expansion in TCA was more than 80 per cent during the 1970s and 1980s. Despite crop intensification, some crops like coarse cereals, and pulses experienced decline in acreage, while the major beneficiaries were rice and wheat, high-value crops, and to some extent oilseeds.

Table 3.2: Changes in Gross Cropped Area: Area expansion and crop intensification effects: TE1973-74 to TE2010-11 *(million ha)*

Indicators	***TE 1973-74 to 1983-84***	***TE 1983-84 to 1993-94***	***TE 1993-94 to 2001-02***	***TE 2001-02 to 2010-11***	***TE 1973-74 to 2010-11***
Change in TCA	10.6	8.5	2.4	7.2	28.7
Change in GIA	13.1	14.5	11.0	9.9	48.5
Area Expansion					
Net Sown Area (NSA)	2.3	0.2	-1.2	-0.2	1.1
Net irrigated area (NIA)	9.1	9.5	6.1	6.5	31.1
Crop intensification					
TCA – NSA	8.3	8.3	3.6	7.3	27.6
GIA – NIA	4.0	5.1	5.0	3.4	17.4

Source: Authors' computation using MoA data (GoI, 2013d)

The trends in total cropped area, net sown area, gross irrigated area and net irrigated area in major states are presented in Table 3.3. Some states like Bihar, Kerala, Odisha and Tamil Nadu witnessed a decline in total cropped area between TE1992-93 and TE2010-11, while at the national level, total cropped area increased by about 9.9 million ha. The number of states which witnessed a decline in net sown area was much higher (9) while at the national level about 1.5 million ha net sown area was lost during the post-reforms period. The above results clearly indicate that most of the growth in TCA in most states was due to crop intensification (irrigation expansion and increased cropping intensity). Despite crop intensification in many states, about half of major States experienced decline in cereals acreage. The state-level cropping pattern changes are discussed in the next section.

Cropping Pattern Changes: State-Level Analysis

The temporal behaviour of crop pattern changes at state level can be seen from Table 3.4 and Table 3.5 that show, respectively, the area shares of major foodgrains, oilseeds and commercial crops for the periods TE1993-94 and TE2009-10.

Table 3.3: Changes in gross cropped area: area expansion and crop intensification effects in selected states, TE1992-93 to TE2010-11 *('000 ha)*

	Change		*Area Expansion*		*Crop Intensification*	
State	***TCA***	***GIA***	***NSA***	***NIA***	***TCA-NSA***	***GIA-NIA***
Andhra Pradesh	588	1275	-161	461	749	814
Assam	654	-343	105	-406	550	62
Bihar[1]	-1163	551	-865	-26	-298	577
Gujarat	961	2282	910	1749	51	532
Haryana	666	1189	29	313	637	876
Karnataka	580	1361	-259	1168	839	194
Kerala	-359	78	-168	63	-191	15
Madhya Pradesh	3418	3940	220	3613	3198	327
Maharashtra	1990	1655	-750	643	2741	1012
Orissa	-2938	-328	-1299	-365	-1639	37
Punjab	366	618	-29	170	395	448
Rajasthan	4293	2713	1357	2013	2936	700
Tamil Nadu	-1176	148	-743	344	-433	-196
Uttar Pradesh	3563	4834	34	2937	3529	1896
West Bengal	1009	3475	-298	1130	1307	2345
India	9891	22569	-1540	13664	11431	8905

Source: Authors' computation using MoA data (GoI, 2013d)

Foodgrains

Area under wheat witnessed the highest increase of about 3.75 million ha between TE1993-94 and TE2009-10 and most of this increase came from expansion in area in states like Uttar Pradesh (972 thousand ha), Gujarat (579 thousand ha), Haryana (551 thousand ha), Maharashtra (432 million ha) and Rajasthan (413 thousand ha), accounting for nearly 80 per cent of the increase (Table 3.4). Only three states, Assam, Chhattisgarh and Odisha, witnessed a decline in area under wheat. Wheat displaced mainly coarse cereals such as ragi, small millets and barley. Maize was the second most important crop in terms of area

[1] *For comparing net changes in area between TE1992-93 and TE2010-11, we have combined Bihar and Jharkhand, Madhya Pradesh and Chhattisgarh and Uttar Pradesh and Uttarakhand data for TE2010-11.*

expansion. During the last two decades, the area under maize increased considerably, by over 2.2 million ha. Karnataka (837 thousand ha), Maharashtra (532.5 thousand ha), Andhra Pradesh (493 thousand ha), Tamil Nadu (213 thousand ha) and Bihar (140 thousand ha) were the major beneficiaries of this increase. The area under rice has increased by about 1.5 million ha between TE1993-94 and TE2009-10. This increase has been concentrated mainly in traditional rice growing states such as Punjab (607 thousand ha), Uttar Pradesh (517 thousand ha), Haryana (465 thousand ha) and Andhra Pradesh (242 thousand ha), where government procurement is very effective. Tamil Nadu, Kerala, Orissa and Assam witnessed a significant decline in area under rice during this period. Area under coarse cereals fell significantly not only at national level but in most of the states, except Rajasthan, Haryana, Assam, Uttarakhand and Chhattisgarh. The area under total cereals declined by about half a million ha, with the highest decline in Maharashtra (1.7 million ha), Madhya Pradesh (1.1 million ha) and Tamil Nadu (704 thousand ha). The area under pulses went up by about 619 thousand ha during the last two decades. Karnataka recorded the highest increase (671 thousand ha), followed by Madhya Pradesh (655 thousand ha), Rajasthan (481 thousand ha), Andhra Pradesh (341 thousand ha) and Maharashtra (241 thousand ha). More than half of the states witnessed a decline in area under pulses and prominent among them, were Uttar Pradesh, Odisha, Haryana, Tamil Nadu and Gujarat. Since the total area under foodgrains increased marginally (154 thousand ha), it shows that farmers are shifting from foodgrains to non-foodgrains, particularly high-value crops.

Oilseeds

Since the focus of the study is on oilseeds, we analyzed changes in area under oilseeds in major states during last two decades and results are presented in Table 3.5. Area under oilseeds increased by about 730 thousand ha during the period from TE1993-94 to TE2009-10 and the major gainers were Madhya Pradesh (more than 2 million ha), Maharashtra (1.3 million ha), Rajasthan (750 thousand ha) and West Bengal (154 thousand ha). On the other hand, states like Karnataka (810 thousand ha), Andhra Pradesh (798 thousand ha), Tamil Nadu (770 thousand ha), Uttar Pradesh (447 thousand ha) and Odisha (426 thousand ha) lost area under oilseeds during this period. Soybean is the only oilseed crop, which has registered an increase in area under cultivation during the last two decades. The area under soybean has increased by about 5.6 million ha between TE1993-94 and 2009-10 and Maharashtra (2.5 million ha) and Madhya Pradesh (2.2 million ha) accounted for about 85

per cent of this increase. However, the other two major edible oilseeds, namely, groundnut and rapeseed-mustard lost their acreage during the last two decades. Groundnut area declined by about 241 thousand ha between TE1993-94 and 2009-10 and almost all major groundnut producing states like Andhra Pradesh (781 thousand ha), Gujarat (97 thousand ha), Tamil Nadu (669 thousand ha), Karnataka (425 thousand ha), and Maharashtra (337 witnessed a decline in area under groundnut and in almost all states cotton replaced groundnut area during the last decade. Rapeseed-mustard lost about 2.4 million ha area since early-1990s, and most of this can be attributed to a decline in area in Uttar Pradesh, Gujarat, Haryana, Odisha, Assam and Punjab. However, in Rajasthan, a major producer of rapeseed-mustard, area under rapeseed-mustard increased by about 170 thousand ha, followed by Madhya Pradesh (102 thousand ha). The area under sesamum, the next important edible oilseed, declined by 474 thousand ha and almost all states except Uttar Pradesh, West Bengal and Madhya Pradesh lost area under sesamum.

Other Crops

The area under cotton increased by about 2.2 million ha in the country during the last two decades and most of the major producers such as Andhra Pradesh, Gujarat, Maharashtra, and Madhya Pradesh witnessed an increase in cotton acreage. However, Karnataka, Tamil Nadu and Rajasthan lost area under cotton. Sugarcane also experienced a moderate increase in acreage by about 936 thousand ha and almost all states except northern states recorded an increase in sugarcane acreage.

The results of changes in the cropping pattern at all-India level show that there has been a shift of area from coarse cereals to rice, wheat, and oilseeds during the last two decades. Total area under coarse cereals saw a significant decline in absolute terms (8.9 million ha). The share of oilseeds in GCA increased from about 10 per cent in TE1973-74 to about 14.1 per cent in TE1993-94 but declined to 13.4 per cent in TE 2001-02, but improved marginally (14.8%) during the last decade. India lost more than 1.5 million ha net sown area during the last two decades. Crop intensification has contributed to the increase in gross cropped area.

Table 3.4: Net changes in absolute and relative terms for major foodgrains crops in India: TE 1993-94 and TE 2009-10

(Absolute change (A) in '000 ha; Relative change (R) in percentage)

	Rice		Wheat		Maize		Other Coarse Cereals		Total Cereals		Total Pulses		Total Foodgrains	
States	A	R	A	R	A	R	A	R	A	R	A	R	A	R
A.P.	241.7	6.5	1.2	12.2	492.6	156.7	-1012.7	-68.3	-277.2	-5.0	341.0	21.3	63.8	0.9
Assam	-90.7	-3.6	-21.6	-28.22	-0.1	-0.5	15.0	156.6	-115.6	-4.4	2.3	2.0	-113.3	-4.1
Chhattisgarh[2]	-86.6	-2.3	-0.5	-0.5	7.3	7.6	8.0	2.8	-174.7	-4.1	-6.4	-0.7	-181.1	-3.5
Bihar[3]	93.5	2.0	257.2	12.8	139.9	19.9	-118.1	-57.9	372.5	4.8	-62.1	-6.1	310.3	3.6
Gujarat	137.9	23.3	578.5	115.1	112.7	31.3	-720.9	-42.0	108.1	3.4	-101.2	-11.2	7.0	0.2
Haryana	464.7	66.5	551.3	28.7	-17.2	-58.1	21.8	3.0	1008.1	29.9	-282.1	-63.7	726.0	19.0
Karnataka	152.6	11.6	56.1	25.5	836.8	275.3	-1128.9	-30.6	-83.4	-1.5	671.2	40.8	587.5	8.2
Jharkhand	21.8	1.5	27.2	39.9	51.9	33.8	-22.1	-31.9	83.2	4.9	207.5	126.8	290.6	15.5
Kerala	-296.6	-56.1	-	-	-	-	-5.9	-62.9	-302.5	-56.2	-13.7	-59.6	-316.2	-56.3
M.P.	110.6	2.1	244.0	6.4	57.4	6.4	-1382.4	-51.1	-1073.4	-8.5	655.2	13.9	-418.2	-2.4
Maharashtra	-33.1	-2.1	431.8	62.9	532.5	305.1	-2640.2	-32.9	-1709.0	-16.4	240.8	7.4	-1468.2	-10.7
Odisha	-91.7	-2.0	-8.8	-64.0	-27.8	-27.2	-67.3	-28.6	-269.8	-5.5	-478.0	-36.2	-747.6	-12.1
Punjab	609.7	28.9	229.0	7.0	-39.0	-20.9	-33.1	-59.7	766.5	13.6	-77.7	-76.3	688.8	12.0
Rajasthan	-13.1	-9.3	412.6	20.5	125.8	13.4	427.4	7.6	962.2	11.0	481.3	15.0	1443.6	12.1
Tamil Nadu	-347.4	-15.8	-	-	213.2	558.2	-569.9	-56.4	-704.3	-21.7	-181.3	-24.4	-885.6	-22.2

[2] *For newly created States, namely, Jharkhand, Chhattisgarh and Uttarakhand the figures are between 2003-04 and 2009-10*

[3] *For comparing net changes in area under different crops between TE1993-94 and TE2009-10, we have combined Bihar and Jharkhand, Madhya Pradesh and Chhattisgarh and Uttar Pradesh and Uttarakhand data for TE2009-10.*

U.P.	517.0	9.5	972.3	11.0	-264.8	-24.6	-457.6	-23.6	736.9	4.3	-520.4	-18.0	216.6	1.1
Uttarakhand	0.0	0.0	0.6	0.2	-8.5	-22.1	12.1	4.9	-24.5	-2.5	24.2	61.2	-0.3	0.0
West Bengal	-1.5	0.0	49.5	17.9	37.3	72.8	-9.0	-32.5	76.5	1.3	-87.5	-32.3	-11.0	-0.2
India	1468.5	3.5	3750.1	15.4	2245.3	37.8	-8929.5	-32.3	-465.1	-0.5	618.7	2.8	153.6	0.1

Source: Authors' calculations using Land Use Statistics, various years (GoI, 2013d)

Table 3.5: Net changes in absolute and relative terms for major commercial crops in India: TE1993-94 and TE2009-10

(Absolute change (A) in '000 ha; Relative change (R) in %age)

	Groundnut		Rapeseed-Mustard		Sesame		Soybean		Total oilseeds		Cotton		Sugarcane	
States	A	R	A	R	A	R	A	R	A	R	A	R	A	R
A.P.	-781.1	-32.5	0.8	16.8	-80.8	-46.1	126.2	5046.7	-798.2	-24.6	586.9	78.6	17.4	9.5
Assam	-	-	-55.5	-19.1	-2.0	-13.6	-	-	-50.6	-16.0	-0.7	-33.9	-10.6	-28.0
Bihar	-	-	-	-	-5.7	-55.7	-	-	98.9	297.3	-	-	2.1	52.9
Chhattisgarh	15.4	326.1	56.3	53.7	-11.3	-61.0	-	-	44.9	19.8	-	-	-14.4	-10.8
Gujarat	-97.4	-5.0	-111.9	-28.4	-10.5	-4.0	60.0	310.3	-37.6	-1.3	1275.8	112.2	70.1	55.9
Haryana	-0.3	-13.8	-85.7	-14.4	-0.6	-17.0	-	-	-125.9	-19.1	-51.0	-9.5	-34.1	-25.2
Jharkhand	-11.3	-85.2	-	-	-8.3	-93.6	-	-	-19.7	-88.6	-9.7	-89.3	-4.2	-63.6
Karnataka	-424.8	-33.1	-0.7	-13.6	-59.2	-44.8	107.6	298.0	-809.9	-27.3	-172.6	-29.0	25.5	9.0
Kerala	-6.4	-18.5	3.6	7.0	-3.5	-14.4	70.0	450.6	78.8	28.2	-	-	7.2	170.6
Madhya Pradesh	-48.1	-17.7	101.8	15.7	12.6	5.7	2212.2	72.8	2028.8	42.0	116.4	23.0	34.2	73.7
Maharashtra	-336.8	-49.2	-1.0	-12.9	-226.1	-76.9	2535.2	666.9	1335.5	52.2	717.7	28.0	471.9	117.9
Orissa	-108.2	-57.1	-85.0	-85.7	-131.5	-75.0	-	-	-426.4	-58.3	49.1	1009.6	-11.1	-46.3
Punjab	-8.2	-74.8	-46.7	-62.2	-11.7	-59.7	-	-	-130.3	-68.4	-95.0	-14.8	-15.7	-15.8

Rajasthan	48.4	18.7	169.6	7.1	-78.1	-14.0	541.1	207.5	749.5	21.4	-117.7	-24.0	-17.7	-69.9
Tamil Nadu	-669.2	-58.3	-0.7	-69.0	-72.9	-52.1	-	-	-769.7	-57.0	-147.5	-58.2	84.4	36.0
Uttarakhand	-0.6	-37.5	1.4	11.1	-0.3	-11.8	-3.5	-24.1	-2.9	-9.4	-	-	-20.4	-15.8
Uttar Pradesh	-31.8	-24.9	-414.6	-34.1	131.1	84.1	-10.6	-36.3	-446.8	-25.8	-8.1	-65.2	338.7	18.3
West Bengal	48.1	244.0	14.6	3.7	87.5	79.7	-	-	154.8	28.5	4.0	4000.0	1.9	13.1
India	-2407.3	-28.7	-693.2	-10.9	-474.2	-20.4	5594.4	147.9	730.1	2.8	2142.8	28.5	935.5	25.9

Source: Authors' calculations using Land Use Statistics, various years (GoI, 2013d).

For newly created states, the figures are between 2003-04 and 2009-10

Trends in Area, Production and Productivity of Oilseeds

Oilseeds occupy a prominent position in the Indian economy. India was a net exporter of edible oils and oilseeds till the mid-1960s. However, concerns for achieving self-sufficiency in foodgrains in general and cereals in particular were so dominant that all efforts were directed in that direction. In the process, while self-sufficiency in foodgrains, particularly cereals was achieved, edible oil, the major source of cooking medium remained neglected, and the country became dependent on imports. The introduction of green revolution in the mid-sixties that resulted in a spectacular growth in rice and wheat production during the late-1960s and 1970s forced the oilseed cultivation to marginal rainfed areas. However, after implementation of Technology Mission on Oilseeds (TMO) in 1986 and protection to domestic sector, there were dramatic changes in the oilseeds scenario in the country and India became self-sufficient in edible oils by early-1990s. After opening up of edible oils sector in 1994 as part of economic reforms, production of edible oilseeds suffered a lot and remained almost stagnant during the 1990s. In order to examine the trends in area, production and yield of oilseeds, time series secondary data for the last six decades was analyzed and the results are presented in Table 3.6.

Average area under oilseeds, which was estimated at 12.4 million ha during the 1950s, increased to about 25.8 million ha during the last decade. Annual production, which was about 6.1 million tonnes during the 1950s registered a rapid rise and reached a level of 25.6 million tonnes during the 2000s. The average productivity per ha also increased from 488 kg/ha to 989 kg/ha during the same period.

The area, production and productivity of oilseeds grew at an annual compound growth rate of 1.51 per cent, 3.06 per cent and 1.77 per cent, respectively during the period 1951-52 to 2010-11. Instability in area, production and productivity of oilseeds computed using coefficients of variation, showed that the highest variability has been observed in case of production (55.6%), and followed by productivity (30.6%) and the lowest in area (27%) of oilseeds during the period 1951-2011. However, performance of oilseeds during different decades shows quite interesting trends. As is evident from Table 3.7, oilseeds production recorded the highest growth rate (5.8%) during the 1980s, followed by 2000s (4.89%) and the lowest (0.57%) during the 1990s. Almost a similar trend was observed in the case of

variability in production. Yield variability has been a major factor for production variability during all decades, which is an indication of high yield risks associated with oilseeds.

Table 3.6: Trends in the average area (million ha), production (million tonnes), and yield (kg/ha) of oilseeds in India

	1951-52 to 1960-61[4]	*1961-62 to 1970-71*	*1971-72 to 1980-81*	*1981-82 to 1990-91*	*1991-92 to 2000-01*	*2001-02 to 2011-12*
Area	12.4	15.2	17.0	20.1	25.5	25.8
Production	6.1	7.6	9.2	13.6	21.3	25.6
Yield	488	497	538	671	836	989

Source: GoI (2013c)

Table 3.7: Trends in compound annual growth rates (%) and variability in area, production and yield of oilseeds in India

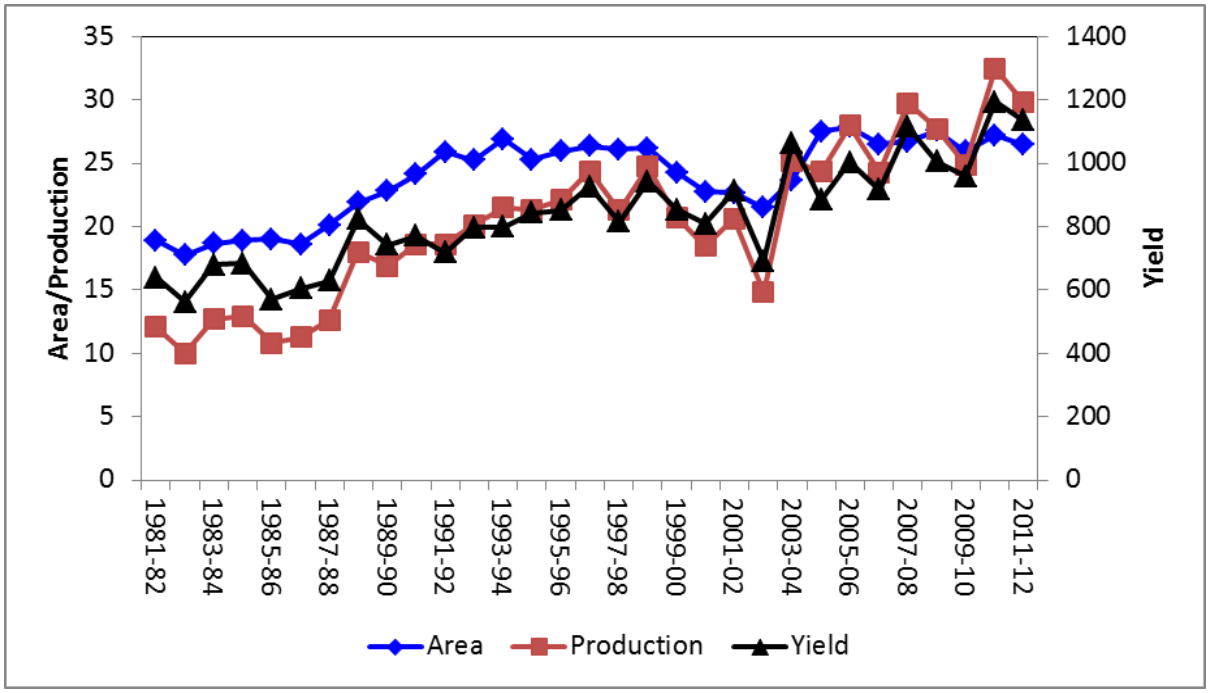
Period	*CAGR (%)*			*Coefficient of variations (%)*		
	Area	*Production*	*Yield*	*Area*	*Production*	*Yield*
1950s	2.41***	4.24***	1.78***	8.0	13.8	8.3
1960s	0.47	1.55	1.08	4.0	13.4	10.5
1970s	0.51	1.22	0.70	3.3	10.4	8.5
1980s	3.02***	5.80***	2.70*	10.6	22.8	12.9
1990s	-0.87	0.57	1.45*	4.7	9.8	7.8
2000s	1.80**	4.89***	3.07**	8.4	19.0	14.2
All Period	1.51***	3.06***	1.53***	27.0	55.6	30.6

****, ** and *: Significant at 1, 5and 10 per cent level, respectively.*
Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Trends in oilseeds acreage, production and productivity during 1981-82 to 2011-12 are presented in Figure 3.2. The total area under oilseeds increased from about 18.9 million ha in 1981-92 to 26.9 million ha in 1993-94 and then witnessed a declining/stagnant trend up to 2003-04 but increased thereafter and reached the peak (27.6 million ha) in 2008-09. Production of oilseeds also witnessed almost a similar trend. Crop yield increased from about 625 kg per ha in early-80s to about 1100 kg per ha in the recent years.

[4] *Data for 1951-52 to 1969-70 relate to total of five major oilseeds viz, Groundnut, Castor seed, Sesamum, Rapeseed & Mustard and Linseed*

Figure 3.2: Trends in area (in million ha), production (in million ha) and yield (in kg/ha) of nine oilseeds in India: 1981-82 to 2011-12



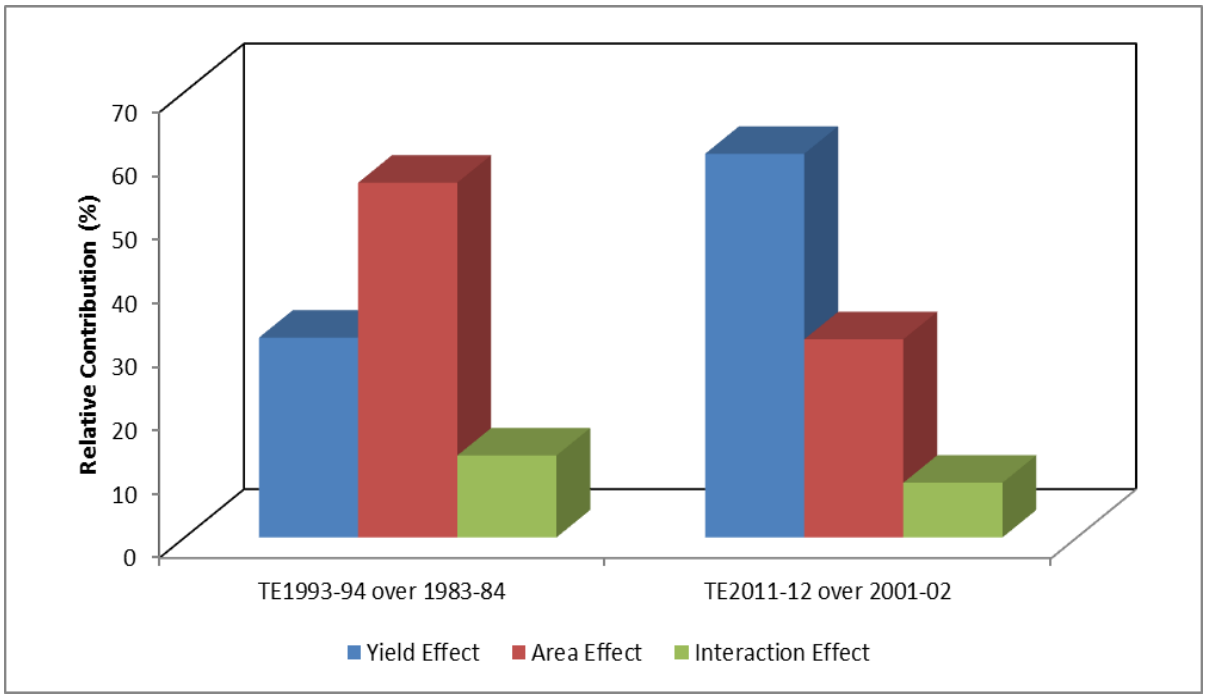
Source: GoI (2013c)

It is important to identify the major sources of growth in production of oilseeds. The relative contribution of area expansion and yield improvement towards the total change in oilseeds production has been examined using decomposition analysis. The analysis helped in identifying the major sources of growth (area effect, yield effect and interaction effect) in the output and the results are presented in Figure 3.3. It is evident from the Figure that acreage expansion was more important source of growth (55.7%) in oilseeds output than yield improvement (31.4%) between TE1983-84 and TE1993-94. However, increase in yield was the largest contributor (60.3%), followed by area expansion (31.1%) to increase in oilseeds production during the TE2001-02 and TE2011-12. These trends clearly show that the yield had a higher contribution than acreage expansion to the total change in output growth during the last decade.

The relative position of various oilseeds in total area and production of oilseeds is given in Table 3.8. As is evident, soybean enjoys a dominant position both in terms of area and production. Its share in output of oilseeds is over 40 per cent and in respect of total oil production, 29.4 per cent during the TE2011-12. Rapeseed-mustard is the second important crop, its share being 24.5 per cent of oilseeds output and about 22.8 per cent of the acreage. It is interesting to note that rapeseed-mustard oil contributes a significant share to

domestic supply, ranking number one, and its share in oil production being 35 per cent. Groundnut, which was the predominant crop during the 1980s and early-1990s, lost its share and accounted for 23.7 per cent of total production and 20.6 per cent in acreage during TE2011-12. The share of kharif oilseeds was about 67 percent and for rabi oilseeds, it was 33 per cent. The share of kharif oilseeds has increased during the last two decades.

Figure 3.3: Decomposition of output growth of oilseeds in India during TE1983-84 and TE2011-12



Source: Authors' calculations using State wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Regional Variations in Oilseeds Production

The share of kharif oilseeds in total oilseeds acreage increased from less than 60 percent in TE1993-94 to 68.7 percent in TE2011-12 while production share in this period increased from 56 per cent to about 67 percent. On the other hand, share of rabi oilseeds declined both in total area and production of oilseeds in the country during the last two decades. The growth rate of production of rabi oilseeds was negative (-2.35%) during the nineties but improved significantly (3.05%) during the last decade. Almost a similar trend was observed in the case of acreage. The average productivity of oilseeds during TE2011-12 was higher in the rabi season (1158 kg/ha) compared with kharif season (1067 kg/ha).

Table 3.8: Share of selected oilseeds in total area and production of nine oilseeds in India: TE2011-12

Oilseeds	Area (lakh ha)	Production (lakh tonnes)		
		Oilseeds	Oil	Oil Meal
Soybean	98.1 (36.6)	116.4 (40.1)	21.0 (27.2)	85.0 (47.3)
Rapeseed & mustard	61.3 (22.8)	71.3 (24.5)	23.5 (30.5)	47.8 (26.6)
Groundnut Total	55.4 (20.6)	68.9 (23.7)	19.3 (25.0)	28.9 (16.1)
Kharif	46.4	52.1	-	-
Rabi	9.0	16.8	-	-
Castor seed	10.3 (3.8)	15.5 (5.3)	6.2 (8.0)	9.3 (5.2)
Sesame	19.8 (7.4)	7.6 (2.6)	3.0 (3.9)	4.6 (2.5)
Sunflower Total	10.4 (3.9)	6.7 (2.3)	2.6 (3.4)	1.4 (0.8)
Kharif	3.8	1.8	-	-
Rabi	6.6	4.9	-	-
Safflower	6.1 (2.3)	1.6 (0.6)	0.6 (0.8)	1.0 (0.5)
Linseed	3.4 (1.3)	1.5 (0.5)	0.5 (0.6)	1.0 (0.6)
Nigerseed	3.7 (1.4)	1.0 (0.3)	0.3 (0.4)	0.7 (0.4)
Total Oilseeds	265.0 (100.0)	290.6 (100.0)	77.0 (100.0)	179.7 (100)
Kharif	182.1 (68.7)	194.5 (66.9)	-	-
Rabi	82.9 (31.3)	96.1 (33.1)	-	-

Source: GoI (2013)

Figures in parentheses show share in Total Area and production.

Oil and oil meal production has been calculated using Conversion factors from Agricultural Statistics at a Glance 2013, pp. 288-289.

Table 3.9: Trends in area, production and yield and compound annual growth rates (%) of kharif and rabi oilseeds in India

Period	*Kharif*			*Rabi*		
	Area	***Production***	***Yield***	***Area***	***Production***	***Yield***
	Area (million ha), production (million tonnes) and yield (kg/ha)					
TE1993-94	15.5 (59.8)	11.2 (56.0)	844	10.5 (40.2)	8.8 (44.0)	783
TE2001-02	15.4 (66.2)	12.5 (62.9)	941	7.9 (33.8)	7.4 (37.1)	879
TE2011-12	18.2 (68.7)	19.4 (66.9)	1037	8.3 (31.3)	9.6 (33.1)	1158
	Compound annual growth rate (%)					
1990s	0.23	2.63*	2.39	-2.80**	-2.35*	0.46
2000s	2.45***	5.90***	3.37*	0.42	3.05*	2.62***
All Period	0.98***	2.85***	1.85***	-1.12**	0.66	1.80***

Figures in parentheses show percent share of area/production of oilseeds during kharif and rabi season.

***, ** and *: Significant at 1, 5and 10 per cent level, respectivel.

Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013a)

The changing shares of major oilseeds in total acreage and production of oilseeds in the country are presented in Figure 3.4. Groundnut was the most important oilseeds crop in the country with 41.9 per cent share in production and 35.2 per cent share in area, followed by rapeseed-mustard with an estimated share of 28.1 per cent and 23.8 per cent in total production and acreage, respectively, during the TE1991-92. The share of soybean was 12.7 per cent in production and 11.0 per cent in area under oilseeds during the TE1991-92. However, during the last two decades, soybean has become increasingly important oilseed with a steady increase in production and has replaced groundnut. In TE2011-12, soybean accounted for over 40 percent of total production under oilseeds and 37.0 per cent of the total area in the country. The share of groundnut in total oilseeds production fell from about 42 per cent in early-1990s to 23.7 per cent in TE2011-12. Cotton, mainly Bt cotton, replaced groundnut crop in Gujarat and Andhra Pradesh, the two major groundnut producing States in the country. Rapeseed-mustard has been able to retain its position both in acreage and production. The share of rapeseed-mustard was 24.5 percent in total production and 23.2

per cent in acreage during the TE2011-12. The shares of other edible oils like sesamum, sunflower, and safflower have declined during the last two decades.

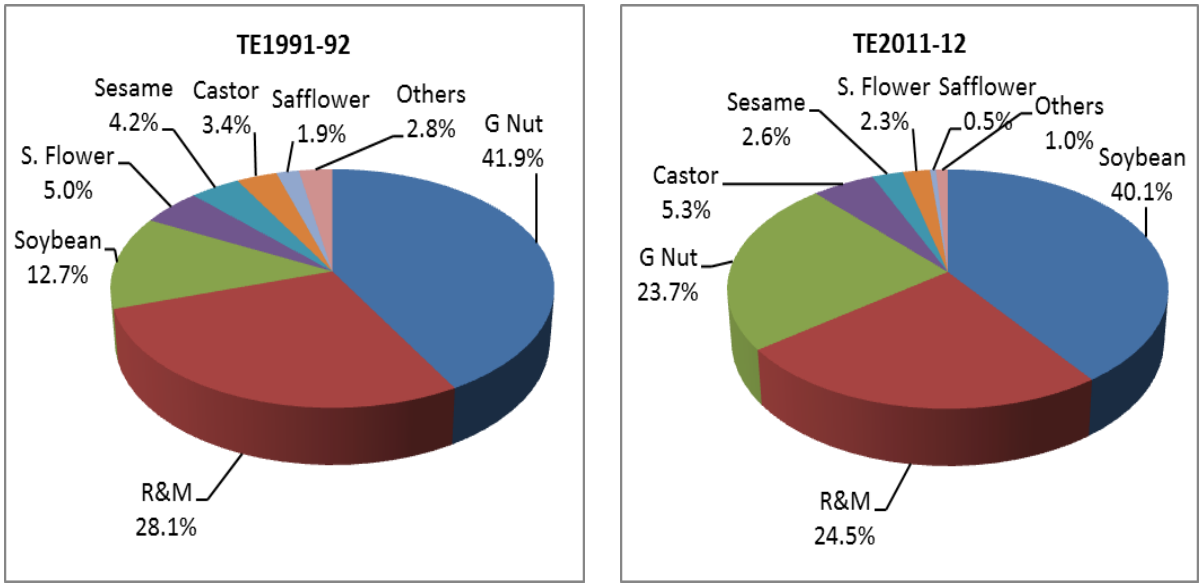
The top-four oilseed producing states, namely, Madhya Pradesh, Rajasthan, Gujarat and Maharashtra accounted for nearly 76 percent of the total production in the TE2011-12. Madhya Pradesh alone accounted for 27.5 per cent of the total oilseed production in India, with other three states contributing 48.3 per cent (Rajasthan, 19.2%, Gujarat, 14.9%, Maharashtra 14.2%). Andhra Pradesh, Karnataka, Tamil Nadu, Haryana, Uttar Pradesh, Haryana, West Bengal, and Odisha are other important oilseed producers in the country. Madhya Pradesh, Rajasthan, Gujarat and Maharashtra have increased their share in oilseeds production during the last two decades while all other States have lost their share. Madhya Pradesh recorded the highest increase (11.7%) in its share, followed by Rajasthan (6.4%) and Maharashtra (5.3%) between TE1991-92 and TE2011-12.

In case of acreage shares, the situation is slightly different. Andhra Pradesh, which is the 5th largest producer of oilseeds in the country, accounted for 12.9 per cent acreage (second largest acreage) during TE1991-92 and 8 per cent (5th position) during the TE2011-12. Madhya Pradesh gained share in area between TE1991-92 and TE2011-12 (from 16.4% to 27.6%). Other states like Rajasthan, Karnataka, Uttar Pradesh, Tamil Nadu, Odisha and Haryana lost their share in oilseeds acreage. Area expansion in Madhya Pradesh and Maharashtra has been primarily driven by soybean cultivation due to increase in exports of soymeal.

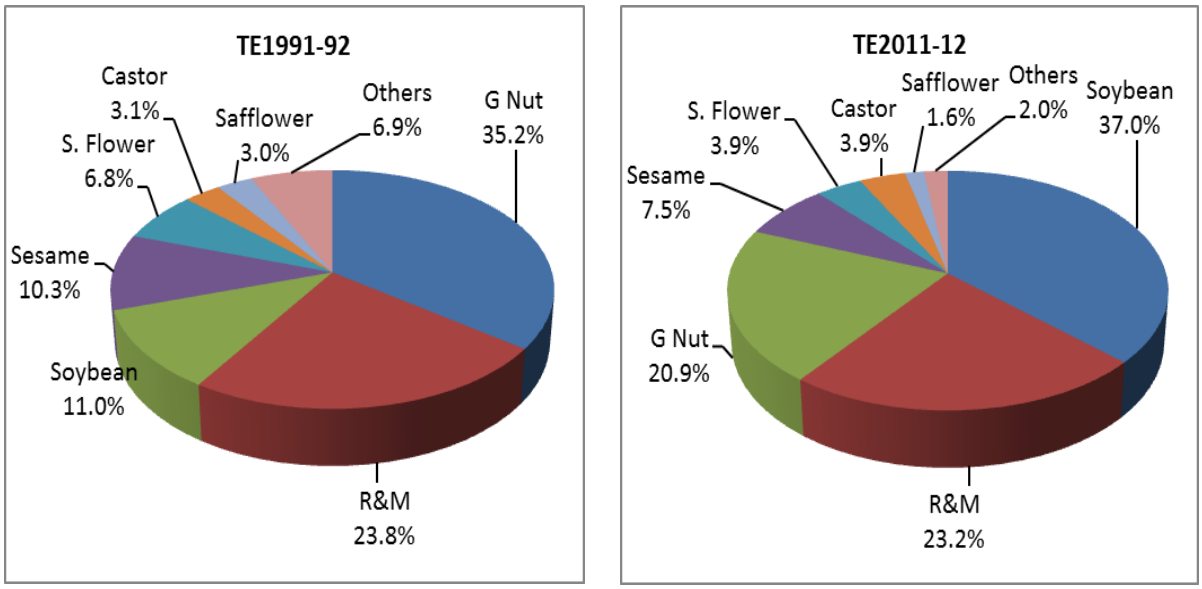
The changing shares of kharif and rabi oilseeds area in important oilseeds producing states in the country are given in Table 3.10. The share of kharif oilseeds in total acreage has increased in major states like Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan during the last two decades and have higher share than national average (66.9%). On the other hand, though the share of rabi oilseeds in total acreage has declined at all India level, some states have recorded increase in share of rabi crops. Rabi oilseeds are important in states like Assam, Haryana, Punjab, Uttar Pradesh, West Bengal, and Bihar, and account for more than 80 per cent of oilseeds acreage.

Figure 3.4: Changing shares of major oilseeds in total acreage and production of oilseeds in India: TE1991-92 to TE2011-12

Production

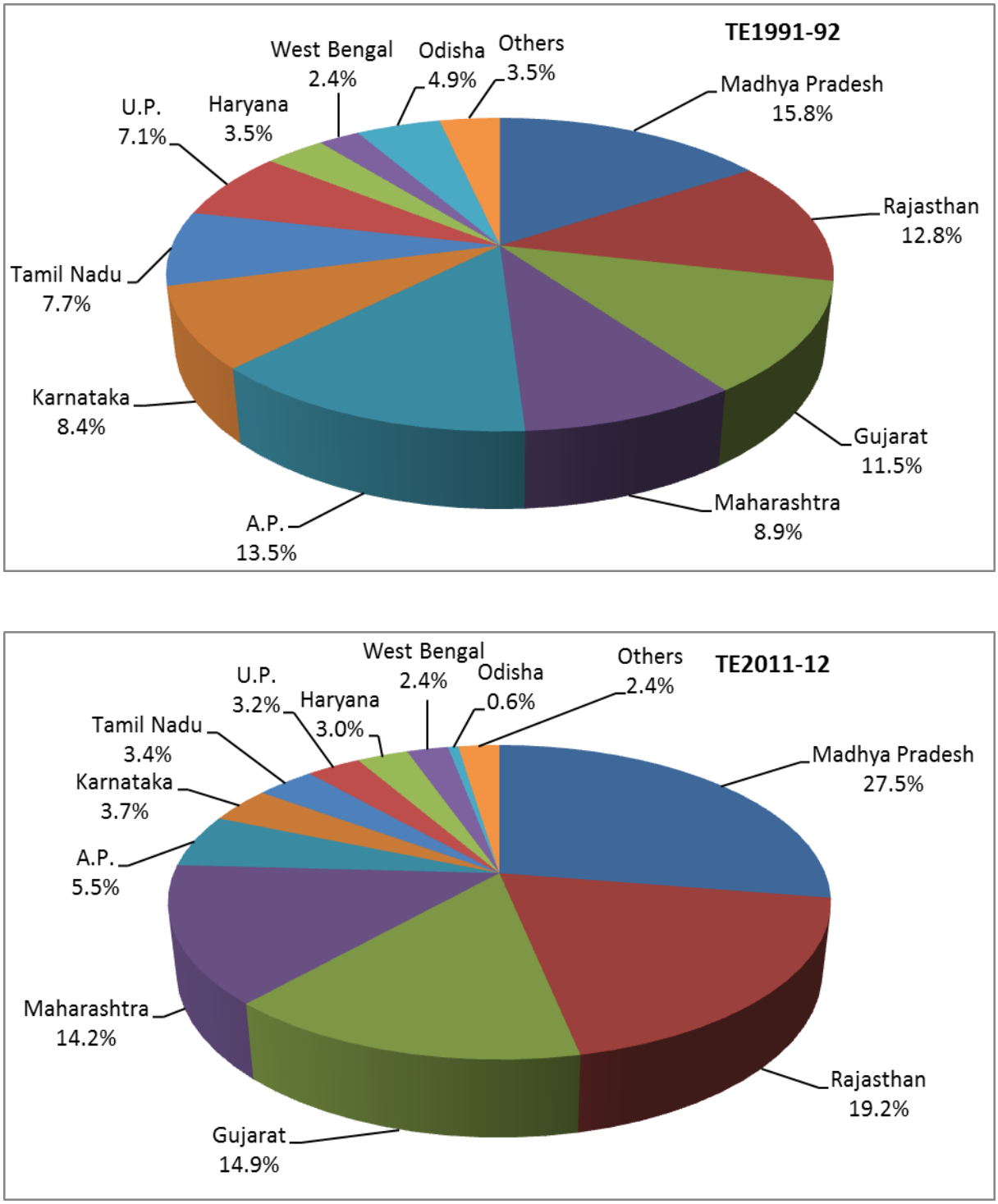


Area



Source: Authors' calculations using State wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

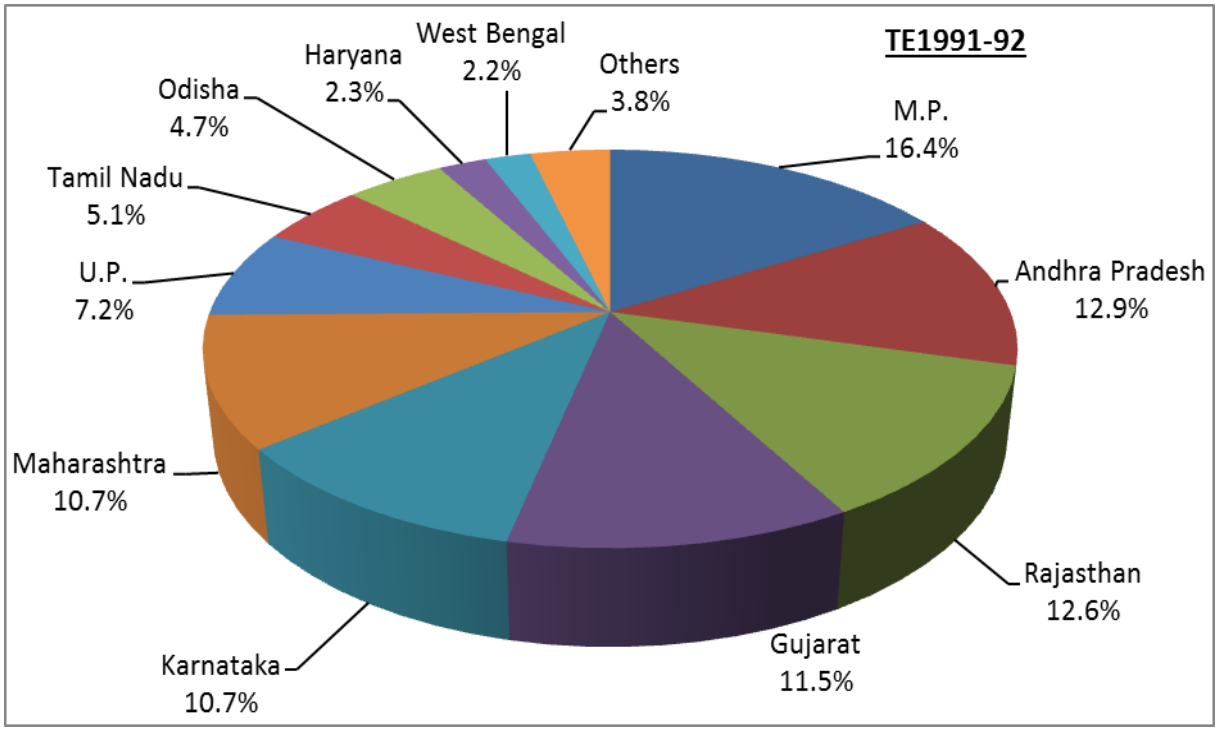
Figure 3.5: Changing shares of major states in the production of oilseeds in India[5]: TE1991-92 and TE2011-12

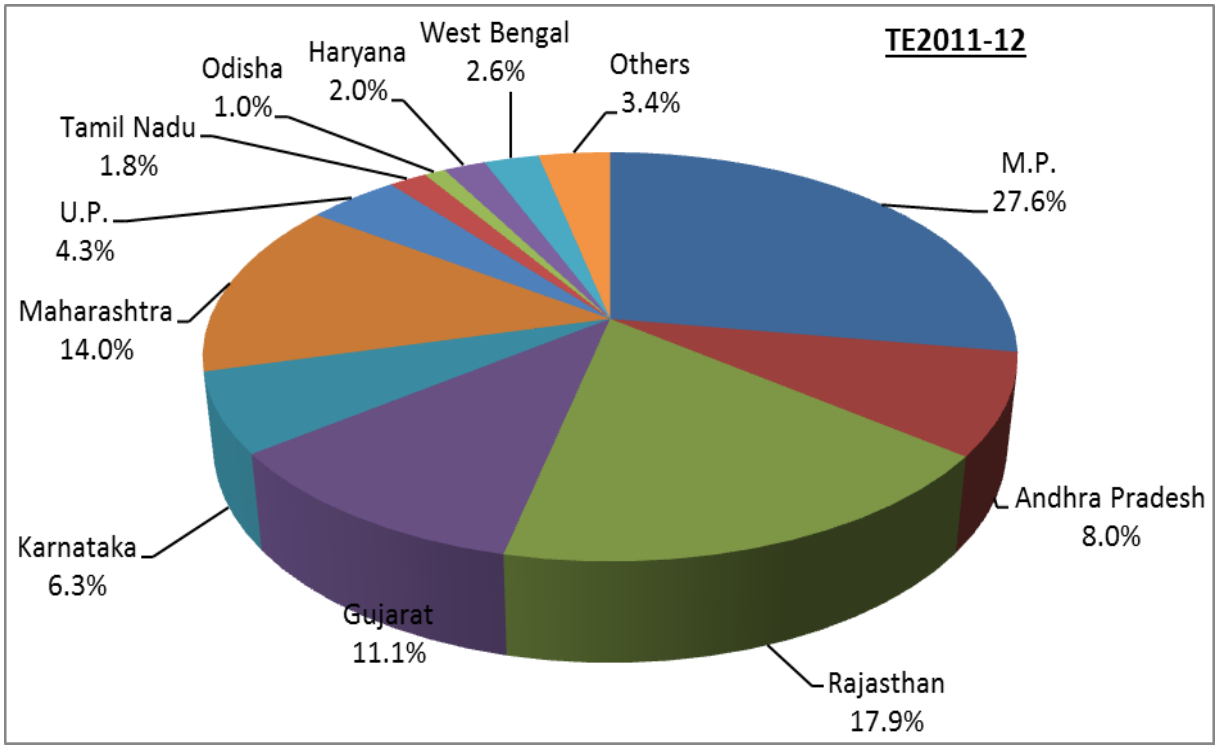


Source: Authors' calculations using State wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

[5] *In order to compare figures between two time period, production/area data for Madhya Pradesh includes both for Madhya Pradesh and Chhatisgarh combined, for Uttar Pradesh both Uttar Pradesh and Uttarakhand and for Bihar both Bihar and Jharkhand.*

Figure 3.6: Share of major states under oilseeds acreage in India: TE1991-92 and TE2011-12





Source: Authors' calculations using State wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Table 3.10: Changing shares (%) of kharif and rabi oilseeds area in major oilseeds producing states in India: TE1991-92, TE2001-02 and TE2011-12

State	Kharif			Rabi		
	TE1991-92	***TE2001-02***	***TE2011-12***	***TE1991-92***	***TE2001-02***	***TE2011-12***
Andhra Pradesh	68.2	69.3	54.7	31.8	30.7	45.3
Assam	4.7	8.9	7.7	95.3	91.1	92.3
Bihar	15.4	15.4	11.9	84.6	84.6	88.1
Gujarat	71.7	85.2	85.9	28.3	14.8	14.1
Haryana	0.6	0.3	0.5	99.4	99.7	99.5
Karnataka	61.9	66.2	67.3	38.1	33.8	32.7
Madhya Pradesh	79.7	88.1	88.2	20.3	11.9	11.8
Maharashtra	54.1	81.8	93.4	45.9	18.2	6.6
Orissa	57.5	60.0	48.2	42.5	40.0	51.8
Punjab	11.2	12.0	7.6	88.8	88.0	92.4
Rajasthan	22.4	32.9	38.5	77.6	67.1	61.5
Tamil Nadu	69.5	61.5	55.4	30.5	38.5	44.6
Uttar Pradesh	13.0	12.3	18.5	87.0	87.7	81.5
West Bengal	20.3	18.7	23.9	79.7	81.3	76.1
Others	35.8	34.1	27.3	64.2	65.9	72.7
All India	53.1	62.9	66.9	46.9	37.1	33.1

Source: Authors' calculations using State wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

The trends in area under kharif and rabi oilseeds are presented in Table 3.11. It is interesting to note that most of the states witnessed a decline in area under rabi oilseeds except Bihar, Rajasthan and West Bengal between TE1993-94 and TE2011-12. In contrast, majority of major oilseeds producing states recorded an increase in kharif crop acreage during the same period. Madhya Pradesh recorded the highest increase (3767.5 thousand ha in TE1993-94 to 6328.6 thousand ha in TE2011-12), followed by Maharashtra and Rajasthan, which recorded significant increases in crop acreage. Total area under kharif oilseeds increased while rabi acreage declined during the period.

Table: 3.11: Kharif and rabi oilseeds acreage in major oilseeds producing states in India: TE 1993-94 and TE 2011-12

State	*Kharif*		*Rabi*	
	TE 1993-94	*TE 2011-12*	*TE 1993-94*	*TE 2011-12*
Andhra Pradesh	2606.1 (16.8)	1627.3 (8.9)	634.8 (6.1)	484.7 (5.8)
Assam	16.5 (0.1)	21.4 (0.1)	299.5 (2.9)	248.8 (3.0)
Bihar	51.5 (0.3)	41.9 (0.2)	175.0 (0.3)	276.3 (3.3)
Gujarat	2434.0 (15.7)	2561.3 (14.1)	502.9 (4.8)	377.7 (4.6)
Haryana	5.9 (0.0)	6.3 (0.0)	654.7 (6.3)	529.0 (6.4)
Karnataka	1945.2 (12.5)	1147.3 (6.3)	1016.3 (9.7)	533.0 (6.4)
Madhya Pradesh	3767.5 (24.2)	6328.6 (34.8)	1065.7 (10.2)	988.6 (11.9)
Maharashtra	1552.4 (10.0)	3334.3 (18.3)	1008.4 (9.6)	387.7 (4.7)
Odisha	508.6 (3.3)	181.3 (1.0)	222.4 (2.1)	96.5 (1.2)
Punjab	30.7 (0.2)	8.2 (0.0)	159.8 (1.5)	46.8 (0.6)
Rajasthan	1089.7 (7.0)	1914.6 (10.5)	2420.0 (23.1)	2833.5 (34.2)
Tamil Nadu	1029.7 (6.6)	330.0 (1.8)	320.0 (3.1)	134.5 (1.6)
Uttar Pradesh	313.0 (2.0)	453.0 (2.5)	1419.0 (13.6)	681.7 (8.2)
West Bengal	116.9 (0.8)	189.9 (1.0)	426.1 (4.1)	486.9 (5.9)
Others	664.5 (4.5)	61.7 (0.3)	697.5 (6.7)	184.4 (2.2)
All India	15541.5	18207.1	10464.7	8290.0

Source: Authors' calculations using State wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Figures are in '000 Hectares and figures in parentheses show the state's per cent share in all-India area under oilseeds

Growth Rates in Oilseeds Production in Major States

There have been wide regional variations in area, production and productivity of oilseeds during the past two decades. Table 3.12 reveals that the country as a whole recorded 0.22 per cent, 2 per cent and 1.78 per cent compound annual growth rates in area, production and productivity respectively, during the period 1991-2011. Among the major states, Maharashtra, Rajasthan, Madhya Pradesh, Gujarat and West Bengal exhibited a healthy growth rate in area, production and productivity during 1991-2011. Maharashtra registered the highest annual growth rate in area (2.56%) and production (5.37%) among the major oilseeds producing states during this period. Gujarat recorded the highest annual growth rate of 3.41 per cent in productivity, while Karnataka showed a negative growth rate of -0.28 per cent in productivity during 1991-2011.

Table 3.12: Classification of States according to compound annual growth rate (CAGR) in oilseeds production in India: 1991-92 to 2011-12

CAGR (%)	***1990s***	***2000s***	***All Period***
>2%	Maharashtra (5.69%), Madhya Pradesh (5.33%),	Bihar (9.15%), Rajasthan (7.69%), MP (7.68%), Maharashtra (6.80%), Gujarat (4.35%), Orissa (3.59%), West Bengal (3.08%), India (4.89%)	Maharashtra (5.37%), Rajasthan (4.33%), Madhya Pradesh (3.63%), Gujarat (3.46%), West Bengal (3.40%), Bihar (2.76%), India (2.00%)
<2%	Rajasthan (1.45%), Bihar (1.02%), Gujarat (0.61%), West Bengal (0.95%), All India (0.54%)	Andhra Pradesh (0.82%), Haryana (0.51%)	Haryana (0.86%)
Negative	A.P. (-3.43%), Assam (-0.67%), Haryana (-3.57%), Karnataka (-3.30%), Orissa (-13.78%), Punjab (-9.84%), Tamil Nadu (-3.24%), UP (-2.03%)	Assam (-0.23%), Karnataka (-0.11%), Punjab (-2.95%), Tamil Nadu (-0.11%), UP (-0.15%)	Punjab (-7.61%), Odisha (-3.44%), Tamil Nadu (-2.74%), Karnataka (-2.41%), Uttar Pradesh (-1.88%), Andhra Pradesh (-1.87%), Assam (-0.87%)

Source: Authors' calculations using State wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

There is a wide variation in the performance of different states during different time periods. During 1991-92 to 2000-01, there were only two states which recorded a growth

rate of more than 2 per cent. The growth performance of oilseeds production in Maharashtra (5.69%) and Madhya Pradesh (5.33%) was much higher than that of all India average of 0.54 per cent. Rajasthan, Bihar, Gujarat and West Bengal also recorded a positive growth rate but much lower than Maharashtra and Madhya Pradesh. Remaining seven states had negative growth in oilseeds production during the 1990s. However, performance of oilseeds sector improved significantly during the last decade. All major oilseeds producing states witnessed a positive growth rate. The number of states with more than 2 per cent growth in oilseeds production increased from two in the 1990s to seven during the last decade. Assam, Karnataka, Punjab, Tamil Nadu and Uttar Pradesh had negative growth rate in oilseeds production during the 2000s.

Table 3.13: Classification of states according to compound annual growth rate in oilseeds acreage in India: 1991-92 to 2011-12

CAGR (%)	***1990s***	***2000s***	***All Period***
>2%	Madhya Pradesh (3.36%)	Bihar (8.43%), Rajasthan (5.11%), Maharashtra (4.75%), M.P. (3.23%),	Maharashtra (2.56%),
<2%	Maharashtra (0.75%), Assam (0.05%)	India (1.77%), West Bengal (1.28%), Gujarat (0.37%)	Madhya Pradesh (1.92%), West Bengal (1.83%), Rajasthan (1.60%), Bihar (1.40%), Gujarat (0.05%), India (0.22%)
Negative	West Bengal (-0.23%), Rajasthan (-0.26%), Gujarat (-0.58%), India (-0.88%), Bihar (-1.74%), U.P. (-1.85%), A.P. (-2.81%), Haryana (-4.57%), Karnataka (-4.79%), Tamil Nadu (-5.07%), Punjab (-7.51%), Orissa (-10.12%)	U.P. (-0.11%), Odisha (-1.10%), Assam (-1.31%), Andhra Pradesh (-1.87%), Haryana (-1.92%), Karnataka (-2.58%), Tamil Nadu (-4.76%), Punjab (-6.44%)	Haryana (-0.69%), Assam (-1.16%), Andhra Pradesh (-1.92%), Karnataka (-2.14%), Uttar Pradesh (-2.41%), Odisha (-4.19%), Tamil Nadu (-5.52%), Punjab (-7.77%)

Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

In case of area under oilseeds, only three states, namely, Madhya Pradesh, Maharashtra and Assam had a positive growth rate during the 1990s (Table 3.13). In contrast, the number of states with positive growth rate in oilseeds acreage increased to 6 during the last decade. It

is interesting to note that the increase in production of oilseeds primarily came from yield improvements in most of the states during the last two decades (Table 3.14). For example, number of states with more than 2 percent growth rate increased from 2 during 1990s to 9 in 2000s, while states with negative growth rate declined from 4 to 2 during the same period.

Table 3.14: Classification of states according to compound annual growth rate in oilseeds yield in India: 1991-92 to 2011-12

CAGR (%)	***1990s***	***2000s***	***All Period***
>2%	Maharashtra (4.90%), Bihar (2.88%)	Tamil Nadu (4.89%), Odisha (4.74%), M.P. (4.28%), Gujarat (3.97%), Punjab (3.73%), India (3.06%), A.P. (2.74%), Karnataka (2.53%), Haryana (2.47%), Rajasthan (2.45%)	Gujarat (3.41%), Tamil Nadu (2.95%), Maharashtra (2.74%), Rajasthan (2.68%)
<2%	Madhya Pradesh (1.99%), Tamil Nadu (1.93%), Rajasthan (1.71%), Karnataka (1.56%), India (1.43%), Gujarat (1.20%), West Bengal (1.18%), Haryana (1.05%)	Maharashtra (1.95%), West Bengal (1.78%), Assam (1.09%), Bihar (0.83%)	Bihar (1.90%), India (1.78%), M.P. (1.76%), Haryana (1.56%), West Bengal (1.54%),Odisha (0.78%), U.P. (0.55%), Assam (0.29%), Punjab (0.17%), Andhra Pradesh (0.05%)
Negative	A.P. (-0.63%), Assam (-0.72%), Punjab (-2.53%), Odisha (-4.06%)	U.P. (-0.02%)	Karnataka (-0.28%)

Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

In order to analyze the major sources of growth in oilseeds production, decomposition analysis was used. The relative contribution of area, yield and interaction effect towards the total change in oilseeds output has been assessed, and the results are presented in Table 3.15. The results of decomposition analysis show that increase in area and productivity of oilseeds has been the major source of increase in production in states like Chhattisgarh, Gujarat, Haryana, Madhya Pradesh, Maharashtra, Rajasthan, Uttarakhand and West Bengal during the last decade. However, yield improvement was the major driver of the increase in production in Chhattisgarh, Gujarat, Haryana, Madhya Pradesh, Uttarakhand and West

Bengal. In some states like Andhra Pradesh, Assam, Tamil Nadu, and Punjab, oilseeds production declined mainly due to a reduction in area, while in Karnataka and Uttar Pradesh, both area and productivity declined sharply, leading to a substantial decline in oilseeds production. Almost all states except Uttar Pradesh experienced positive growth rate in oilseeds yield during the last decade. Tamil Nadu, Odisha, Madhya Pradesh, Gujarat, Punjab, Andhra Pradesh, Karnataka, Haryana and Rajasthan recorded more than 2 per cent growth rate. The above results clearly show that performance of oilseeds sector has improved significantly during the last decade compared with the 1990s.

Looking at average productivity between TE2001-02 and TE2011-12, most major oilseed producing states except Karnataka and Uttar Pradesh witnessed an increase in productivity, albeit at a varying rate. Gujarat, the third largest producer of oilseeds, registered an impressive increase of about 76 per cent, while the average yield rose by 31.6 per cent in Madhya Pradesh (the largest producer), 29.5 per cent in Rajasthan (2nd largest producer) and Maharashtra saw a rise of over 22 per cent. Among the major oilseed producing states, only Karnataka (-2.3%) and Uttar Pradesh (-4%) witnessed a fall in the average productivity over these years. During the TE2011-12, average productivity was found to be higher in Tamil Nadu, Haryana, Gujarat, Punjab, Rajasthan, Madhya Pradesh, and Maharashtra. All major oilseeds producing states recorded an average productivity higher than the all-India average, while Andhra Pradesh, Assam, Orissa, Karnataka and Uttar Pradesh fell far behind.

The cropping pattern in many states has undergone changes which were pertinent to oilseed crops as well. The relative importance of oilseed crops has increased in many states during the last three decades. Soybean, which was fifth in terms of area during mid-80s in Madhya Pradesh, occupied the first place (more than 25% of total cropped area) in TE2010-11. During the same period, rapeseed-mustard moved from fourth place to second place in terms of area in Rajasthan. In the case of Gujarat, groundnut which had occupied the first position with respect to area was replaced by cotton and accounted for about 16 per cent of total cropped area during TE2010-11. During the same period, soybean in Maharashtra, and rapeseed-mustard in Haryana occupied a place among the top five crops of the states in terms of acreage. The area expansion in oilseeds during the past few decades was possible mainly because of replacement of non-remunerative crops like millets and minor food crops and partly from an increase in cropping intensity.

Table 3.15: Changes in oilseeds productivity and decomposition of oilseeds production during TE2001-02 to TE2011-12

State	*Yield (kg/ha)*		*Production ('000 tonnes)*		*Percent Contribution of*		
	TE2001-02	*TE2011-12*	*TE2001-02*	*TE2011-12*	*Yield*	*Area*	*Interaction effect*
A.P.	709	745	1835.9	1586.8	36.7	-130.2	-6.6
Assam	493	553	154.5	149.3	350.5	-402.0	-48.5
Bihar	804	1045	130.3	140.1	449.0	-268.6	-80.4
Chhattisgarh	367	614	67.0	195.7	71.2	17.2	11.6
Gujarat	836	1470	2341.1	4342.7	89.2	6.1	4.7
Haryana	1384	1632	661.5	870.8	54.9	38.2	6.8
Jharkhand	625	622	18.7	116.2	-0.2	100.6	-0.5
Karnataka	665	650	1251.5	1072.3	-18.0	-83.9	1.9
M.P.	847	1115	4828.0	7799.8	50.7	37.4	11.8
Maharashtra	912	1114	2330.6	4113.0	28.3	58.7	13.0
Orissa	442	623	140.0	172.6	168.9	-48.9	-20.0
Punjab	1027	1350	93.9	74.3	152.5	-192.0	-60.4
Rajasthan	905	1171	2857.3	5585.5	30.5	53.7	15.8
Tamil Nadu	1626	2151	1410.4	995.5	109.3	-158.2	-51.2
Uttar Pradesh	838	804	1155.1	890.1	-17.5	-86.0	3.4
Uttaranchal	686	1077	10.7	31.0	61.5	24.5	14.0
West Bengal	860	1036	490.8	701.0	47.2	43.9	9.0
All India	859	1095	19937.5	29053.1	60.4	31.0	8.5

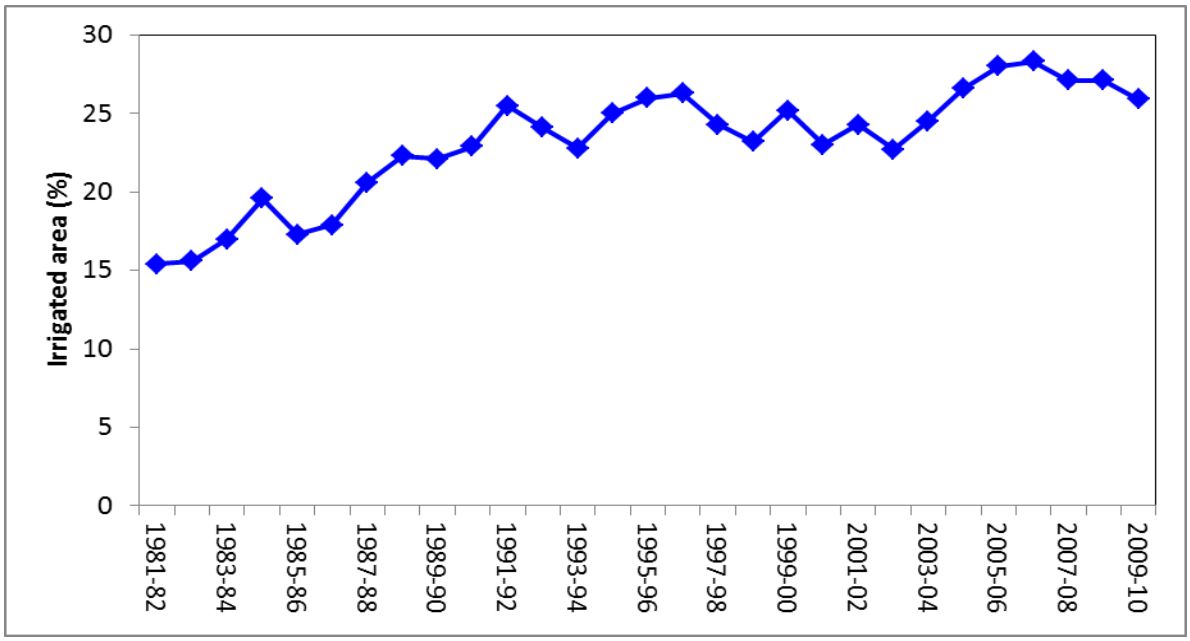
Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Irrigation

Oilseeds are predominantly grown under rainfed conditions, but the area under irrigation for oilseed crops has shown an increasing trend over the years (Figure 3.7). The percentage of irrigated area under oilseeds increased from 14.1 per cent in TE1981-82 to 23.5 per cent in TE1991-92 and remained almost constant during the 1990s. However, area under irrigation for oilseeds increased during the last decade and reached a level of 26 percent in TE2010-11. The irrigated area under oilseeds recorded a growth rate of 9.3 per cent during

the 1980s, which declined to -1.03 per cent during the 1990s but improved (2.83%) during the last decade. The extent of irrigated area under oilseed crops is lower when compared with cereal crops.

Figure 3.7: Trends in area under irrigation in oilseeds in India: 1981-82 to 2010-11



Source: GoI (2013)

Among major oilseed crops, the area under irrigation was high in case of rapeseed-mustard (72.1%), whereas it was quite low in the case of groundnut (22.6%), soybean (0.8%) and sesamum (10.2%) during the TE2010-11. The percentage area under irrigation for other oilseed crops was also very low. The irrigated area as a percentage of the total area under oilseeds varied from less than five percent in Maharashtra to more than 80 percent in Punjab (86.4%) and West Bengal (82.3%). Madhya Pradesh, the largest producer of oilseeds in the country has less than 6 percent area under irrigation (Table 3.16). There has not been any significant increase in irrigated area in most of the states. At all India level, the percentage of area under irrigation for oilseeds increased from 24.2 per cent to 26.2 percent during the last decade. Though oilseed crops in general require relatively less irrigation, scope for yield improvements even with protective irrigation is very high. Yield increases to the tune of 45 per cent, 42 per cent and 60 per cent have been recorded in groundnut, rapeseed-mustard and sunflower, respectively due to proper irrigation (Jha, *et. al.* 2012).

Table 3.16: Irrigated Area (%) under total oilseeds and major oilseed(s) in selected states in India

State	*TE2003-04*	*TE 2010-11*	*Major oilseed crop(s)*	*TE2010-11*
Andhra Pradesh	16.6	22.0	Groundnut	19.4
Assam	2.4	0.2	-	-
Bihar	29.8	43.2	Rapeseed-mustard	45.6
Chhattisgarh	4.4	4.6		
Gujarat	22.4	27.7	Groundnut Rapeseed-mustard	12.4 95.3
Haryana	79.9	78.5	Rapeseed-mustard	78.6
Jharkhand	3.9	8.0		
Karnataka	21.8	27.5	Groundnut Sunflower	25.6 23.1
Madhya Pradesh	4.2	5.8	Rapeseed-mustard Soybean	48.5 0.3
Maharashtra	7.3	3.8	Soybean	0.4
Orissa	11.6	17.2	Groundnut Sesamum	32.7 7.2
Punjab	86.0	86.4	Rapeseed-mustard	91.9
Rajasthan	56.5	51.5	Rapeseed-mustard Soybean	83.0 1.5
Tamil Nadu	47.1	58.0	Groundnut	36.4
Uttar Pradesh	54.1	48.1	Sesamum Rapeseed-mustard	0.5 81.1
Uttarakhand	22.1	27.7		
West Bengal	70.4	82.3	Sesamum Rapeseed-mustard	73.4 88.1
All India	24.2	26.1	Groundnut Sesamum Rapeseed-mustard Soybean Sunflower	22.5 10.2 72.1 0.8 30.0

Source: Authors' calculations using State wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Oilseeds are generally grown on marginal lands with scanty irrigation facilities or in dry land areas. Irrigation has been a major source of yield growth in oilseed crops. Given the uneven growth and differences between oilseed crops in the area under irrigation and the potential for yield increase under irrigation, it will be prudent to bring more oilseed area under assured irrigation.

Instability in Oilseeds Production

Nearly three-fourth of the total area under oilseeds is still unirrigated and largely rainfed, leading to unstable oilseeds production. Instability in productivity, production and area under oilseeds and major competing crops during the period 1991-92 to 2011-12 were analyzed for major oilseeds in selected states of India and the results are presented in Table 3.17. The yield instability in terms of coefficient of variation (CV) increased in all major edible oilseeds except for rapeseed-mustard at all India level. It showed a mixed response in major oilseeds producing states during the last two decades. In the case of groundnut, it declined in Gujarat but increased in Andhra Pradesh and Tamil Nadu during Period II. The instability of soybean yield increased in the case of both major producers and decreased for rapeseed-mustard in Rajasthan and Uttar Pradesh. In the case of sunflower, the instability increased in Andhra Pradesh but marginally declined in Karnataka during the last decade compared with the preceding decade of 1990s. While for sesamum, yield instability increased in Rajasthan and Madhya Pradesh but declined in West Bengal and Gujarat.

Oilseed crops are not high yielding crops in comparison with cereals and other competing crops. Moreover, compared with traditional cereals, these crops are generally more risky because oilseeds are mostly grown under rainfed conditions, and market price support is also not very effective. A comparison of instability in yield of major oilseeds and competing crops in selected states is given in Table 3.18. It is evident from the Table that the instability of groundnut yield in the two major oilseed producing states, namely, Gujarat and Andhra Pradesh is higher when compared with competing crops. Almost a similar trend was observed for rapeseed-mustard and sesamum in all major producing states. Soybean has relatively lower instability of crop yields, and that could be one of the reasons why the area under soybean cultivation has increased significantly in the country. Almost similar trends

were observed in the case of oilseeds acreage and production in different states (Table 3.19 and 3.20).

Table 3.17: Instability in yield, acreage and production of major oilseeds in selected states of India, 1991-92 to 2011-12

Crop	***Major Producers***	***Yield***		***Area***		***Production***	
		1990s	2000s	1990s	2000s	1990s	2000s
Groundnut	Gujarat	21.6	29.7	4.4	5.5	25.0	39.2
	A.P.	52.6	35.7	10.8	13.2	53.1	36.7
	Tamil Nadu	25.9	18.3	15.8	18.8	27.0	13.2
	All India	12.0	19.9	8.3	7.3	13.5	21.4
Soybean	M.P.	11.7	16.4	17.4	11.4	24.3	24.9
	Maharashtra	19.2	21.4	41.7	29.3	52.1	35.4
	All India	11.9	14.6	21.7	16.9	28.6	27.1
Rapeseed & Mustard	Rajasthan	11.8	11.2	18.7	26.8	18.3	30.5
	Uttar Pradesh	16.0	8.1	8.1	12.6	15.1	12.2
	M.P.	13.0	13.4	10.9	19.1	18.9	27.8
	All India	10.9	8.8	10.4	14.3	12.6	18.9
Sunflower	Karnataka	15.6	14.3	19.4	28.1	18.0	29.9
	A.P.	11.6	17.6	32.0	36.2	27.8	40.2
	All India	8.0	13.8	22.6	30.4	22.3	30.5
Sesamum	West Bengal	11.4	8.7	12.2	19.9	9.9	22.7
	Rajasthan	38.4	39.4	38.3	30.9	57.8	44.9
	Gujarat	38.5	27.3	11.5	18.7	41.1	39.1
	M.P.	13.2	18.7	24.5	24.2	27.6	42.6
	All India	9.8	12.8	16.2	8.9	14.2	17.1

Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Table 3.18: Instability in yield of major oilseeds and competing crops in selected states of India, 1991-92 to 2011-12

Main Crop	*Major Producers*	*CV of Main Crop (%)*	*Competing Crops*	*CV of Competing Crop (%)*
Groundnut	Gujarat	51.8	Cotton	45.3
	Andhra Pradesh	39.8	Maize Jowar Cotton	24.0 20.9 25.6
	Tamil Nadu	33.7		
	All India	22.0	Cotton	38.4
Soybean	Madhya Pradesh	15.0	Maize	20.3
	Maharashtra	20.6	Groundnut Cotton	14.8 42.2
	All India	14.2		
Rapeseed & Mustard	Rajasthan	18.1	Wheat	12.1
	Uttar Pradesh	14.2	Wheat	8.6
	Madhya Pradesh	15.1	Wheat	11.9
	All India	13.9	Wheat	7.6
Sunflower	Karnataka	16.2	Jowar	29.3
	Andhra Pradesh	17.8	Cotton Maize Jowar	25.6 24.0 20.9
	All India	12.2	Jowar	11.7
Sesamum	West Bengal	10.4	Rice	4.4
	Rajasthan	51.6	Maize	28.1
	Gujarat	32.9	Maize	27.4
	Madhya Pradesh	27.5	Maize	20.3
	All India	16.2	Maize	16.7

Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Table 3.19: Instability in area under major oilseeds and competing crops in selected states of India, 1991-92 to 2011-12

Main Crop	*Major Producers*	*CV of Main Crop (%)*	*Competing Crops*	*CV of Competing Crop (%)*
Groundnut	Gujarat	6.3	Cotton	28.9
	Andhra Pradesh	18.7	Maize Jowar Cotton	36.0 18.4 29.1
	Tamil Nadu	41.1		
	All India	14.1	Cotton	26.5
Soybean	Madhya Pradesh	18.4	Maize	5.2
	Maharashtra	61.4	Groundnut Cotton	27.8 12.9
	All India	29.6		
Rapeseed & Mustard	Rajasthan	23.9	Wheat	12.7
	Uttar Pradesh	20.7	Wheat	4.2
	Madhya Pradesh	16.6	Wheat	10.5
	All India	20.7	Wheat	19.7
Sunflower	Karnataka	25.9	Jowar	40.4
	Andhra Pradesh	34.3	Cotton Maize Jowar	29.1 36.0 18.4
	All India	27.3	Jowar	18.8
Sesamum	West Bengal	26.1	Rice	15.2
	Rajasthan	34.6	Maize	6.6
	Gujarat	17.1	Maize	12.9
	Madhya Pradesh	35.0	Maize	5.2
	All India	13.8	Maize	13.5

Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

Table 3.20: Instability in production of major oilseeds and competing crops in selected states of India, 1991-92 to 2011-12

Main Crop	*Major Producers*	*CV of Main Crop (%)*	*Competing Crops*	*CV of Competing Crop (%)*
Groundnut	Gujarat	52.1	Cotton	71.3
	Andhra Pradesh	48.9	Maize Jowar Cotton	56.0 18.3 52.5
	Tamil Nadu	40.0		
	All India	21.2	Cotton	59.1
Soybean	Madhya Pradesh	29.5	Maize	21.2
	Maharashtra	65.5	Groundnut Cotton	24.6 53.8
	All India	39.2		
Rapeseed & Mustard	Rajasthan	33.5	Wheat	19.7
	Uttar Pradesh	17.4	Wheat	12.5
	Madhya Pradesh	28.0	Wheat	21.5
	All India	19.3	Wheat	13.1
Sunflower	Karnataka	30.0	Jowar	24.8
	Andhra Pradesh	37.5	Cotton Maize Jowar	52.5 56.0 18.3
	All India	26.9	Jowar	20.3
Sesamum	West Bengal	30.0	Rice	16.5
	Rajasthan	59.5	Maize	34.0
	Gujarat	41.4	Maize	32.0
	Madhya Pradesh	63.4	Maize	21.2
	All India	17.7	Maize	30.1

Source: Authors' calculations using state wise Area, Production and Yield Statistics, various issues (GoI, 2013c)

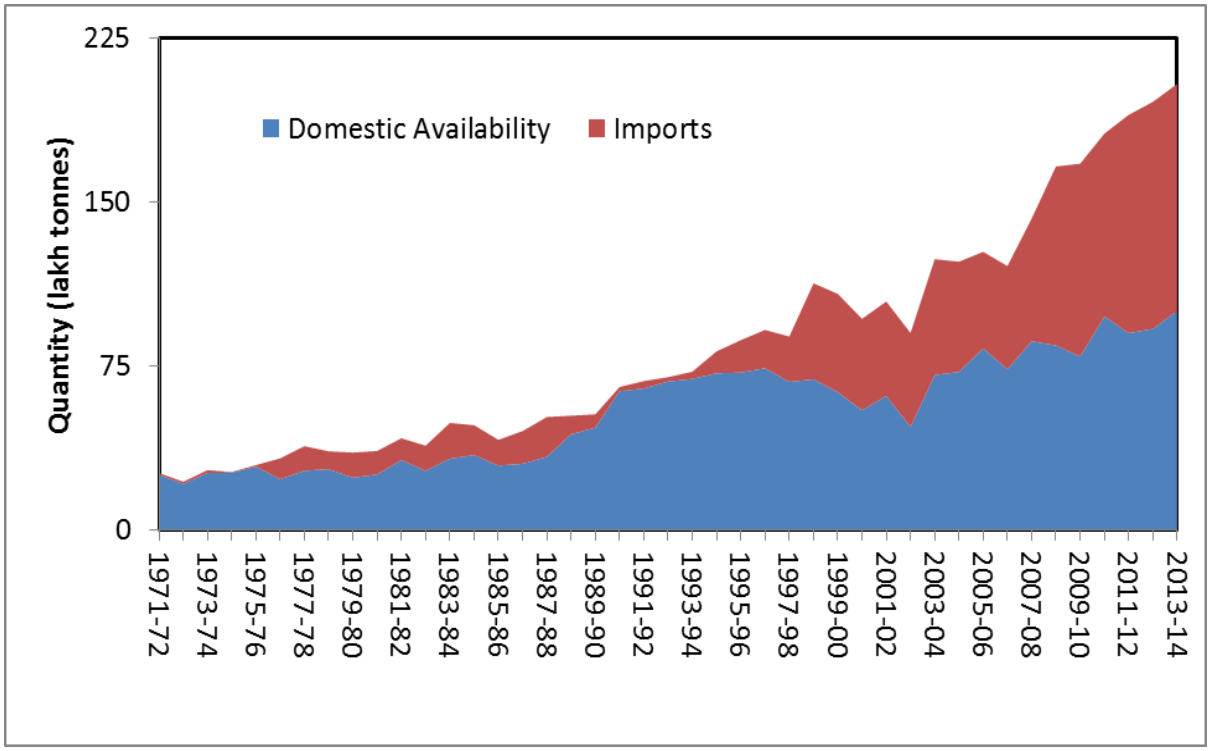
Trade Patterns and Policies in Edible Oilseed Complex

India is the largest producer of oilseeds in the world but domestic production of edible oils has not kept pace with the rising demand for edible oils in the country, leading to a substantial increase in the imports of edible oils over time.

India was nearly self-sufficient in edible oils and a net exporter of oilseeds complex till the mid-sixties. However, with stagnating production and yield as well as rise in demand for edible oils due to increasing in population, oilseed production fell far short of its demand in the 1970s. Oilseeds sector was adversely affected by the green revolution as this breakthrough in technology was accompanied by a significant shift in the area under oilseeds, pulses and coarse cereals to high yielding varieties of wheat and rice. The share of imports in total edible oils consumption, which was about 3 per cent in the first half of 1970s, increased to 28.5 per cent in the second half and to over 30 per cent during 1981-1987. By the mid-80s, India became one of the major importers of edible oil, constituting about one-third of the total supply. This was a cause of concern for the policy planners and a decision was taken to improve oilseeds production, reduce the import of edible oils and achieve self-sufficiency in edible oils by launching Technology Mission on Oilseeds (TMO) through integrated approach involving different developmental, scientific, input, banking and marketing agencies in May 1986. The programme helped in increasing production of oilseeds from 11.3 million tonnes in 1986-87 to 21.5 million tonnes during 1993-94 and import dependence declined from about one-third during 1986-87 to about 7.5 per during 1988-93. From a high quantum of about 1.8 million tonnes in 1987-88, imports came down to about two lakh tonnes in 1992-93.

However, as part of the Uruguay Round of Agreement on Agriculture commitments and domestic market reforms as well as to contain rise in edible oil prices, India opened up edible oilseeds/oils sector by removing quantitative restrictions on edible oil imports. The first significant shift in policy was announced in April 1994, when imports of palmolein were shifted from the negative list to Open General License (OGL) which was followed by enlarging the basket of oils under OGL imports in 1995, when all edible oils except coconut oil, palm kernel oil, RBD Palm Oil and RBD Palm Stearin were brought under OGL import. Following the liberalization of edible oils sector, edible oil market experienced an explosion of imports. Imports of edible oils have grown significantly over the years, from less than one million tonnes in mid-1990s to about 5.3 million tonnes in 2003-04 and further to about 10.4 million tonnes in 2012-13 (Figure 3.8).

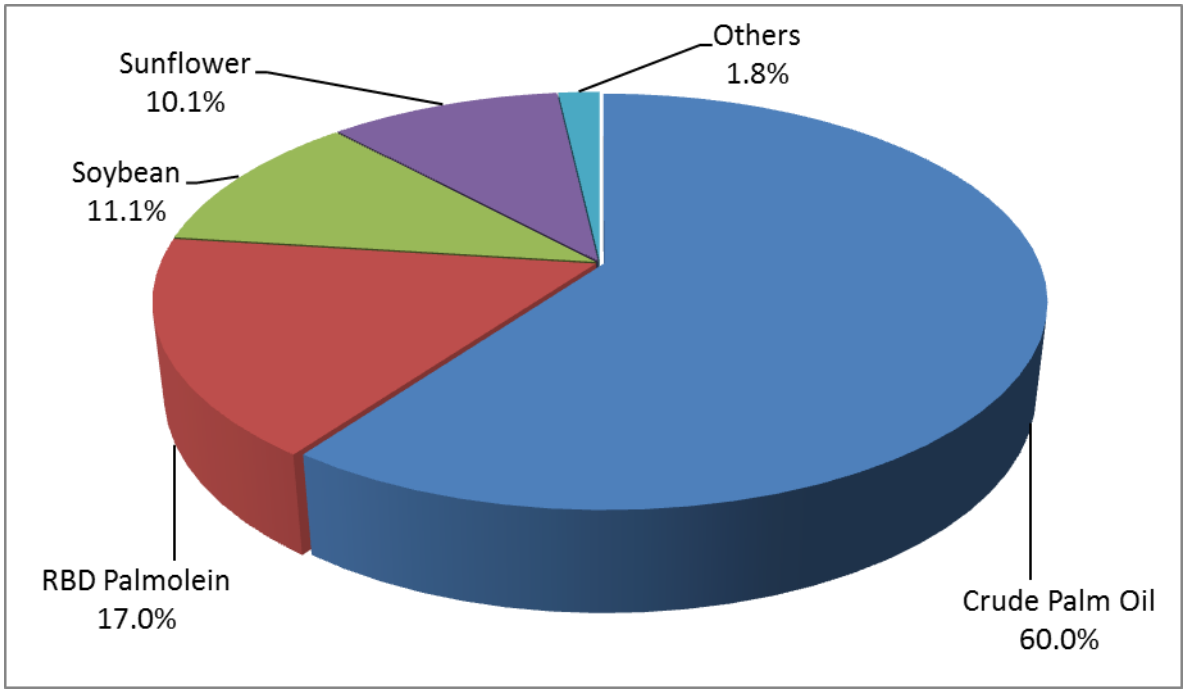
Figure 3.8: Trends in domestic supply and imports of edible oils in India: 1971-72 to 2013-14



Source: GOI (2003), SEA (2014)

Palm oil accounted for the largest share (75-80%) of India's total vegetable oil imports followed by soybean (11.1 per cent) and sunflower (10.1 per cent) in TE2012. The share of sunflower oil has increased significantly from 1.3 per cent in TE2005-06 to over 10 per cent in recent years while that of soybean oil has declined from about one-third to about 11 per cent during the same period. About 80 per cent of the palm oil is imported as crude palm oil and the remaining as refined oil because of high import duty on crude oil compared to refined. India imports palm oil mainly from Indonesia and Malaysia and the share was about 71 per cent and 28 per cent, respectively during the TE2013. During the last decade, Indonesia has lost its share while Malaysia has increased its share. Soybean oil is primarily imported from Argentina, Brazil and the USA, with an estimated share of about 73 per cent, 16 per cent and 9 per cent, respectively during the last five years. Ukraine is the single largest supplier of sunflower oil with over 90 per cent share. Argentina is the second largest exporter of soybean oil to India but its share is only 5 per cent.

Figure 3.9: Share of major oils in total imports of edible oils in India: TE2012-13



Source: SEA (2014)

With the exception of palm oil, substantial inter-year variability in imports of other edible oils has been observed. The soybean import have shown a negative growth rate (-0.4%) during 2003-04 to 2013-14. However, a sharp increasing trend was observed in the quantum of sunflower oil imports during the last decade. Palm oil imports have shown a consistent upward trend and increased from about 3 million tonnes in early-2000s to about 8.3 million tonnes in 2012-13 (Table 3.21). It is evident from the Table that for palm oil, which is a major import item for India, imports have grown at a consistent rate. The growth rates for sunflower oil and other oils are very high, but this may be due to the low base year values as the volume of imports of sunflower, coconut oil and rape oil in the early-2000s were very small. High values of coefficients of variation indicate a high degree of inter-year fluctuations in imports of all edible oils.

Exports of oil meals from India

India is one of the largest exporters of oil meals, particularly of soybean meal. Soybean accounts for more than 70 per cent of the total exports of oil meals, followed by rapeseed (20%), castor seed (6%) and rice bran (3%). In this study, the export data of oil meals have been analysed from 1991-92 to 2012-13 and are presented in Figure 3.10. It is evident from the Figure that there has been a significant increase in exports of oil meals. Total exports of

oil meals which were about 625 crore in 1991-91 increased to about 2045 crore in 2000-01 and reached a record level of about 15822 crore in 2012-12. However, the share of oil meals in total agricultural exports has witnessed a declining trend and has fallen from 13-14 per cent in late-1990s to 7-8 per cent in the recent years. The exports of oil meals have increased significantly during the last decade as shown by the higher compound annual rate of growth (21.5%) during 2001-2012 relative to the earlier decade (5.6%). The growth rate of oil meals exports was also higher than total agricultural exports (19.7%) during the last decade.

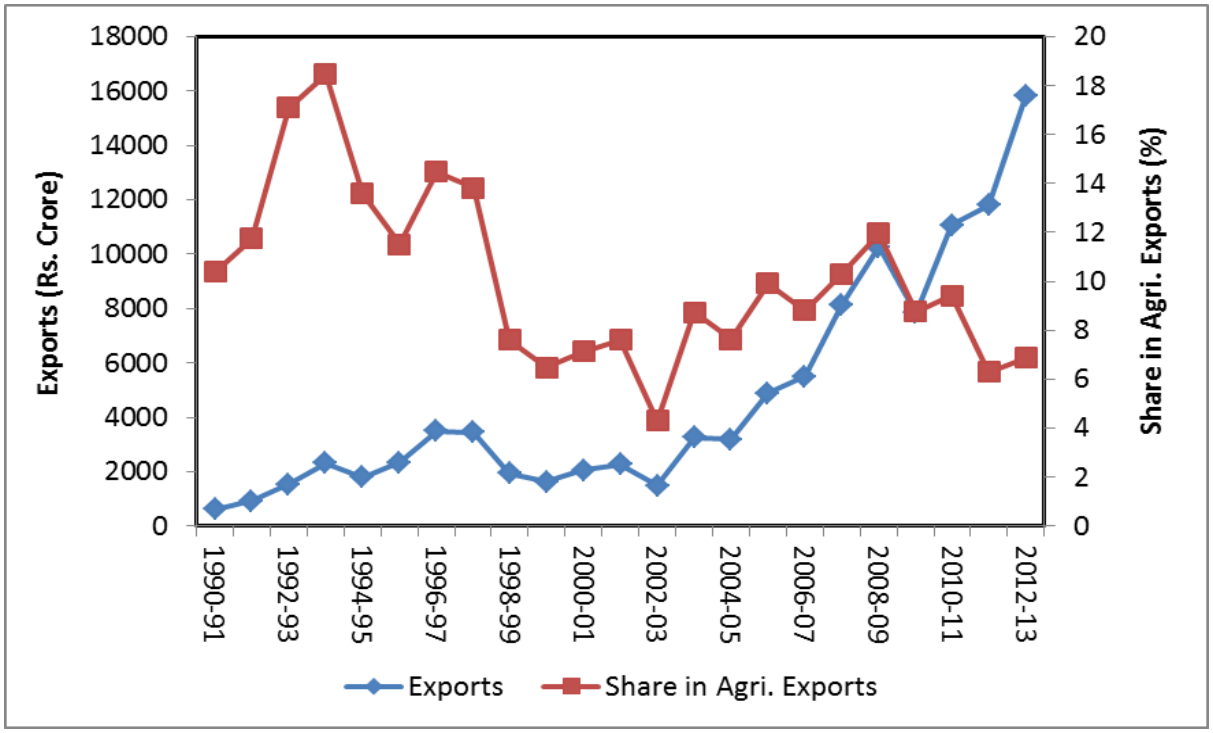
Table 3.21: Trends in imports of important edible oils in India: 2003-04 to 2013-14 (Oil year November to October) (In '000 tonnes)

Year	Palm Oil	Sunflower	Soybean	Total
2003-04	3412.7	75.8	906.0	5208.8
2004-05	3002.6	5.0	2026.7	5489.3
2005-06	2568.8	101.9	1723.8	4551.8
2006-07	3172.5	195.2	1334.0	4841.0
2007-08	4809.5	26.5	759.4	6339.2
2008-09	6535.4	590.2	989.6	8183.4
2009-10	6499.3	630.0	1666.5	10036.7
2010-11	6547.1	803.6	1006.7	9453.1
2011-12	7669.4	1134.9	1079.0	11558.8
2012-13	8292.4	973.1	1091.3	12608.0
2013-14 (Nov. to Sep.)	7092.4	1407.9	1732.6	11821.4
CAGR (%)	12.3	56.0	-0.4	11.5
Coefficient of Variation (%)	38.4	91.6	32.2	37.3

Source: SEA (2014)

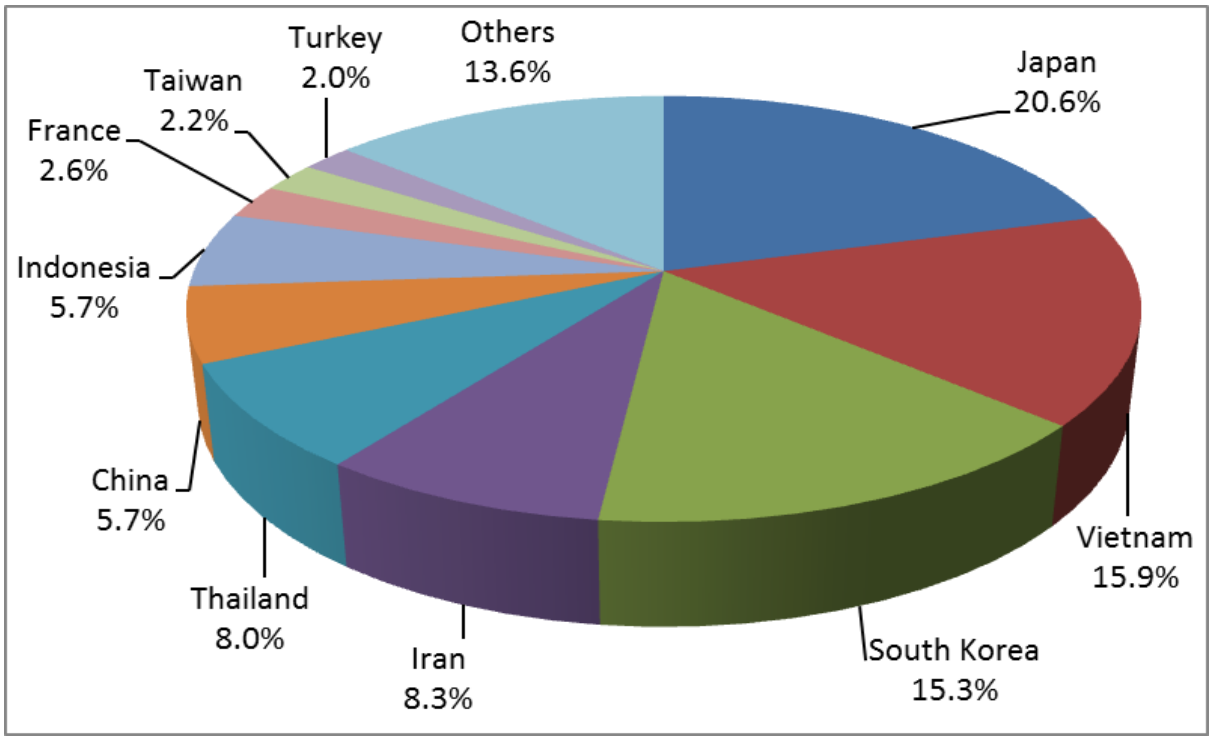
India exports oil meals to a large number of countries but bulk of exports are to South and South East Asian countries with a share of over 77 per cent followed by Middle-East and Africa region (about 15%). Japan is the largest importer (20.6%) of oil meals from India, followed by Vietnam (15.9%), South Korea (15.3%), Iran (8.3%) and Thailand (5.7%).

Figure 3.10: Trends in exports of oil meals in India: 1991-92 to 2012-13



Source: MoA (2014)

Figure 3.11: Country-wise exports of oil meals from India: TE2012-13



Source: SEA (2014)

Trade Policy

Trade policy has played a key role in shaping the overall structure and performance of India's edible oil sector for decades. Edible oils were on the negative list of imports and all imports were canalized through State Trading Corporation (STC) and the Hindustan Vegetable Oils Corporation (HVOC) for sale through the Public Distribution System (PDS). However, the sector was first liberalised partially in April 1994 with permission to import palmolein under OGL at 65 per cent duty. This was followed by bringing more edible oils under OGL import and gradual reduction in import duty until 1999. However, India has fairly high bound rates of tariffs on most of the edible oils ranging from 45 per cent in the case of soybean to 300 per cent in palm oil and groundnut oil (Table 3.22). The applied rates have never exceeded 92.5 per cent in the post-reforms period and are under free list. Since India is not self-sufficient in edible oils, Government of India, with a view to meet the demand for edible oils and to check market prices, has been allowing import of edible oils at varying tariff rates. Import duties which witnessed a declining trend between 1994 and 1999, increased during the next 2-3 years (Figure 3.12). However, import duties started declining from July 2007 and reached the lowest level of zero per cent on crude and 7.5 per cent on refined palm oil in April 2008 before rising slightly from April 2010.

Since January 23, 2013, the custom duty on imported crude edible oils has been revised from zero to 2.5 per cent and subsequently since January 20, 2014 custom duty on imported refined edible oils has been revised from 7.5 per cent to 10 per cent. However, due to bumper oil seeds production globally and declining prices, there has been a demand for raising import duty on crude and refined edible oils to restrict cheap imports and protect domestic farmers as well as processors.

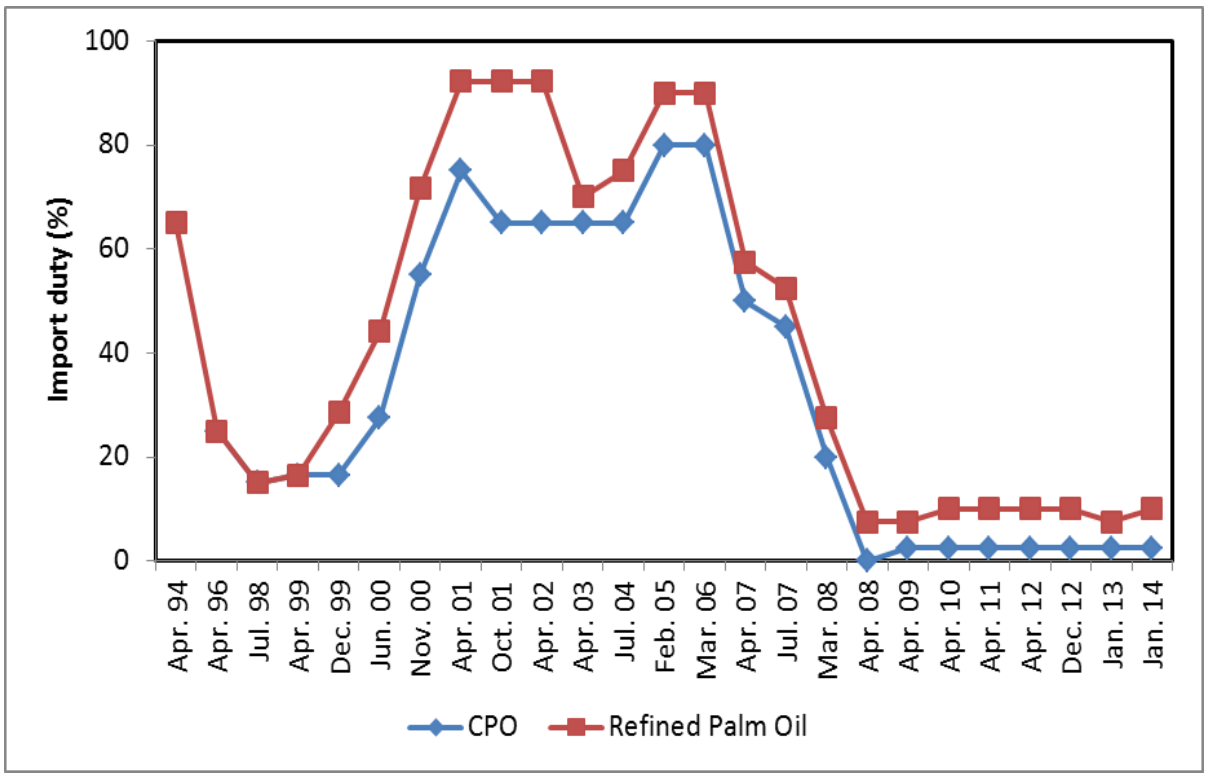
The Government started fixing tariff values on import of certain edible oils from August 3, 2001 and revisions from time to time in accordance with the variation in the international prices (Figure 3.13). This was in order to check the problem of under-invoicing of edible oil imports. The tariff value was revised by more than 30 times between August 2001 and July 2006 and remained unchanged during July 2006 and January 2013. However, from January 23, 2013 it has been revised about 40 times. Frequent changes in the tariff rates sometimes create uncertainty for farmers in allocating land for oilseeds cultivation. The current tariff value is US$ 722 per tonne for crude palm oil and US$845 for crude soybean oil.

Table 3.22: Tariff and trade policy of edible oils in India

Oil	*Bound Rate (%)*	*Applied Duty Jan 20, 2014 (%)*	*Policy Condition*	*Tariff Value (CIF US$/MT) Sep. 2014*
Crude Palm Oil	300	2.5	Free	722
RBD Palm Oil	300	10.0	Free	728
Crude Palmolein	300	2.5	Free	731
RBD Palmolein	300	10.0	Free	734
Crude Soybean Oil	45	2.5	Free	845
Refined Soybean Oil	45	10.0	Free	-
Refined Sunflower Oil	300	10.0	Free	-
Refined Rape/Mustard Oil	75	10.0	Free	-
Refined Groundnut oil	300	10.0	Free	-

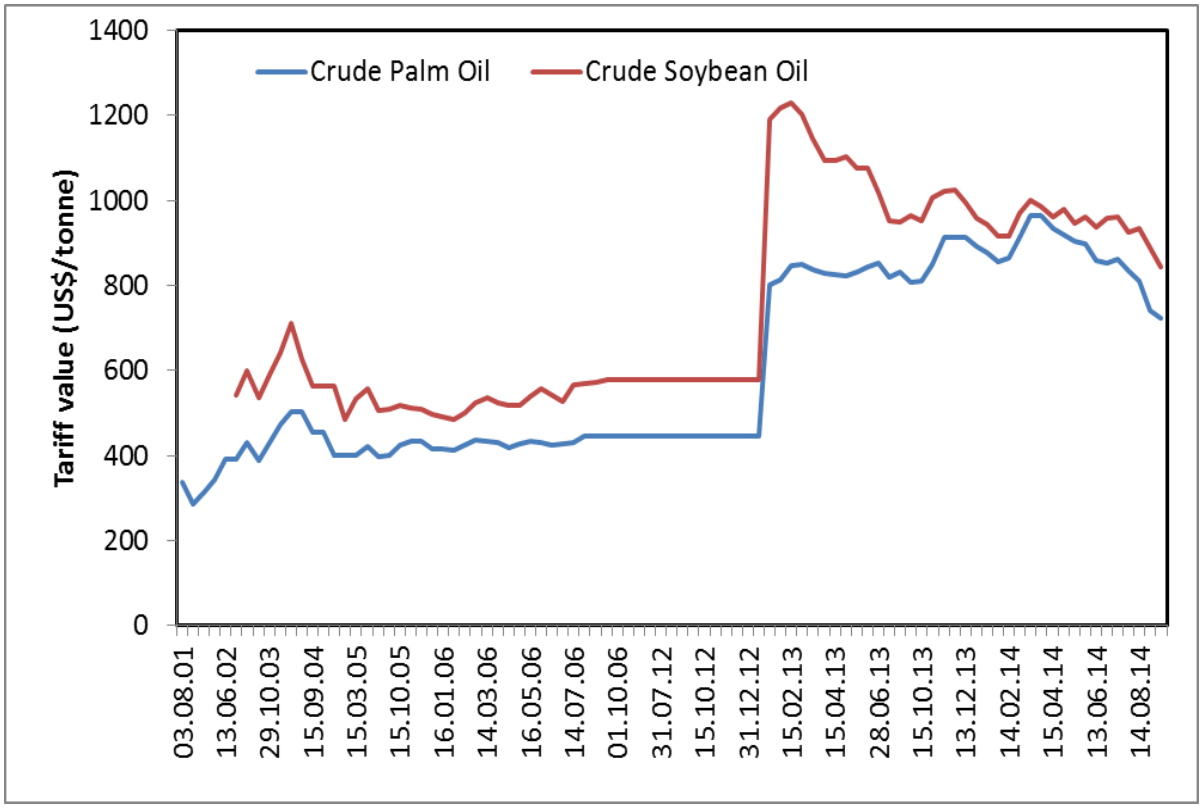
Source: SEA (2014)

Figure 3.12: Import duty on crude and refined palm oil in India: 1994-2014



Source: SEA (2014)

Figure 3.13: Trends in tariff values of crude palm oil and crude soybean oil in India: 2001-2014



Source: SEA (2014)

Summing Up

One of the most important changes observed in the cropping pattern over the last few decades has been a shift of area from coarse cereals to rice, wheat, oilseeds, fruits and vegetables and other commercial crops. In relative terms, the share of cereals in the total cropped area has declined from 60.7 per cent during TE1973-74 to about 51.7 per cent during TE2010-11, indicating that increase in area under rice and wheat (about 3.2% increase) fell short of decline in area under coarse cereals (12.3%) during the period. The share of oilseeds increased from around 10 per cent during TE1973-74 to 14.8 per cent during TE2010-11. The change in the area under oilseeds was more pronounced during the mid-80s and mid-90s and then during 2000s owing to concerted efforts of the government. Area under oilseeds declined in the late-90s because of large imports. The area under pulses remained stagnant at around 22-23 million ha during 1970s, 1980s and 1990s but increased to 24 million ha during the last decade. The acreage under fruits and vegetables more than doubled between TE1973-74 and TE2010-11. India lost nearly 1.5 million ha of

net sown area since early-1990s, but total cropped area increased by over 9.5 million ha mainly due to crop intensification.

When it comes to oilseeds, India is the largest producer of the crop in the world and the oilseed sector occupies a prominent position in the country's economy. The area and production of oilseeds were about 26.5 million ha and 29.1 million tonnes, respectively during TE2011-12. As per the fourth advance estimates for 2012-13, the production of total oilseed crops is over 31 million tonnes, which is a significant jump compared with production in the early 2000s.. Oilseeds area and output are concentrated mainly in the central, western and southern parts of India, mainly in the states of Madhya Pradesh, Gujarat, Rajasthan, Andhra Pradesh and Karnataka. Among different oilseeds, groundnut, rapeseed-mustard and soybean account for over 81 per cent of the area and over 88 per cent of production of oilseeds in the country during TE2011-12.

The area, production and productivity of oilseeds grew at a compound annual growth rate of 1.51 per cent, 3.06 per cent and 1.53 per cent, respectively, during the period 1951-2011. Among the oilseed crops, the growth rate in area and production was the highest for soybean. There was a relative decline in the annual growth rate of area, production and productivity of oilseeds during 1991-2000 as compared to 1981-1990 but improved during the last decade. Both area and yield have contributed to increased production, but yield has been a primary source of growth during the last decade. Although irrigated area under oilseeds has increased, but still nearly 74 per cent area is unirrigated. The highest variability has been observed in the production (30.2%), followed by productivity (19.9%) and area (13.5%) of oilseeds during the period 1981-2011. It is well known that scope for increasing oilseed production through area expansion is limited, future increases in oilseed production have to be driven mainly by productivity improvements through use of high-yielding varieties/ hybrids, better crop nutrition, efficient crop management, protective irrigation, effective disease and pest management, etc.

Chapter 4

Performance of Soybean: Recent Trends, Prospects and Constraints

Soybean is not only an important oilseed crop and feed for livestock and aquaculture, but also a good source of protein for the human diet. Of late, it has also emerged out to be a major biofuel feedstock. It accounts for about 56 per cent of total oilseeds production, 25 per cent of global edible oil, and about two-third of the world protein concentrate for livestock feed. Soybean acreage has expanded mainly by substituting other crops, e.g. sunflower in Argentina, cotton in the United States, and utilizing pasture lands in Argentina and Brazil (Masuda and Goldsmith, 2009).

The world soybean production was 28.6 million metric tons in 1961-65, and reached 256.9 million metric tons in 2010-12, which was an increase of about 9 times during the half century. During the last decade, world soybean production increased by 38 per cent between TE2002-03 (185.8 million tons) and TE2012-13 (256.9 million tons). Though the world-wide soybean harvested area increased by 33 per cent, it drove about 87 per cent of the increased production during the last decade. Yield increased by only four percent since early-2000s and contributed only 13 per cent to the increased output. Major global producers of soybean in the order of importance include the United States of America, Brazil, Argentina, China and India. The USA produced more than 50 percent of the world soybean production until the 1980s, but its share declined to about 33 per cent in 2010-12. Brazil and Argentina have significantly increased their shares steadily over the same period. Brazil is the second largest producer with 74.6 million tonnes or 29 per cent of the world production. Argentina ranks third, producing 46.2 million tonnes and 18 per cent of the world output. The top five countries, United States, Brazil, Argentina, China, and India, produce about 90 per cent of the world's soybean. Even though India ranks 5th globally in respect of soybean production, the yield levels of soybean in India are far below (1.2

tonnes/ha) compared to yield recorded in major soybean producing countries and the world average (2.4 tonnes/ha).

Trends in Area, Production and Yield

The commercial cultivation of the soybean crop in India started in the late sixties. As of now, it has emerged as one of the most important rainfed *Kharif* season crop and despite low level of irrigation (<1% area under irrigation), the crop productivity has improved significantly (22.7%) during the last decade. The area under soybean is mainly spread in the states of Madhya Pradesh, Maharashtra, Rajasthan, Chhattisgarh, Andhra Pradesh and Karnataka. In most parts of India, soybean is planted from June through end-August and harvested from mid-September through end-December. Soybean is grown either as a pure crop or in a mixture with maize or autumn paddy. The products and by-products of soybean have great potential in the domestic and world markets.

The growth in area and production has been unparallel during the last four decades; however a positive trend in area, production and yield was witnessed. Area under soybean increased from 0.04 million ha in 1971-73 to 0.7 million ha in 1981-83 and further to 3.78 million ha in 1991-93. During the 1990s, area under soybean almost doubled and reached a level of about 6.3 million ha during TE2001-02. Soybean acreage increased at an annual compound growth rate of about 5.5 per cent during the 2000s and reached about 9.8 million ha during the TE2011-12. Soybean production, which was about 30 thousand tonnes during 1971-73 increased sharply to about half a million tonnes in 1981-83 and 3.5 million tonnes in 1991-93. Soybean production increased at an annual growth rate of 8.9 per cent during the last decade and was 11.6 million tonnes in TE2011-12. Soybean productivity has also increased from 691 kg per ha in 1971-73 to 704 kg per ha in 1981-83 and 921 kg per ha in 1991-93. Productivity growth rate decelerated during the 1990s, but productivity increased from 921 kg per ha in TE1993-94 to 967 kg per ha during TE2001-02. However, yield picked up during the last decade and recorded a growth rate of 3.2 per cent, the highest ever during the last four decades. It is very clear from the above trends that the soybean crop has witnessed a phenomenal growth in production in the country during the last four decades, but growth has been driven majorly by area expansion. During the last two decades, area expansion drove about 80 per cent of the increased production while yield contributed about 20 per cent to the increase in soybean production.

Soybean cultivation like many other crops grown in the country faces several risks related to production and prices, which result in fluctuations in the income of soybean producers. Production risks can be observed from the deviations in area, yield and output, while price risks can be measured through instability of prices. During the period 1971-1972 to 2011-12, soybean acreage, production and yield witnessed significant variability as measured by coefficient of variation. The highest instability was observed in production (98.1%), followed by acreage (87.6%) and yield (22%). However, instability in area, production and yield has declined significantly during the last 2-3 decades. The coefficient of variation in area declined from 102.3 per cent in 1970s to 17.8 per cent in 2000s and instability in yield declined from 23.4 percent to 15.3 percent between the two periods, leading to significant decline in fluctuations in soybean production (Table 4.1).

Table 4.1: Average area (million ha), production (million tonnes), and yield (kg/ha) of soybean in India: 1971-72 to 2011-12

	1971-72 to 1973-74	***1981-82 to 1983-84***	***1991-92 to 1993-94***	***1999-00 to 2001-02***	***2009-10 to 2011-12***
Area	0.04	0.70	3.78	6.33	9.81
Production	0.03	0.48	3.54	6.11	11.64
Yield	691	704	921	967	1186
Compound annual growth rate (%)					
	1970s	***1980s***	***1990s***	***2000s***	***All Period***
Area	43.4***	17.8***	8.1***	5.5***	14.7***
Production	47.3***	21.1***	9.9***	8.9***	16.2***
Yield	2.3	2.6	1.6	3.2**	1.3***
Coefficient of Variation (%)					
Area	102.3	45.5	22.9	17.8	87.6
Production	93.1	61.5	30.1	28.4	98.1
Yield	23.4	17.9	12.6	15.3	22.0

****, ** and *: Significant at 1, 5 and 10 per cent level, respectively.*
Source: Authors calculations using GoI (2013)

Soybean has played an important role in meeting edible oil demand in India, and it constitutes about 30 per cent of edible oil produced in the country. In addition, it has been a

major foreign exchange earner due to export of soybean de-oil cake. The soybean oil cake exports have increased from about Rs. 2731 crores in 1996-97 to Rs. 14156 crores in 2012-13.

Shifts in Area

The relative position of the major soybean producing states in terms of acreage, production, and yield in different time periods is presented in Tables 4.2 and 4.3 and Figures 4.1 and 4.2. It is evident from Table 4.2 that Madhya Pradesh, Maharashtra and Rajasthan account for the bulk of area under soybean in the country, accounting for 57.4, 29.8 and 8.3 per cent during the TE2011-12, respectively. The share of Madhya Pradesh in total area under soybean has declined from 80.4 per cent during TE1993-94 to 70.5 per cent during TE2001-02 and 57.4 per cent during TE2011-12. In contrast, the share of Maharashtra increased during the last two decades from about 10 percent in early-1990s to nearly 30 percent in TE2010-11. As the share of soybean increased in the state, area under other kharif crops like groundnut and jowar declined (Kajale and Shroff, p.36, 2013). The share of Rajasthan increased during the 1980s and 1990s but declined during the last decade. The share of Uttar Pradesh showed a dramatic decline from 21.7 per cent in the early 1970s to an insignificant share (0.2%) in the recent period.

Table 4.2: Share of major states in area under soybean in India: TE1983-84 and TE2011-12

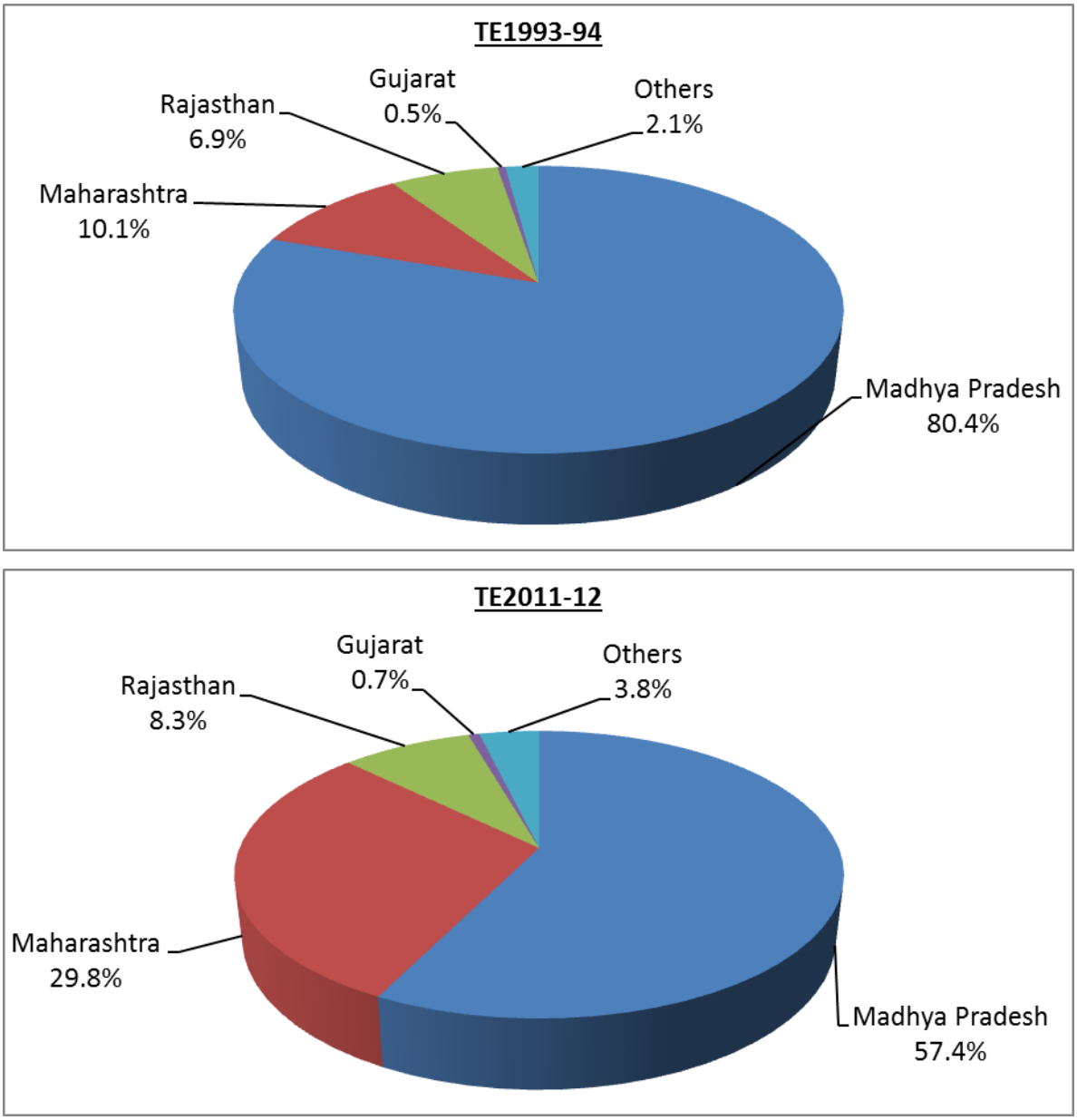
State	Share in all-India acreage				Share in edible oilseed acreage in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
M.P.[6]	65.9	80.4	70.5	57.4	25.3	62.9	76.2	77.0
Maharashtra	-	10.1	18.0	29.8	-	14.8	44.5	78.4
Rajasthan	2.7	6.9	9.5	8.3	1.6	7.4	19.3	17.1
U.P.[7]	21.7	0.8	0.3	0.2	5.8	1.7	1.4	2.0
Gujarat	1.3	0.5	0.1	0.7	0.4	0.7	0.2	2.4
Others	8.3	1.4	1.6	3.6			1.3	5.6
India	100.0	100.0	100.0	100.0	4.5	14.5	27.2	37.0

Source: GoI, various sources.

[6] *TE2011-12 data Includes data for both Madhya Pradesh and Chhattisgarh for comparison purpose*

[7] *TE2011-12 data Includes data for both Uttar Pradesh and Uttarakhand*

Figure 4.1: Share of major states in area of soybean in India: TE 1993-94 and TE2011-12



Source: GoI (2013)

The share of soybean in total cropped area has increased substantially from about 0.8 per cent in mid-1980s to about 5 per cent in TE2010-11. Vis-à-vis other oilseeds, soybean enjoys a prominent place in the edible oilseeds economy of the country, accounting for about 37 per cent of area under edible oilseeds in TE2011-12. It is also interesting to note that the share of soybean in total area under edible oilseeds showed an increasing trend in the last three decades, from about 4.5 per cent in 1980-83 to 27.2 per cent in TE2001-02 and 37 per cent in TE2010-12. Soybean is an important oilseed crop in Madhya Pradesh with a share of

about 77 per cent in total oilseeds acreage during 2009-11 but has remained almost constant during the last decade. Soybean has gained prominence in Maharashtra particularly during the last two decades and its share in total edible oilseeds acreage in the state has increased from 14.8 per cent in 1980-83 to 78.4 per cent in 2009-11. It has also gained importance in Rajasthan where the share has increased from 1.6 per cent in the early-1980s to 19.3 per cent in TE2001-02, but marginally declined to 17.1 per cent in 2009-11.

Shifts in Production

In terms of production, Madhya Pradesh, Maharashtra and Rajasthan are the largest producers accounting for about 96 per cent of the production in 2009-11 (Table 4.3 and Figure 4.2). The share of Madhya Pradesh increased from 74.5% during TE1983-84 to 78% during TE1993-94 and then declined to about 65 per cent during TE2001-02 and reached 56.3 per cent in 2009-11. Maharashtra was the major gainer as it improved its share from 11.5 per cent in 1991-93 to 30 per cent in 2009-11. The other notable gainer is Rajasthan, whose share increased from less than 2 per cent in 1980-83 to 9.8 per cent in 2009-11. Looking at the importance of soybean vis-à-vis other edible oilseeds, it is evident from the Table that soybean has gained importance in the edible oilseeds economy and increased its share in total oilseeds production. The share of soybean in total edible oilseeds production has increased from 4.5 per cent in 1980-83 to over 40 per cent in 2009-11.

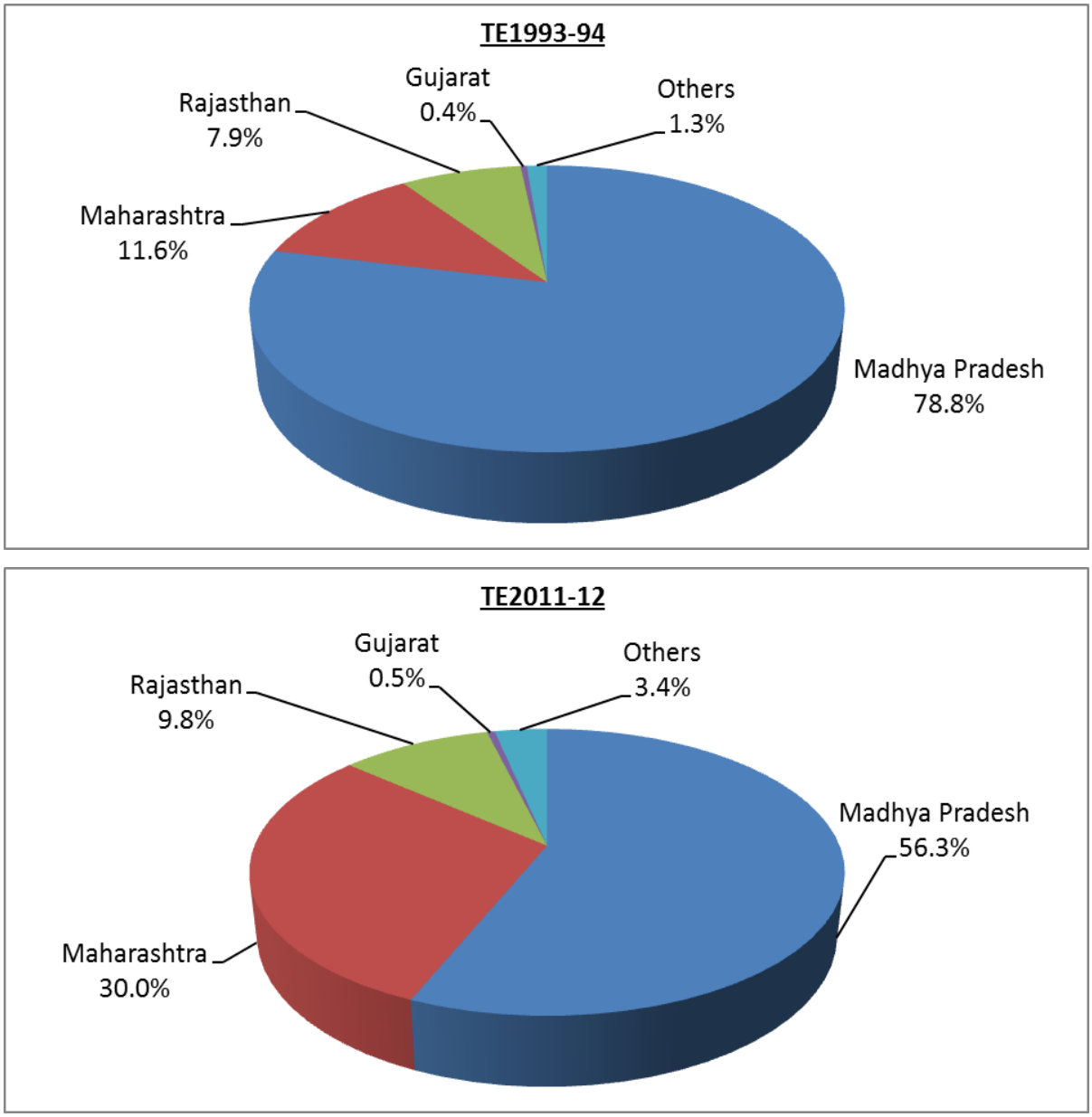
Table 4.3: Share of major states in soybean production in India: TE1983-84 and TE2011-12

State	Share in all-India oilseed production				Share in edible oilseed production in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
M.P.	74.5	78.0	65.1	56.3	40.4	73.4	81.2	82.0
Maharashtra	-	11.5	23.3	30.0	-	23.5	61.1	85.0
Rajasthan	1.8	7.8	9.7	9.8	1.3	10.9	20.7	20.4
U.P.	22.1	1.0	0.2	0.3	8.2	2.5	1.2	3.4
Gujarat	0.9	0.4	0.1	0.5	0.2	0.6	0.2	1.3
Others	0.8	1.3	1.6	3.1	-	-	1.5	3.7
India	100.0	100.0	100.0	100.0	4.5	17.6	30.6	40.1

Source: GOI (2013)

In Madhya Pradesh, the share of soybean in total edible oilseeds production in the state has more than doubled from 40.4 per cent in 1980-83 to 82 per cent in 2009-11. Soybean has gained momentum in Maharashtra during the last two decades. Its share has increased significantly from 23.5 per cent in 1990-93 to about 85 per cent in 2009-11. Soybean production has also increased in Rajasthan, and the share improved from 1.3 per cent in 1980-83 to over 20 per cent in TE2011-12. Hence, the share of soybean in edible oilseeds acreage and production has witnessed a significant increase at the national level as well as in some states like Madhya Pradesh, Rajasthan and Maharashtra.

Figure 4.2: Share of major states in soybean production in India: TE1993-94 and TE2011-12

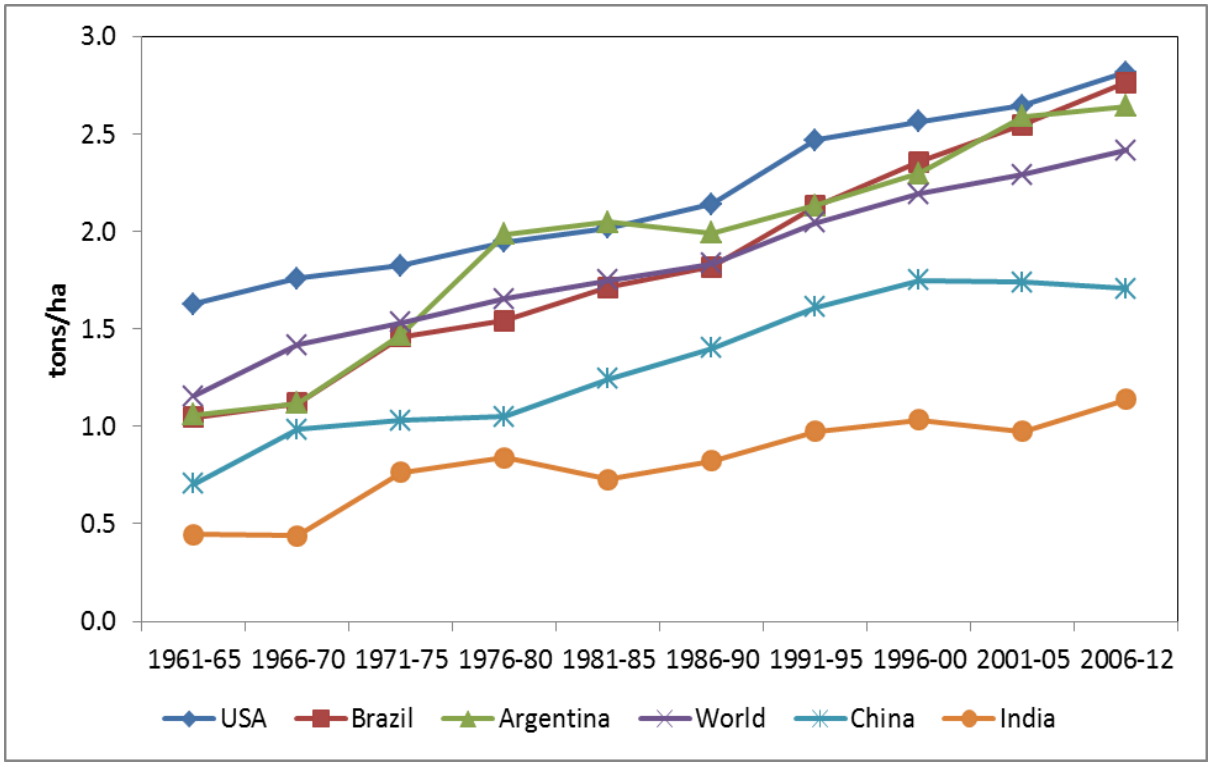


Source: GoI (2013)

Yield

The world average soybean yield doubled from 1.16 metric tons per ha in 1961-65 to 2.41 metric tons per ha in 2005-12 (Figure 4.3). Out of the top five soybean producing countries, USA, Brazil and India produce about 2.82 metric tons per ha, 2.76 metric tons per ha and 1.14 metric tons per ha, respectively. Soybean yields are not merely low in India compared to that of other major soybean producing countries, but it also suffered a decline in yield during the 1990s in comparison with other countries. More than quadrupling of the area under soybean, and a doubling of the yield since 1961, has increased world soybean production by about 9.5 times. During the same period, the main production area of soybean shifted to South America, especially Brazil and Argentina.

Figure 4.3: Changes in soybean yield by major producing countries and world average: 1961-2012

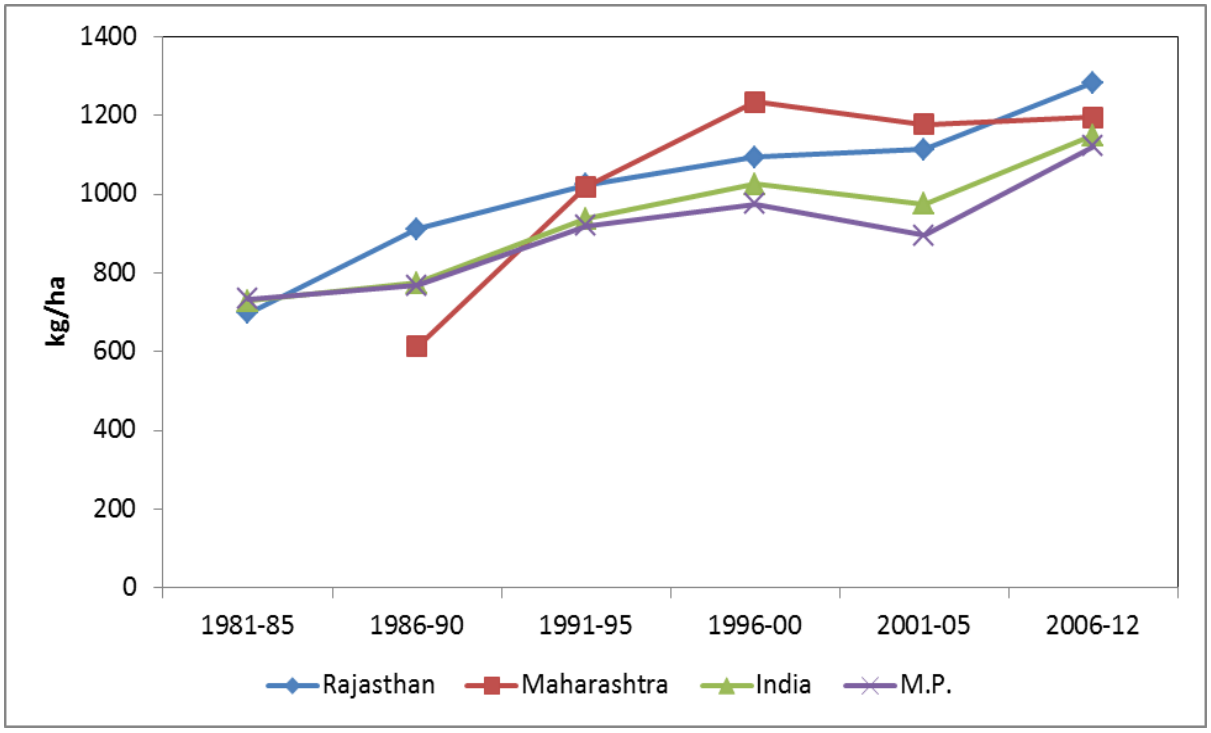


Source: FAOSTAT and authors' calculation

Figure 4.4 presents data on yield levels in India as well as in individual states. Soybean yields, which were low (about 729 kg/ha on the average) during the early 1980s, had increased (about 1026 kg/ha on the average) during the late-1990s, and then declined (about 975 kg/ha on the average) during the early 2000s while improving (1150 kg/ha) in the recent period. The state of Madhya Pradesh and Maharashtra followed almost the same

pattern of trend in yields, whereas yield trends were found to be positive in Rajasthan. One of the interesting observations is that yield levels were lower for the largest soybean producing state, Madhya Pradesh, than in any other state and even all India level.

Figure 4.4: Changes in soybean yield by major producing states and all India average: 1981-2012



Source: GoI (2013) and authors' calculation

Growth Rates in Area, Production and Yield

Growth rates of area, production, and productivity of soybean in major producing states and at national level during different time periods were computed and the results are presented in Table 4.4. The compound annual growth rate for India in soybean production during the period 1981-2011 (31 years) was, 16.23 per cent, and can be disaggregated into area (14.68%) and yield (1.27%). In the long term, of the 16.23 per cent annual growth in soybean production, the increase in yield accounted for less than 10 per cent of the growth in production. After 1990s, however, the contribution of yield growth to production growth has improved. The compound annual growth rates of soybean yield were 2.64 per cent in the 1980s, 1.64 per cent in the 1990s and 3.17 per cent in 2000s (Table 4.4). The soybean production growth rates during the above three periods (21.08%, 9.85%, and 8.88%) are mainly supported by the area growth rates (17.75%, 8.08%, and 5.53%). Out of the annual

9.85 per cent and 8.87 per cent production growth in the decades of the 1990s and 2000s, the area contributed about 17 per cent and 36 per cent, respectively (Table 4.4).

Table 4.4: Annual growth rates of soybean area, production, and yield in selected states, 1981-82 to 2011-12

Period	*M.P.*[8]	*Maharashtra*[9]	*Gujarat*	*Rajasthan*	*All India*
Area					
1980s	20.7***	-	7.1	38.6***	17.9***
1990s	6.2***	17.1***	-15.5***	13.3***	8.1***
2000s	3.4***	10.4***	25.3***	5.1**	5.5***
All	8.0***	16.7***	6.1***	14.2***	9.4***
Production					
1980s	23.7***	-	17.4**	46.9***	21.0***
1990s	7.2***	22.2***	-13.5***	13.6***	9.9***
2000s	7.8***	10.0***	26.0***	9.9**	8.9***
All	9.7***	20.4***	7.8***	16.6***	11.3***
Yield					
1980s	2.5	-	9.6**	6.0**	2.6
1990s	1.0	4.4	2.4**	0.3	1.6
2000s	4.4**	-0.4	0.6	4.5*	3.2**
All	1.6***	3.1***	1.5**	2.1***	1.8***

Source: Authors' computation using MoA data

All the major soybean producing states, Madhya Pradesh, Maharashtra, and Rajasthan, which account for about 96 per cent of the soybean output in the country, witnessed an impressive growth rate in production. The growth rate of production was highest in Maharashtra (20.38%) followed by Rajasthan (16.64%) and Madhya Pradesh (9.71%) between 1981-82 and 2011-12. This steep increase in production was the result of a significant expansion of area. Increase in crop productivity also contributed to increased production but the contribution was marginal. There were spectacular increases in the

[8] *Madhya Pradesh data during the 2000s is combined data for Madhya Pradesh and Chhattisgarh to compare across different time periods.*

[9] *For Maharashtra, analysis is based on data from 1986-87 to 2011-12*

growth rates of area under soybean cultivation in Maharashtra (16.72%), Rajasthan (14.24%), and Madhya Pradesh (7.95%). The growth rate in Gujarat was also considerable, but the state's share in national production was negligible. Area seems to be the most important source of soybean output expansion while yield being of less importance. In Gujarat, the growth rate in yield was the lowest (1.52%). Maharashtra and Rajasthan reported higher growth rates in yield compared with the national average. The lower growth in yield may be because of more marginal lands being brought under soybean cultivation, less area under assured irrigation and lack of appropriate technological breakthroughs in soybean production in the country.

Growth in crop output is determined by the rate of growth in the area under crop and its productivity level. The growth performance of states is analyzed by classifying states on the basis of the sign and statistical significance of their trends in area and productivity levels. There are nine types of association:

1. **AA:** Significant positive growth rate of area associated with significant positive growth rate of yield. This means that crop is either replacing other crops or is grown in newly cultivated areas and productivity of both existing and new acreage has increased.
2. **AB:** Significant positive growth rate of area associated with significant negative growth rate of yield. This means that crop is either replacing other crops or is grown in newly cultivated areas and productivity of both existing and new acreage has declined.
3. **AC:** Significant positive growth rate of area associated with stagnant (either positive or negative) growth rate of yield. This means that crop is either replacing other crops or is grown in newly cultivated areas and productivity of both existing and new acreage has remained stagnant.
4. **BA:** Significant negative growth rate of area associated with significant positive growth rate of yield. This means that crop is being replaced by other crops and productivity has increased.

5. **BB:** Significant negative growth rate of area associated with significant negative growth rate of yield. This means that crop is being replaced by other crops and productivity has declined significantly.
6. **BC:** Significant negative growth rate of area associated with stagnant growth rate of yield. This means that crop is being replaced by other crops but yield has remained stagnant.
7. **CA:** Stagnant growth rate of area associated with significant positive growth rate of yield. This means that acreage is stagnant and yield has increased significantly.
8. **CB:** Stagnant growth rate of area associated with significant negative growth rate of yield. This means area under is stagnant and productivity has declined significantly.
9. **CC:** Stagnant growth rate of area associated with stagnant growth rate of yield. This means that both acreage and yield are stagnant.

For an improvement in the soybean economy, AA is the best situation while BB is the worst situation. BA would be preferred to AB, CA would be preferred to AC, and BC would be preferred to CB. The analysis of growth rates of soybean acreage and yield levels shows different kinds of association and the results are given in Table 4.5.

Among the major soybean producing states, Madhya Pradesh has improved its position and moved from AC category during the 1980s and 1990s to AA category in 2000, which is a healthy sign. Maharashtra, the 2nd largest producer, has consistently remained in the AC category. Rajasthan moved from AA category in 1980s to AC category during 1990s but again improved its position and shifted to AA in 2000s. During the last three decades, in almost all major producing states, area expansion has been a major driver for increased production. However, during the last decade productivity improvement has also contributed to increase in production in case of Madhya Pradesh, Rajasthan and Gujarat, while yields have remained stagnant in Maharashtra. There is a need to improve productivity of soybean as scope for bringing more area under cultivation is very limited.

Table 4.6 presents a list of soybean producing states classified on the basis of their growth performance in respect of yield per ha and average yield levels during the last two decades. Maharashtra was the only state with high productivity level which reported significant

increase in yield during 1990s but fell in the category of stagnant yield during the last decade. Andhra Pradesh, Rajasthan and Karnataka with high productivity level and Madhya Pradesh with low productivity reported stagnant yield in the 1990s. However, Madhya Pradesh improved its position and recorded significant increase in yield during the last decade. On the other hand, all other states witnessed stagnation in crop yield. However, yield variability increased in almost all states except Karnataka during the 2000s with the highest fluctuations in Andhra Pradesh and Rajasthan and the lowest in Madhya Pradesh. Wide differences among major producers in the country and low yield levels at the national level are indicative of the scope to increase yield through improved varieties, better management practices and market infrastructure.

Table 4.5: Classification of states according to growth in area and yield of soybean

Type of association	1980s	1990s	2000s	1981-82 to 2011-12
AA	Rajasthan	-	Madhya Pradesh, Rajasthan, Gujarat, All India	Madhya Pradesh, Maharashtra, Rajasthan, , Gujarat, All India
AB				
AC	Madhya Pradesh, All India	Madhya Pradesh, Maharashtra, Rajasthan, All India	Maharashtra	-
BA	-	-	-	-
BB	-	-	-	-
BC	-	Gujarat	-	-
CA	Gujarat	-	-	-
CB	-	-	-	-
CC	-	-	-	-

Source: Authors' computation using MoA (2013) data

Table 4.6: Classification of states according to productivity levels and growth in productivity of soybean in India

	Significant increase in yield	Significant decline in yield	Stagnant yield with positive sign	Stagnant yield with negative sign
1991-92 to 2000-01				
High Productivity	Maharashtra	-	Rajasthan, Karnataka, All India	Andhra Pradesh
Low Productivity	Gujarat	-	Madhya Pradesh	-
2001-02 to 2011-12				
High Productivity	All India	-	Rajasthan, Andhra Pradesh	Maharashtra
Low Productivity	Madhya Pradesh	-	Chhattisgarh, Gujarat, Karnataka	-
1991-92 to 2011-12				
High Productivity	Andhra Pradesh, All India	-	Maharashtra, Rajasthan	-
Low Productivity	Madhya Pradesh	-	Karnataka	Gujarat

Source: Authors' computation using MoA data

Problems and Prospects of Soybean Cultivation

In order to understand problems and prospects of soybean cultivation, primary data from soybean farmers in two major soybean producing states, namely, Madhya Pradesh and Maharashtra were collected for the year 2010-11. Due to time constraint, primary data was collected from three districts of Madhya Pradesh and two districts of Maharashtra. The districts were selected based on area under the crop and productivity level as discussed in chapter 2. This section reports the general findings of the survey of 250 households (110 marginal, 70 small, 69 medium and one large) from 8 villages in Maharashtra and 240 soybean farmers (51 marginal, 55 small, 83 medium and 51 large) from 8 villages in Madhya Pradesh.

Socio-economic Status and Land Ownership Pattern

The average family size in the household samples was 6.5 persons per family with an average age of 48.8 years (Table 4.7). On average, 96.2 per cent of the households had crop farming as their main occupation and farm production was the main source of income in these areas. Marginal farm households have higher proportion of family members working as farm labourers (9.3%). Almost all households were male headed. The average operational land holding was 3.33 ha per family though the average holding ranged from 0.73 ha on marginal households to 12.87 ha on large households (Table 4.8). About two-third of the total land was irrigated and there was a positive relationship between the farm size and the irrigated area. In the case of marginal households, nearly 60 per cent of the arable land was unirrigated. Also, leasing of land was not very common in the study area.

Table 4.7: Socio economic status of sample households

Indicators	**Marginal**	**Small**	**Medium**	**Large**	**All**
Age (years)	49.2	48.5	48.1	50.3	48.8
Main Occupation (%)					
Crop farming	88.3	99.2	97.3	100.0	96.2
Dairy	1.2	0.0	1.3	0.0	0.6
Services	1.2	0.0	0.7	0.0	0.5
Farm Labour	9.3	0.8	0.7	0.0	2.7
Education (years of schooling)	7.5	8.1	9.1	11.3	8.6
Average Family Size (no)	5.6	6.6	6.9	7.7	6.5
Male	3.1	3.5	3.9	4.4	3.6
Female	2.5	3.1	3.0	3.3	2.9
Social Groups (%)					
General	29.8	33.9	30.9	38.5	31.8
OBC	46.8	55.9	58.6	61.5	54.1
SC/ST	13.5	5.1	6.8	0.0	8.2
Others	9.9	5.1	3.7	0.0	5.9
Head of household (%)					
Male	97.5	100.0	98.7	100.0	98.8
Female	2.5	0.0	1.3	0.0	1.2

Source: Field Survey

Table 4.8: Land ownership pattern on sample households (in ha.)

Indicators	Marginal	Small	Medium	Large	All Farms
Total owned land	0.72	1.45	4.10	12.87	3.24
Irrigated	0.28	0.84	2.64	9.35	2.12
Un-irrigated	0.44	0.61	1.46	3.52	1.13
Leased-in land	0.01	0.03	0.24	0.00	0.08
Irrigated	0.01	0.02	0.09	0.00	0.04
Un-irrigated	0.00	0.01	0.15	0.00	0.05
Leased-out land	0.00	0.00	0.00	0.00	0.00
Irrigated	0.00	0.00	0.00	0.00	0.00
Un-irrigated	0.00	0.00	0.00	0.00	0.00
Total Operational holding (2+3-4)	0.73	1.48	4.34	12.87	3.33
Irrigated	0.29	0.86	2.72	9.35	2.15
Un-irrigated	0.44	0.62	1.61	3.52	1.17

Source: Field Survey

Soybean Cropping Systems: Productivity, Profitability and Risks

Soybean is a major crop during the kharif season in both the states and accounts for about 33 per cent and over 50 per cent of the total cropped area in the sample districts in Madhya Pradesh and Maharashtra, respectively. About 60 percent of the soybean acreage in Madhya Pradesh and about 73 percent area in Maharashtra is rainfed. Other major crops grown in the area include cotton, pulses, and wheat in Madhya Pradesh and cotton, pulses, and sugarcane in Maharashtra. Large part of the soybean crop is grown as a monocrop, however, in some areas soybean is intercropped with other food crops. In all farm categories, in both the states, the soybean crop area is much higher than other crops, which indicates that the farmers cultivate soybean as a main crop (Sharma and Rathi, 2013 and Kajale and Sharoff, 2013). The average productivity of soybean was significantly higher (18.4%) on irrigated farms compared with unirrigated farms. The yield was found to be higher (13.58 q/ha) in Maharashtra than Madhya Pradesh (11.52 q/ha). Similarly, crop yields were significantly higher under irrigated conditions compared with rainfed conditions. The

average productivity of all major crops such as maize, cotton and pulses were significantly higher in Madhya Pradesh compared with Maharashtra but yield of groundnut was marginally higher in Maharashtra.

Table 4.9: Average yield of soybean and competing crops of sample households (Qtl/ha)

Crops	Marginal	Small	Medium	Large	All farm
Soybean					
Irrigated	14.5	15.1	15.6	13.0	14.8
Unirrigated	12.5	12.9	12.4	12.3	12.5
Maize					
Irrigated	24.1	20.3	25.6	25.0	24.6
Unirrigated	14.1	15.3	17.9	15.5	16.6
Groundnut					
Irrigated	15.5	18.3	17.5	15.6	17.1
Unirrigated	16.4	15.8	10.4	8.0	13.5
Cotton					
Irrigated	23.5	22.9	25.2	26.0	24.5
Unirrigated	12.3	9.4	10.5	0.0	10.4
Pulses					
Irrigated	17.4	14.3	14.9	14.4	15.0
Unirrigated	12.0	13.0	11.8	11.7	12.1

Source: Field Survey

Relative Profitability and Risks Associated with Soybean Farming

A farmer evaluates many factors in choosing which crops to plant, and these include his resources, various constraints he faces, the technology options available, price and market risks, profitability, marketing, etc. In this section, we analyze relative profitability and risks associated with soybean farming vis-à-vis competing crops.

Table 4.10 shows the comparative profitability of soybean with major competing crops in the selected states. Maize is main competing crop in the study area in Madhya Pradesh. It is evident from the Table that average profitability of soybean is significantly higher than maize on all farm categories. The net income from soybean cultivation varied from Rs.

18,180/ha in case of small farms to Rs. 20,455/ha on large farms. In case of Maharashtra, cotton, groundnut and moong were the main competing crops in the study districts. The net profitability per hectare of soybean cultivation varied from Rs. 5,085 on marginal farms to Rs. 14,062 in case of large farms. However, all categories of farmers incurred a net loss in all major competing crops with the exception of groundnut on small and moong on medium farms. These results clearly indicate that soybean cultivation is more profitable than competing crops and therefore, there has been a significant increase in area under soybean in these two states during the last 2-3 decades.

Table 4.10: Profitability[10] (Rs/ha) of soybean vis-à-vis major competing crops per hectare in sample states

State/Crop	Marginal	Small	Medium	Large	All Farms
Madhya Pradesh					
Soybean	18389	18180	19784	20455	19201
Maize	8561	14711	16315	13370	13239
Maharashtra					
Soybean	5085	7480	5484	14062	5506
Cotton	-5776	-5971	-7164	-	-6310
Groundnut	-2917	803	-11241	-8300	-5506
Moong	-113	-709	870	-	-733

Source: Authors' computations using data from participating AERCs

Climate variability is an important source of risk in soybean production in India as less than one percent of area is under irrigation and therefore, weather variability affects yield and often leads to yield losses. Small and marginal farmers have a slightly higher yield and price variability in soybean compared with large farmers in both the states as measured by coefficient of variation (Table 4.11). However, yield and price risks are much higher in Maharashtra (60% and 23%) than Madhya Pradesh (16.3% and 15.7%). The yield risks are higher than price risks in Maharashtra while, in Madhya Pradesh, there is no significant

[10] *Profitability = Gross Value of Output – Total Operational Costs*

difference in price and yield risks in case of soybean. The low variation in prices shows that farmers get competitive prices.

Table 4.11: Yield and price risks in soybean and competing crops in sample states (In %)

State/Crop	Marginal	Small	Medium	Large	All Farms
Madhya Pradesh					
Soybean					
Yield Risk	17.7	15.4	18.5	13.8	16.3
Price Risk	15.8	18.7	14.6	13.5	15.7
Maize					
Yield Risk	23.9	20.7	15.2	18.9	19.7
Price Risk	7.2	5.9	8.7	10.9	8.2
Maharashtra					
Soybean					
Yield Risk	61.0	58.0	55.0	-	60.0
Price Risk	32.0	8.0	14.0	-	23.0
Cotton					
Yield Risk	61.0	43.0	35.0	-	52.0
Price Risk	9.0	8.0	11.0	-	9.0
Groundnut					
Yield Risk	76.0	66.0	50.0	-	68.0
Price Risk	22.0	32.0	33.0	-	28.0
Moong					
Yield Risk	29.0	33.0	111.0	-	59.0
Price Risk	21.0	26.0	18.0	-	20.0

Source: Field Survey

Yield Gap Analysis

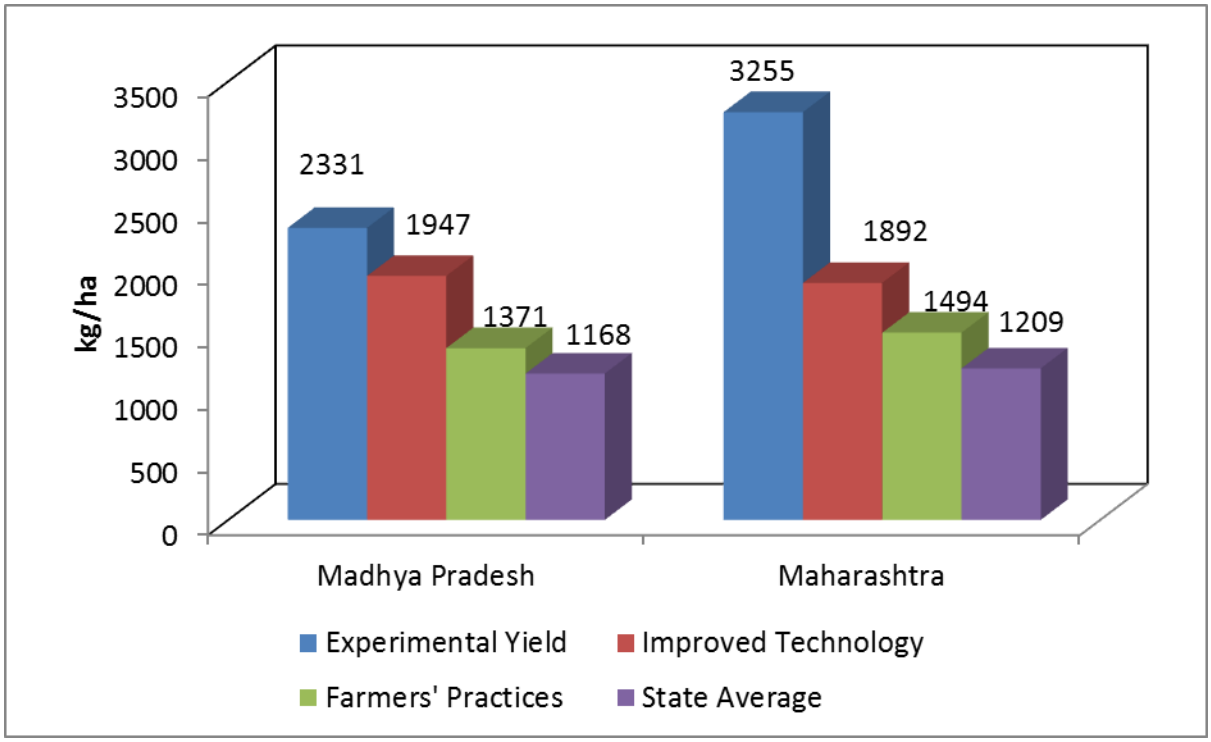
Future increases in crop production will be based on yield improvement because little productive land is available for expansion in crop area. A yield gap analysis, which evaluates magnitude of the difference between crop yield potential and actual farm yields, provides a

measure of production capacity for the country. Based on the data provided by Directorate of Soybean Research, Indore, the yield gaps between potential and achievable yields, between achievable and farmers' yields and total yield gaps between potential and farm level yields were estimated. Among the major soybean producing states, both Madhya Pradesh and Maharashtra, which account for more than 85 per cent of total soybean area and production in the country, the average potential yield was 2331 and 3255 kg per ha, respectively during the TE2011-12. The magnitude of yield gaps in soybean in Madhya Pradesh and Maharashtra are presented in Figure 4.5. The average yield gap between potential and farm level yield under improved technology was 384 and 1363 kg per ha in Madhya Pradesh and Maharashtra, respectively. The average yield gap between improved technology and under farmers' practices was 576 and 398 kg per ha in Madhya Pradesh and Maharashtra, respectively. The average yield gap between potential and actual farm level yields was quite large (960 kg/ha in Madhya Pradesh and 761 kg/ha in Maharashtra). There is a wide gap even between actual farm level yields obtained under the Front Line Demonstrations (FLDs) and the state average (203 kg/ha in Madhya Pradesh and 285 kg/ha in Maharashtra).

The high variation in yield gap among states indicates the varying levels of adoption of technology and improved package of practices among soybean farmers in these states. The extent of yield gaps particularly that of under improved technology and farmers' practices shows that there is considerable scope to improve the productivity levels in India provided the factors responsible for these yield gaps are understood and appropriate interventions are made to bridge these gaps.

Although yield gap between experimental/potential and farm level yields is difficult to bridge because of environmental differences between on-farm and research station situations, and technical expertise available at experimental stations. On the other hand, gap between FLD improved technology and farm level yields can be managed as it is due to the differences in the management practices and input use. The above trends clearly show that there exist huge yield gaps in case of soybean in the country. Therefore, there is a need to estimate correct reasons for the extent of yield gaps and variations among different states/regions and to suggest appropriate strategies in order to narrow down such large gaps. This will help in increasing production of soybean in the country.

Figure 4.5: Potential yield and front line demonstration on-farm average yields of soybean in Madhya Pradesh and Maharashtra: 2009-10 to 2011-12



Source: DSR

Post-Harvest Handling, Price Situation and Access to Technology and Markets

Most farmers sell all their produce immediately after harvest as they require cash for their next crop or for other urgent needs. Some farmers who have holding capacity sell part of the produce at a time, depending on market prices and their need for cash. Farmers normally do not store soybean grain for a long time, except for seeding purposes. Table 4.12 shows production, retention and marketed surplus pattern of soybean and price realization by farmers.

The average production increases with an increase in size class of holding in both states. However, farmers keep small quantities of soybeans to ensure seed availability for the next crop cycle and for self-consumption. In Maharashtra, 97.7 per cent of the total production was sold in the market, while in Madhya Pradesh, farmers retained about one-third of the total produce. There was no significant difference in price received by different farm households but farmers in Madhya Pradesh received significantly higher price compared with Maharashtra farmers.

Table 4.12: Total oilseed production, retention and sales pattern

	Madhya Pradesh				*Maharashtra*			
Farm category	***Prod (Qtl)***	***Retention (Qtl)***	***Sold (Qtl)***	***Price (Rs./q)***	***Prod (Qtl)***	***Retention (Qtl)***	***Sold (Qtl)***	***Price (Rs./q)***
Marginal	6.21	1.49	4.72 (76.0)	2865	6.94	0.08	6.83 (98.4)	2108
Small	7.16	2.06	5.10 (71.2)	2877	12.76	0.15	12.66 (99.2)	2064
Medium	23.88	8.08	15.80 (66.2)	2908	30.32	0.28	29.30 (96.6)	2115
Large	77.36	28.27	49.09 (63.5)	2959	100.00	-	100.00 (100.0)	2000
All Farms	28.65	9.98	18.67 (65.2)	2903	15.40	0.15	15.04 (97.7)	2097

Source: Field Survey
Figures in parentheses indicate percentage of quantity sold to total production

The marketing pattern of soybean shows that more than 40 percent of marginal and small farmers sell their produce to local village traders while about three-fourth of large and medium farmers sell their produce to commission agents in APMC mandies (Table 4.13). Nearly 8 percent of large farmers sell their produce to other channels like private companies and processing units. These results clearly show that small and marginal farmers are heavily dependent on Local traders/regulated mandies and have poor access to other channels. On an average, farmers travelled a distance of about 15-19 km to sell their produce.

Table 4.13: Relative importance of different marketing channels

Marketing channel	***Marginal***	***Small***	***Medium***	***Large***	***All Farms***
Commission Agent (%)	*54.9*	*52.7*	*72.4*	*75.8*	*60.2*
Local Village Trader (%)	43.9	44.9	25.6	16.3	37.1
Others including private company (%)	1.2	2.4	2.0	7.8	2.2
Average distance to sale point (km)	15.4	15.9	14.8	18.8	15.7

Source: Field Survey

Access to Technology and Inputs

The major challenges faced by the farmers in general and small and marginal farmers in particular include poor access to quality inputs and services, markets and technologies. In order to assess soybean producers' access to inputs particularly better quality seeds and prices, information about their access to inputs and services was collected, and the results are presented in Table 4.14. Almost all farmers used high yielding variety seeds and more than two-third of marginal farmers used either own seed or seeds taken from fellow farmers. About 60 per cent of farmers used either own seed or bought it from fellow farmers and share of farmers using own seed was relatively higher on marginal and small farms compared with large farms. The share of market purchased seed was relatively low in case of marginal farmers (13.1%) compared with large farmers (30%). The share of seed purchased from ICAR/State Agricultural Universities and department of agriculture was less than 20 per cent. However, there are inter-state differences. For example, in Madhya Pradesh about 80 per cent of sample farmers used their own seed, the share being higher on small and marginal farmers while in Maharashtra, majority of farmers purchased seed from markets and other agencies and share of own seed was much lower.

Table 4.14: Access to inputs, technology and markets (%)

	Marginal	Small	Medium	Large	All Farms
Use of HYV					
Yes	98.8	99.2	96.7	100.0	98.4
No	1.2	0.8	3.3	-	1.6
Source of Seed					
Own	45.1	37.3	37.0	40.0	40.2
Fellow farmer	23.4	19.5	20.7	16.7	20.9
State Department of Agri.	12.3	13.5	18.0	13.3	14.4
ICAR/SAU	5.0	2.1	3.7	0.0	3.4
Market	13.1	23.9	19.6	30.0	19.3
Awareness about MSP					
Yes	90.1	91.2	88.2	84.6	89.2
No	9.9	8.8	11.8	15.4	10.8
Price realization					

Higher than MSP	98.8	99.2	98.7	100.0	99.0
Lower than MSP	1.2	0.8	1.3	0.0	1.0
Marketing problems					
Yes	28.6	20.8	24.3	11.5	23.5
No	71.4	79.2	75.7	88.5	76.5
Source of information					
Radio/TV	5.4	4.1	3.8	0.0	4.0
Print Media	20.1	24.2	31.3	50.3	27.7
Fellow farmers	37.7	35.1	30.4	28.1	34.3
APMC Mandi	13.7	15.9	18.1	19.6	16.0
Commission agent	15.1	11.7	9.1	0.0	10.8
Private company	4.6	5.5	3.8	0.0	4.1
Others	3.4	3.5	3.5	0.0	3.1

Source: Field Survey

It is interesting to note that the majority of farmers were aware of the minimum support price announced by the government and received higher than minimum support price. Less than one-fourth of the sample households reported marketing related problems but the share of marginal and small farmers facing marketing problems was slightly higher than large farmers. The most important source of market related information were fellow farmers (34.4%), followed by print media (27.7%) and APMC mandies (16%). Electronic media were not an important channel of information in the study area.

Constraints in Soybean Cultivation

As soybean production has increased significantly over the past 30 years, so has the intensity of biotic and abiotic constraints that ultimately threaten crop yield and farm income. In the present study, efforts were made to identify major constraints faced by the farmers in soybean cultivation. Farmers were asked to identify main constraints to increasing soybean production and productivity. The constraints were broadly categorized into five major categories viz., technological, agro-climatic, economic, institutional and post-harvest management and marketing related issues. Table 4.15 shows the constraints experienced by soybean farmers of Madhya Pradesh and Maharashtra. Economic constraints were the most important constraints faced by soybean producers, followed by

technological constraints (2.54), agro-climatic factors (2.52) institutional (2.44) and post-harvest management and marketing (2.31) related problems. Among technological constraints, incidence of insect pests, weed infestation, non-availability of suitable varieties, and poor crop germination were major constraints faced by farmers in the study area. The major agro-climatic constraints experienced by farmers were risk of crop failure/yield variability due to biotic and abiotic stresses, poor grain setting, drought, excessive rains and extreme temperature variations at critical stages of crop growth. High risk in soybean cultivation compared with other crops, relatively less profitability, high input costs and low and fluctuating crop prices and shortage of human labour were major economic constraints. Poor extension services leading to lack of knowledge about insect pest and disease management, non-availability and poor quality of inputs and services including institutional credit were important institutional constraints being faced by soybean farmers. Rural infrastructure particularly poor road conditions leading to high transportation costs, lack of storage facilities, lack of reliable and timely information about prices and adequate processing facilities were impacting soybean cultivation in the area. Among all constraints, incidence of insect pests and high price and production risks were ranked as the most severe constraints in production of soybean.

Table 4.15: Constraints faced by farmers in cultivation of soybean

	Marginal	***Small***	***Medium***	***Large***	***All Farms***
Technological	2.56	2.59	2.55	2.39	2.54
Incidence of insect pests	3.07	2.98	3.18	3.21	3.10
Weeds Infestation	2.84	3.00	2.76	2.77	2.85
Non-availability of suitable varieties	2.70	2.83	2.86	2.73	2.79
Poor crop germination	2.61	2.73	2.70	2.42	2.65
Incidence of diseases	2.43	2.52	2.61	2.97	2.56
Poor quality of soils	2.35	2.28	2.07	1.33	2.14
Lack of irrigation facilities	1.89	1.78	1.66	1.33	1.73
Agro-climatic Factors	2.65	2.60	2.49	2.01	2.52
Risk of crop failure/yield variability due to biotic & biotic stresses	2.81	2.88	2.76	2.42	2.77
Poor pod/grain setting	2.89	2.77	2.74	2.23	2.74

Drought at critical stages of crop growth	2.54	2.47	2.42	2.19	2.45
Excessive rains	2.58	2.52	2.44	1.87	2.44
Extreme variations in temperature	2.42	2.34	2.10	1.33	2.18
Economic	2.50	2.54	2.64	2.79	2.59
Oilseeds more risky compared with other crops	3.17	3.04	3.06	2.85	3.07
Oilseeds less profitable compared with other crops	3.05	2.90	2.84	2.13	2.85
High-input cost (diesel, fertilizers, agrochemicals)	2.32	2.50	2.69	3.19	2.57
Low and fluctuating prices	2.25	2.37	2.66	3.23	2.51
Price risks – Fear of glut leading to low price	2.41	2.50	2.41	2.60	2.45
Shortage of human labour	1.83	1.94	2.18	2.75	2.06
Institutional	2.53	2.52	2.41	2.02	2.44
Inadequate knowledge about disease and pest management	2.73	2.81	2.78	2.46	2.73
Lack/Poor extension services	2.71	2.68	2.66	2.33	2.65
Non-availability of other inputs	2.58	2.68	2.68	2.50	2.63
Poor quality of inputs	2.62	2.57	2.57	2.37	2.56
Non-availability of institutional credit	2.85	2.70	2.33	1.48	2.50
Problem of timely availability of seed	2.51	2.54	2.48	2.10	2.47
Lack of awareness of improved oilseed technologies	2.16	2.13	1.95	1.54	2.02
Irregular supply of power/electricity	2.12	2.08	1.86	1.38	1.95
Post-harvest, Marketing and Value-addition	2.45	2.37	2.28	1.78	2.31
Lack of appropriate transport means	3.07	2.94	2.78	2.12	2.85
High transportation costs	2.80	2.90	2.78	2.23	2.76
Poor road infrastructure	2.89	2.82	2.64	1.88	2.69
Inadequate storage facilities	2.46	2.34	2.22	1.52	2.25
Lack of information about prices	2.39	2.26	2.15	1.63	2.20

and markets					
Lack of processing facilities in the area	2.07	1.95	1.97	1.79	1.98
Exploitation by market intermediaries	2.01	1.89	1.92	1.63	1.91
Poor marketing system and access to markets	1.93	1.85	1.82	1.44	1.82

Source: Field Survey
Composite indices constructed based on weights (severe=4, moderate=3, minor=2, not important=1) and the number of households in each category.

Farmer Recommendations for Improving Soybean Productivity and Income

Farmers were asked to give suggestions/recommendations to address the constraints they faced in soybean cultivation. Important recommendations based on the survey results to improve soybean productivity are presented in Table 4.16.

The results in Table 4.16 indicate that irregular supply of electricity; poor extension and market intelligence services are the major problems for farmers in the study area in Madhya Pradesh. About 84 percent of respondents advocated for availability of high yielding varieties and other quality inputs, more regulated markets/purchase centers and suitable machinery and implements for soybean cultivation, while 75 recommended proper storage facility at village level. More than half of the respondents demanded better crop insurance cover and price risk management instruments including futures trading.

In Maharashtra, more than 20 percent of respondents suggested for improvement in irrigation facilities and subsidies on inputs. About 15 per cent of the respondents suggested for provision of inputs by government at concessional rates. Other suggestions included higher minimum support price, technical assistance for soybean cultivation and timely availability of inputs.

Table 4.16: Suggestions for improving production and productivity of soybean *(%)*

Suggestions	***Marginal***	***Small***	***Medium***	***Large***	***All Farms***
Madhya Pradesh					
Better extension and market intelligence services	83	90	93	97	91

Ensure availability of high yielding variety of seed and other quality inputs	73	80	90	93	84
Proper storage facilities at village level	60	53	90	97	75
Stabilization of prices	40	47	53	60	50
Regular supply of electricity	100	100	100	100	100
Establishment of more regulated market/purchase centres	70	86	83	97	84
Knowledge about future trading	40	70	53	60	56
Strengthen crop insurance facilities	53	60	70	40	56
Suitable machinery and implements for soybean cultivation	70	83	86	97	84
Maharashtra					
Better irrigation facilities	21.8	22.9	24.6	-	22.9
Subsidy on inputs	1.8	41.4	31.9	-	21.3
Provision of inputs by government at concessional rates	32.7	1.4	0.0	-	14.9
Higher MSP	14.5	10.0	10.1	-	12.0
Technical assistance for Soybean cultivation	2.7	5.7	4.3	-	4.0
Timely availability of Inputs	0.9	1.4	1.4	-	1.2

Source: Field Survey

Chapter 5

Performance of Rapeseed and Mustard: Recent Trends, Prospects and Constraints

Global canola production has increased rapidly over the past four decades, moving from the sixth largest oil crop to the second largest. Canola production was 12.8 per cent of the total world oilseed production during the triennium ending (TE) 2010-11 and canola oil is the third largest (15.8%) source of vegetable oil in the world after palm oil (32.6%) and soybean oil (27.5%). Also, Canola meal is the second largest feed meal (13.5% share) after soybean meal (67.5%).The European Union, China, Canada and India collectively produce over 80 per cent of the world's canola crop.

India is one of the largest rapeseed-mustard growing countries in the world, occupying the second position in area (19.3%) and third position in production (11.1%) after China and Canada (TE2010-11). Rapeseed-mustard is also an important oilseed crop in the country occupying the second position after soybean. Rapeseed-Mustard is cultivated over an area of about 61.3 lakh ha with a production of 71.3 lakh tonnes and productivity of about 1163 kg per ha during the TE2011-12.

Trends in Area, Production and Yield

Production of rapeseed and mustard has increased significantly in the country during the last few years. Area under rapeseed-mustard increased from 3.46 million ha in 1971-73 to 4.03 million ha in 1981-83 and further to 6.34 million ha in 1991-93. During the 1990s, area under the crop declined and reached a level of 5.19 million ha in TE2001-02 but again increased during the last decade (Table 5.1). Rapeseed-mustard acreage increased at an annual compound growth rate of about 1.82 per cent during the 2000s compared with a negative growth rate (-1.78%) observed during the nineties. The production, which was about 1.65 million tonnes during 1971-73, increased sharply during the 1970s and 1980s and reached 5.33 million tonnes in 1991-93. However, during the 1990s rapeseed & mustard production witnessed some decline (5.02 million tonnes) before picking up during

the last decade (7.13 million tonnes). During the last five years, production of rapeseed-mustard ranged from 5.83 million tonnes in 2007-08 to 8.18 million tonnes in 2010-11. Rapeseed-mustard production recorded the highest growth rate (9.10%) during the eighties but could not maintain momentum and growth rate slipped to the negative zone (-1.15%) during nineties. During the last decade, the growth rate accelerated and production grew at 3.71 per cent. Rapeseed and mustard productivity has also increased from 478 kg per ha in 1971-73 to 597 kg per ha in 1981-83 and 839 kg per ha in 1991-93. Productivity growth rate decelerated from 5.36 per cent in the eighties to 0.63 per cent during the 1990s, but the average productivity increased from 839 kg per ha in 1991-93 to 966 kg per ha in TE2001-02. However, yield growth rate picked up (1.85%) during the last decade. The growth in production was mainly driven by productivity improvement during the eighties while both area expansion and productivity improvement contributed almost equally to the growth in production during the 2000s.

Table 5.1: Average area (million ha), production (million tonnes), and yield (kg/ha) of rapeseed-mustard in India: 1971-72 to 2011-12

	1971-72 to 1973-74	***1981-82 to 1983-84***	***1991-92 to 1993-94***	***1999-00 to 2001-02***	***2009-10 to 2011-12***
Area	3.46	4.03	6.34	5.19	6.13
Production	1.65	2.40	5.33	5.02	7.13
Yield	478	597	839	966	1163
Compound annual growth rate (%)					
	1970s	***1980s***	***1990s***	***2000s***	***All Period***
Area	0.88	3.55**	-1.78	1.82	1.87***
Production	1.17	9.10***	-1.15	3.71*	4.35***
Yield	0.27	5.36***	0.63	1.85**	2.43***

****, ** and *: Significant at 1, 5 and 10 per cent level, respectively*
Source: Authors calculations using GoI (2013c)

Shifts in Area

The relative position of major rapeseed-mustard producing states in terms of acreage, production, and yield in different time periods is presented in Tables 5.2 and 5.3 and Figures 5.1 and 5.2. Rajasthan accounts for 46.2 per cent of total rapeseed-mustard acreage in the country and has increased its share significantly (from 17.2% in TE1983-84 to 46.2% in TE2011-12). Uttar Pradesh, with the largest share in acreage in early-1980s, lost its

dominant position over time and accounted for 10.3 per cent of crop acreage in TE2011-12. The share of Madhya Pradesh increased from 7.3 per cent in TE1983-84 to 13.5 per cent in TE2011-12. Haryana and West Bengal have also increased their share in crop acreage. Vis-à-vis other oilseeds, rapeseed-mustard has an important place in the edible oilseeds economy of the country and its share has hovered around 22-24 per cent during the last three decades.

Rapeseed-mustard is a prominent oilseed crop in Haryana (96.6%), Assam (89.4%), West Bengal (61.1%), Rajasthan (59.6%) and Uttar Pradesh (55.8%) accounting for more than half of the total acreage under oilseeds in the states. However, the share of rapeseed-mustard acreage in total oilseeds has witnessed a decline in almost all the states except Haryana between TE1993-94 and TE2011-12. In Uttar Pradesh and West Bengal, sesamum has increased its share in total area under oilseeds while, in Rajasthan share of groundnut, sesamum and soybean have increased during the last decade.

Table 5.2: Share of major states in area under rapeseed-mustard in India: TE1983-84 and TE2011-12

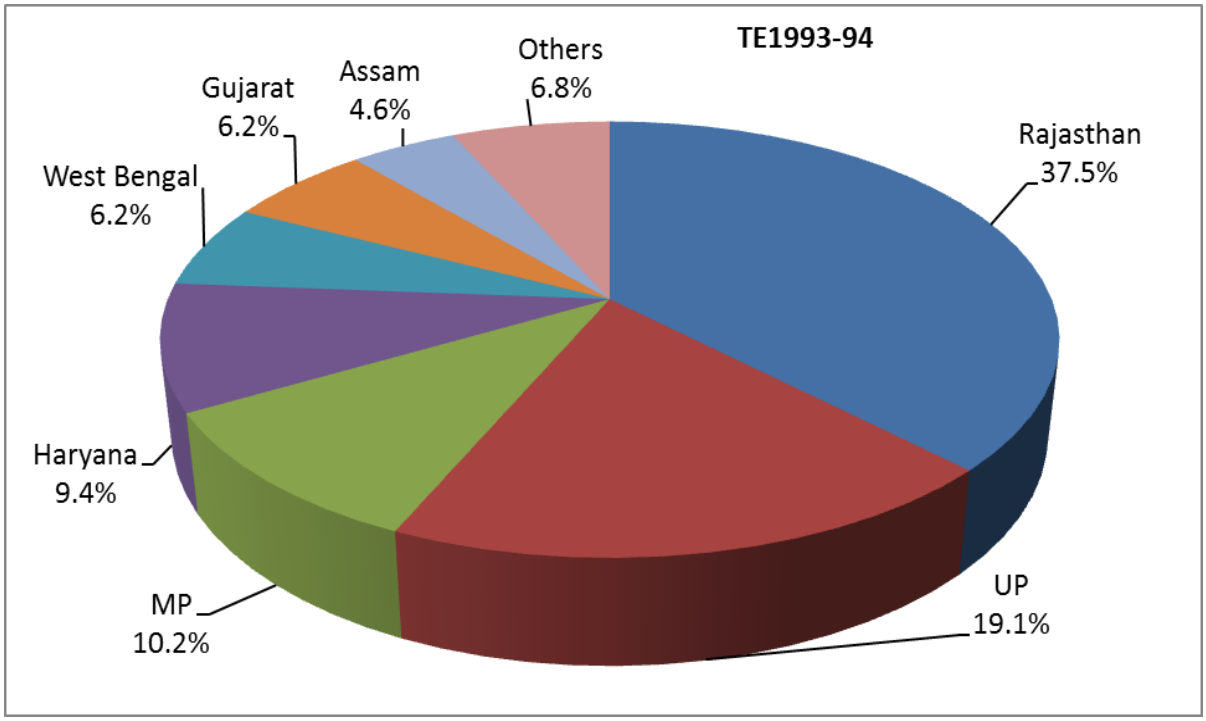
State	Share in all-India acreage				Share in edible oilseed acreage in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
Rajasthan	17.2	37.5	36.6	46.2	49.7	67.8	62.6	59.6
M.P.[11]	7.3	10.2	10.4	13.5	13.5	13.4	9.2	11.3
U.P.[12]	46.5	19.1	16.7	10.3	59.4	70.2	70.1	55.8
Haryana	4.7	9.4	11.7	8.4	94.5	90.0	97.0	96.6
West Bengal	4.3	6.2	8.6	6.7	49.4	72.8	70.0	61.1
Gujarat	4.8	6.2	4.5	3.5	7.4	13.4	7.9	7.3
Assam	6.1	4.6	5.3	3.9	87.2	92.1	88.2	89.4
Others	9.2	6.8	6.2	7.3	-	-	-	-
India	100.0	100.0	100.0	100.0	21.9	24.4	22.2	23.1

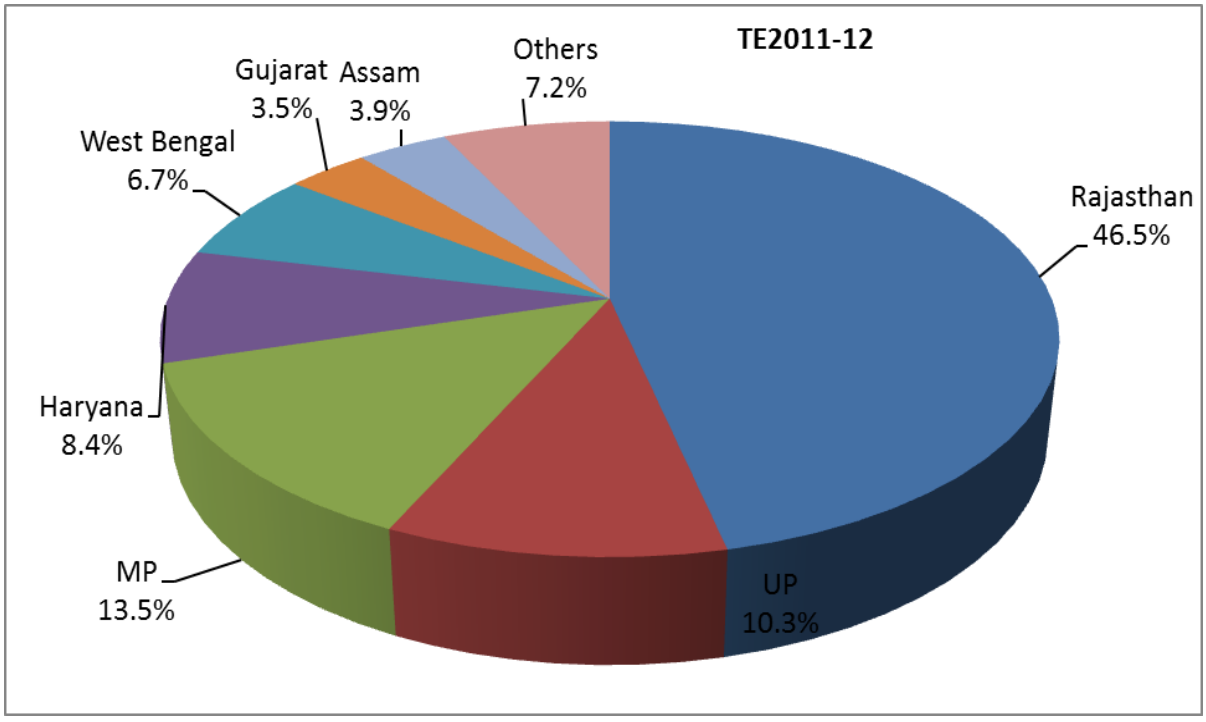
Source: GOI (2013C)

[11] *TE2011-12 data Includes data for both Madhya Pradesh and Chhattisgarh for comparison purpose*

[12] *TE2011-12 data Includes data for both Uttar Pradesh and Uttarakhand*

Figure 5.1: Share of major states in area of rapeseed-mustard in India: TE1993-94 and TE2011-12





Source: GoI (2013c)

Shifts in Production

In terms of production, Rajasthan is the largest producer of rapeseed-mustard with a share of 48.1 per cent, followed by Madhya Pradesh (12.3%) and Uttar Pradesh (10.1%) as shown in Table 5.3 and Figure 5.2. During the last three decades, share of Rajasthan has increased significantly from 20.7 per cent to 48.1 per cent. In contrast, Uttar Pradesh has lost its share from 38 per cent in TE1983-84 to nearly 10 per cent in TE2011-12. Haryana has also increased its share in national production while Gujarat and Assam have lost their shares. The share of rapeseed-mustard in total oilseeds production in the country has remained stagnant at around 25-26 per cent during the last two decades. Rapeseed-mustard, being the most important oilseed crop in Haryana (97.2%), Assam (89.8%), Uttar Pradesh (78.2%), Rajasthan (61.4%) and West Bengal (59.1%), accounts for the highest share in oilseeds production in all the states.

Table 5.3: Share of major states in production of rapeseed-mustard in India: TE1983-84 and TE2011-12

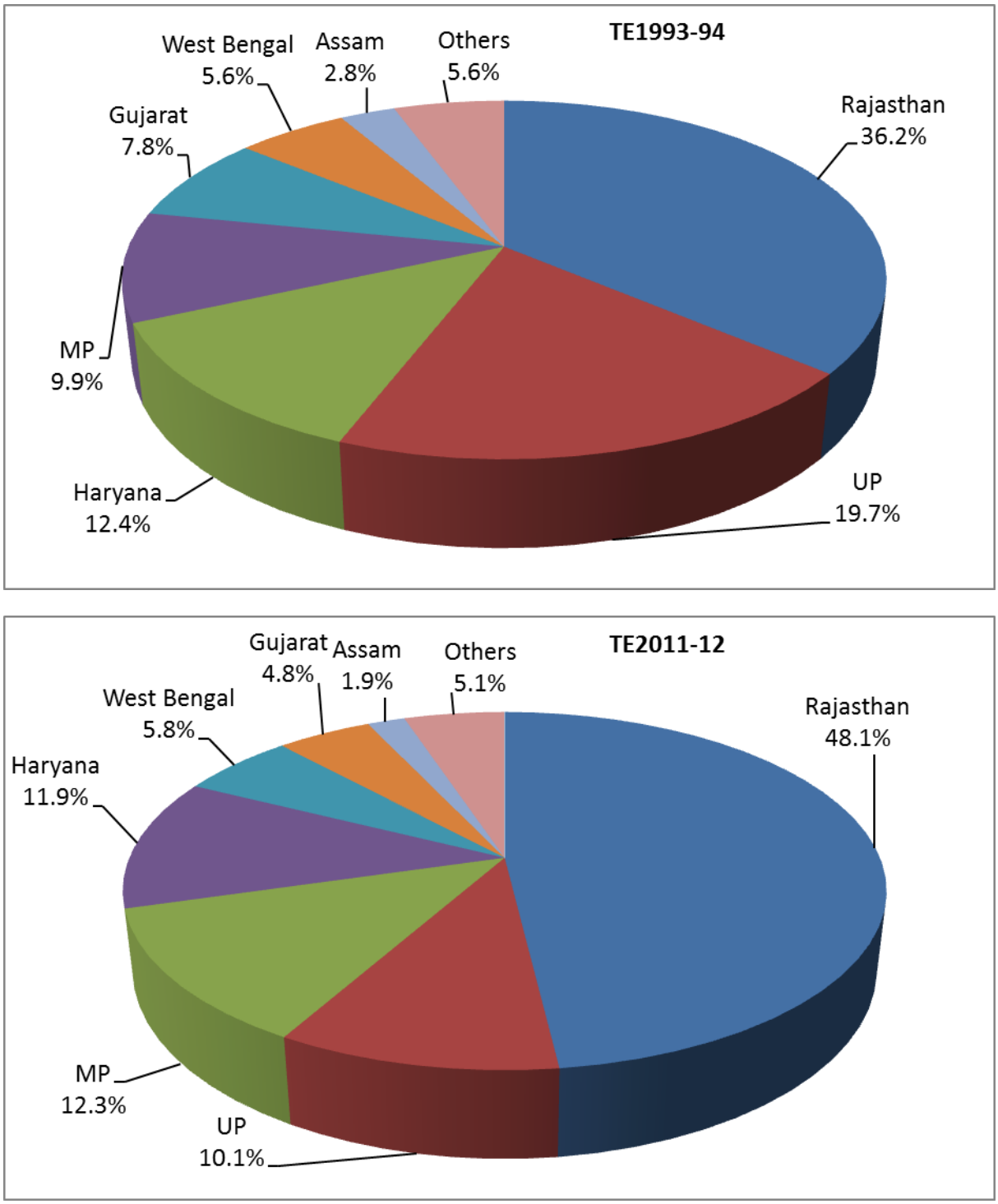
State	Share in all-India production				Share in edible oilseed production in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
Rajasthan	20.7	36.2	39.3	48.1	66.9	75.6	67.6	61.4
M.P.[13]	7.4	9.9	8.8	12.3	18.3	14.0	9.8	11.0
U.P.[14]	38.0	20.3	15.9	10.1	64.7	81.2	82.9	78.2
Haryana	5.7	12.4	16.1	11.9	94.7	86.9	97.7	97.2
West Bengal	4.2	5.6	7.1	5.8	55.2	69.7	66.9	59.1
Gujarat	11.3	7.8	5.6	4.8	12.2	19.4	7.8	7.8
Assam	4.8	2.8	2.7	1.9	87.2	92.6	87.7	89.8
Others	7.9	5.1	4.5	5.0	-	-	-	-
India	100.0	100.0	100.0	100.0	20.7	26.6	25.1	24.5

Source: GOI (2013C)

[13] *TE2011-12 data Includes data for both Madhya Pradesh and Chhattisgarh for comparison purpose*

[14] *TE2011-12 data Includes data for both Uttar Pradesh and Uttarakhand*

Figure 5.2: Share of major states in production of rapeseed-mustard in India: TE 1993-94 and TE2011-12

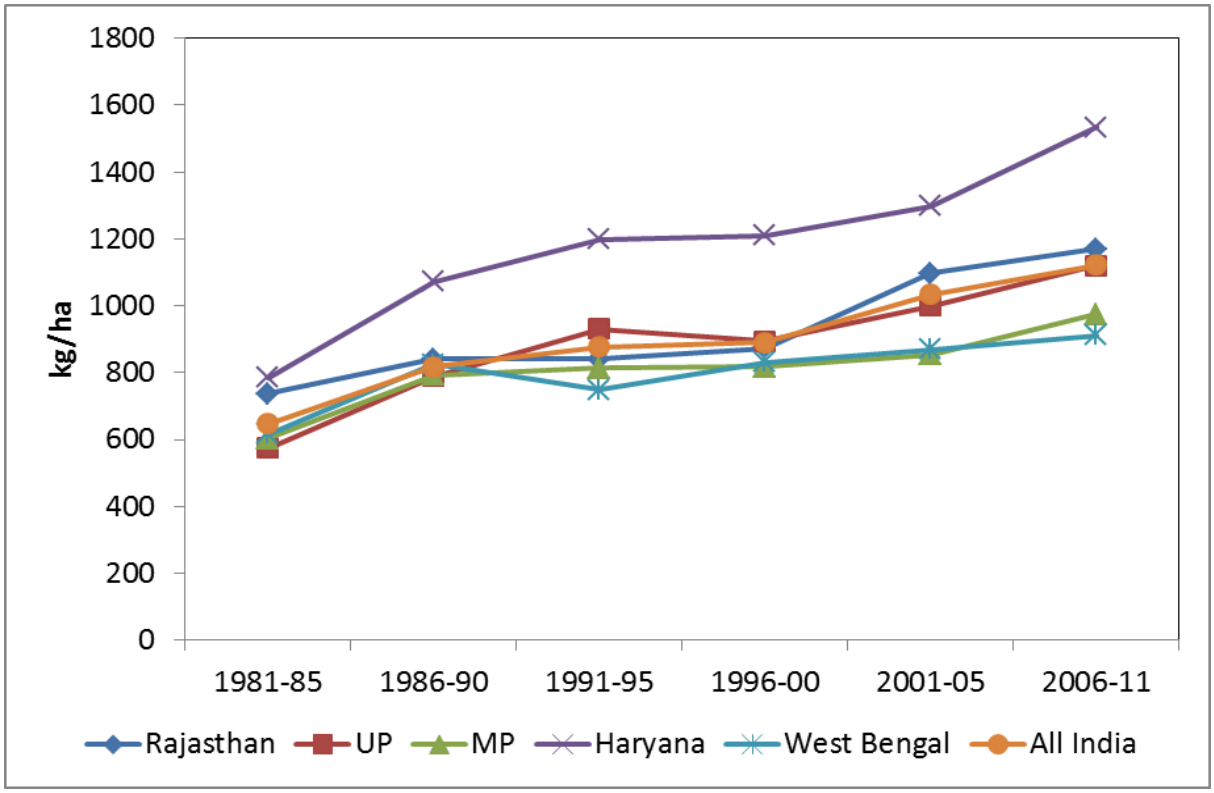


Source: GoI (2013c)

Shifts in Yield

Rapeseed-mustard yields are lower in India compared to other rapeseed-mustard producing countries such as Germany (3811 kg/ha), France (3240 kg/ha), China (1834 kg/ha) and Canada (1769kg/ha) as well as the world average (1849 kg/ha). Figure 5.3 presents data on yield level in India as well as in individual states. Rapeseed-mustard yields, which were low (about 647 kg/ha on the average) during the early-1980s, witnessed a steady increase during the last three decades and reached a level of 1121 kg/ha in the recent decade in India. Among the major oilseed producing states, Haryana has the highest yield (1533 kg/ha), followed by Rajasthan (1170 kg), and Uttar Pradesh (1121 kg), while West Bengal (911 kg), has the lowest yield. It is interesting to note that all states witnessed a positive growth in rapeseed-mustard yield during the last three decades but rate of growth was the highest during the decade of 1980s, which decelerated during 1990s but again picked up during the last decade.

Figure 5.3: Changes in rapeseed-mustard yield by major producing states and all India average: 1981-2012



Source: GoI (2013c)

Growth Rates in Area, Production and Yield

Growth rates of area, production, and productivity of rapeseed-mustard in major producing states and at national level during different time periods were computed, and the results are presented in Table 5.4. The Indian rapeseed-mustard production grew at an annual compound growth rate of 3.57 per cent during 1981-2011 (31 years) and can be disaggregated into area (1.51%) and yield (2.03%). In the long term, of the 3.57 per cent annual growth in rapeseed-mustard production, the increase in yield accounted for about 57 per cent of the growth in production. The compound annual growth rate of rapeseed-mustard yield was also the highest (5.35%) during the 1980s, and the lowest (0.65%) during the decade of nineties. Almost all states experienced the highest growth in area, production and productivity during the eighties while during the nineties, growth rates were negative in most of the states but revived in major producing states like Rajasthan and Madhya Pradesh during the last decade.

Table 5.4: Annual growth rates of rapeseed-mustard area, production and yield in selected states, 1981-82 to 2011-12

Period	*Rajasthan*	*M.P.*[15]	*U.P.*[16]	*Haryana*	*West Bengal*	*Gujarat*	*Assam*	*All India*
Area								
1980s	13.32***	7.66***	-6.95***	11.31***	11.43***	8.21***	2.57***	3.55**
1990s	-1.11	-1.26	-2.21***	-3.98***	-0.82	-5.58***	-0.52	-1.80
2000s	4.08*	5.09***	-2.84**	-2.05*	-0.67*	-0.18	-1.13	1.82
All	4.43***	3.10***	-2.43***	3.00***	2.33***	0.84	-0.82	1.51***
Production								
1980s	15.82***	13.72***	0.27***	18.91***	18.37***	12.73***	3.57***	9.10***
1990s	-0.33	-1.12	-1.63	-2.56	0.85	-4.98**	-1.42	-1.16
2000s	5.86*	8.42***	-0.76	0.35	1.00	2.53	0.09	3.70*
All	6.29***	4.87***	-0.06	5.36***	3.68***	2.25***	-0.34	3.57***

[15] *Madhya Pradesh data during the 2000s is combined data for Madhya Pradesh and Chhattisgarh to compare across different time periods.*

[16] *TE2011-12 data Includes data for both Uttar Pradesh and Uttarakhand*

Yield								
1980s	2.21**	5.63***	7.76***	6.82***	6.23***	4.18	0.98	5.35***
1990s	0.79	-0.12	0.59	1.48	1.68	0.63	-0.90	0.65
2000s	1.72	3.41***	2.15***	2.45	1.68	2.71*	1.24	1.85**
All	1.78**	1.57**	2.42***	2.29***	1.32**	1.39***	0.49***	2.03***

****, ** and * corresponds to 1%, 5%, and 10% level of significance, respectively*
Source: Authors' computation using GoI (2013c) data

Table 5.5: Classification of states according to growth in area, production and yield of rapeseed-mustard: 1981-82 to 2011-12

	1980s	1990s	2000s	1981-82 to 2011-12
Area				
Significant positive growth in area	Assam, Gujarat, Haryana, Madhya Pradesh, Rajasthan, West Bengal		Madhya Pradesh, Rajasthan	Haryana, Madhya Pradesh, Rajasthan, West Bengal
Significant negative growth in area	Uttar Pradesh	Gujarat, Haryana, Uttar Pradesh	Haryana, Uttar Pradesh, West Bengal	Uttar Pradesh
Positive stagnant area				Gujarat
Negative stagnant area		Assam, Madhya Pradesh, Rajasthan, West Bengal	Assam, Gujarat	Assam
Production				
Significant increase in production	Assam, Haryana, Gujarat, Madhya Pradesh, Rajasthan, West Bengal, Uttar Pradesh		Madhya Pradesh, Rajasthan,	Gujarat, Haryana, Madhya Pradesh, Rajasthan, West Bengal
Significant decline in production		Gujarat		
Positive		West Bengal	Uttar Pradesh	

trend but statistically non-significant				
Negative trend but statistically non-significant		Assam, Haryana, Madhya Pradesh, Rajasthan, Uttar Pradesh	Assam, Gujarat, Haryana, West Bengal	Assam, Uttar Pradesh
Yield				
Significant positive growth in yield	Haryana, Rajasthan, Madhya Pradesh, Uttar Pradesh, West Bengal		Gujarat, Assam, Madhya Pradesh, Uttar Pradesh	Haryana, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, West Bengal, Assam
Significant negative growth in yield				
Positive stagnant yield	Assam, Gujarat	Haryana, Gujarat, Uttar Pradesh, West Bengal, Gujarat	Haryana, Rajasthan, West Bengal	
Negative stagnant yield		Assam, Madhya Pradesh		

Source: Authors' computation using GoI (2013c) data

In the case of production, all major producers had significant positive growth rate in rapeseed-mustard production during the 1980s, and in the next decade, all major producers witnessed negative or stagnant growth in production. The rapeseed-mustard production growth improved during the last decade and the number of states having positive growth rate increased to two, while Haryana, Uttar Pradesh and West Bengal had significant negative growth rate in production. The above trends clearly indicate that performance of rapeseed-mustard crop was the best during the 1980s and became worse during the 1990s but improved slightly during the last decade but still much lower than the eighties.

The distribution of major rapeseed-mustard growing states according to types of association between growth rates of area and yield shows that the number of states falling under AA

category was the highest (4) in the 1980s and in the next decade, none of the states were in AA category (Table 5.6). Rajasthan, which is the largest producer of rapeseed-mustard crop in the country, moved from AA in the 1980s to BC in the 1990s, while other producers like Haryana, Madhya Pradesh and West Bengal shifted from AA to CC and BC categories. However, there was a slight improvement during the 2000s, where Madhya Pradesh moved to AA category. The analysis shows that most of the states performed poorly in the 1990s owing to reduction in yields and area growth rates, with a marginal improvement during the last decade. Therefore, efforts are needed to improve rapeseed-mustard yield to increase production as there is a limited scope for increasing area under oilseeds.

Table 5.6: Classification of states according to growth in area and yield of rapeseed-mustard

Type of association	1980s	1990s	2000s	1981-82 to 2009-10
AA	Haryana, Madhya Pradesh, Rajasthan, West Bengal	-	Madhya Pradesh	Haryana, Madhya Pradesh, Rajasthan, West Bengal
AB	-	-	-	-
AC	Assam, Gujarat	-	Rajasthan	
BA	Uttar Pradesh	-	Uttar Pradesh	Uttar Pradesh
BB	-	-	-	-
BC	-	Haryana, Gujarat, Uttar Pradesh, Rajasthan, West Bengal	Haryana, West Bengal	-
CA	-		Assam, Gujarat	Gujarat
CB	-	-	-	-
CC	-	Assam, Madhya Pradesh		Assam

Source: Authors' computation using GoI (2013c) data

Yield at all-India level has increased from 597 kg/ha in 1981-83 to about 1163 kg/ha in 2009-11. Gujarat, Haryana and Rajasthan have higher yield than the national average, while in other states, the yield was less than the national average. However, most of the major producers reported a significant increase in yield during the period 1981-83 and 2009-11. Gujarat, Haryana, and Rajasthan, with high productivity levels and Assam, Madhya Pradesh,

Uttar Pradesh and West Bengal with low productivity levels recorded significant increases in yields during the last three decades (Table 5.7). However, performance of the states differed quite significantly during the sub-periods.

Table 5.7: Classification of states according to productivity levels and growth in productivity of rapeseed-mustard in India

	Significant increase in yield	Significant decline in yield	Stagnant yield with positive sign	Stagnant yield with negative sign
1981-82 to 1990-91				
High Productivity (> All India)	Haryana, Rajasthan	-	Gujarat	-
Low Productivity	Madhya Pradesh, Uttar Pradesh, West Bengal	-	Assam	-
1991-92 to 2000-01				
High Productivity	-	-	Haryana, Gujarat, Uttar Pradesh	
Low Productivity	-	-	West Bengal, Gujarat	Assam, Madhya Pradesh
2001-02 to 2011-12				
High Productivity	Gujarat	-	Haryana, Rajasthan	-
Low Productivity	Assam, Madhya Pradesh, U.P.	-	West Bengal	-
1981-82 to 2009-10				
High Productivity	Haryana, Gujarat, Rajasthan	-	-	-
Low Productivity	Madhya Pradesh, Uttar Pradesh, West Bengal, Assam	-	-	-

Source: Authors' computation using GoI (2013c) data

Among the high productivity states, Haryana and Rajasthan reported significant increase in yield during the eighties. Among the low productivity states, Madhya Pradesh, Uttar Pradesh, and West Bengal recorded significant increase in productivity levels. Gujarat from high productivity category and Assam from low productivity category states had stagnant yields during the 1980s. However, in the nineties there was a dramatic shift in the

distribution of states. The performance of all major rapeseed-mustard producing states deteriorated during the post-reform period (1990s) and none of the states with either high productivity or low productivity level registered significant increase in yield. All states witnessed either stagnant positive or stagnant negative growth rates. However, during the last decade there was some revival and Gujarat from high productivity category and Assam, Madhya Pradesh, and Uttar Pradesh with low productivity level reported significant increases in crop yield, whereas, other states like Haryana, Rajasthan and West Bengal registered positive but statistically non-significant growth rate in yield.

From the above analysis it is clear that rapeseed-mustard has shown a dismal performance in respect of production and productivity during the nineties as compared to eighties, but performance has improved during the last decade, though much lower than the eighties. This should be a matter of concern for policy planners, and necessary steps should be taken to improve productivity levels as the Indian productivity is much lower than its potential.

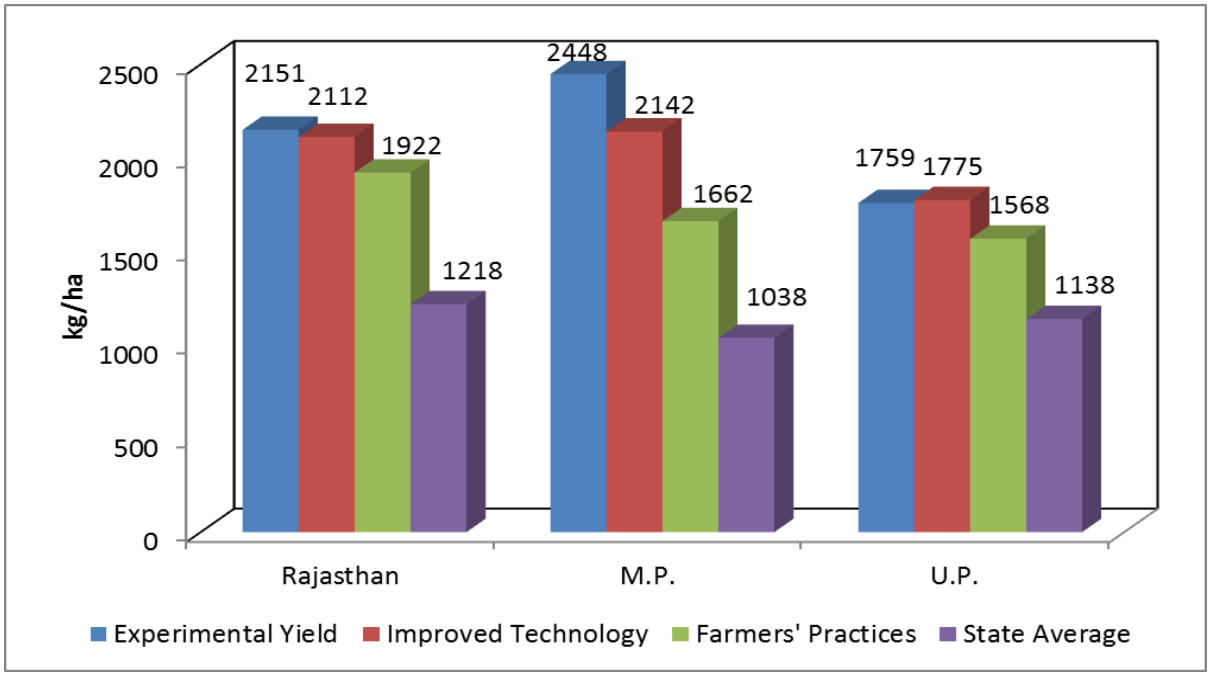
Yield Gap Analysis

The data on potential yield and actual yield obtained under improved technology and farmers' practices under front line demonstrations (FLD) in selected states are presented in Figure 5.4. The data shows that average experimental station yield of rapeseed-mustard varied from 1759 kg per ha in Uttar Pradesh to 2448 kg per ha in Madhya Pradesh during TE2011-12. The yield fluctuated over the years in all states. Higher yields were recorded in all states (2239 kg/ha in Rajasthan, 3624 kg/ha in Madhya Pradesh and 2009 kg/ha in Uttar Pradesh) during 2010-11 while lower yields were recorded in year 2009-10 in Madhya Pradesh (1493 kg/ha) and Uttar Pradesh (1493 kg/ha) and in 2011-12 in Rajasthan (2057 kg/ha). The crop yields obtained under FLDs with improved technology varied from 1775 kg/ha in Uttar Pradesh to 2142 kg/ha in Madhya Pradesh during TE2011-2. The yield levels under farmers' practices were lower than obtained under improved technology, and the state average yields were much lower than obtained under farmers' practices.

It is interesting to note that technology gap (difference between potential yield at experimental station and FLD yield under improved technology) is not much wide in all states, the highest (12.5%) being in Madhya Pradesh. However, extension gap (difference between FLD yield under improved technology and farmers' practices) ranged from about 9 per cent in Rajasthan to over 22 per cent in Madhya Pradesh. It can be observed from Figure

5.4 that there exists a wide yield gap in rapeseed-mustard under farmers' practices in FLDs and the state average yields. The gap varied from 27.4 per cent in Uttar Pradesh to 37.6 per cent in Madhya Pradesh. The difference between state average yield and yield under improved technology, however, was very high at 35.9 per cent in Madhya Pradesh to 51.5 per cent in Madhya Pradesh. The above findings clearly show that yield of rapeseed-mustard can be increased by about 27-38 per cent by providing better technical support through effective extension services and provision of timely supply of quality inputs and other services.

Figure 5.4: Potential yield and front line demonstration on-farm average yields of rapeseed-mustard in Rajasthan, Madhya Pradesh and Uttar Pradesh: 2009-10 to 2011-12



Source: ICAR (2013b)

In order to identify and address some of the constraints affecting rapeseed-mustard production and productivity, a detailed analysis of major constraints affecting rapeseed-mustard cultivation was undertaken, and the results are discussed in the next section.

Problems and Prospects of Rapeseed-Mustard Cultivation

In order to understand the problems and prospects of rapeseed-mustard cultivation, primary study in four major rapeseed-mustard producing states, namely, Rajasthan, Madhya Pradesh, Uttar Pradesh and West Bengal was conducted during the year 2010-11. We collected primary data from three districts (Bharatpur, Tonk and Kota) of Rajasthan (Swain,

2013), three districts (Morena, Chhatarpur and Mandla) of Madhya Pradesh (Sharma and Rathi, 2013) and three districts (Agra, Etah and Lakhimpur Kheri) of Uttar Pradesh (Roy, 2013). The districts were selected based on area under the crop and productivity level as discussed in chapter 2. This section reports the general findings of our survey of 200 farmers from about 19 villages in Rajasthan, 120 farmers from nine villages in Madhya Pradesh, and 200 farmers from six villages of Uttar Pradesh. In all total sample size was 520 rapeseed-mustard growers spread over about 40 villages from four major producing states in the country (Table 5.8).

Table 5.8: Size-distribution of sample households in selected states

State	***Marginal***	***Small***	***Medium***	***Large***	***Total***
Rajasthan	19	38	116	27	200
Madhya Pradesh	21	36	46	17	120
Uttar Pradesh	55	68	57	20	200
Total	95	142	219	64	***520***

Source: Field Survey

General Characteristics

The average family in our household samples consists of 8.4 persons with an average age of little over 50 years (Table 5.9). On an average, 91.7 per cent of the households had crop farming as their main occupation. Marginal farm households have the largest proportion of family members working as farm labourers (5.3%) and in dairy farming (7.4%). Almost all households were male headed. Farm production was still the main source of income in these areas.

Land Ownership Pattern

The average operational land holding in the study area was 5.68 ha per family though the size of holding ranges from 0.82 ha on marginal households to 18.26 ha on large households (Table 5.10). About 80 per cent of the total operational land was irrigated, and there was an inverse relationship between farm size and irrigated area. Leasing of land was not very common in the study area. There was a positive association between farm size and leased-in land in the study area.

Table 5.9: Socio-economic status of sample HH

Indicators	Marginal	Small	Medium	Large	All Farms
Age (years)	47.9	52.0	50.2	52.8	50.2
Main Occupation (%)					
Crop farming	81.0	93.0	94.0	96.9	91.7
Dairy	7.4	2.1	0.9	0.0	2.3
Services	6.3	4.9	4.6	3.1	4.8
Farm Labour	5.3	0.0	0.5	0.0	1.2
Education (years of schooling)	7.1	8.0	8.0	7.5	7.7
Average Family Size (no)	7.9	8.1	8.4	9.8	8.4
Male	3.9	3.9	4.4	5.0	4.3
Female	4.0	4.2	4.0	4.8	4.1
Social Groups					
General	31.6	33.1	32.0	21.9	31.0
OBC	47.4	50.7	48.4	50.0	49.0
SC/ST	16.8	13.4	8.2	17.2	12.3
Others	4.2	2.8	11.4	10.9	7.7

Source: Field Survey

Table 5.10: Land ownership pattern of sample households (in ha)

Indicators	Marginal	Small	Medium	Large	All Farms
Total owned land	0.85	1.63	3.89	15.28	4.85
Irrigated	0.80	1.40	3.11	11.80	3.85
Un-irrigated	0.05	0.23	0.78	3.48	1.00
Leased-in land	0.01	0.03	0.70	2.98	0.85
Irrigated	0.01	0.03	0.65	2.78	0.79
Un-irrigated	0.00	0.00	0.05	0.20	0.06
Leased-out land	0.04	0.04	0.01	0.00	0.02
Irrigated	0.04	0.04	0.01	0.00	0.02
Un-irrigated	0.00	0.00	0.00	0.00	0.00
Total Operational holding	0.82	1.62	4.59	18.26	5.68
Irrigated	0.77	1.39	3.76	14.58	4.62
Un-irrigated	0.05	0.23	0.83	3.68	1.06

Source: Field Survey

Rapeseed-Mustard Cropping Systems: Productivity, Profitability and Risks

Rapeseed-mustard is a major oilseed crop during rabi season in all selected states and accounts for about 24 per cent of total rabi acreage in Madhya Pradesh and about 60 per cent in the selected districts in Rajasthan and West Bengal. As rapeseed-mustard is mostly grown as intercrop with wheat, large area is under irrigation. More than 80 percent of crop acreage in Rajasthan, Uttar Pradesh and West Bengal and about half of the crop area in Madhya Pradesh is irrigated.

The average productivity of rapeseed-mustard in sample households at all India level was 15.7 q per ha. The yield was the highest for Uttar Pradesh (22.4 q/ha), followed by Rajasthan (19.1 q/ha), West Bengal (10.6 q/ha) and the lowest in Madhya Pradesh (9.4 q/ha).

Table 5.11: Average yield (q/ha) of rapeseed-mustard on sample households in selected states

Crops	Marginal	Small	Medium	Large	All farm
Rajasthan	16.9	19.6	19.3	19.5	19.1
Madhya Pradesh	8.6	10.4	8.9	9.7	9.4
Uttar Pradesh	23.7	21.7	22.1	21.5	22.4
West Bengal	10.5	10.7	11.1	-	10.6
All	13.6	16.5	16.8	17.5	15.7

Source: Field Survey

Table 5.12 shows comparative profitability of rapeseed-mustard and major competing crops in selected states. Wheat and coriander are the main competing crops in Rajasthan, as are wheat and potato in Uttar Pradesh and wheat in Madhya Pradesh.

It is evident from the Table that average profitability of rapeseed-mustard is significantly higher than competing crops, namely, wheat and coriander in Rajasthan and wheat in Uttar Pradesh. The average returns from rapeseed-mustard were the highest (Rs. 45,000/ha) in Uttar Pradesh, followed by Rajasthan (Rs. 39,198/ha) and the lowest (Rs. 17,314/ha) in Madhya Pradesh. The net income from rapeseed-mustard in Rajasthan was the highest (Rs. 41,692/ha) for large farms and the lowest (Rs. 32,086/ha) for small farms, while in the case of Uttar Pradesh, there was an inverse relationship between profitability and farm size. However, in case of Madhya Pradesh, rapeseed-mustard profitability was lower than wheat.

These results clearly indicate that rapeseed-mustard cultivation is more profitable than competing crops in Rajasthan and Uttar Pradesh.

Table 5.12: Profitability[17] rapeseed-mustard vis-à-vis major competing crop (wheat) per hectare in selected states *(Rs/ha)*

	Marginal	Small	Medium	Large	All Farms
Rajasthan					
Rapeseed-mustard	32086	34847	40791	41692	39198
Wheat	20583	22575	18386	20359	19527
Coriander[18]	-	-	-	-	26888
Uttar Pradesh					
Rapeseed-mustard	50122	48090	43759	41606	45000
Wheat	19310	20164	15121	14010	16132
Potato	67779	65529	40019	141717	88227
Madhya Pradesh					
Rapeseed-mustard	18314	16777	18293	15872	17314
Wheat	21450	24562	28319	27306	25409

Source: Authors' computations using data from Field Survey

More than 70 per cent of area under rapeseed-mustard is under irrigation and therefore expected to be less prone to weather variability. In order to compare price and yield risks of rapeseed-mustard with competing crops, we computed coefficient of variation of yield and price, the results for which are presented in Table 5.13. It is evident from the Table that farmers face higher yield risks compared with price risks in rapeseed-mustard. The yield and production risks in rapeseed-mustard are relatively higher than wheat yield risks. It is ironical that even expansion of irrigation in rapeseed and mustard did not help in reducing risk in yield and production. Rapeseed-mustard, in general, is highly vulnerable to diseases and insects pests and yield losses can be substantial. It is interesting to note that small and marginal farmers face higher price risks in rapeseed-mustard cultivation measured by coefficient of variation compared with large farmers. The yield risks are much higher in Madhya Pradesh (53.5%) than in Rajasthan (28.4%) or Uttar Pradesh (29.2%) The rapeseed-

[17] *Profitability = Gross Value of Output – Total Operational Costs*

[18] *Category-wise analysis could not be done due to small sample size.*

mustard growers face several biological, natural resources and policy-induced constraints, which affect crop production and yield, some of which will be discussed in the next section.

Table 5.13: Yield and price risks in rapeseed-mustard and competing crop in sample states

State/Crop	Marginal	Small	Medium	Large	All Farms
All India					
Rapeseed-mustard					
Yield Risk	45.0	42.1	40.8	41.7	42.1
Price Risk	18.5	10.1	10.7	6.6	12.0
Wheat					
Yield Risk	31.4	43.9	38.1	35.7	39.7
Price Risk	8.7	9.2	12.1	7.9	10.4
Rajasthan					
Rapeseed-mustard					
Yield Risk	27.8	26.9	28.8	28.4	28.4
Price Risk	18.9	11.0	11.4	8.3	12.0
Wheat					
Yield Risk	28.6	27.7	30.4	32.6	30.5
Price Risk	10.9	9.0	8.2	8.8	8.7
Uttar Pradesh					
Rapeseed-mustard					
Yield Risk	28.0	31.6	30.9	31.5	29.2
Price Risk	7.1	7.3	8.0	4.7	7.3
Wheat					
Yield Risk	17.3	42.6	35.2	11.6	34.0
Price Risk	4.4	3.6	3.3	3.8	3.9
Madhya Pradesh					
Rapeseed-mustard					
Yield Risk	58.7	52.7	56.9	39.9	53.5
Price Risk	34.1	11.2	11.2	4.7	16.7
Wheat					
Yield Risk	41.4	27.0	39.1	22.3	36.9
Price Risk	0	2.5	6.1	8.0	6.0

Source: Field Survey

Post-Harvest Handling, Price Situation and Access to Technology and Markets

Most farmers sell all their produce immediately after harvest as they require cash for their next crop or for other urgent needs. Some farmers, who have holding capacity, sell part of their produce depending on market prices and their need for cash. Farmers generally do not store rapeseed-mustard grain for a long time, except for self-consumption. Table 5.14 shows the production, retention and marketed surplus pattern of rapeseed-mustard and price realization by farmers.

Table 5.14: Total oilseed production, retention and sales pattern on sample farms

	Rajasthan				***Madhya Pradesh***			
Farm category	***Prod (Qtl)***	***Retention (Qtl)***	***Sold (Qtl)***	***Price (Rs./q)***	***Prod (Qtl)***	***Retention (Qtl)***	***Sold (Qtl)***	***Price (Rs./q)***
Marginal	8.5	-	8.5 (100.0)	2808	2.8	1.0	1.9 (67.9)	2757
Small	17.8	-	17.8 (100.0)	2979	4.4	1.8	2.7 (61.4)	2926
Medium	53.8	0.3	53.5 (99.4)	3039	9.2	2.8	6.3 (68.5)	2971
Large	179.7	1.2	178.5 (99.3)	3174	24.5	3.0	21.5 (87.8)	3065
All Farms	59.7	0.4	59.3 (99.3)	3024	8.8	2.2	6.6 (75.0)	2933
	Uttar Pradesh				***All India***			
Marginal	8.9	1.0	7.9 (88.8)	3205	7.5	0.8	6.7 (89.4)	3026
Small	13.1	1.1	12.0 (91.6)	3299	12.2	1.0	11.3 (91.9)	3126
Medium	27.8	1.6	26.2 (94.2)	3285	37.7	1.2	36.5 (96.8)	3090
Large	68.8	2.4	66.4 (96.5)	3300	103.8	2.1	101.8 (98.0)	3184
All Farms	21.8	1.4	20.4 (93.6)	3269	33.4	1.2	32.2 (96.5)	3099

Source: Field Survey

Figures in parentheses indicate percentage of the quantity sold to total production

The average production increases with an increase in the size class of holding in all states. However, farmers keep small quantities of the produce to ensure seed availability for the next crop cycle and for self-consumption, mainly as mustard oil. About 96.5 per cent of total crop output is sold in the market at all-India level and share of marketed surplus varies from 89.4 per cent on marginal farms to 98 per cent on large farms. In Rajasthan, almost all output is sold in the market, while in Uttar Pradesh, 93.6 per cent of total production is sold. However, in Madhya Pradesh farmers retain about one-fourth of the total produce. In case of output prices, farmers in Uttar Pradesh received the highest price (Rs. 3269/q) while farmers in Madhya Pradesh received the lowest price (Rs. 2933/q). The small and marginal farmers received marginally lower price compared with large farmers, but the difference was not significant.

The marketing pattern of rapeseed-mustard shows that the sale to commission agent is the main marketing channel for all categories of farms in the study area. Local village traders account for about 27 per cent of sales, followed by government agencies (13.5%) and processor (9%). Access to government agencies and processors is significantly higher in case of medium and large farms compared with small farms. The average distance to sale point ranged from about 8.5 km in case of marginal farms to 17.7 km for large farms. These findings clearly show that small and marginal farmers have poor access to organized markets and are dependent on unorganized sector for sale of their produce. The price realization is highest in the case of government agencies (Rs. 3227/q), followed by processor (Rs. 3186/q), commission agents (Rs. 3146/q) and local village traders (Rs. 3092/q). However, there are inter-state differences in terms of marketing channels and price received by farmers. For example, nearly half of the farmers sold their produce to commission agents in Rajasthan as government agencies did not procure rapeseed-mustard. Large farmers had better access (about 30%) to the organized private sector including processing mills, which offered better prices compared with other marketing channels. In the case of Madhya Pradesh, about half of respondents sold their produce to local village traders and remaining half in regulated mandis. Majority of small and marginal farmers sold the produce to local village traders while majority of large farmers sold their produce in regulated mandis. The average price received was found to be higher in regulated mandies compared with village traders. More than 60 per cent of the farmers in Uttar Pradesh sold

their produce to commission agents. Local village trader was the second important marketing channel in the state. Although there was no significant difference in the prices paid by different marketing agencies, processing mills and commission agents paid marginally higher prices than other channels.

Table 5.15: Relative importance of different marketing channels and price paid to farmers

Marketing channel	***Marginal***	***Small***	***Medium***	***Large***	***All Farms***
Commission Agent/Arhtia	47.4	45.1	45.1	41.7	45.2
Local Village Trader	42.3	38.2	16.1	14.9	27.1
Government Agencies	4.4	7.6	18.8	24.7	13.5
Processor	4.2	5.6	11.3	11.5	9.0
Private Company	1.1	3.5	8.6	7.3	5.2
Average distance to sale point (km)	8.5	10.7	14.2	17.7	12.6
Price Received (Rs./q)					
Commission Agent/ Arhtia	3039	3146	3125	3223	3146
Local Village Trader	2996	3117	2996	3503	3092
Government Agencies	3262	3049	3141	3419	3227
Processor	3088	3281	3128	3146	3186
Private Company	3200	3040	2945	3096	3062

Source: Field Survey

The oilseeds producers in general and small and marginal farmers in particular had poor access to quality inputs like fertilizers and pesticides and services like credit facilities, markets, information and technology. In order to assess producers' access to inputs, particularly better quality seeds, prices, information about their access to market information, etc. data was collected, and the results are presented in Table 5.16. Almost all farmers used high yielding variety seeds and more than one source to purchase seeds. The share of market purchased seed was high for all farm sizes (Table 5.16). About one-third of the seeds were purchased from ICAR/State Agricultural Universities and State Department of Agriculture and about 36 per cent of sample households used their own seed. Majority of the farmers were aware of the minimum support price announced by the government, and 96.7% households received price higher than MSP. Nearly 21 per cent of the sample households reported marketing related problems. Farmers use a variety of media for

sourcing market information and in the present study, most important source were fellow farmers (48.4%), followed by print media (36%) and APMC mandies (34.2%). It is evident from the Table that small farmers are heavily dependent on informal sources of information such as commission agents/arhtias and fellow farmers, while large farmers have better access to electronic and print media for seeking market information.

Table 5.16: Access to inputs, technology, markets and market information on sample households (%)

	Marginal	Small	Medium	Large	All Farms
Use of HYV					
Yes	89.9	89.5	91.7	93.0	91.2
No	10.1	10.5	8.3	7.0	8.8
Source of Seed					
Own	27.4	34.5	55.3	43.8	36.1
Fellow farmer	10.5	17.6	25.6	14.1	16.1
State Department of Agri.	16.8	16.9	31.5	31.3	20.8
ICAR/SAU	10.5	11.3	18.7	23.4	13.2
Market	66.3	69.7	58.0	64.1	53.2
Awareness about MSP					
Yes	69.5	75.4	95.0	96.9	85.2
No	30.5	24.6	5.0	3.1	14.8
Price realization					
Higher/Equal to MSP	93.7	97.2	96.8	100.0	96.7
Lower than MSP	6.3	2.8	3.2	-	3.3
Marketing problems					
Yes	16.8	20.4	24.2	18.8	21.2
No	83.2	79.6	75.8	81.3	78.8
Source of market information					
Radio/TV	20.0	26.1	53.0	42.2	32.1
Print Media	17.9	33.1	55.7	57.8	36.0
Fellow farmers	54.7	47.9	65.3	57.8	48.4
APMC Mandi	16.8	28.9	56.2	50.0	34.2

Commission agent	38.9	42.3	29.7	21.9	28.4
Private company	11.6	21.1	28.8	31.3	20.0
Others	1.1	0.0	2.3	1.6	1.1

Source: Field Survey

Constraints in Rapeseed-Mustard Cultivation

Despite rapeseed-mustard being more profitable compared to competing crops, farmers are allocating less area to it, due to the high degree of risks in oilseeds cultivation. The oilseed growers face a variety of risks such as technological, institutional, agro-climatic, marketing and economic. The extent of risk depends on the personal characteristics of farmers, probability of occurrence of constraints and the severity of that constraint. In order to identify and analyze major constraints confronting rapeseed-mustard growers, farmers were asked to rank main constraints affecting production and productivity. The results of the study on various constraints have been analyzed and presented in Table 5.17. It is evident from the Table that institutional constraints are the most important constraints (2.61) faced by the growers, followed by economic (2.44) and technological constraints (2.13). Among institutional constraints, non-availability of inputs and services was the most important constraint. Further, dissemination of technologies and knowledge about package of practices is an important instrument of bringing new technologies and knowledge to farmers but inadequate knowledge about disease and pest management and poor quality of extension services were important constraints faced by farmers in the study area. High cost of inputs, shortage of labor, production and price risks were important economic constraints faced by oilseed growers in the study area. Incidence of insect pests and diseases, lack of suitable varieties, and irrigation facilities were the main technological constraints in rapeseed-mustard cultivation. High transportation costs due to poor road infrastructure, exploitation by middlemen and lack of processing facilities were the main marketing related issues reported by the respondents. The above results clearly indicate that rapeseed-mustard farmers face a variety of constraints which restrict their access to technologies, markets, inputs and services, transport logistics, market information, etc. and overcoming these constraints is critical for improving production and productivity of rapeseed-mustard in the country.

Table 5.17: Constraints faced by farmers in cultivation of rapeseed-mustard on sample households

(Composite index value)

	Marginal	***Small***	***Medium***	***Large***	***All Farms***
Technological	**2.02**	**2.01**	**2.21**	**2.06**	**2.13**
Incidence of insect pests	2.34	2.29	2.53	2.28	2.44
Poor crop germination	2.53	2.40	2.21	2.16	2.35
Non-availability of suitable varieties	2.09	2.02	2.46	2.53	2.30
Incidence of diseases	2.09	2.29	2.34	2.23	2.27
Lack of irrigation facilities	2.12	2.05	2.26	1.86	2.15
Weeds Infestation	1.72	1.57	2.03	1.94	1.90
Poor quality of soils	1.28	1.43	1.67	1.44	1.48
Agro-climatic Factors	**1.62**	**1.63**	**2.14**	**1.91**	**1.91**
Risk of crop failure/yield variability due to biotic & a biotic stresses	1.96	1.69	2.40	1.97	2.15
Poor pod/grain setting	1.59	1.79	2.26	1.92	1.96
Extreme variations in temperature	1.53	1.64	2.27	1.98	1.94
Drought at critical stages of crop growth	1.52	1.50	1.87	1.94	1.75
Excessive rains	1.51	1.55	1.90	1.75	1.74
Economic	**2.30**	**2.26**	**2.56**	**2.54**	**2.44**
High-input cost (diesel, fertilizers, agrochemicals)	3.32	3.45	3.06	3.08	3.18
Oilseeds more risky compared with other crops	3.16	3.05	2.24	2.30	2.63
Shortage of human labour	2.26	2.07	2.91	3.13	2.60
Low and fluctuating prices	1.74	1.83	2.75	2.72	2.34
Price risks – Fear of glut leading to low price	1.57	1.62	2.37	2.23	2.03
Oilseeds less profitable compared with other crops	1.74	1.55	2.03	1.77	1.86
Institutional	**2.68**	**2.67**	**2.62**	**2.50**	**2.61**
Irregular supply of power/electricity	3.21	3.48	3.02	2.72	3.07
Non-availability of timely inputs	3.26	3.26	2.61	2.69	2.89
Inadequate knowledge about	3.09	3.17	2.45	2.33	2.70

disease and pest management					
Seed availability	2.72	2.55	2.69	2.80	2.67
Lack/Poor extension services	2.83	2.45	2.61	2.59	2.66
Poor quality of inputs	2.51	2.26	2.53	2.63	2.44
Non-availability of institutional credit	1.71	1.79	2.59	1.83	2.12
Post-harvest, Marketing and Value-addition	**1.95**	**1.96**	**2.27**	**2.21**	**2.12**
High transportation costs	3.49	3.67	2.67	2.64	3.04
Exploitation by market intermediaries	2.60	2.14	2.32	2.13	2.33
Lack of processing facilities in the area	1.91	1.98	2.33	2.41	2.15
Poor Roads	1.62	1.71	2.31	2.13	2.02
Lack of appropriate transport means	1.75	1.57	2.09	2.03	1.95
Inadequate storage facilities	1.46	1.62	2.26	2.41	1.93
Lack of information about prices and markets	1.44	1.60	2.12	1.95	1.82
Poor marketing system and access to markets	1.35	1.40	2.03	1.98	1.72

Source: Field Survey

Composite indices constructed based on weights (severe=4, moderate=3, minor=2, not important=1) and number of households in each category.

Farmer Recommendations for Improving rapeseed-mustard Productivity and Income

Farmers were asked to give suggestions to address the constraints faced by them in rapeseed-mustard cultivation, the results for which are presented in Table 5.18.

The assured supply of electricity, better irrigation facilities, availability of quality seeds, better market and production infrastructure and availability of quality inputs particularly plant protection chemicals were some of the important suggestions for improving productivity and production of rapeseed-mustard in the selected states. Some state-specific suggestions were also observed. For example, in Rajasthan crop damage by wild animals particularly blue bull has been a major issue and 23 per cent of farmers suggested to provide assistance for fencing. About 88 per cent farmers in Madhya Pradesh suggested

creation of proper storage facilities at village level and establishment of regulated market/purchase centre. Other suggestions included better output price, training of farmers in cultivation of rapeseed-mustard, crop insurance, and better extension services.

Table 5.18: Farmers' suggestions (%) for improving rapeseed-mustard productivity and income

	Marginal	***Small***	***Medium***	***Large***	***All Farms***
Rajasthan					
Assured Supply of electricity for irrigation	78.9	52.6	45.2	55.6	54.0
Better irrigation facilities	31.6	47.4	30.6	23.5	31.0
Assistance for fencing for protection from wild animals	26.3	31.6	19.4	21.0	23.0
Stable and affordable prices of chemical fertilizers, seeds and other inputs	10.5	31.6	27.4	22.2	24.5
Availability of quality plant protection chemicals	5.3	31.6	22.6	22.2	22.5
Better infrastructure such as road and transport facilities	42.1	47.4	4.8	11.1	19.0
Better extension services	10.5	10.5	30.6	14.8	18.5
Availability of quality seed	5.3	18.4	22.6	17.3	18.0
Better output prices	5.3	15.8	8.1	14.8	12.0
Training to farmers on cultivation of rapeseed-mustard	-	2.6	19.4	11.1	11.0
Madhya Pradesh					
Regular supply of electricity	100.0	100.0	100.0	100.0	100.0
Proper storage facilities at village level	80.0	83.0	90.0	97.0	88.0
Strengthen of extension and market intelligence services	70.0	83.0	93.0	97.0	86.0
Establishment of more regulated market/purchase centre	70.0	83.0	93.0	97.0	86.0
Ensure availability of better seed and other inputs	80.0	93.0	73.0	93.0	85.0
Price stabilization	40.0	47.0	53.0	60.0	50.0

Knowledge about future trading	40.0	47.0	53.0	60.0	50.0
Strengthen crop insurance facilities	47.0	60.0	53.0	40.0	50.0
Uttar Pradesh					
Availability of quality certified seed	100.0	100.00	100.0	100.00	100.0
Availability of quality inputs particularly insecticides & pesticides at reasonable prices	100.0	100.00	100.0	100.00	100.0
Crop insurance for risk management	100.0	100.00	100.0	100.00	100.0
Development of market infrastructure and facilities	100.0	100.00	100.0	100.00	100.0
Better extension services	100.0	100.00	100.0	100.00	100.0
Entrepreneurship development	51.0	59.0	100.0	100.0	68.0

Source: Field Survey

Chapter 6

Performance of Groundnut: Recent Trends, Prospects and Constraints

Groundnut is one of the principal oilseeds in the world. According to USDA estimates for the TE2010-11, from a world total oilseeds production of about 432 million metric tons, groundnut share was approximately 8 per cent, behind soybeans (56.7%) and rapeseed-mustard (13.8%). Although groundnut originated in South America, it is now widely cultivated in tropical, sub-tropical and warm temperate areas in Asia, Africa, North and South America, and Oceania. The production is confined mainly to Asia and Sub-Saharan Africa. Asia accounts for about half of the global area under groundnut and around two-thirds of the production. Sub-Saharan Africa accounts for nearly 45 per cent of world groundnut area and over 25 per cent of total production. China is the largest producer of groundnut contributing over 40% of the world production and around 20 percent of area (Table 6.1). India is the second largest producer and accounts for about 15 per cent of global production and nearly 25 per cent of area. Other important producers are Nigeria, USA, Myanmar and Indonesia. The average productivity of groundnut in India is quite low and is nearly a third of those of USA and China and even lower than the world average.

In terms of consumption, while groundnut has been steadily substituted by soybeans and oil palm for oil and soybeans and rapeseed for meal purposes, its use for food purpose has increased. Globally, over half of groundnut produced is crushed for oil extraction and cake and remaining is used directly as raw or processed food. While in India, earlier over 80 per cent of the total production was used for oil extraction, 10-12 per cent for seed, 5-6 per cent for direct consumption, and small quantity for exports, recent estimates indicate that less than half of total production is crushed for oil and rest is used for direct consumption.

Trends in Area, Production and Yield

In India, groundnut is cultivated largely in *kharif* season mostly under rain-fed conditions with protective irrigation, as less than one-fourth of the total area is irrigated. The area

during kharif season is about 85 per cent and contributes nearly 75 per cent of the total production. The share of kharif season in total acreage and production has remained more or less constant during the last three decades. The average yield is significantly higher (about 67%) during rabi season compared with the kharif season. Table 6.2 presents the estimates of area, production, and yield of groundnut in India from 1971-72 to 2011-12.

Table 6.1: Groundnut area, production and yield in major producing countries in the world: 2011-12

Country	***Area (million ha)***	***Production (million tons)***	***Yield (tons/ha)***
World	23.06	37.87	1.64
China	4.58	16.05	3.50
India	5.30	5.50	1.04
USA	0.44	1.66	3.80
Myanmar	0.88	1.39	1.58
Indonesia	0.70	1.17	1.66
SSA	*10.26*	*9.87*	*0.96*
Nigeria	2.34	2.96	1.26
Sudan	1.00	0.80	0.85
Senegal	0.87	0.53	0.61

Source: USDA (2013)

The area under groundnut cultivation estimated to be about 7.2 million ha in TE1973-74, registered a significant growth in the next two decades. The average area under groundnut, which was about 7.17 million ha in early-1970s, increased to 7.4 million ha in TE1983-84 and reached to about 8.4 million ha in TE1993-94 (the highest in 1989-90 at 8.7 million ha). However, during the last two decades, the area under groundnut cultivation witnessed a significant decline, being 6.56 million ha in TE2001-02, it reached 5.53 million ha in TE2011-12. Average groundnut production which was about 5.4 million tonnes in the TE1973-74, increased rapidly to 6.53 million tonnes in TE1983-84 and 7.83 million tonnes in TE1993-94. Between TE1993-94 and TE2001-02, groundnut output declined by over 1.5 million tonnes but marginally increased during the last decade. However, crop output witnessed wide fluctuations, from 4.12 million tonnes in 2002-03, a drought year to 9.18 million tonnes in 2007-08. The coefficient of variation was the highest (23.6%) during the last decade.

Average productivity of groundnut improved from 751 kg per ha in TE1973-74 to 1242 kg per ha in TE2011-12. However, yields vary widely across states (less than 750 kg in Karnataka to 2410 kg in Tamil Nadu) and even within states because of high dependency on monsoon. The fluctuations in yield have been generally higher than acreage fluctuations during the last four decades.

Table 6.2: Average area (million ha), production (million tonnes), and yield (kg/ha) of groundnut in India: 1971-72 to 2011-12

	1971-72 to 1973-74	**1981-82 to 1983-84**	**1991-92 to 1993-94**	**1999-00 to 2001-02**	**2009-10 to 2011-12**
Area	7.17	7.40	8.39	6.56	5.53
Production	5.40	6.53	7.83	6.23	6.89
Yield	751	881	936	957	1242
Irrigated Area (%)	7.7	15.0	19.4	18.0	23.4
Share of kharif crop (%) in total area/production					
Share in area	-	85.2	84.1	86.4	83.8
Share in production	-	73.9	73.7	76.3	75.0
Compound annual growth rate (%)					
	1970s	***1980s***	***1990s***	***2000s***	***All Period***
Area	-0.28	1.70*	-2.75***	-1.26*	-0.54***
Production	0.62	2.92	-2.26	1.63	0.64
Yield	0.90	1.20	0.51	2.92	1.19***
Irrigated Area	5.76	4.62	-3.38	3.23	2.22
Coefficient of Variation (%)					
Area	3.0	9.0	8.7	6.7	11.3
Production	13.7	20.5	14.8	23.6	21.0
Yield	12.3	13.3	13.4	21.3	20.6

****, **, and * significant at 1, 5 and 10 per cent level of significance, respectively*

Source: Authors calculations using GoI (2013c)

Shifts in Area

The groundnut acreage in the country has been constant during the last 2-3 decades; however, there have been some regional shifts. Although groundnut is grown in different parts of the country, its production is concentrated in relatively few states. More than 85 per cent of acreage is in the five states of Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu and Rajasthan. The relative position of major soybean producing states in terms of acreage and production in different time periods are presented in Tables 6.3 and 6.4 and Figures 6.1 and 6.2.

Gujarat is the leading groundnut producer, with the largest area under groundnut cultivation in the country. The state alone accounted for 32 per cent of area and 38 per cent of groundnut production of the entire country during TE2011-12 (Table 6.2 and 6.3). Andhra Pradesh has the second largest share (25.5%) in groundnut acreage, followed by Karnataka (14.1%) and Tamil Nadu (7.1%). Other producers include Rajasthan (6.6%), Maharashtra (5.9%), and Madhya Pradesh (4.2%). Among major producers, Gujarat is the only state which has increased its share in groundnut acreage, while other states like Andhra Pradesh, Karnataka, and Tamil Nadu have lost their share during the last two decades. Rajasthan is another state which has increased its share from about 3 per cent in early-1990s to 6.6 per cent in TE2011-12. Therefore, if one looks at the distribution of groundnut cultivation, the southern and western states constitute main groundnut producing tracts of the country.

Though groundnut area constitutes only about 3 per cent of the gross cropped area in the country, two states, Gujarat and Andhra Pradesh have more than 10 per cent of total cropped area under groundnut. In Gujarat, groundnut occupied about 17 per cent of the gross cropped area in the state during TE2010-11, while in Andhra Pradesh, the crop accounted for 11.5 per cent of gross cropped area. Tamil Nadu and Karnataka are other important states producing groundnut, and account for about 7.5 and 6.5 per cent of total cropped area in the state, respectively. In the remaining states (Rajasthan, Maharashtra, Madhya Pradesh and Odisha) the share of groundnut in total cropped area is insignificant, around or less than 2 per cent.

Groundnut is one of the most important oilseed crops in states like Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu with 60.3%, 66.8%, 46.5% and 85% of total oilseeds acreage in their states respectively. However, the crop has lost its importance in terms of its

share in total oilseeds acreage in almost all the States. For example, in Gujarat, the share of groundnut in total oilseeds area has declined from 81.3 per cent in TE1983-84 to 60.3 per cent in TE2011-12, Andhra Pradesh from 73.6 per cent to 66.8 percent, Karnataka from 57.1 percent to 46.5 percent and Maharashtra from 37.3 percent to 8.8 percent during the same period (Table 6.3). Tamil Nadu, Uttar Pradesh and Odisha have been able to retain the area shares. Other competing and more profitable crops have replaced area under groundnut, in states like Gujarat and Andhra Pradesh, where expansion of Bt cotton has led to a significant decline in area under groundnut during the last decade.

Table 6.3: Share of major states in area under groundnut in India: TE1983-84 and TE2011-12

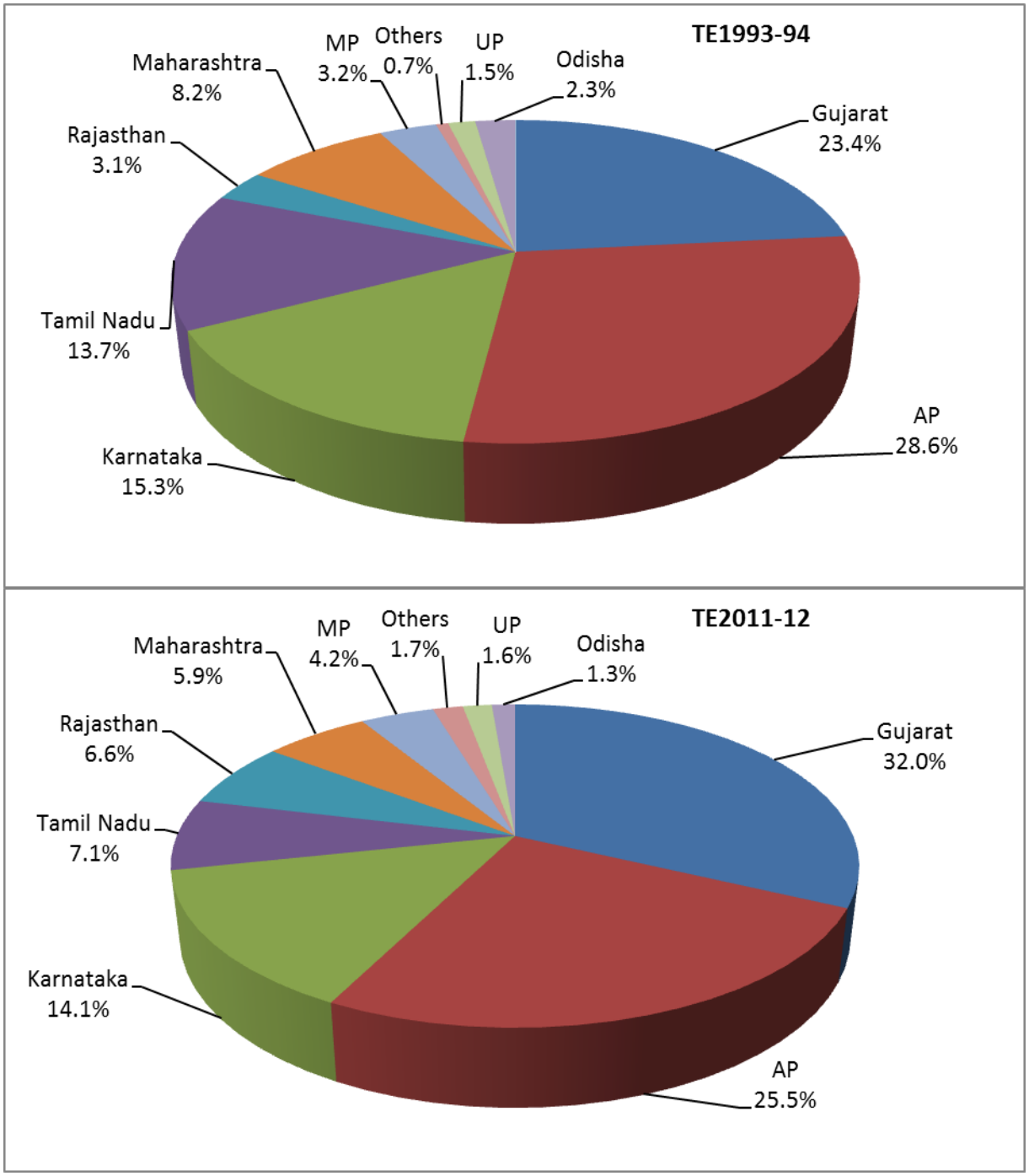
State	Share in all-India acreage				Share in edible oilseed acreage in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
Gujarat	28.9	23.4	27.8	32.0	81.3	66.7	65.2	60.3
A.P.	20.8	28.6	27.3	25.5	73.6	74.1	69.5	66.8
Karnataka	11.6	15.3	15.5	14.1	57.1	43.3	53.9	46.5
Tamil Nadu	13.0	13.7	11.2	7.1	84.7	85.1	83.9	85.0
Rajasthan	2.4	3.1	3.6	6.6	12.7	7.4	7.6	7.6
Maharashtra	10.6	8.2	7.4	5.9	37.3	26.7	19.1	8.8
M.P.[19]	4.3	3.2	3.7	4.2	14.7	5.6	4.1	3.1
U.P.[20]	3.6	1.5	1.7	1.6	28.2	25.9	22.6	25.8
Odisha	3.3	2.3	1.1	1.3	8.4	7.4	8.1	8.0
Others	1.5	0.7	0.8	1.7	7.7	2.7	2.9	4.5
All India	100.0	100.0	100.0	100.0	40.1	32.2	28.2	20.9

Source: GOI, various sources.

[19] *TE2011-12 data Includes data for both Madhya Pradesh and Chhattisgarh for comparison purpose*

[20] *TE2011-12 data Includes data for both Uttar Pradesh and Uttarakhand*

Figure 6.1: Share of major states in area under groundnut in India: TE 1993-94 and TE2011-12



Source: GoI (2013c)

Shifts in Production

Despite some increase in groundnut production in the country since the 1970s, groundnut share in the total production of oilseeds, vegetable oil and meal has decreased following the emergence of soybeans. The all-India groundnut production averaged 6.9 million tonnes during the last decade, growing at an annual compound growth rate of about 0.6 per cent

between 1971-72 and 2011-12. The production increase was mainly due to increase in yields. While the aggregate production of groundnut remained stagnant during the last two decades, there has been some regional variation in production. Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan and Karnataka constitute over 80 per cent of the production. Comparing the production shares for TE2011-12 with that of TE1983-84, we see that the share of Gujarat in national production has increased from 27.2 per cent to 38 per cent, followed by Rajasthan, which increased its share from 2 per cent to about 9 per cent (Table 6.3). It is important to note that all other major producers lost their share in total production. For example, Andhra Pradesh, the second largest producer of groundnut in the country lost its share from about 22 percent in TE1983-84 to 16 per cent in TE2011-12. Similarly Tamil Nadu lost its share from about 22 per cent in early-1980s to 13.8 per cent in TE2011-12. Between TE1993-94 and TE2011-12, Gujarat and Rajasthan were the only two states where there was increase in the share in total groundnut production, while all other states had lost their share (Figure 6.2).

In order to capture the relative importance of groundnut in oilseeds scenario in the state, Table 6.4 shows that the share of groundnut in total oilseeds production is quite high in many states such as Tamil Nadu (95.3%), Andhra Pradesh (69.5%), Gujarat (60.2%) and Karnataka (54.1%). In other states, groundnut is not a major oilseed crop. However, groundnut has lost relative share in total oilseeds production in all states except Tamil Nadu between TE1983-84 and TE2011-12. The above results clearly show that groundnut share in total production of oilseeds has decreased in all major producing areas following the emergence of soybeans and rapeseed-mustard. Therefore, there is a need to check this declining trend and make necessary efforts to increase groundnut production in the country as it has great potential in the domestic market as well as exports markets.

Yield

As shown in Figure 6.3, Gujarat, Tamil Nadu Rajasthan and Madhya Pradesh have shown steady increase in yields since the 1980s. On aggregate when comparing the average for the 2006-11 period with the one for 1981-85, Rajasthan showed the greatest increase (131.7%), followed by Gujarat and Tamil Nadu (about 100%) and Madhya Pradesh (89.9%). A closer look shows decline in the yields of Andhra Pradesh and Karnataka, which are even lower than the national average. At all India level, groundnut yield increased from 852 kg per ha

during 1981-85 to 1202 kg per ha during 2006-11. Yields in Andhra Pradesh, Karnataka, Maharashtra and Madhya Pradesh remained below all India yield. However, it is important to note that in Gujarat, the main producer of groundnut in the country, there was an increasing trend in yields. Two other major producers, Tamil Nadu and Rajasthan, also showed improvement in yields during the last decade.

Growth Rates in Area, Production and Yield

An in-depth analysis of growth behaviour of groundnut across states and time periods was done. The period selected for the study covered 1981-82 to 2011-12. The annual compound growth rates for different time periods, 1981-82 to 1990-91, 1991-92 to 2000-01, 2001-02 to 2011-12 and 1981-82 to 2011-12 were computed and the detailed results showing the growth rates for major groundnut producing states (accounting for about 97% of total production) are presented in Table 6.5.

Table 6.4: Share of major states in groundnut production in India: TE1983-84 and TE2011-12

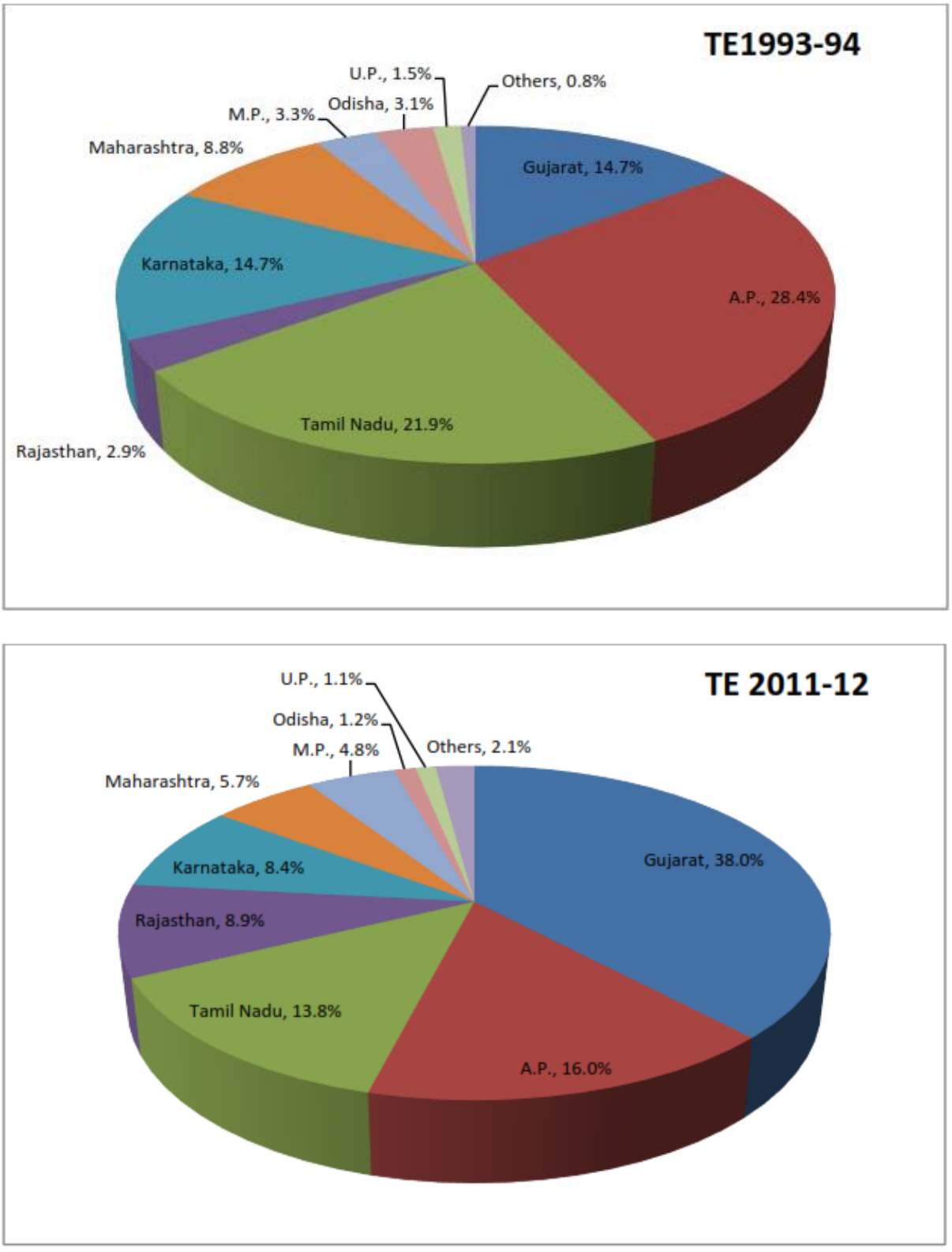
State	Share in all-India production				Share in edible oilseed production in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
Gujarat	27.2	14.7	21.7	38.0	79.6	53.8	57.7	60.2
A.P.	21.9	28.4	24.0	16.0	92.4	86.5	81.4	69.5
Tamil Nadu	15.7	21.9	21.3	13.8	94.6	94.8	94.2	95.3
Rajasthan	2.0	2.9	4.0	8.9	17.4	8.9	8.7	11.0
Karnataka	9.9	14.7	13.0	8.4	70.7	63.1	64.9	54.1
Maharashtra	10.5	8.8	8.2	5.7	55.2	39.7	21.9	9.5
M.P.[21]	10.5	8.8	8.2	5.7	22.0	6.8	5.2	4.1
Odisha	5.2	3.1	1.0	1.2	13.9	9.0	8.0	8.6
U.P.[22]	3.0	1.5	1.5	1.1	53.9	51.6	45.5	49.0
Others	1.4	0.8	1.2	2.1	1.2	0.8	1.4	-
All India	100.0	100.0	100.0	100.0	35.4	30.1	26.8	26.0

Source: GOI, various sources.

[21] *TE2011-12 data Includes data for both Madhya Pradesh and Chhattisgarh for comparison purpose*

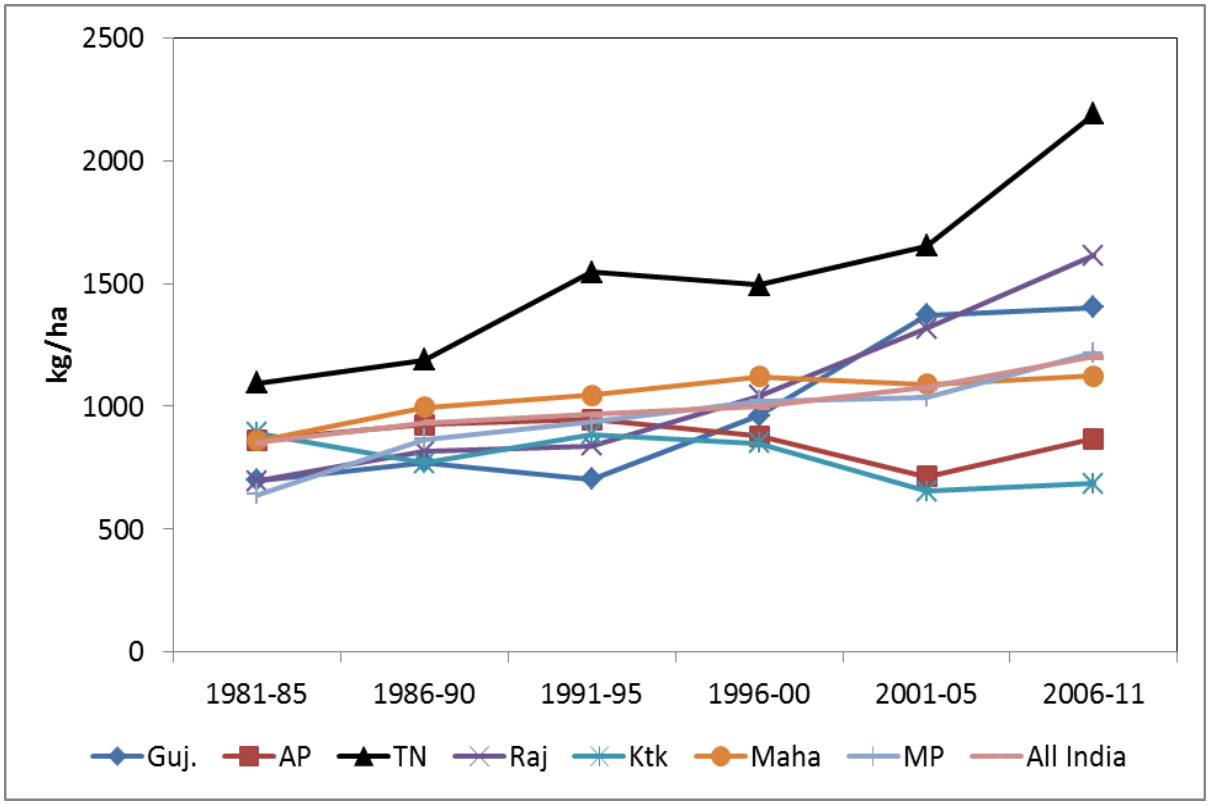
[22] *TE2011-12 data Includes data for both Uttar Pradesh and Uttarakhand*

Figure 6.2: Share of major states in groundnut production in India: TE 1993-94 and TE2011-12



Source: GOI, various sources.

Figure 6.3: Changes in groundnut yield by major producing states and all India average: 1981-2012



Source: GoI (2013c)

Groundnut acreage in the country registered a significant increase during the 1980s, the growth rate being 1.7 per cent, while during the 1990s; groundnut acreage witnessed a significant decline at the growth rate of about 2.75 per cent per annum (significant at 1 per cent level of significance). The deceleration in growth in area under groundnut continued in the next decade and recorded a statistically significant negative growth rate (-1.25%). Thus looking at the performance of groundnut acreage during the last three decades, it is clear that area under groundnut cultivation has not witnessed significant increase during the last three decades, the growth rate being -1.11 per cent per annum between 1981-82 and 2011-12. While the aggregate national acreage declined, there have been significant regional variations (Table 6.5). The groundnut production remained approximately stable with an annual growth rate of 0.09 per cent but was statistically insignificant during 1981-2011 period, with a higher coefficient of variation. During the same period, yields steadily grew at an annual compound growth rate of about 1.21 per cent. Furthermore, most of the growth in yield and production occurred during the 1990s and 2000s. In fact, the annual growth rate in production during the 1990s was negative (-2.35%), which increased (1.63%) during the

next decade. While the aggregate national production and yields have increased marginally, there have been regional variations in the country. (Table 6.5)

Table 6.5: Annual growth rates of groundnut area, production and yield in selected states, 1981-82 to 2011-12

Period	*Gujarat*	*A.P.*	*Tamil Nadu*	*Rajasthan*	*Karnataka*	*Maharashtra*	*M.P.*[23]	*Odisha*	*India*
Area									
1980s	-3.06	5.86***	0.94	4.19***	5.67**	1.28	0.53	6.65***	1.70*
1990s	-0.96**	-3.47***	-5.16	0.24	-2.00***	-3.86***	-1.62***	-9.99**	-2.75***
2000s	-1.32***	-1.30	-4.83***	5.13***	-1.39	-3.24***	-0.91**	1.11	-1.25*
All	-0.10	-0.64*	-3.21***	1.69***	-0.60	-3.19***	-1.14***	-6.11***	-1.11***
Production									
1980s	-5.15	6.75***	2.51*	7.84***	4.72*	4.81	4.67*	5.75***	2.92
1990s	0.18	-3.78	-3.37	2.53	-2.32	-2.58	0.38	-14.02***	-2.35
2000s	2.28	0.86	-0.12	10.65***	0.12*	-2.46**	3.38	2.93	1.63
All	3.33***	-1.16*	-0.66	5.09***	-1.45	-2.22***	1.08***	-6.97***	0.09
Yield									
1980s	-2.16	0.84	1.56	3.50	-0.89	3.49	4.12	-0.84	1.20
1990s	1.15	-0.32	1.88	2.29	-0.32	1.33	2.12	-4.48***	0.42
2000s	3.65	2.18	4.95***	5.25*	1.54	0.80	4.72**	1.80*	2.92
All	3.43***	-0.53	2.63***	3.34***	-0.86**	1.01***	2.19***	-0.92***	1.21***

Source: Authors' computation using MoA data

In order to analyze and compare the performance of various states during different periods, major groundnut producing states have been classified on the basis of area, production and yield trends. The states have been classified into four categories: (i) states with positive

[23] *Madhya Pradesh data during the 2000s is combined data for Madhya Pradesh and Chhattisgarh to compare across different time periods.*

significant growth in area, (ii) states with significant negative growth in area, (iii) states with stagnant acreage but positive trend, and (iv) states with stagnant acreage but negative trend. The category of states according to growth in area during different time periods is presented in Table 6.6. Out of the top 8 groundnut producing states, namely, Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan, Karnataka, Maharashtra, Madhya Pradesh and Odisha, only one state (Rajasthan) reported a significant increase (1.69%) in area under groundnut between 1981-82 and 2011-12.

Groundnut acreage declined significantly in Andhra Pradesh, Tamil Nadu, Maharashtra, Madhya Pradesh and Odisha. Odisha experienced the highest negative growth rate of -6.11 per cent per annum, followed by Tamil Nadu (-3.21%) and Maharashtra (-3.19%). Area has remained stagnant in Gujarat and Karnataka and both states witnessed negative but non-significant trend. During the 1980s, four out of the eight major producers recorded a significant positive growth in acreage, while during the 1990s, none of the states were in this category. However, during the last decade, Rajasthan was the only state which witnessed a significant positive growth rate. The number of states with significant negative growth rate increased during the 1990s (from none in 1980s to 6 in 1990s) but fell to four in the 2000s. It is evident from the above results that performance of groundnut during the last three decades has not been very impressive in terms of acreage and major groundnut producing states like Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan and Karnataka reported either significant decline in acreage or stagnation. This is a matter of concern, especially in view of the fact that there is an urgent need to bridge the shortfall in demand and supply of edible oilseeds and oils.

It is interesting to observe from Table 6.6 that Gujarat, the largest producer of groundnut in the country reported a significant increase in production between 1981-82 and 2011-12. Rajasthan and Maharashtra were the only two other states which experienced a significant positive growth in groundnut production. Andhra Pradesh, Maharashtra and Odisha recorded significant decline in production, the growth rates being -1.16, -2.22, and -6.97 per cent per annum, respectively. Production remained stagnant in Tamil Nadu and Karnataka. Rajasthan reported the highest growth rate of 5.09 per cent per annum, followed by Gujarat (3.33%) and Madhya Pradesh (1.08%). As shown in Table 6.6, six out of eight groundnut producing states had significant positive growth rate during the 1980s and this number

declined to zero in the 1990s and all states had either significant negative or stagnant growth rates. During the last decade, the number of states in the category of significant positive growth rate increased to two (Rajasthan and Karnataka). Maharashtra had significant negative growth rate and all other states had either non-significant positive or non-significant negative growth rates. These findings clearly show that groundnut production, which declined during the 1990s, has marginally picked up during the last decade in most of the groundnut producing states.

Table 6.6: Classification of states according to growth in area, production and yield of groundnut: 1981-82 to 2011-12

	1980s	1990s	2000s	1981-82 to 2011-12
Area				
Significant Positive Growth in Area	Andhra Pradesh, Karnataka, Rajasthan, Odisha		Rajasthan	Rajasthan
Significant Negative Growth in Area		Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha	Gujarat, Maharashtra, Tamil Nadu, Madhya Pradesh	Andhra Pradesh, Maharashtra, Tamil Nadu, Madhya Pradesh, Odisha
Positive Stagnant Area	Maharashtra, Madhya Pradesh, Tamil Nadu		Odisha	
Negative Stagnant Area	Gujarat	Tamil Nadu	Andhra Pradesh, Karnataka	Gujarat, Karnataka
Production				
Significant increase in production	Andhra Pradesh, Karnataka, Madhya Pradesh, Rajasthan, Tamil Nadu, Odisha		Rajasthan, Karnataka	Rajasthan, Gujarat, Madhya Pradesh

Significant decline in production		Odisha	Maharashtra	Andhra Pradesh, Karnataka, Maharashtra, Odisha
Positive trend but statistically non-significant	Maharashtra	Gujarat, Rajasthan, Madhya Pradesh	Gujarat, Andhra Pradesh, Madhya Pradesh, Odisha	
Negative trend but statistically non-significant	Gujarat	Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra	Tamil Nadu	Tamil Nadu
Yield				
Significant Positive Growth in Yield	-	-	Tamil Nadu, Rajasthan, Madhya Pradesh, Odisha	Gujarat, Tamil Nadu, Rajasthan, Maharashtra, Madhya Pradesh
Significant Negative Growth in Yield	-	Odisha	-	Odisha, Karnataka
Positive Stagnant Yield	Andhra Pradesh, Tamil Nadu, Rajasthan, Maharashtra, Madhya Pradesh	Gujarat, Tamil Nadu, Rajasthan, Maharashtra, Madhya Pradesh	Gujarat, Andhra Pradesh, Karnataka, Maharashtra	-
Negative Stagnant Yield	Gujarat, Karnataka, Odisha	Andhra Pradesh, Karnataka, Odisha	-	Andhra Pradesh

Source: Authors' computation using MoA data (2013)

The performance of yields closely resembles the pattern observed for groundnut production. As shown in Table 6.5, all states except Andhra Pradesh, Karnataka and Odisha have presented a steady growth in yields since the 1980s. Gujarat yields grew at the highest annual compound growth rate of 3.43 per cent, followed by Rajasthan (3.34%), Tamil Nadu (2.63%) and Madhya Pradesh (2.19%). The growth rate in groundnut yields at all India level

was positive but statistically non-significant during all the decades. Some states like Tamil Nadu, Rajasthan, Madhya Pradesh and Odisha recorded significant positive growth rates during the last decade. The results of distribution of states based on growth rate in yields show that none of the states recorded significant positive growth rate during the 1980s and 1990s, while 4 out of 8 major producers were in significant positive growth rate category during the 2000s. However, it is important to note that top two producers, Gujarat and Andhra Pradesh, had positive but statistically non-significant growth rate during the last decade. A closer look at trends in area, production and yields of groundnut shows that performance of groundnut has not improved during the last 2-3 decades as area under the crop has declined, yields have remained approximately stable and much below the world average and main producer yields. Moreover, the average yields achieved at farm level are much lower than its potential yield and crop productivity level can be improved by 15-20 per cent by improving farm practices and 65-70 per cent by transfer of improved technology to farmers.

Growth in crop output is determined by the rate of growth in area under crop and its productivity level. The growth performance of states can be analyzed by classifying states on the basis of the sign and statistical significance of their trends in area and productivity levels. There are nine types of association:

AA: Significant positive growth rate of area associated with significant positive growth rate of yield. This means that groundnut is either replacing other crops or is grown in newly cultivated areas and productivity of both existing and new acreage has increased.

AB: Significant positive growth rate of area associated with significant negative growth rate of yield. This means that groundnut is either replacing other crops or is grown in newly cultivated areas and productivity of both existing and new acreage has declined.

AC: Significant positive growth rate of area associated with stagnant (either positive or negative) growth rate of yield. This means that groundnut is either replacing other crops or is grown in newly cultivated areas and productivity of both existing and new acreage has remained stagnant.

BA: Significant negative growth rate of area associated with significant positive growth rate of yield. This means that groundnut is being replaced by other crop and productivity has increased.

BB: Significant negative growth rate of area associated with significant negative growth rate of yield. This means that groundnut is being replaced by other crops and productivity has declined significantly.

BC: Significant negative growth rate of area associated with stagnant growth rate of yield. This means that groundnut is being replaced by other crops but yield has remained stagnant.

CA: Stagnant growth rate of area associated with significant positive growth rate of yield. This means that acreage is stagnant and yield has increased significantly.

CB: Stagnant growth rate of area associated with significant negative growth rate of yield. This means area under is stagnant and productivity has declined significantly.

CC: Stagnant growth rate of area associated with stagnant growth rate of yield. This means that both acreage and yield are stagnant.

For improvement of the groundnut economy, AA is the best situation while BB is the worst situation. BA would be preferred to AB, CA would be preferred to AC, and BC would be preferred to CB. Rajasthan was the only state which exhibited AA association during 1981-2011. However, none of the major groundnut producing states (except Rajasthan in the 2000s) was in the AA category for the three sub-periods, which is not a very healthy sign (Table 6.7). Odisha was the only state in BB category. Gujarat, the largest producer of groundnut in the country, shifted from CC category in 1980s to BC in the successive decades. Andhra Pradesh, the second largest producer, shifted from AC to BC between 1980s and 1990s and then to CC in the last decade. Tamil Nadu, the third largest producer, remained in CC category during the 1980s and 1990s and shifted its position to BA during the last decade. During the 1990s, most of the groundnut producing states witnessed a significant decline in acreage and stagnant crop yields. However, in the subsequent period, Tamil Nadu and Madhya Pradesh witnessed a significant decline in growth rate in area and a significant positive growth rate in yields. Rajasthan recorded significant increase in both yield and acreage. Gujarat and Maharashtra were the only states which witnessed a significant decline in groundnut area and stagnation in crop yields. The analysis shows that growth path in production for major groundnut producing states has not yet stabilized and whatever increase has taken place has come primarily from some improvement in yields.

Table 6.7: Classification of states according to growth in area and yield of groundnut

Type of association	1980s	1990s	2000s	1981-82 to 2011-12
AA			Rajasthan	Rajasthan
AB				
AC	Andhra Pradesh, Rajasthan, Karnataka, Odisha			
BA			Tamil Nadu, Madhya Pradesh	Tamil Nadu, Maharashtra, Madhya Pradesh
BB		Odisha		Odisha
BC		Gujarat, Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh	Gujarat, Maharashtra	Andhra Pradesh
CA			Odisha	Gujarat
CB				Karnataka
CC	Gujarat, Tamil Nadu, Maharashtra, Madhya Pradesh	Tamil Nadu, Rajasthan	Andhra Pradesh, Karnataka	

Source: Authors' computation using GoI (2013c) data

Table 6.8 presents a list of major groundnut producing states classified on the basis of their growth performance in respect of yield per ha and average yield levels. Tamil Nadu, Rajasthan and Maharashtra are the only states with high productivity levels which reported significant increases in yield during 1981-2011. Comparing performance of high and low yield states during different time periods, it is clear that none of the states witnessed a statistically significant increase in yields during the 1980s and 1990s, but the situation improved during the last decade and yields increased significantly in Tamil Nadu and Rajasthan from high productivity category and Madhya Pradesh and Odisha from low productivity category. It is important to note that none of the states experienced significant negative growth rate in yields during the 2000s. However, yield variability increased during the last decade in Andhra Pradesh, Karnataka, Madhya Pradesh and Rajasthan with the

highest fluctuations in Andhra Pradesh (31.2%) and the lowest in Odisha and Maharashtra (<10%). Gujarat, Maharashtra, Odisha, and Tamil Nadu witnessed decline in yield variability during the 2000s compared with 1990s. Wide differences among major producers in the country (685 kg ha in Karnataka to 2193 kg/ha in Tamil Nadu) and low yield levels at the national level (about 1200 kg/ha) are indicative of the vast scope of increase in yields through improved varieties, better management and market infrastructure.

Table 6.8: Classification of states according to productivity levels and growth in productivity of groundnut in India

	Significant increase in yield	Significant decline in yield	Stagnant yield with positive sign	Stagnant yield with negative sign
1981-82 to 1990-91				
High Productivity (> All India)	-	-	Andhra Pradesh, Tamil Nadu, Maharashtra	Odisha
Low Productivity	-	-	Madhya Pradesh, Rajasthan	Gujarat, Karnataka
1991-92 to 2000-01				
High Productivity		Odisha	Tamil Nadu, Maharashtra	
Low Productivity			Gujarat, Madhya Pradesh, Rajasthan	Andhra Pradesh, Karnataka
2001-02 to 2011-12				
High Productivity	Tamil Nadu, Rajasthan		Gujarat	
Low Productivity	Madhya Pradesh, Odisha		Karnataka, Andhra Pradesh, Maharashtra	
1981-82 to 2011-12				
High Productivity	Tamil Nadu, Rajasthan, Maharashtra	Odisha		
Low Productivity	Madhya Pradesh, Gujarat	Karnataka		Andhra Pradesh

Source: Authors' computation using GoI (2013c) data

Problems and Prospects of Groundnut Cultivation

Owing to various biotic and abiotic constraints and competition from other crops, the area under groundnut cultivation has declined in the country over the years. The area under groundnut, which was over 8.5 million ha in late-1980s, reduced to about 5.5 million hectares in the recent years. Groundnut which had the largest share in edible oilseeds production in the country has lost its position and is now at the third place. In order to understand constraints in groundnut cultivation, the study was conducted in two major groundnut producing states, namely, Gujarat and Andhra Pradesh. The household data were collected from groundnut farmers in the selected states during the year 2010-11.

The primary data were collected from three districts (Junagadh, Porbandar and Rajkot) of Gujarat (Swain, 2013) and three districts (Ananthapur, Srikakulam and Mahbubnagar) of Andhra Pradesh (Rao, 2014). The districts were selected based on acreage and yield. All districts growing groundnut were categorized into four groups such as high area and high yield (HH), high area and low yield (HL), low area and high yield (LH), and low area and low yield (LL). Since HH, HL and LH categories of districts have the potential for further increase in production of groundnut, at least one district each from these three categories were selected for the household survey. Accordingly, Junagadh, Rajkot and Porbandar were selected from Gujarat as HH, HL and LH category of districts respectively for the detailed study. Similarly, Mahbubnagar, Ananthapur, and Srikakulam districts from Andhra were selected as HH, HL, and LH categories.

This section reports the general findings of our survey of 250 households from about 25 villages in Gujarat, and 250 farmers from three villages of Andhra Pradesh. In all total sample size was 500 groundnut farmers spread over 6 districts from two top groundnut producing states in the country.

Table 6.9: Size-distribution of sample households in selected states

State	***Marginal***	***Small***	***Medium***	***Large***	***Total***
Gujarat	15	66	161	8	250
Andhra Pradesh	31	78	130	11	250
Total	46	144	291	19	***500***

Source: Field Survey

General Characteristics

The average family size in the selected household sample was 5.5 persons with an average age of 47.8 years (Table 6.10). About 96 per cent of the households had crop farming as main occupation and were male headed. A small proportion of marginal (4.3%) and small farmers (2.8%) were involved in dairy farming for their main occupation. The average years of schooling were 6.1 and varied from 4 on marginal farms to 10.5 on large farms. In terms of social groups, nearly 54 per cent of the households belonged to general category, 37 per cent to other backward classes and about 9 per cent to schedule castes and schedule tribes' categories. The share of OBCs and SCs/STs was higher in case of small and marginal farmers compared with large farmers.

Table 6.10: Socio-economic status of sample households

Indicators	**Marginal**	**Small**	**Medium**	**Large**	**All Farms**
Age (years)	46.7	48.8	47.4	48.1	47.8
Main Occupation (%)					
Crop farming	95.7	92.4	97.9	100.0	96.2
Dairy	0.0	4.1	-	-	1.2
Services	4.3	3.5	2.1	-	2.6
Education (years of schooling)	4.0	5.4	6.6	10.5	6.1
Average Family Size (no)	4.7	5.3	5.6	7.8	5.5
Male	2.6	2.8	2.9	4.0	2.9
Female	2.1	2.5	2.7	3.8	2.6
Social Groups					
General	19.6	36.1	64.5	80.2	53.8
OBC	63.0	46.5	31.1	9.3	24.4
SC/ST	17.4	17.4	4.4	10.5	21.8
Head of household (%)					
Male	95.7	96.5	95.5	100.0	96.0
Female	4.3	3.5	4.5	0.0	4.0

Source: Field Survey

Land Ownership pattern

The average operational land holding of the sample was 3.37 ha per family though the average holding ranged from 0.73 ha on marginal households to 13.71 ha on large households (Table 6.11). About 63 per cent of total land was irrigated and share of irrigated area was the lowest (52.1%) on marginal farms and highest (69.5%) on small farms. Leasing of land was not very common in the study area as land leasing was regulated /prohibited in some of the selected districts/states.

Table 6.11: Average land ownership pattern of sample households (in ha)

Indicators	Marginal	Small	Medium	Large	All Farms
Total owned land					
Irrigated	0.38	1.00	2.37	8.06	1.99
Un-irrigated	0.35	0.45	1.45	5.05	1.19
Total	**0.73**	**1.45**	**3.81**	**13.10**	**3.18**
Leased-in land					
Irrigated	0.00	0.05	0.17	0.35	0.13
Un-irrigated	0.00	0.01	0.12	0.25	0.09
Total	**0.00**	**0.06**	**0.29**	**0.60**	**0.23**
Leased-out land					
Irrigated	0.00	0.00	0.00	0.00	0.00
Un-irrigated	0.00	0.00	0.05	0.00	0.03
Total	**0.00**	**0.00**	**0.05**	**0.00**	**0.03**
Total Operational holding (2+3-4)					
Irrigated	0.38	1.05	2.53	8.41	2.13
Un-irrigated	0.35	0.46	1.52	5.30	1.25
Total	0.73	1.51	4.05	13.71	3.37

Source: Field Survey

Groundnut Cropping Systems: Productivity, Profitability and Risks

Groundnut is a major crop during kharif season in both the states and accounts for over 69 per cent and 60 per cent of kharif acreage on sample farms, respectively. About 80 percent

of groundnut acreage in Gujarat and about 16 percent area in Andhra Pradesh were irrigated. However, in case of Gujarat, more than 85 per cent of area during kharif season was provided protective irrigation and was mainly dependent on rainfall. Other major kharif crops grown were cotton in Gujarat and rice and maize in Andhra Pradesh.

The average productivity of kharif groundnut was 1421 kg per ha at all India level but was higher (1594 kg/ha) in Gujarat compared with Andhra Pradesh (1248 kg/ha). The crops yields were significantly higher under irrigated conditions compared with rainfed conditions. The average productivity of cotton in Gujarat ranged from 2255 kg per ha on medium farms to 2500 kg per ha on marginal farms. In the case of Andhra Pradesh, maize yield was 2734 kg per ha.

Table 6.12: Average yield of groundnut and competing crops of sample households (Qtl/ha)

State/Crop	Marginal	Small	Medium	Large	All farm
Groundnut					
Gujarat	1824	1515	1575	2187	1594
Andhra Pradesh(Kharif)	1913	1466	1213	1117	1248
Andhra Pradesh (Rabi)	2146	2000	1956	1970	1991
All (Kharif)	1884	1488	1358	2060	1421
Cotton					
Gujarat	2500	2274	2255	2455	2274
Maize					
Andhra Pradesh	2891	2660	2576	-	2734

Source: Field Survey

Table 6.13 shows the comparative profitability of groundnut and major competing crops in Gujarat and Andhra Pradesh. Cotton is the main competing crop in Gujarat while maize is the main competing crop in the study area of Andhra Pradesh. It is evident from the Table that average profitability of cotton is significantly higher than groundnut on all farm categories in Gujarat. The net income from cotton cultivation varied from Rs. 41527/ha in

case of small farms to Rs. 63941/ha on large farms while, for groundnut, it varied from Rs. 12472 per ha on small farms to Rs. 26649 on large farms.

In the case of Andhra Pradesh, net profitability per hectare of groundnut cultivation varied from Rs. 35224 on marginal farms to Rs. 30470 in case of large farms, while maize profitability varied from Rs. 34919 on small farms to Rs. 40866 on marginal farms and was significantly higher than groundnut.

Table 6.13: Profitability[24] groundnut vis-à-vis major competing crops per hectare in sample states

(Rs/ha)

State/Crop	Marginal	Small	Medium	Large	All Farms
Gujarat					
Groundnut	12472	18809	22911	26649	22842
Cotton	41527	51764	51149	63941	54454
Andhra Pradesh					
Groundnut	35224	29327	23369	30470	28971
Maize	40866	34919	37323	-	37710

Source: Authors' computations using data from participating AERCs

In addition to profitability of the crop, production and market risks play an important role in production decisions of a farmer. In order to examine production and market risks in groundnut and competing crops, coefficient of variation of yield and prices were computed, and the results are presented in Table 6.14. As shown in the table, it is evident that both yield (65.1%) and price risks (17.1%) are much higher in case of groundnut production compared with competing crop, cotton (27.2% and 11.8%) in Gujarat. The price risks were lower than yield risks. In the case of Andhra Pradesh, yield and price risks were lower in case of groundnut than maize, (the competing crop). It is interesting to note that yield risks (77.8%) in case of groundnut were significantly higher than price risks (16.8%) at all India level. The above results clearly show that groundnut cultivation in Gujarat is less profitable and more risky compared with competing crop (cotton) and this could be a reason for

[24] *Profitability = Gross Value of Output – Total Operational Costs*

decline in area and production of groundnut in the state. Therefore, steps are needed to improve productivity of groundnut and also reduce yield variability.

Table 6.14: Yield and price risks in groundnut and competing crops in sample states (In %)

State/Crop	Marginal	Small	Medium	Large	All Farms
Gujarat					
Groundnut					
Yield Risk	49.8	62.6	69.7	17.6	65.1
Price Risk	18.2	18.9	16.3	13.6	17.1
Cotton					
Yield Risk	14.1	23.0	29.5	11.3	27.2
Price Risk	8.4	12.1	11.3	15.6	11.8
Andhra Pradesh					
Groundnut					
Yield Risk	29.0	34.9	41.0	46.0	39.4
Price Risk	8.4	14.8	16.7	9.1	15.6
Maize					
Yield Risk	56.7	43.1	32.0	-	47.8
Price Risk	56.1	44.6	17.8	-	44.7
All India					
Groundnut					
Yield Risk	61.3	69.0	85.0	64.5	77.8
Price Risk	11.5	16.6	17.7	17.4	16.8

Source: Field Survey

Post-Harvest Handling, Price Situation and Access to Technology and Markets

The sample farmers growing groundnut on an average produced 29.8 quintals per household and it varied from 19.7 quintals per household in Andhra Pradesh to 39.9 quintals per household in Gujarat. Out of 29.8 quintals, 28.7 quintals of groundnut (96.3%) was sold at an average price of Rs. 3675 per quintal (Table 6.15). About 1.9 quintals of groundnut (3.7%) per household was retained for household consumption and for use as seed. The retention of groundnut by marginal, small, medium and large farmers were about 2.6, 4.2,

3.9, and 2.6 per cent, respectively. The share of marketed surplus was marginally higher in Gujarat (95.6%) than AP (94.2%)

Table 6.15: Total oilseed production, retention and sales pattern

	All India				*Gujarat*			
Farm category	***Prod (Qtl)***	***Retention (Qtl)***	***Sold (Qtl)***	***Price (Rs./q)***	***Prod (Qtl)***	***Retention (Qtl)***	***Sold (Qtl)***	***Price (Rs./q)***
Marginal	11.2	0.7	10.9 (97.4)	3546	12.7	0.5	12.2 (96.2)	3290
Small	14.8	2.0	14.2 (95.8)	3618	18.3	0.9	17.4 (95.0)	3559
Medium	38.2	1.9	36.7 (96.1)	3733	45.6	2.1	43.5 (95.4)	3540
Large	120.8	4.0	117.6 (97.4)	3805	155.4	4.6	150.8 (97.0)	3378
All Farms	29.8	1.9	28.7 (96.3)	3675	39.9	1.8	38.2 (95.6)	3525
	Andhra Pradesh (Kharif)				***Andhra Pradesh (Rabi)***			
Marginal	9.45	0.72	8.73 (92.4)	4080	13.45	1.25	12.06 (89.7)	3918
Small	7.80	0.86	6.95 (89.1)	4031	15.50	1.25	14.25 (91.9)	3921
Medium	25.33	1.18	24.15 (95.3)	4431	11.19	1.08	10.11 (90.3)	3997
Large	66.11	1.61	64.51 (97.6)	4641	48.55	0.00	48.55 (100.0)	4060
All Farms	19.62	1.13	18.49 (94.2)	4310	14.46	1.08	13.38 (92.5)	3954

Source: Field Survey

Marketing of produce is one important constraint for farmers. It may be noted from Table 6.16 that more than two-third of farmers reported that they faced marketing related problems in groundnut. More than 80 per cent of marginal farmers faced marketing problems while this share was lower in case of medium and large farms. Farmers sold their produce to different marketing agencies. About half of the produce was sold to local village traders, followed by commission agents/arhtias (37.6%) and processors (8.2%). The average price paid to farmers was the highest (Rs. 3947/q) in case of processors and the lowest (Rs.

3766/q) by local village traders. The average price realisation was higher in case of large and medium farmers compared with small and marginal farmers for almost all marketing channels.

Table 6.16: Relative importance of different marketing channels and price paid to farmers

Marketing Problems/channel	***Marginal***	***Small***	***Medium***	***Large***	***All Farms***
Marketing problems					
Yes (%)	*80.9*	*69.9*	*62.3*	*72.2*	*66.6*
No (%)	*19.1*	*30.1*	*37.7*	*27.8*	*33.4*
Marketing Channels (%)					
Local Village Trader	55.3	44.7	51.5	77.8	50.9
Commission Agent/Ahrtia	40.4	44.7	34.7	22.2	37.6
Processor	-	7.8	10.3	-	8.2
Government Agencies	4.3	2.1	2.4	-	2.4
Others	0.0	0.7	1.0	-	0.8
Average distance to sale point (km)	4.3	6.3	5.7	3.1	5.6
Price Received (Rs./q)					
Local Village Trader	3813	3751	3845	3925	3766
Commission Agent/Ahrtia	3923	3906	4082	4200	3902
Processor	-	3809	3798	-	3947
Government Agencies	2750	3250	3393	-	3854
Private Company	3810	4500	3625	-	3872

Source: Field Survey

Groundnut production is hindered by the non-availability of timely inputs and services such as quality seed, credit, agricultural inputs, markets, modern technologies, etc. Therefore, improving access to production inputs, technologies and markets can increase farm income. In order to examine farmers' access to modern inputs, technologies and markets, sample

households were asked questions related to these issues, and results are presented in table 6.17.

Table 6.17: Access to inputs, technology and markets

	Marginal	Small	Medium	Large	All Farms
Use of HYV (%)					
Yes	87.2	90.9	98.6	100.0	95.4
No	12.8	9.1	1.4	0.0	4.6
Source of Seed (%)					
Own	12.8	16.8	14.0	11.1	14.6
Market	87.2	83.2	86.0	88.9	84.8
Awareness about MSP (%)					
Yes	40.4	49.7	50.0	55.6	49.2
No	59.6	50.3	50.0	45.4	51.8
Price realization					
Higher/Equal to MSP	97.9	97.2	96.2	100.0	96.8
Lower than MSP	2.1	2.8	3.8	0	3.2
Source of market information (%)					
Fellow Farmers	85.1	88.8	89.4	88.9	88.8
Print Media	68.1	83.2	69.9	61.1	73.2
APMC Mandi	57.4	73.4	66.8	61.1	67.6
Commission agent	72.3	66.4	59.6	61.1	62.8
Radio/TV	42.6	54.5	65.8	50.0	59.8
Private company	17.0	30.8	37.0	16.7	32.6
Others	2.1	10.5	12.7	11.1	11.0

Source: Field Survey

It is encouraging to find that about 95.4 per cent of the sample farmers used HYVs for better yields. The area under HYVs coverage was over 90 per cent. The major source of seed was market purchased seed as nearly 85 per cent of farmers purchased seed from the market and less than 15 per cent of sample farmers used their own seeds. The awareness about MSP was low among the sample households as only around half of the selected farmers were aware of the minimum support price (MSP). It is noteworthy that a large proportion

(96.8%) of sample farmers received prices higher than the MSP. There was a positive association between farm size and awareness about MSP. However, there were inter-state differences. In Gujarat, 84.4 per cent farmers were aware of the MSP and 96.4 per cent farmers received price equal to or higher than MSP. In contrast, in Andhra Pradesh only about 31.6 per cent of farmers reported that they were aware of MSP, however, 97.6 per cent farmers received price higher than MSP, indicating a competitive market. Fellow farmers remained the most important source (88.8%) of market information, followed by print media (73.2%), APMC mandi (67.2%) and commission agent (62.8%).

Constraints in Groundnut Cultivation

Fluctuating yields and uneven growth in groundnut production is a serious problem in the country. In order to identify and analyse the key biophysical, economic and institutional constraints to productivity, profitability and sustainability of groundnut production, sample households were asked to identify and rank key constraints using a relative scale (1 to 4; 1 = not important, 4 = severe) and the results that were obtained are presented in Table 6.17. The results show that farmers perceive economic constraints as the most important (3.01) in groundnut cultivation, followed by technological (2.72), institutional (2.52) and agro-climatic factors (2.47).

The technological factors attributed to the basic constraints in groundnut production include incidence of diseases and insect pests, lack of irrigation facilities, etc. One of the most important technological constraints expressed by a high proportion of the farmers was problem of disease and insect/pests. Lack of irrigation facilities and poor germination were other important constraints perceived by the farmers. The respondents across all farm categories believed that the choice of variety/non-availability of suitable varieties was also a problem.

Among agro-climatic constraints, crop failure due to various biotic and abiotic stresses was the most significant constraint reported by the farmers. Other important agro-climatic constraints included poor pod/grain setting and extreme weather conditions such as heavy rains/drought at critical stages of crop growth and temperature variations. The economic constraints included high prices of input and output, and price and profit risks associated with groundnut farming. Rising input prices coupled with low and fluctuating product prices restrict marketing margins and adversely affect profitability. The failure to generate stable

and remunerative returns does not encourage capital investment and restricts technology adoption. High input costs was the most important constraint (3.24), followed by shortage of human labour (3.07), low and fluctuating output prices (3.06), and relatively lower profitability and higher production and price risks. Irregular power supply for irrigation, inadequate knowledge about disease and pest management due to poor extension services, timely availability of inputs as well as poor quality of inputs particularly pesticides and fertilisers were major institutional constraints. The limited access to capital was perceived as less serious constraint for groundnut production. The lack of organized marketing channels, coupled with reliable sources of market information, as well as insufficient storage and processing facilities in the area, impede development of groundnut economy of the country.

Table 6.18: Constraints faced by farmers in cultivation of groundnut

	Marginal	***Small***	***Medium***	***Large***	***All Farms***
Technological	***2.71***	***2.79***	***2.68***	***2.71***	***2.72***
Incidence of diseases	2.72	3.09	3.00	3.00	3.00
Incidence of insect pests	2.85	2.97	2.87	2.61	2.88
Lack of irrigation facilities	2.85	2.94	2.83	2.94	2.86
Poor crop germination	2.81	2.91	2.75	2.83	2.81
Weeds Infestation	2.79	2.90	2.77	2.67	2.81
Non-availability of suitable varieties	2.53	2.45	2.35	2.72	2.41
Poor quality of soils	2.40	2.27	2.20	2.17	2.24
Agro-climatic Factors	**2.49**	**2.42**	**2.50**	**2.46**	**2.47**
Risk of crop failure/yield variability due to biotic & biotic stresses	2.81	2.92	2.88	3.11	2.89
Excessive rains	2.55	2.62	2.91	2.50	2.78
Poor pod/grain setting	2.49	2.52	2.45	2.39	2.47
Drought at critical stages of crop growth	2.57	2.18	2.28	2.11	2.27
Extreme variations in temperature	2.00	1.86	1.97	2.17	1.95
Economic	***2.97***	***3.13***	***2.95***	***3.28***	***3.01***
High-input cost (diesel, fertilizers, agrochemicals)	3.19	3.36	3.18	3.39	3.24

Shortage of human labour	3.11	3.11	3.03	3.39	3.07
Low and fluctuating prices	3.15	3.15	2.99	3.39	3.06
Oilseeds less profitable compared with other crops	2.91	3.06	2.90	3.17	2.96
Price risks – Fear of glut leading to low price	2.91	3.17	2.84	3.22	2.96
Oilseeds more risky compared with other crops	2.53	2.90	2.77	3.11	2.80
Institutional	***2.64***	***2.54***	***2.49***	***2.62***	***2.52***
Irregular supply of power/electricity	3.13	3.14	2.83	3.00	2.95
Inadequate knowledge about disease and pest management	2.70	2.48	2.72	2.11	2.63
Non-availability of timely inputs	2.60	2.59	2.53	3.22	2.58
Seed availability	2.47	2.56	2.47	2.94	2.51
Poor quality of inputs	2.51	2.48	2.43	2.72	2.46
Lack/Poor extension services	2.60	2.27	2.32	2.61	2.34
Non-availability of institutional credit	2.47	2.08	2.04	1.89	2.09
Post-harvest, Marketing and Value-addition	***2.29***	***2.12***	***2.04***	***2.15***	***2.09***
Exploitation by market intermediaries	2.70	2.50	2.21	2.33	2.34
Lack of information about prices and markets	2.32	2.45	2.18	2.50	2.28
Inadequate storage facilities	2.66	2.22	2.18	2.56	2.25
Lack of processing facilities in the area	2.51	2.24	2.14	2.17	2.20
Poor marketing system and access to markets	2.30	2.07	2.14	1.94	2.13
Lack of appropriate transport means	2.26	1.95	1.97	2.50	2.01
High transportation costs	1.74	1.79	1.88	1.67	1.83
Poor Roads	1.83	1.74	1.63	1.56	1.68

Source: Field Survey

Composite indices constructed based on weights (severe=4, moderate=3, minor=2, not important=1) and the number of households in each category.

Farmers' Suggestions for Improving Groundnut Productivity and Income

In order to improve groundnut production and profitability, following measures were suggested by the sample households in the study area:

Improved Irrigation Facilities: The current level of irrigation for groundnut is low when compared with other oilseeds and the crop is mainly dependent on rains. Increase in area under assured irrigation would greatly stabilise as well as increase groundnut productivity and farm incomes. About 20 per cent of the farmers suggested provision of improved irrigation facilities in the study area. Besides, they were of the view that the adoption of drip irrigation system should be promoted in order to improve water use efficiency. Since farmers in the study area normally used electric pump sets for lifting water, assured supply of electricity was also essential. About 13.2 per cent of sample farmers wanted that electricity should be made available on a regular basis for longer duration.

Table 6.19: Suggestions for improving production and productivity of groundnut

Suggestions	Marginal	Small	Medium	Large	All Farms
Provision of improved seeds, fertilizers and pesticides	37.2	32.8	34.8	37.6	33.7
Affordable prices of fertilizers & pesticides	29.9	20.6	21.5	36.0	23.5
Timely availability of inputs and services	21.7	11.7	19.2	23.8	17.1
Production risk mitigation	27.0	26.0	24.3	37.1	26.1
Assured supply of electricity.	38.6	38.1	37.4	37.1	36.9
Assured irrigation facilities	39.5	33.7	37.2	27.8	36.3
Requirement of irrigation facilities in Rabi and summer or all season	23.6	19.4	17.7	26.6	19.5
Better drainage system	6.5	3.5	11.7	5.3	17.2
Better output price	28.1	28.2	32.0	48.2	31.3
Protection from wild animals	12.8	16.1	14.9	14.5	15.4
Farm mechanization	16.8	22.7	28.1	34.8	25.9

Source: Field Survey

Better Output Prices: The oilseeds market is characterized by relatively low prices and high degree of price fluctuations due to seasonality and poor access to markets. About 19 per

cent of the respondents across all farm sizes believed that the low price was a major problem, and there is a need to provide better and assured prices for groundnut producers.

Farm Mechanization: With rising wages and shrinking supply of human labour, availability of human labour has become a major issue. Groundnut is a labour-intensive crop, especially for operations like sowing, weeding, harvesting, and drying. Due to non-availability of timely labour, farmers are not able to complete operations timely resulting in low yield realization. Therefore, farmers suggested that there is a need to address farm labour shortage problem and mechanization in selected farm operations could be an alternative.

Better Quality of Farm Inputs: Groundnut crop is prone to attack by numerous diseases and insects-pests and is one of the most important factors contributing to low crop yields. There has been an increasing problem of supply of spurious plant protection chemicals and 18.4 per cent sample farmers suggested that there is a need to ensure supply of quality pesticides/plant protection chemicals for controlling insect pests and diseases.

Proper Drainage System: Waterlogging is a problem in certain areas. Therefore, about 17.2 per cent farmers suggested that proper drainage system should be developed for release of excess water during the rainy season to avoid water logging.

Affordable Input Prices: The prices of some inputs such as phosphatic and potassic fertilisers and seed have increased significantly during the past 2-3 years, which have led to increase in cost of production. About 15 per cent of sample farmers suggested reducing prices of chemical fertilizers, seeds and other inputs.

Adoption of Improved Varieties/Seeds: Although a large number of farmers use improved varieties of seeds, still farmers feel that provision of good quality improved seed at affordable prices will enhance production and productivity of groundnut in the area.

Improved Marketing and Market Infrastructure: The market intermediaries/middlemen enjoy a sizeable proportion of margins in groundnut marketing. Thus, farmers suggested for designing policies to check the influence of market intermediaries. Improvement in groundnut processing and marketing and improvement in transport and market infrastructure would help boost groundnut production in the country.

Chapter 7

Performance of Sunflower: Recent Trends, Prospects and Constraints

Sunflower is one of the most important oilseed crops in the world, the global production of which grew steadily in the last three decades and reached about 25 million tonnes in 2011-12 (USDA, 2013). The four largest producers (Ukraine, European Union, Russia and Argentina) account for 75 per cent of the global production, with significant growth of production taking place during the last decade in the Black Sea region, with increased acreage and higher yields achieved by replacing old varieties with hybrid seeds. Even though, sunflower seed production has increased in last decades, its share in total oilseeds production declined, whereas, soybean and rapeseed production grew at faster rates.

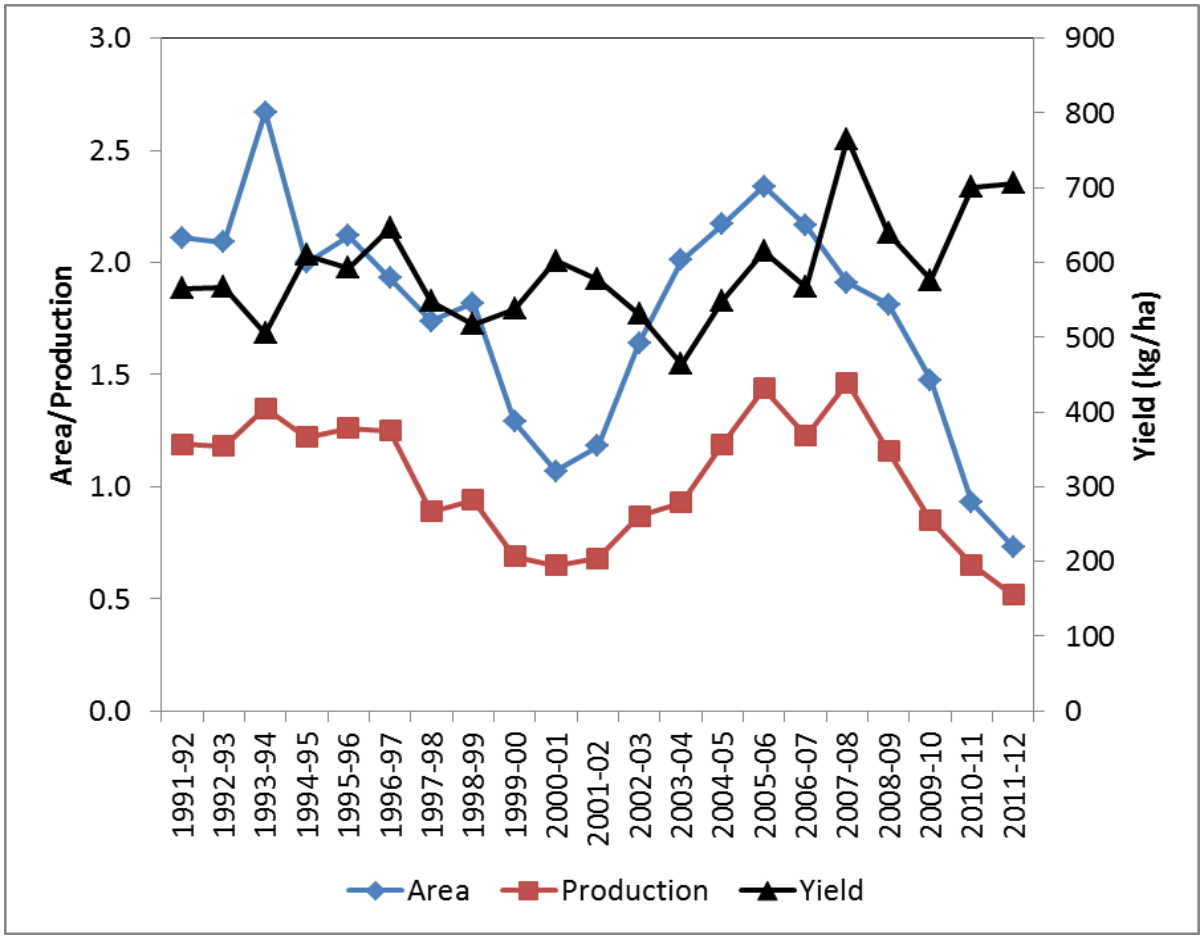
Trends in Area, Production and Yield

Even though India ranks fourth in terms of area under sunflower, it ranks eighth in production globally. This is due to very low productivity compared to other sunflower producing countries. Figure 7.1 shows the level of sunflower acreage, production and yields in India since 1991. It is evident from the Figure that there are large fluctuations in both sunflower area and production in the country. Between 1991 and 1996 sunflower seed output was relatively stable at an average level of 1.2 million tonnes and acreage at 2.2 million ha. The average yield in the country during this period was 580 kg per hectare, compared to 1.5 to 2.0 tonnes per ha in major producing countries in the world. During the next five years, between 1996 and 2001, crop acreage declined to 1.5 million ha, production fell to 0.8 million tonnes and yields also declined sharply (540 kg/ha). Production recovered during 2003-2007 but started declining in 2008-09 and reached its lowest level of 0.52 million tonnes in the last two decades.

Table 7.1 presents estimates of area, production, and yield and compound annual growth rates of sunflower from 1971-72 to 2011-12. Sunflower is cultivated in both kharif and rabi

seasons but share of kharif sunflower has declined during the last four decades from about 60 per cent in early 1970s to 36.4 per cent in terms of area and 28.7 per cent in production.

Figure 7.1: Sunflower acreage (million ha), production (million tonnes) and yield (kg/ha) in India, 1991-92 to 2011-12



Source: GoI (2013c)

The area under sunflower cultivation was 0.16 million ha during TE1973-74, registered a significant growth during the 1980s and reached about 2.3 million ha in TE1993-94. However, it witnessed a declining trend after mid-1990s and reached 1.05 million ha in TE2011-12. Average sunflower production which was about 0.11 million tonnes in the TE1973-74, increased during the next two decades to 1.25 million tonnes in the TE1993-94. Between TE1993-94 and TE2001-02, sunflower output fell by about half and reached a level of 0.67 million tonnes in TE2001-02. The average productivity of sunflower improved from 497 kg per ha in TE1983-84 to 546 kg per ha in TE2001-02. The crop yields also witnessed an increase during the last decade. However, yields vary widely across states (about 500 kg/ha in Karnataka to 1430 kg in Tamil Nadu) and even within a state because of high dependency on monsoon in major sunflower producing states. The average productivity of rabi

sunflower is significantly higher (about 30%) than kharif sunflower. The crop acreage and production recorded significant positive growth rate during the 1980s, but the growth rates became significantly negative during the 1990s and remained negative but non-significant during the last decade. However, sunflower yield witnessed a significant positive growth rate, which is a healthy sign. There has also been a significant increase in area under irrigation but intensity of the irrigation is still low (about 30%). As discussed earlier, sunflower acreage and production witnessed wide fluctuations during the last few decades. Although the coefficient of variation of area and production has declined over time, it is still very high compared with other oilseeds. The fluctuations in area and production have been much higher than yield fluctuations during the last four decades.

Table 7.1: Average area (million ha), production (million tonnes), and yield (kg/ha) of sunflower in India: 1971-72 to 2011-12

	1971-72 to 1973-74	***1981-82 to 1983-84***	***1991-92 to 1993-94***	***1999-00 to 2001-02***	***2009-10 to 2011-12***
Area	0.16	0.48	2.29	1.18	1.05
Production	0.11	0.23	1.24	0.67	0.67
Yield	673	497	546	572	661
Irrigated Area (%)	-	-	18.65	25.00	29.50
Share of kharif season (%) in total area/production					
Share in area	-	60.0	47.6	34.0	36.4
Share in production	-	60.0	35.0	29.7	28.7
Compound annual growth rate (%)					
	1970s	***1980s***	***1990s***	***2000s***	***All Period***
Area	-4.26	17.85***	-6.97***	-5.44	6.76***
Production	-7.39	16.27***	-6.99***	-2.55	6.97***
Yield	-3.23***	-1.29	0.05	3.04**	0.23
Irrigated Area	-	-	4.12***	5.38**	2.74***
Coefficient of Variation (%)					
Area	47.4	47.0	23.9	27.4	65.8
Production	52.4	50.6	23.6	29.3	69.4
Yield	12.5	17.6	7.7	14.2	16.5

**** and ** significant at 1, and 5 per cent level of significance, respectively*
Source: Authors calculations using GoI (2013c)

Shifts in Area

Sunflower is mainly grown in southern and western regions of the country. Karnataka has the largest area under sunflower in the country, accounting for about half of the total area, and there has been an increase in its share during the last one and a half decade. Top three states, namely, Karnataka, Andhra Pradesh and Maharashtra, account for about 90 per cent of total crop acreage. Andhra Pradesh, the second largest state, has increased its area share significantly during the last three decades, from 3 per cent in TE1983-84 to 23.4 per cent in TE2011-12. While, Maharashtra, which had the highest area under sunflower cultivation in the country during TE1983-84, lost its position and now accounts for 16.7 per cent of the national acreage. Bihar, Tamil Nadu, and Haryana are the other sunflower growing states, each accounting for about 1-2 per cent of the total area.

Sunflower is still an important crop accounting for 31.4 per cent of total area under oilseeds in Karnataka. The crop has gained importance in Andhra Pradesh and increased its share from less than one per cent in early-1980s to 11.6 per cent in TE2011-12. In contrast, sunflower cultivation has significantly lost its share in oilseeds acreage in Maharashtra, from over 18 per cent in early-1990s to less than five per cent in the recent period. In Bihar, share of sunflower acreage is 5.9 per cent and in other states share of sunflower acreage in total oilseeds acreage is less than 3 per cent.

The share of major states in sunflower production is given in Table 7.3. It is evident that Karnataka is the largest producer of sunflower seed in the country and has maintained its leadership during the last two decades. Although Karnataka accounts for about 50 per cent of total acreage, the state makes up only about 37 percent of the production, which shows that yields are quite low in the state. The other two major producers, Andhra Pradesh (27.2%) and Maharashtra (14.6%) account for over 40 per cent of the total production. Maharashtra has lost its share in sunflower production to other oilseeds, particularly soybeans, while Andhra Pradesh has increased its share during the last three decades. In Bihar, share of sunflower in total oilseeds production is about 10 per cent while in Tamil Nadu, Haryana and Uttar Pradesh the share is as low as 1 to 2 percent. The above trends clearly show that the crop has lost its share in Maharashtra but improved in Karnataka, Andhra Pradesh and Bihar. Sunflower, which performed extremely well in Punjab and

Haryana during the 1990s, has lost its position due to lack of assured market and price, and high production risks compared with other competing crops.

Yield

As shown in Figure 7.2, Tamil Nadu is the only state which has shown a steady increase in yields since the 1980s. The average yield for which has increased from about 507 kg per ha in 1981-85 to 1507 kg in 2006-11. Karnataka, the largest producer, has shown a steady increase in yields since 1986-90, but yield levels are very low compared with other sunflower producing states. Comparison of the average for the 2006-11 period with the one for 1981-85, Andhra Pradesh and Maharashtra showed a mixed trend. Yields in Karnataka and Maharashtra remained below all-India average. The all-India yield increased between 1981-85 and 1986-90 but then declined in the two subsequent periods and improved in the recent period (2006-11).

Table 7.2: Share of major states in area under sunflower in India: TE1983-84 and TE2011-12

State	Share in all-India acreage				Share in edible oilseed acreage in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
Karnataka	43.5	54.4	44.0	50.5	13.9	42.0	27.6	31.4
A.P.	3.0	14.3	21.0	23.4	0.7	10.1	9.6	11.6
Maharashtra	44.2	20.6	28.6	16.7	10.1	18.4	13.2	4.7
Bihar[25]	0.1	0.2	1.1	1.8	0.2	1.7	6.9	5.9
Tamil Nadu	7.4	1.4	1.0	1.2	3.1	2.3	1.4	2.6
Haryana		2.6	0.6	1.1	0.0	9.1	1.6	2.2
U.P.	0.8	1.3	0.9	0.5	0.1	1.7	0.8	0.4
Others	1.0	5.2	2.8	4.9	-	-	-	-
All India	100.0	100.0	100.0	100.0	2.6	8.8	5.1	3.9

Source: GOI (2013C) various sources.

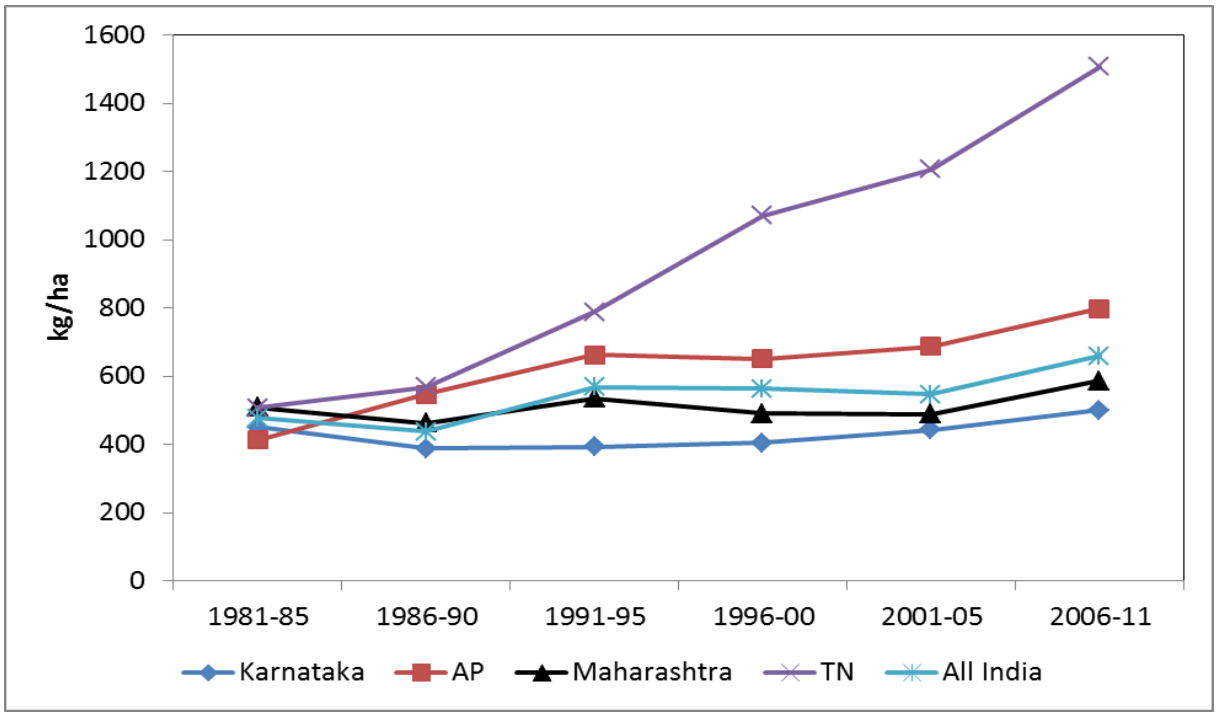
[25] *TE2011-12 data Includes data for both Bihar and Jharkhand for comparison purpose*

Table 7.3: Share of major states in sunflower production in India: TE1983-84 and TE2011-12

State	Share in all-India production				Share in edible oilseed production in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
Karnataka	42.3	38.0	34.4	37.3	10.6	25.9	18.5	23.4
A.P.	2.3	16.8	27.0	27.2	0.3	8.1	9.9	11.6
Maharashtra	45.9	19.8	25.5	14.6	8.5	14.2	7.4	2.4
Bihar[26]	0.1	0.1	2.3	3.9	0.2	0.9	10.5	10.3
Tamil Nadu	7.4	1.8	2.0	2.7	1.6	1.3	0.9	1.8
Haryana	-	7.8	1.7	3.0	0.0	12.8	1.7	2.3
U.P.	1.1	2.7	2.1	1.5	0.2	2.5	1.2	1.1
Others	0.9	12.9	5.0	9.7	-	-	-	-
All India	100.0	100.0	100.0	100.0	2.6	8.8	5.1	3.9

Source: GOI (2013C)

Figure 7.2: Changes in sunflower yield by major producing states and all India average: 1981-2012



Source: GoI (2013c) and authors' calculation

[26] *TE2011-12 data Includes data for both Bihar and Jharkhand for comparison purpose*

Growth Rates in Area, Production and Yield

An in-depth analysis of the growth behaviour of sunflower across major states and time periods was done. Since reliable and consistent state-level data for the eighties were not available, the period selected for the study covered 1991-92 to 2011-12. The annual compound growth rates for different time periods, 1991-92 to 2000-01, 2001-02 to 2011-12 and 1991-92 to 2011-12 were computed and the results showing growth rates for major sunflower producing states (accounting for over 90% of the total production) and classification of states based on growth rates as well as productivity levels are presented in Table 7.4, 7.5 and 7.6.

Sunflower acreage, as well as production in the country, registered a significant decline during the period 1991-92 to 2011-12, growth rate being -2.61 per cent and -1.74 per cent in areas and production, respectively. During the 1990s, the growth rate in sunflower area was negative and statistically significant (-6.94%), and production growth rate was also negative and significant (-6.98%). During the next decade, sunflower acreage and production showed a negative trend but was statistically non-significant. However, sunflower yields witnessed a significant increase during the 1990s and 2000s but the growth rate was higher (3.03%) during the 2000s. Thus looking at the overall performance of sunflower crop during the last two decades, it is clear that the crop did not do well as both area and production witnessed a significant decline. While the aggregate national acreage and production declined, there have been significant regional variations. The top three producers had similar trends as both area and production recorded negative growth rates during the 1990s and 2000s while yield showed a positive trend. However, Bihar was the only state which witnessed a significant increase in sunflower production and acreage during the last two decades. In case of Tamil Nadu, performance of sunflower improved in the last decade as both area and production recorded positive but non-significant growth.

The classification of states based on growth rates in area and yield presented in Table 7.5 shows that none of the states were in the preferred category of AA during the last two decades. Majority of the states were in the CC category, one state each in CA and BA during both decades, two states in BC category during the 1990s and one state during the 2000s. The above results show a dismal performance of sunflower crop in the country.

Table 7.4: Annual growth rates of sunflower area, production and yield in selected states, 1991-92 to 2011-12

Period	*Karnataka*	*A.P.*	*Maharashtra*	*Bihar*	*Tamil Nadu*	*Haryana*	*India*
Area							
1990s	-9.80***	-3.14	-2.40	45.29	-12.53***	-16.31**	-6.94***
2000s	-6.22	-5.65*	-6.84***	4.62	6.01	6.31	-5.41
All	-2.04	-0.40	-1.03***	14.00	-3.17	-8.00***	-2.61**
Production							
1990s	-9.18***	-3.14	-2.38	45.48***	-6.54	-17.26**	-6.98***
2000s	-3.79	-4.56	-4.09	4.94**	8.44	7.96	-2.55
All	-0.45	0.72	-4.31***	17.07***	0.65	-7.74***	-1.74*
Yield							
1990s	0.70	0.00	0.02	18.64***	6.84***	-1.13	0.04***
2000s	2.59	1.15	2.96**	0.64	2.29	1.55***	3.03**
All	1.62***	1.12**	0.86	8.11***	3.94***	0.28	0.90***

Source: Authors' computation using MoA data

Table 7.5: Classification of states according to growth in area and yield of sunflower

Type of association	1990s	2000s	1991-92 to 2011-12
AA	-	-	-
AB	-	-	-
AC	-	-	-
BA	Tamil Nadu	Maharashtra	Uttar Pradesh
BB	-	-	-
BC	Karnataka, Haryana	Andhra Pradesh	Maharashtra
CA	Bihar	Haryana	Karnataka, Andhra Pradesh, Bihar, Tamil Nadu
CB	-	-	-
CC	Andhra Pradesh, Maharashtra, Uttar Pradesh	Karnataka, Bihar, Tamil Nadu, Haryana, Uttar Pradesh	-

Source: Authors' computation using MoA data

During the nineties, Karnataka was the only major producer with yields lower than the national average, but in 2000s, Maharashtra also slipped into this category. It is interesting to note that all major producers except Haryana (during the 1990s) witnessed positive growth rate during the last two decades. However, significant growth was only in the case of Bihar and Tamil Nadu during the 1990s and Haryana and Maharashtra during the 2000s.

Table 7.6: Classification of states according to productivity levels and growth in productivity of sunflower in India

	Significant increase in yield	Significant decline in yield	Stagnant yield with positive sign	Stagnant yield with negative sign
1991-92 to 2000-01				
High Productivity	Bihar, Tamil Nadu	-	Maharashtra, Uttar Pradesh, Andhra Pradesh	Haryana
Low Productivity	-	-	Karnataka	-
2001-02 to 2011-12				
High Productivity	Haryana	-	Andhra Pradesh, Bihar, Tamil Nadu, Uttar Pradesh	-
Low Productivity	Maharashtra		Karnataka	
1991-92 to 2011-12				
High Productivity	Andhra Pradesh, Bihar, Tamil Nadu, Uttar Pradesh	-	Haryana	-
Low Productivity	Karnataka	-	Maharashtra	-

Source: Authors' computation using MoA data

Problems and Prospects of Sunflower Cultivation

Sunflower in India was cultivated over an area of about 10.5 lakh ha with a production of 6.73 lakh tonnes and productivity of 660 kg/ha during the TE2011-12. The sunflower cultivation in the country has shown drastic reduction as well as wide fluctuation in area and production during the last two decades. The production which was over one million tonnes

in the mid-1990s and 2000s declined to about half a million tonne in 2011-12. The decline in acreage and production occurred largely due to various technological and institutional constraints and relatively high and stable expected profitability of alternative crops. In order to identify the constraints in sunflower cultivation, a study was conducted in two major sunflower producing states, namely, Karnataka and Andhra Pradesh.

The primary data were collected from four districts (Shimoga, Belgaum, Bagalkot and Bijapur) from Karnataka (Kumar, *et. al*., 2013) and three districts (Kurnool, West Godavari and Prakasam) from Andhra Pradesh (Rao, 2014). The districts were selected based on acreage and yield of the crop and the potential for further increase in production as discussed in chapter 2. This section discusses the general findings of the survey of 320 farmers from selected districts of Karnataka and 150 farmers from three districts of Andhra Pradesh. In all total sample size was 470 sunflower farmers spread over 7 districts and two major producing states in the country (Table 7.7).

Table7.7: Size-distribution of sample households in selected states

State	***Marginal***	***Small***	***Medium***	***Large***	***Total***
Andhra Pradesh	10	35	95	10	150
Karnataka	65	92	136	27	320
Total	***75***	***127***	***231***	***37***	***470***

Source: Field Survey

General Characteristics

The average age of head of the household was 46.3 years and there were no significant differences among various farm categories. About 90 per cent of the households had crop farming as the primary occupation and over 98 per cent were male headed. A small proportion of marginal (4.8%) and small farmers (2.7%) had farm labour as their main occupation. The average family size in the selected sample was 6.6 persons, while large farms had a larger family size (10.8). The average years of schooling were 5.8 and varied from 4.7 years for marginal and small farms to 8.7 years for large farms. In terms of social groups, nearly 50 per cent of the selected households belonged to general category, 39.5 per cent to other backward classes and about 11 per cent to scheduled castes and

scheduled tribes categories. The share of OBCs and SCs/STs were higher in case of marginal farmers compared with large farmers.

Table 7.8: Socio-economic status of sample households

Indicators	Marginal	Small	Medium	Large	All Farms
Age (years)	46.8	47.3	45.6	46.5	46.3
Main Occupation (%)					
Crop farming	91.3	91.7	87.4	92.7	89.8
Dairy	0.0	0.0	0.0	0.0	0.0
Services	3.9	5.6	10.4	7.3	7.9
Farm Labour & Others	4.8	2.7	2.2	0.0	2.3
Education (years of schooling)	4.7	4.7	6.3	8.7	5.8
Average Family Size (no)	6.3	5.8	6.4	10.8	6.6
Male	3.9	3.8	4.2	6.1	4.2
Female	3.7	3.6	3.9	6.1	4.0
Social Groups					
General	30.7	53.5	53.7	51.4	49.8
OBC	53.3	33.1	39.0	35.1	39.5
SC/ST	16.0	13.4	7.3	13.5	10.7
Head of household (%)					
Male	96.7	98.9	100.0	100.0	98.3
Female	3.3	1.1	-	-	1.7

Source: Field Survey

Land Ownership Pattern

The average operational land holding size was 4.47 ha per family and varied from 0.79 ha for marginal households to 18.78 ha for large households (Table 7.9). Only 40 per cent of the total operational area was irrigated and the share of irrigated area was the highest (48.1%)

in case of marginal farms and the lowest (39.8%) in case of medium farms. About 84 per cent of the total operational area was owned land and the share of leased-in land was about 16 per cent, the highest (22.7%) on large farms and the lowest (3.8%) on marginal farms. However, there were significant differences between the two states, the share of leasing being higher in Karnataka compared with Andhra Pradesh. The fixed rent was the predominant mode of lease arrangements and varied from Rs. 14820 per ha in case of small farms to Rs. 22435 per ha on medium farms in Karnataka.

Table 7.9: Land ownership pattern of sample households (in ha)

Indicators	Marginal	Small	Medium	Large	All Farms
Total owned land					
Irrigated	0.38	0.69	1.78	6.40	1.58
Un-irrigated	0.39	0.87	2.49	8.12	2.19
Total	0.76	1.56	4.26	14.52	3.77
Leased-in land					
Irrigated	0.03	0.07	0.30	1.78	0.30
Un-irrigated	0.00	0.05	0.19	1.39	0.22
Total	0.03	0.12	0.49	3.17	0.53
Leased-out land					
Irrigated	0.00	0.00	0.00	0.00	0.00
Un-irrigated	0.00	0.03	0.01	0.15	0.03
Total	0.00	0.03	0.01	0.15	0.03
Total Operational holding (2+3-4)					
Irrigated	0.38	0.71	1.96	7.64	1.78
Un-irrigated	0.42	0.96	2.97	11.14	2.69
Total	0.79	1.67	4.92	18.78	4.47

Source: Field Survey

Sunflower Cropping Systems: Productivity, Profitability and Risks

Sunflower is a major crop during rabi/summer season in both the states and accounts for about 58 per cent and 43 per cent of rabi acreage for sample households in Andhra Pradesh

and Karnataka, respectively. About 46 percent of the sunflower acreage in Andhra Pradesh and about 45 percent area in Karnataka were irrigated. In case of Karnataka, share of irrigated area was much higher (56.1%) during rabi season compared with kharif season (9.8%). The sunflower productivity was higher (1025 kg/ha) in rabi season than kharif season (791 kg/ha) in Karnataka. The average productivity of sunflower on sample households is given in Table 7.10.

Table 7.10: Average yield of sunflower and competing crops of sample households (Qtl/ha)

Crops	**Marginal**	**Small**	**Medium**	**Large**	**All farm**
Andhra Pradesh					
Sunflower (Rabi)					
Irrigated	1005	986	761	621	797
Unirrigated	636	717	584	515	603
Karnataka					
Sunflower (Rabi)	*1419*	*1228*	*986*	*904*	*1025*
Irrigated	1740	1620	1310	1270	1390
Unirrigated	760	730	650	430	560
Sunflower (Kharif)	*921*	*668*	*932*	*773*	*791*
Irrigated	1730	1140	800	2150	1650
Unirrigated	820	630	940	560	700
All					
Sunflower (Rabi)					
Irrigated	1654	1483	1150	1132	1247
Unirrigated	745	727	631	448	570

Source: Field Survey

The average yield of sunflower was significantly higher on irrigated farms compared with unirrigated farms in both the states. For example, average productivity of sunflower in Andhra Pradesh was 797 kg per ha under irrigated conditions and 603 kg per ha under unirrigated conditions. Similarly, average yields on irrigated farms were much higher (1390 kg/ha in rabi season and 1650 kg in kharif season) than unirrigated farms (560 kg/ha in rabi

season and 700 kg in kharif season). The yields in Karnataka were comparatively higher than in Andhra Pradesh under both irrigated and unirrigated conditions.

Table 7.11 shows the comparative profitability of sunflower and major competing crop(s) in Karnataka and Andhra Pradesh. Jowar is a major competing crop in Karnataka and cotton is the main competing crop in Andhra Pradesh. The results of relative profitability of sunflower and the main competing crops given in Table 7.11 show that average profitability of sunflower is significantly higher than jowar during the kharif season but lower than jowar in rabi season. The net income from sunflower was significantly higher during kharif season compared with rabi season. During rabi season, there was an inverse relationship between farm size and income from sunflower cultivation, while during kharif season, income was highest on medium farms and the lowest on small farms.

In case of Andhra Pradesh, net profitability per hectare of sunflower cultivation varied from Rs. 24482 per ha on marginal farms to Rs. 22555 per ha in case of large farms. The average profitability of cotton, major competing crop was significantly higher than sunflower in all farm categories.

Table 7.11: Profitability[27] sunflower vis-à-vis major competing crops per hectare in selected states

(Rs/ha)

	Marginal	Small	Medium	Large	All Farms
Andhra Pradesh					
Sunflower	24482	21836	26474	22555	23974
Cotton	38499	30399	35958	36192	35262
Karnataka					
Sunflower Rabi	16803	10149	5694	9903	9763
Jowar Rabi	23004	21092	-425	10452	10916
Sunflower Kharif	3085	2295	8356	6354	5128
Jowar Kharif	1663	2930	9696	-8264	3802

Source: Field Survey

[27] *Profitability = Gross Value of Output – Total Operational Costs*

Table 7.12: Yield and price risks (%) in sunflower and competing crops in sample states

State/Crop	Marginal	Small	Medium	Large	All Farms
Sunflower					
Karnataka					
Yield Risk	37.6	45.1	53.0	67.9	59.1
Price Risk	14.5	15.0	14.6	16.7	15.3
Andhra Pradesh					
Yield Risk	33.0	33.4	33.1	35.8	34.1
Price Risk	47.9	62.7	57.5	56.2	57.9
Sunflower All					
Yield Risk	48.9	62.1	58.4	68.0	71.9
Price Risk	52.0	51.6	58.4	46.5	55.4
Competing Crops					
Cotton (Andhra Pradesh)					
Yield Risk	36.2	15.5	11.6	11.6	18.2
Price Risk	19.1	1.2	1.2	0.7	5.7
Jowar (Karnataka)					
Yield Risk	16.8	62.3	50.7	62.3	105.3
Price Risk	12.4	33.1	23.6	37.8	33.0

Price and yield risks are measured in terms of coefficient of variation (%)
Source: Field Survey

Post-Harvest Handling, Price Situation and Access to Technology and Markets

The average production of sunflower per household was 15.2 quintals and varied from 8.5 quintals on marginal farm households to over 40 quintals on large farms (Table 7.13). All the produce was sold in the market. The price received was relatively higher on medium and large farmers compared with small and marginal farmers. The average production per household was higher in Karnataka (15.8q) than in Andhra Pradesh (13.7q). However, the difference was significant only in the case of large farms.

Table 7.13: Sunflower production, retention and sales pattern

Farm category	*Prod.* (Qtl)	*Retention*(Qtl)	*Sold*(Qtl)	*Price (Rs./q)*
All				
Marginal	8.5	0.0	8.5	3350
Small	9.7	0.0	9.7	3235
Medium	16.4	0.0	16.4	3719
Large	40.2	0.0	40.2	3692
All Farms	15.2	0.0	15.2	3524
Andhra Pradesh (Kharif)				
Marginal	3.17	0.0	3.17	2333
Small	8.00	0.0	8.00	3500
Medium	3.58	0.0	3.58	3547
Large	2.69	0.0	2.69	3500
All Farms	3.79	0.0	3.79	3487
Andhra Pradesh (Rabi)				
Marginal	8.14	0.79	7.36	6786
Small	8.60	0.65	7.95	4590
Medium	15.18	1.03	14.15	5220
Large	21.00	1.21	19.79	4438
All Farms	13.69	0.93	12.76	5102
Karnataka				
Marginal	8.5	0.0	8.5	2901
Small	10.2	0.0	10.2	2835
Medium	16.9	0.0	16.9	2915
Large	46.7	0.0	46.7	3243
All Farms	15.8	0.0	15.8	2917

Source: Field Survey

More than half of the sample households reported marketing related problems and the share was higher in case of small and marginal farmers (Table 7.14). It is evident from the data that the majority of sunflower growers sold their produce to either commission agents in APMC mandies or local village traders. About 45.7 per cent of households sold their produce to commission agents and 39.4 per cent to local village traders. It is interesting to

note that the majority of small and marginal farmers sold their produce to local village traders while on the other hand; majority of medium and large farmers sold the produce to commission agents. A small share of marketed surplus was sold to other channels like processors and government agencies. The farmers received higher prices from commission agents than from local village traders. This clearly shows that large farmers were having better access to market and process. Processors paid the highest price and purchased a subtle share of total marketed surplus whereas the government agencies paid the lowest price. The average distance to the sale point varied from about 3 km in case of small farm to 9.6 km in large farmers. This difference is due to the fact that large number of small and marginal farmers sold their produce to the local village traders who purchased directly from farmers' field and hence avoiding travelling long distances. However, they received lower prices compared with large farmers due to small volumes and low bargaining power.

Table 7.14: Relative importance of different marketing channels and price paid to farmers

Marketing Problems/channel	***Marginal***	***Small***	***Medium***	***Large***	***All Farms***
Marketing problems (%)					
Yes	48.0	64.6	48.5	40.5	52.1
No	*52.0*	*35.4*	*51.5*	*59.5*	*47.9*
Marketing Channels (%)					
Commission agent	24.3	33.8	53.2	59.5	45.7
Local Village Trader	71.4	59.5	30.5	26.4	39.4
Processor	0.0	1.1	1.0	11.0	5.3
Government Agencies	4.3	5.6	15.3	3.1	9.6
Average distance to sale point (km)	***3.0***	***4.5***	***7.0***	***9.6***	***5.7***
Price Received (Rs./q)					
Local Village Trader	2931	2826	2928	3096	2944
Commission Agent/Ahrtia	2941	2984	2813	3284	3106
Processor	-	2900	2923	3620	3558
Government Agencies	2700	2983	2979	2950	2956

Source: Field Survey

The rural poor farmers lacked access to competitive markets not just for their produce but also for inputs and services, technology and institutions. Therefore, improving their access to production inputs, technologies and markets can increase farm income. In order to examine farmers' access to modern inputs, technology and markets, sample households were asked questions related to their knowledge and access to quality seeds, output prices and market information and the results are presented in Table 7.15.

Table 7.15: Access to inputs, technology and markets

	Marginal	Small	Medium	Large	All Farms
Use of HYV (%)					
Yes	94.0	95.4	96.4	95.0	95.5
No	60.0	4.6	3.6	5.0	4.5
Source of Seed (%)					
Own	6.7	5.5	3.0	10.8	4.9
Market	93.3	94.5	97.0	89.2	95.1
Awareness about MSP (%)					
Yes	33.3	39.4	38.5	51.4	38.9
No	66.7	60.6	61.5	48.6	61.1
Price realization (%)					
Higher/Equal to MSP	25.3	18.9	24.2	40.5	24.3
Lower than MSP	74.7	81.1	75.8	59.5	75.7
Source of information					
Fellow Farmers	41.6	49.3	56.7	58.4	52.3
APMC Mandi	41.2	39.0	42.0	48.6	41.1
Commission agent/Arhtia	33.7	35.9	39.8	37.5	36.6
Print media	37.4	36.3	26.0	48.0	34.9
Private company	12.7	13.8	19.2	11.1	15.5
Radio/TV	11.1	14.5	12.3	19.6	14.3
Others	2.4	0.0	0.0	0.0	0.4

Source: Field Survey

The results show that 95.5 per cent of sample farmers used high yielding varieties of seeds and most of them purchased their seed requirement from the market. The awareness about

minimum support price of sunflower was quite low in the study area and less than 40 per cent of farmers were not aware of MSP. As expected, large farmers (51.4%) had better knowledge about MSP compared with small (39.4%) and marginal farmers (33.3%). It is disturbing to note that about 3/4th of the sample households received prices lower than MSP and this proportion was higher in case of small and marginal farmers. These findings clearly indicate that small and marginal farmers have poor access to markets as well as prices.

Farmers face difficulties in marketing their produce due to lack of or poor access to reliable and timely market information. Farmers get information about markets and prices from different sources and have different degrees of access to this information. This affects marketing choices i.e. where, when, to whom and at what price to sell. The principal sources of gathering information for the farmers in the study area were fellow farmers (52.3%), followed by APMC mandis (41.1%) and market intermediaries (36.6%). In addition, farmers also used print and electronic media for seeking information about markets and prices.

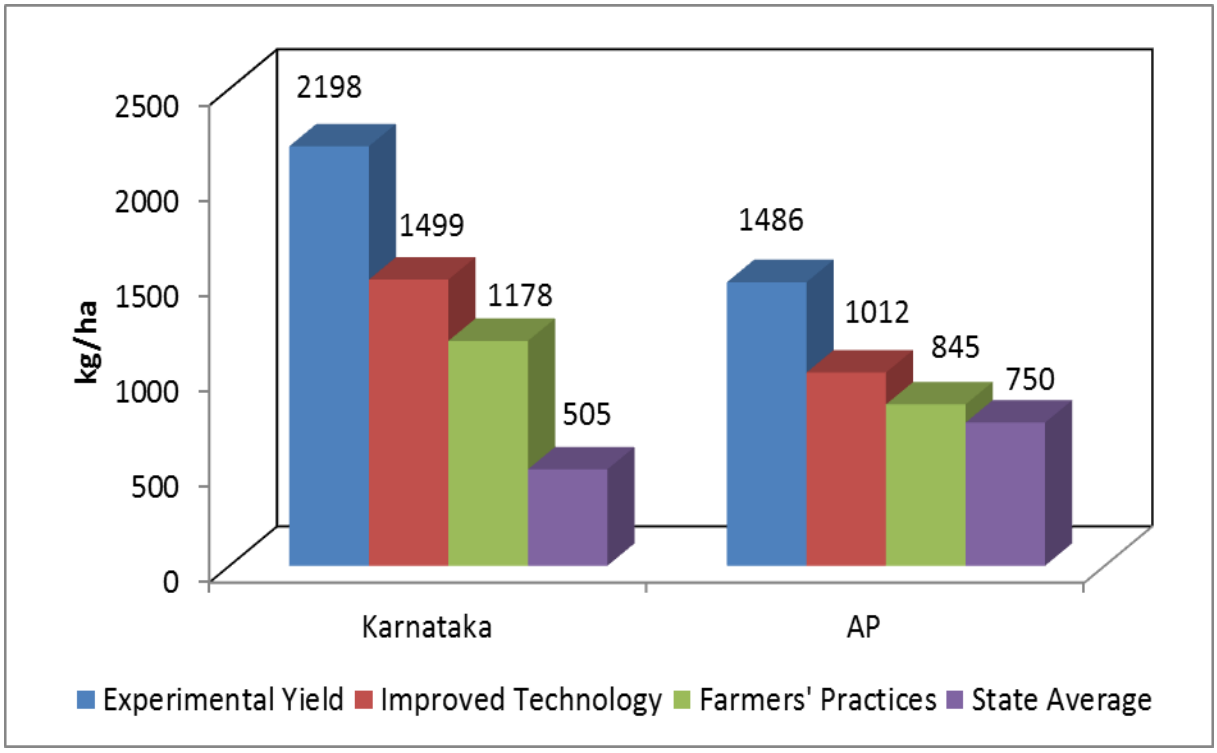
Yield Gap Analysis

The yields obtained by farmers have always been lower than those potential yields attainable under best practices. The farmers' yields are affected by various environmental and socio-economic factors. Since it is difficult to increase yield potential over a short term through genetic improvement, closing the existing yield gaps between attainable potential and farmers' yields are essential to increase production and to help formulate policies. To evaluate yield gap between yield potential and actual on-farm yield achieved by farmers under improved technology and farmers' practices, we used data for the period 2009-10 to 2011-12 from Directorate of Oilseeds Research, Hyderabad and the results are presented in Figure 7.3.

In Karnataka, the experimental station mean yield, which was the average data of initial hybrid trials at Bangalore, Raichur and Savalvihir centres of experimental yields, was 2198 kg per ha in TE2011-12, ranging from 1638 kg/ha in 2009-10 to 2870 kg/ha in 2011-12. The mean yield from front line demonstrations (FLD) under improved technology was 1499 kg per ha and ranged from 1203 kg in 2011-12 to 2003 kg in 2010-11. Sunflower yields under farmers' practices varied from 902 kg/ha in 2009-10 to 1650 kg/ha in 2010-11, with an

average of 1178 kg/ha in TE2011-12. The average yield at the state level during the TE2011-12 was much lower (505 kg/ha).

Figure 7.3: Potential yield and front line demonstration on-farm average yields of sunflower in Karnataka and Andhra Pradesh: 2009-10 to 2011-12



Source: ICAR (2013c)

Figure 7.3 shows the average experimental yield, FLD yield under improved technology and farmers' practices and the state average based on the above yield data. The difference between yield potential and the actual yield achieved by farmers under improved technology, which represents the exploitable yield gap, is 31.8 per cent and under farmers' practices, it is much higher (46.4%). The yields achieved under farmers' practices are roughly 22 per cent lower than under improved technology and are mainly due to poor crop management practices and socio-economic and institutional factors. While gap between experimental yield and FLD yields could be due to agro-climatic and socio-economic factors, some of which may be difficult to address. However, yield gap between improved technology and farmers' practices can be reduced by addressing some of these constraints. The above analysis indicates that one of the ways to improve sunflower yields and close the exploitable yield gap at farm level is by improving socio-economic and institutional constraints and agronomic management. In order to identify the major technological, socio-economic and institutional constraints to productivity and profitability of sunflower

production, selected sunflower producers were asked to identify and rank key constraints affecting sunflower production in the study area and the results are presented in Table 7.16.

Major Constraints in Sunflower Cultivation

Post-harvest management and marketing related constraints were perceived as the most important constraint for improving sunflower production and productivity in the study area. Exploitation by market intermediaries, lack of processing facilities, poor marketing system and access to markets and lack of reliable information about markets and price were identified as the main constraints by the respondents. Economic constraints ranked number two in terms of relative importance and high inputs costs was identified as the most important economic constraint (3.69), followed by low and fluctuating prices, shortage of human labour and low profitability of sunflower compared with competing crops were other major economic constraints to sunflower cultivation. Inadequate knowledge about disease and pest management due to poor extension services, irregular supply of power for irrigation, non-availability of quality seed and poor quality of inputs were the major institutional constraints. Other significant problems mentioned by the respondents were non-availability of institutional credit and timely availability of inputs. Technological constraints ranked fourth, whereas agro-climatic factors ranked fifth. Among various technological constraints, lack of irrigation facilities, incidence of insects-pests and diseases, non-availability of suitable varieties were perceived as major problems in sunflower cultivation. The important agro-climatic constraints mentioned by the respondents were drought at critical stages of plant growth, poor grain setting, temperature variations and yield fluctuations.

Table 7.16: Constraints faced by farmers in cultivation of sunflower (Composite Index)

	Marginal	***Small***	***Medium***	***Large***	***All Farms***
Technological	***2.63***	***2.68***	***2.77***	***2.83***	***2.72***
Lack of irrigation facilities	3.30	3.30	3.26	3.24	3.26
Incidence of insect pests	2.83	3.02	3.10	3.15	3.05
Incidence of diseases	2.84	2.96	3.09	3.13	3.01
Non-availability of suitable varieties	2.62	2.61	2.52	2.88	2.59
Weeds Infestation	2.35	2.40	2.72	2.71	2.58

Poor crop germination	2.55	2.39	2.35	2.55	2.41
Poor quality of soils	1.93	2.07	2.36	2.12	2.15
Agro-climatic Factors	***2.34***	***2.38***	***2.51***	***2.49***	***2.43***
Drought at critical stages of crop growth	2.85	2.94	3.09	2.79	2.96
Poor pod/grain setting	2.33	2.43	2.57	2.66	2.50
Extreme variations in temperature	2.42	2.35	2.47	2.82	2.46
Risk of crop failure/yield variability due to biotic & biotic stresses	2.25	2.29	2.47	2.32	2.35
Excessive rains	1.82	1.91	1.94	1.88	1.90
Economic	***3.01***	***2.85***	***2.78***	***2.90***	***2.84***
High-input cost (diesel, fertilizers, agrochemicals)	3.78	3.70	3.59	3.86	3.69
Low and fluctuating prices	3.12	3.10	2.98	2.92	3.03
Price risks – Fear of glut leading to low price	3.03	2.87	2.91	3.06	2.95
Shortage of human labour	3.09	2.98	2.89	2.94	2.94
Oilseeds less profitable compared with other crops	2.61	2.36	2.26	2.45	2.35
Oilseeds more risky compared with other crops	2.45	2.08	2.04	2.15	2.11
Institutional	***2.95***	***2.98***	***2.84***	***2.87***	***2.83***
Inadequate knowledge about disease and pest management	3.12	3.22	3.03	3.17	3.12
Irregular supply of power/electricity	3.38	3.39	3.37	3.10	3.11
Seed availability	3.06	3.01	2.80	2.98	2.93
Lack/Poor extension services	2.97	2.93	2.64	2.98	2.88
Poor quality of inputs	3.02	3.00	2.76	2.81	2.74
Non-availability of institutional credit	2.80	2.89	2.78	2.66	2.72
Non-availability of timely inputs	2.84	2.80	2.58	2.63	2.58
Post-harvest, Marketing and Value-addition	***3.04***	***3.08***	***2.91***	***3.04***	***2.99***
Exploitation by market intermediaries	3.36	3.57	3.33	3.48	3.43
Lack of processing facilities	3.27	3.44	3.28	3.28	3.31

Poor marketing system and access to markets	3.39	3.39	3.21	3.23	3.28
Lack of information about prices and markets	3.22	3.21	3.03	3.11	3.11
Inadequate storage facilities	2.95	3.08	2.84	2.83	2.94
Lack of appropriate transport means	2.86	2.91	2.79	3.02	2.86
High transportation costs	2.72	2.55	2.37	2.72	2.53
Poor Roads	2.50	2.46	2.43	2.61	2.49

Source: Field Survey

Composite indices constructed based on weights (severe=4, moderate=3, minor=2, not important=1) and the number of households in each category.

Farmers' Recommendations for Improving Sunflower Productivity and Income

In order to know about the problems, aspirations and experiences of the sunflower cultivators, farmers were asked to give feedbacks and recommendations for improving sunflower production and yield. In Karnataka, almost 90% of the 320 farmers surveyed responded with one or more different suggestions. Some of the most valuable suggestions based on the survey results are presented in Table 7.17.

Table 7.17: Suggestions for improving production and productivity of sunflower (In %)

Suggestions	Marginal	Small	Medium	Large	All Farms
Adequate water facility	3.1	3.3	3.7	11.1	4.1
Need a good APMC in the village without malpractices	1.5	4.3	5.9	7.4	4.7
Better transport facility	6.2	0.0	3.7	3.7	3.1
Fertilizer subsidy	6.2	4.3	5.1	3.7	5.0
Good quality fertiliser	40.0	40.2	39.7	33.3	39.4
Good quality seeds	44.6	48.9	43.4	85.2	48.8
Good market facility in the village	13.8	8.7	9.6	11.1	10.3
Good market price	9.2	5.4	3.7	11.1	5.9
Good Processing facility required	3.1	1.1	1.5	0.0	1.6

Good warehouse facility to store the crop	4.6	5.4	0.7	3.7	3.1
Improved irrigation facility	7.7	2.2	9.6	7.4	6.9
Timely removal of weeds	0.0	1.1	2.2	0.0	1.3
Lack of electricity	0.0	1.1	2.2	0.0	1.3
Organic manure/homemade fertiliser	1.5	2.2	0.0	3.7	1.3
Soil should be tested	3.1	0.0	0.0	0.0	0.6
Need mechanical machinery	0.0	0.0	0.0	3.7	0.3

Source: Field Survey

Majority of the recommendations suggested by the farmers were related to better quality supply of inputs and improvement in facilities. Around 40-50% of the farmers demanded better quality seeds and fertilisers for improving sunflower productivity. Some farmers also recommended for better marketing facility and warehouses in their villages. Services like water, irrigation, electricity, transport and processing mills were some of the other recommendations given by the farmers. Some farmers were also of the view that there was a need for a good APMC in the village that functions without any malpractices. Some of the farmers (5%) also demanded an increase in the subsidy for fertilisers, in order to get fertiliser at cheaper rates. Few of the others recommended subsidies on seeds, agricultural equipments, crop loans, etc.

Chapter 8

Performance of Sesamum: Recent Trends, Prospects and Constraints

Sesamum (Sesamum indicum L.), thought to have originated in Africa, is considered to be the oldest oilseed crop known to man and is now cultivated in many parts of the world. Grown mainly in the tropics, sesamum production is dominated by small landholders in developing countries. The top three producers, Myanmar, India and China account for nearly half of the world's sesamum acreage and production (Table 8.1). Other major producers include Tanzania, Ethiopia, Sudan, Uganda and Nigeria. The average yield varied from 399 kg per ha in India to 1307 kg per ha in China, with the world average being 535 kg per ha in TE2012.

Table 8.1: Area, production and yield of sesamum in major crop growing countries: TE2012

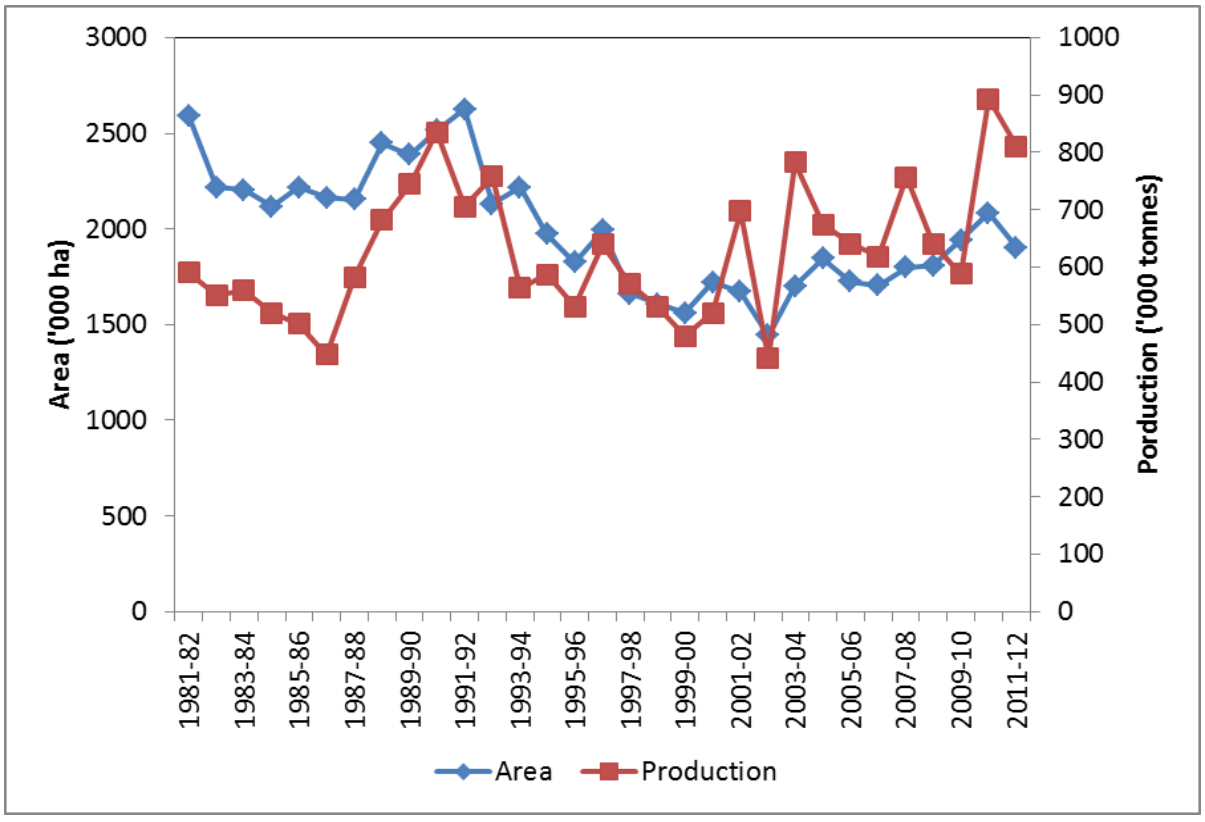
Country	*Area(Lakh ha)*	*Production (Lakh tonnes)*	*Yield(Kg/ha)*
Myanmar	15.99 (19.3)	7.96 (18.0)	497
India	18.93 (22.9)	7.57 (17.1)	399
China	4.58 (5.5)	5.97 (13.5)	1307
Tanzania	4.55 (5.5)	3.19 (7.2)	703
Ethiopia	3.46 (4.2)	2.78 (6.3)	800
Sudan	11.92 (14.4)	2.66 (6.0)	227
Uganda	3.08 (3.7)	1.96 (4.4)	636
Nigeria	3.26 (3.9)	1.54 (3.5)	472
World	82.74	44.32	535

Source: FAO (2014)

Trends in Area, Production and Yield

India is the second largest producer of sesamum in the world, accounting for about 18 percent of the world output and 22.9 per cent of the total acreage. Sesamum production in India during the last decade averaged at 17.84 lakh tonnes per year and has grown by about 19 per cent between TE2003-04 and TE2011-12, while area has increased by over 23 per cent during the same period (Figure 8.1). The highest production of 8.93 lakh tonnes was recorded during 2010-11, and the lowest was 4.41 lakh tonnes during 2002-03. As is evident from the Figure, sesamum production and acreage witnessed a declining trend during the nineties with production experiencing wide fluctuations during the last two decade.

Figure 8.1: Trends in sesamum area and production in India: 1981-82 to 2011-12



Source: FAO (2014)

Estimates of area, production and productivity of sesamum from 1971-72 to 2011-12 are given in Table 8.2. The area under sesamum witnessed a consistent decline during the last four decades. The area fell from 2.36 million ha during TE1973-1974 to 2.32 in TE1993-94 and reached 1.65 million ha in TE2001-02, increasing marginally to 1.98 million ha in TE2011-12. However, production showed an increasing trend from 4.4 lakh tonnes in TE1973-74 to 6.76 lakh tonnes in TE1993-94 and declining trend during the nineties while

reaching 5.66 lakh tonnes in TE2001-02. Sesamum production had improved during the last decade and was 7.64 lakh tonnes in TE2011-12. Despite a consistent decline in area under sesamum in the country, production was increasing primarily due to yield improvements, even though Indian yield is among the lowest in the world. The yield per ha witnessed a steady increase during the last four decades from less than 200 kg per ha in early-1970s to about 400 kg per ha in the recent period.

Table 8.2: Average area (million ha), production (lakh tonnes), and yield (kg/ha) of sesamum in India: 1971-72 to 2011-12

	1971-72 to 1973-74	***1981-82 to 1983-84***	***1991-92 to 1993-94***	***1999-00 to 2001-02***	***2009-10 to 2011-12***
Area	2.36	2.34	2.32	1.65	1.98
Production	4.40	5.67	6.76	5.66	7.64
Yield	186	243	293	343	386
Compound annual growth rate (%)					
	1970s	***1980s***	***1990s***	***2000s***	***All Period***
Area	0.50	0.48	-4.74***	2.31***	-0.94***
Production	0.14	3.99***	-3.67	2.56	1.22***
Yield	-0.36	3.49***	1.13	0.24	2.18***
Coefficient of Variation (%)					
Area	3.9	7.4	17.1	9.4	15.1
Production	12.9	19.7	14.9	17.9	22.5
Yield	12.7	15.0	10.3	13.4	28.1

*** *Significant at 1 per cent level of significance*
Source: Authors calculations using GoI (2013c)

The sesamum seed production has grown at 1.22 per cent compounded annually in the past four decades and is currently about 8 lakh tonnes (2011-12). However, it has undergone a momentous shift with respect to decade-wise contribution. During the 1980s, sesamum production registered a spectacular growth of about 4 per cent, followed by 2.56 per cent in the 2000s and a negative growth rate at -3.67% during the nineties. The total area under sesamum has declined by 0.94 per cent (compound annual growth rate) in the past four

decades. However, area under the crop recorded a significant increase (2.31%) during the last decade compared with negative (-4.74%) growth rate in the 1980s. Sesamum yields had shown the highest (3.49%) growth rate during the eighties but became stagnant in the subsequent decades. Increase in production has been driven by increased yield per unit area rather than by expansion of the cultivated area. However, the production variability has remained quite high during the last three decades and was dominated by the fluctuation of yield per unit of area. The yield variability was invariably higher than area variability during all decades except the 1990s. This high variability in production and productivity introduces additional uncertainty and risk in sesamum cultivation.

Shifts in Area

The share of major states in total area and production of sesamum for the TE 1983-84, 1993-94, 2001-02 and 2011-12 are given in Tables 8.3 and 8.4. In TE1983-84, Uttar Pradesh had the largest share in sesamum acreage and accounted for about 20.4 per cent of the area. Other major states were Rajasthan (17.8%), Madhya Pradesh (11.2%), Odisha (11.1%), Maharashtra (8.3%), and Andhra Pradesh (7.3%). Gujarat, Tamil Nadu and Karnataka each accounted for about 5 per cent. All these states together accounted for about 90 per cent of the area under the crop. However, in TE2011-12, Rajasthan replaced Uttar Pradesh to become a state with the highest area under sesamum accounting for about 28 per cent of area. It was followed by Uttar Pradesh with 17.2% of area and Madhya Pradesh with 12.1% area under sesamum. Other major sesamum growing states in terms of acreage in the same period were Gujarat (12.8%), West Bengal (9.3%), Andhra Pradesh (4.8%), Karnataka (3.8%) and Maharashtra (2.6%). Odisha lost its share from over 11 per cent in early-1970s to about 2 per cent in 2011-12. Among the primary producers, Rajasthan and Gujarat were the main gainers in area under sesamum in the country during the last four decades.

Shifts in Production

There have been significant changes in sesamum production during the last four decades. Odisha, which was the largest producer of sesamum in the country during the TE1983-84, lost its leading position and is now at the 10^{th} position. In TE1983-84, the leading producers were Odisha (22.9%), Uttar Pradesh (12.8%), West Bengal (10.5%), Rajasthan (9.2%), Maharashtra (7.6%), Madhya Pradesh (7.4%), Tamil Nadu (6.3 per cent), Karnataka (5.8%) and Andhra Pradesh (4.8%). In TE2011-12, West Bengal became the largest producer

accounting for about 21.3 per cent of the production, followed by Rajasthan (21.2%), Madhya Pradesh (17.8%) and Gujarat (14.1%). Top five producers accounted for over 80 per cent of the total production in the country in TE2011-12 compared with about 63 per cent in TE1983-94, indicating a concentration of sesamum production in few states.

Table 8.3: Share of major states in area under sesamum in India: TE1983-84 and TE2011-12

State	Share in all-India acreage				Share in edible oilseed acreage in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
Rajasthan	17.8	23.9	15.4	28.0	29.9	15.8	8.1	11.6
U.P.[28]	20.4	6.7	10.7	17.2	15.1	9.0	12.6	29.9
M.P.[29]	11.2	9.6	9.3	14.3	12.1	4.6	2.6	3.9
Gujarat	5.1	11.4	20.9	12.8	4.6	9.0	12.4	8.6
West Bengal	4.7	4.7	6.5	9.3	31.3	20.2	18.7	27.1
A.P.	7.3	7.5	9.8	4.8	8.1	5.4	6.3	4.5
Karnataka	5.1	5.7	5.6	3.8	7.9	4.5	4.9	4.5
Maharashtra	8.3	12.7	7.8	2.6	9.2	11.5	5.0	1.4
Tamil Nadu	5.2	6.0	6.1	2.6	10.7	10.4	11.5	11.1
Odisha	11.1	7.5	3.0	2.1	30.2	24.0	15.8	14.9
Others	3.7	4.2	5.0	2.4	8.3	6.1	6.4	3.3
All India	100.0	100.0	100.0	100.0	12.7	8.9	7.1	7.5

Source: GOI (2013C)

The sesamum has lost its share in total oilseeds acreage as well as production during the last four decades. The share of sesamum in oilseeds acreage has declined from 12.7 per cent in TE1983-84 to 7.5 per cent in TE2011-12, while output share too has declined from 4.9 per cent to 2.6 per cent during the same period.

[28] *TE2011-12 data includes data for both Uttar Pradesh and Uttarakhand for comparison purpose*

[29] *TE2011-12 data includes data for both Madhya Pradesh and Chhattisgarh for comparison purpose*

Table 8.4: Share of major states in sesamum production in India: TE1983-84 and TE2011-12

State	Share in all-India Production				Share in edible oilseed Production in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
West Bengal	10.5	14.5	15.1	21.3	33.0	23.0	17.5	23.3
Rajasthan	9.2	13.6	8.9	21.2	7.0	3.6	1.8	2.9
M.P.[30]	7.4	7.7	7.2	17.8	4.3	1.4	0.8	1.7
Gujarat	6.9	11.9	24.4	14.1	1.8	3.8	5.9	2.5
U.P.[31]	12.8	3.9	6.1	7.7	5.2	2.0	3.0	6.4
Karnataka	5.8	7.0	7.0	4.9	3.6	2.6	3.2	3.5
Tamil Nadu	6.3	9.2	10.4	3.5	3.3	3.4	4.2	2.7
A.P.	4.8	5.8	6.0	2.9	1.8	1.5	1.9	1.4
Maharashtra	7.6	12.3	6.3	2.2	3.5	4.8	1.5	0.4
Odisha	22.9	8.3	1.6	1.2	20.5	12.0	6.5	5.2
Others	5.7	5.9	7.0	3.1	0.3	0.2	0.2	0.1
All India	100.0	100.0	100.0	100.0	4.9	3.4	2.8	2.6

Source: GOI (2013C)

Sesamum was an important edible oilseed in states like West Bengal, Odisha, Rajasthan, Uttar Pradesh, Madhya Pradesh and Tamil Nadu accounting for more than 10 per cent of the total acreage in TE1983-84. The share in total oilseeds acreage varied from 10.7 per cent in Tamil Nadu to over 30 per cent in Odisha and West Bengal. However, sesamum share in total area under oilseeds declined significantly in most states, except Uttar Pradesh, Gujarat and Tamil Nadu between TE1983-84 and TE2011-1. However, sesamum is still an important oilseed in West Bengal, accounting for 23.3 per cent of total oilseeds production

[30] *TE2011-12 data includes data for both Madhya Pradesh and Chhattisgarh for comparison purpose*

[31] *TE2011-12 data includes data for both Uttar Pradesh and Uttarakhand for comparison purpose*

in the state. The share of sesamum in total production is 5-6 per cent in Odisha and Uttar Pradesh and in other states the share is small, ranging from less than one per cent in Maharashtra to about 3 per cent in Rajasthan and Karnataka. Sesamum has lost its share in total oilseeds production in almost all the states during the last forty years.

Shifts in Yield

As discussed in the earlier section, yield increases have been responsible for an increase in sesamum production in the country, in the same way as area under crop has witnessed a decline. However, yield levels are much lower than major sesamum producing countries and there are also considerable inter-state differences in the yield levels. Among the major producers, West Bengal has the highest yield, followed by Karnataka and Madhya Pradesh. Other states have yields lower than the national average. In the case of West Bengal, average yield has increased from 565 kg/ha in 1981-85 to 861 kg/ha in 2006-11. There has been a substantial increase in yields in Karnataka (from 289 kg/ha in 1981-85 to 530 kg/ha in 2011-12) and Madhya Pradesh (from 169 kg/ha to 425 kg/ha) during the last three decades (Figure 8.2). Gujarat and Uttar Pradesh have shown decline in sesamum yields in the recent years. At all India level, average yield has hovered around 385 kg per ha. However, average yield under Front Line Demonstrations under improved package of practices is much higher (874 kg/ha), which shows that there is a tremendous potential to improve crop yields even with existing technologies. Almost a similar potential exists in all major sesamum producing states as well.

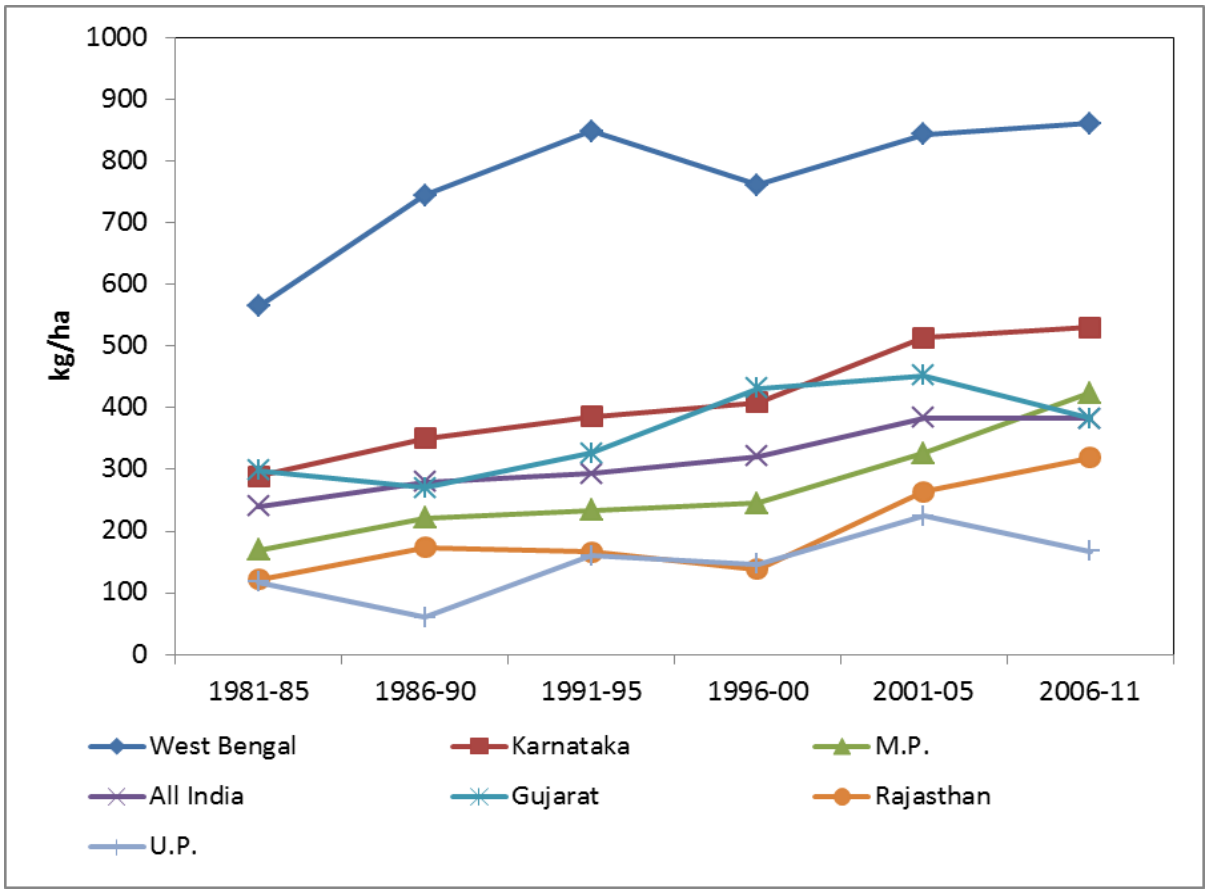
Growth Rates in Area, Production and Yield

The compound annual growth rates (CAGRs) of area, production and yield of sesamum in major sesamum producing states during the last three decades are summarized in Table 8.5. The findings indicate that area under sesamum declined significantly (-1.14%) during the last three decades, however, growth rates observed for different sub-periods show different trends. For example, area under sesamum increased significantly (2.31%) during the 2000s while the growth rate was significantly negative (-4.74%) during the nineties.

The individual states show a great variety of different trends for the analyzed period and sub-periods. Gujarat (3.65%) and West Bengal (2.53%) were the only states which recorded significant positive growth rates in sesamum acreage during 1981-2011. Negative trends,

both significant and non-significant were found in all other major sesamum growing states. During the 1980s, Gujarat, Karnataka, Tamil Nadu, Maharashtra and Odisha recorded significant positive growth rates, while in the next decade, Gujarat was the only state which witnessed significant positive growth rate. However, the situation improved in the last decade as four major producers, West Bengal, Rajasthan, Madhya Pradesh and Gujarat registered significant increases in area under the crop. Other states, namely, Uttar Pradesh, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra and Odisha had significant negative growth rates in sesamum acreage during the 2000s. Overall there has been a decline in area under sesamum cultivation in the country.

Figure 8.2: Changes in sesamum yield by major producing states and all India average: 1981-2012



Source: GoI (2013c) and authors' calculation

When it comes to production, the growth rate was highest (3.99%) during the decade of 1980s, which became significantly negative (-3.67%) during the 1990s but improved during the last decade. Among the top ten producers, Gujarat recorded the highest growth rate (6.61%), followed by Rajasthan (3.89%) and West Bengal (2.53%), while Tamil Nadu and

Odisha recorded negative growth rates between 1981-82 and 2011-12. During the 1980s, only two states, namely, Uttar Pradesh and Andhra Pradesh had negative growth rate in sesamum production and the number of states having negative growth rate increased to eight in 1990s. However, during the last decade, West Bengal, Rajasthan, Madhya Pradesh, and Uttar Pradesh showed significant increases in growth rates while Gujarat and Tamil Nadu experienced negative growth rates.

Table 8.5: Annual growth rates of sesamum area, production and yield in selected states, 1991-92 to 2011-12

States	***1980s***	***1990s***	***2000s***	***All***
Area				
West Bengal	-1.74	-0.14	5.62***	2.53***
Rajasthan	-0.34	-11.43***	8.14***	-0.18
M.P.	-1.92***	-4.59***	7.87***	-0.45
Gujarat	5.65**	3.04***	-5.03***	3.65***
UP	-7.56**	2.08	11.76***	-1.80**
Karnataka	4.57**	-3.19**	-0.81	-2.42***
Tamil Nadu	2.61*	-4.31***	-4.87***	-3.18***
A.P.	-0.39	-0.54	-5.66**	-1.79***
Maharashtra	6.94***	-10.25***	-9.86***	-5.33***
Odisha	4.00***	-13.73**	-2.41	-8.08***
All India	0.48	-4.74***	2.31***	-1.14***
Production				
West Bengal	3.10	-1.85*	5.93***	3.87***
Rajasthan	7.57	-17.25***	13.48*	3.89**
M.P.	4.82	-2.61	14.36***	3.20***
Gujarat	0.50	7.45	-6.29*	6.61***
U.P.	-14.32*	0.84	8.56***	2.10**
Karnataka	7.86**	-1.03	1.59	-0.09
Tamil Nadu	1.72	-0.48	-2.99**	-1.23**
A.P.	-2.89	-2.14	-3.33	-0.26
Maharashtra	7.95	-9.92	-9.33	-4.20
Odisha	5.46***	-19.83***	-2.23	-11.72***

All India	3.99**	-3.67***	2.56	0.71**
Yield				
West Bengal	4.92***	-1.72	0.29	1.31***
Rajasthan	7.93	-6.57	4.95	4.07***
M.P.	6.88*	2.08	6.02***	3.67***
Gujarat	-4.87	4.28	-1.33	2.86*
UP	-7.32	-1.22	-2.86	3.97***
Karnataka	3.15*	2.23	2.42	2.39***
Tamil Nadu	-0.87	4.00***	1.98	2.02***
A.P.	-2.51	-1.61	2.47	1.56***
Maharashtra	0.94	0.37	0.59	1.20***
Odisha	1.41*	-7.07***	0.19	-3.95***
All India	3.49*	1.13	0.24	1.87***

Source: Authors' computation using GOI (2013c) data

It is interesting to note that although area under sesamum witnessed a significant decline during the last three decades in most of the states and at national level, sesamum yields have shown significant positive growth rates in most of the state's growing sesamum during the 1981-82-2011-12 period. Although the yields have been increasing since the 1980s, rate of growth has declined during the last two decades. The number of states with significant positive growth rate in yield declined from four in the 1980s to only one in the 1990s and 2000s. During the last decade, Madhya Pradesh was the only state which registered significant positive growth rate (6.02%) and all other states had statistically non-significant growth rates indicating stagnation in yield growth rates. The above trends clearly indicate that performance of sesamum has not been satisfactory during the last two decades.

The classification of states based on growth rates in area and yield is presented in Table 8.6. Between 1981-82and 2011-12, five out of ten top producers were in BA category and one in the BB category, both of which are less desired classes. Only two states, West Bengal and Gujarat, were in the most preferred category "AA". During the 1980s, only Karnataka and Odisha were in the most preferred category of AA, while no state witnessed a significant increase in both area and yield (AA) during the 1990s. Most of the states were in either BC or CC category during the 1990s and 2000s. The above results show a dismal performance of sesamum crop productivity in the country during the last two decades.

Table 8.6: Classification of states according to growth in area and yield of sesamum

Type of association	1980s	1990s	2000s	1981-82 to 2011-12
AA	Karnataka, Odisha	-	M.P.	West Bengal, Gujarat
AB		-		-
AC	Gujarat, Tamil Nadu, Maharashtra	Gujarat	West Bengal, U.P., All India	-
BA	M.P.	Tamil Nadu, Odisha	-	U.P., Karnataka, Tamil Nadu, A.P., Maharashtra, All India
BB	-	-	-	Odisha
BC	U.P.	Rajasthan, M.P., Karnataka, Maharashtra, All India	Rajasthan, Gujarat, Tamil Nadu, A.P., Maharashtra	-
CA	West Bengal, All India	-	-	M.P., Rajasthan
CB	-	-	-	-
CC	Rajasthan, A.P.	West Bengal, U.P., A.P.	Karnataka,Odisha	-

Source: Authors' computation using GoI (2013c) data

The classification of major sesamum producing states based on estimated productivity growth rates and productivity levels are presented in Table 8.7. During the 1980s, five out of the top ten sesamum producing states had productivity higher than national average and three states, Karnataka, Odisha, West Bengal, recorded significant positive growth rates in yield while the other two, Gujarat, and Tamil Nadu, had significant negative growth rates. The number of states having yields higher than national average declined to four during the 1990s and 2000s, and only one state (Tamil Nadu), witnessed a significant growth in crop yields, while others experienced stagnation in sesamum productivity. All other states, with lower yields than the national average, recorded either statistically negative growth rate or non-significant positive/negative growth rates.

Table 8.7: Classification of states according to productivity levels and growth in productivity of sunflower in India

	Significant increase in yield	Significant decline in yield	Stagnant yield with positive sign	Stagnant yield with negative sign
1981-82 to 1990-91				
High Productivity	Karnataka, Odisha, West Bengal	-	-	Gujarat, Tamil Nadu
Low Productivity	Madhya Pradesh	-	Maharashtra, Rajasthan,	Andhra Pradesh, Uttar Pradesh
1991-92 to 2000-01				
High Productivity	Tamil Nadu		Gujarat, Karnataka	West Bengal
Low Productivity	-	Odisha	Madhya Pradesh, Maharashtra	Andhra Pradesh, Rajasthan, Uttar Pradesh
2001-02 to 2011-12				
High Productivity	-	-	Karnataka, Tamil Nadu, West Bengal	Gujarat
Low Productivity	Madhya Pradesh	-	Andhra Pradesh, Maharashtra, Odisha, Rajasthan	Uttar Pradesh
1981-82 to 2011-12				
High Productivity	Gujarat, Karnataka, Tamil Nadu, West Bengal	-	-	-
Low Productivity	A.P., M.P., Maharashtra, Rajasthan, Uttar Pradesh	Odisha	-	-

Source: Authors' computation using GoI (2013c) data

Problems and Prospects of Sesamum Cultivation

The main objective of this section is to analyze problems and prospects of sesamum cultivation in the major sesamum producing areas based on primary data collected through field surveys. Since West Bengal is the largest producer of sesamum in the country, with an estimated share of about 21.3 per cent of total production in the TE2011-22, it was selected for an in-depth study. We selected three districts, Nadia from high acreage and high yield category districts, Bankura from high acreage and low yield districts, and 24 Parganas from low acreage and high yield districts (Roy and Khan, 2013). The reason for this selection was that these categories of districts had potential for increasing production of oilseeds in the study areas. At the next stage, major oilseeds producing blocks in the selected districts and an appropriate number of villages in the selected blocks were selected for a household survey. From each selected village, an appropriate number of farmers representing different farm categories (marginal: 0-1 ha, small: 1-2 ha, semi-medium: 2-4 ha, medium: 4-10 ha and large: >10ha) proportional to the size in each district were selected with the condition that there are minimum 20 households in each category in the final household sample. Since farm sizes in West Bengal are very small, samples of large farmers were not included in the study, hence a total of 250 sample households, consisting of 165 marginal, 43 small and 42 medium farmers were selected.

General Characteristics of Sample Households

The average age of the respondents was 46.7 years and farmers in medium households were relatively older than those in small and marginal households. About 96 per cent of the sample households were primarily dependent on crop farming. The share of small (96.4%) and marginal farmers (97.7%) having crop farming as their main occupation was higher than medium farms (90.5%). The average years of schooling were quite high (12.7) and showed an increasing trend with an increase in farm size, indicating a positive relationship between higher educational achievement and greater economic affluence.

Further, the average family size for the sample households stands at near about 6 persons per family, with a low sex ratio. This gender bias in favour of males was observed consistently for all the size-classes concerned. It should also be noted that average family size, just as educational attainment, shows a positive relationship with farm size. In terms of

social demographics, more than half (53.6%) of sample households belonged to the Other Backward Classes, followed by the General Castes (22.8%), and the Scheduled Castes/Tribes (23.6%). Almost all sample households (99.6%) were headed by a male member, and a similar trend was observed for all farm sizes.

Table 8.8: Socio-economic status of sample households

Indicators	**Marginal**	**Small**	**Medium**	**All Farms**
Age (years)	46.5	43.2	50.5	46.6
Main Occupation (%)				
Crop farming	96.4	90.5	97.7	95.6
Dairy	1.2	0.0	0.0	0.8
Service	1.2	7.1	2.3	2.4
Others	1.2	2.4	0.0	1.2
Education (years of schooling)	11.8	14.5	14.6	12.7
Average Family Size (no)				
Male	3.0	3.0	3.5	3.1
Female	2.6	2.8	3.2	2.7
Social Groups				
General	22.4	28.6	18.6	22.8
SC & ST	53.9	54.7	51.2	53.6
OBC	23.7	16.7	30.2	23.6
Head of household (%)				
Male	99.4	100.0	100.0	99.6
Female	0.6	0	0	0.4

Source: Roy and Khan (2013)

Land Ownership and Cropping Pattern

The average size of operational holding in the study area was 1.23 hectares, ranging from 0.62 ha on marginal to 3.47 ha on medium farms. The incidence of leasing-in of land was found to be generally higher for the smaller farms (0.09 ha) compared to the large farm

households (0.02 ha). Majority (93.7%) of lease contracts/arrangements were on fixed cash basis, and a very few contracts were on fixed produce arrangements. About 80 per cent of area was irrigated and more than 96 percent of area covered under irrigation was irrigated through groundwater sources.

Table 8.9: Land ownership pattern on sample households

Indicators	**Marginal**	**Small**	**Medium**	**All Farms**
Total owned land (ha)	0.54	1.36	3.55	1.18
Leased-in land (ha)	*0.09*	*0.05*	*0.02*	*0.07*
Leased-out land (ha)	*0.01*	*0.01*	*0.05*	*0.01*
Total Operational holding (2+3-4)	0.62	1.40	3.47	1.23
Cropping Pattern (%)				
Kharif Paddy	33.1	34.7	37.1	35.2
Summer Paddy	25.7	26.5	34.0	29.7
Wheat	8.4	7.3	8.5	8.2
Rapeseed-mustard	19.2	16.8	11.8	15.4
Sesamum	12.8	13.9	7.4	10.5
Crop Yields (q/ha)				
Kharif Paddy	51.3	53.2	54.7	53.3
Summer Paddy	50.2	50.5	47.7	48.7
Wheat	24.4	25.8	27.5	26.1
Rapeseed-mustard	10.8	10.7	10.9	10.8
Sesamum	10.6	11.5	12.2	11.4

Source: Roy and Khan (2013)

The principal cereal crops grown in the area included kharif paddy (35.2%), followed by summer paddy (29.7%) and wheat (8.2%) and among non-cereal crops, a large area was devoted to rapeseed-mustard (15.4%), and followed by sesamum (10.5%) and sunflower. The average yield of kharif paddy was 53.3 quintals per hectare, and for boro (summer) paddy was 48.7 quintals per hectare. In the case of kharif paddy, average yield showed positive association between crop yield and farm size. In the case of oilseeds, average sesamum yield was 11.4 quintals per hectare, and it varied from 10.6 quintals on small

farms to 12.2 quintals on medium farms. The average yield of rapeseed-mustard was about 10.8 quintals per hectare in the study area.

Production, Retention and Marketed Surplus Pattern of Oilseeds

The average quantities of sesamum produced, retained for self-use and sold are shown in Table 8.10. It can be observed from the Table that average production increases as the farm-size increases, but in case of retention, it is observed that a progressively lower share of produce is retained for self-consumption/use and higher proportion is sold in the market with increase in farm-size. In case of small households, 68.3 per cent of total produce is sold in the market compared with 76.5 per cent in case of medium farms. Lastly, comparing prices received by different farm classes, it is observed that average price per quintal of produce was relatively higher in case of small and medium farms compared with marginal farms.

Table 8.10: Sesamum production, retention and sales pattern on sample households

Farm category	*Production(Qtl)*	*Retention(Qtl)*	*Quantity Sold(Qtl)*	*Price (Rs./q)*
Marginal	2.18	0.69	1.49 (68.3)	2688
Small	5.73	1.15	4.58 (79.9)	2762
Medium	7.03	1.11	5.92 (84.2)	2745
All Farms	3.66	0.85	2.8 (76.5)	2713

Source: Field Survey

Profitability and Risks in Sesamum vis-à-vis Competing Crop

In general, sesamum does not compete with other crops in the study area but acts as a complementary source of income from fallow land during the dry summer season. However, in some cases, sesamum competes with summer paddy for land. So profitability and risks associated with sesamum and summer paddy cultivation have been computed and the results are presented in Table 8.11.

The results show that profitability of sesamum is much lower than that of summer paddy as the net returns from sesamum were about one-third compared with summer paddy. The

average returns from sesamum were Rs. 6468 per ha and ranged from Rs. 7087 per ha on marginal farms to Rs. 9054 per ha on small farms. In case of summer paddy, average returns were Rs. 19052 per ha and varied from Rs. 17919/ha on small households to Rs. 19056/ha on medium farms.

Table 8.11: Profitability and risks of sesamum and competing crop (Rs./ha)

	Marginal	***Small***	***Medium***	***All Farms***
Sesamum				
Total Operational Costs	22503	24090	25181	23364
Gross returns	29590	33144	32928	29832
Net Income	7087	9054	7747	6468
Summer Paddy				
Total Operational Costs	32782	33671	34103	33203
Gross returns	52233	51590	53609	52255
Net Income	19451	17919	19506	19052
Coefficient of Variation				
Sesamum				
Yield	*52.9*	*45.6*	*42.0*	*49.9*
Price	*45.0*	*41.5*	*33.8*	*42.4*
Summer Paddy				
Yield	18.6	6.7	7.3	15.6
Price	16.5	5.6	6.3	13.8

Source: Roy and Khan (2013)

The results for risks associated with cultivation of sesamum clearly indicate that oilseeds cultivation is more risky compared to summer paddy. This is true in respect of risks associated with crop yield as well as price of output. The coefficient of variation was higher on marginal and small farms compared with medium farms for both the crops.

Access to Improved Technology and Markets

Table 8.12 summarizes the results obtained for farmers' access to improved technology, markets and information. It is interesting to note that all farmers interviewed used high-yielding varieties of seeds of sesamum. The State department of agriculture was found to be a major source of seeds (40.8%), followed by markets (38.8%) and progressive farmers (6%).

More than 14 per cent of the respondents purchased seed from other sources. The share of medium farmers buying seed from these two sources is less compared with marginal and small farmers. The awareness about minimum support price announced by the government was totally absent and none of the sample households had knowledge about MSP. Due to poor knowledge and dominance of traders, almost all farmers received lower market prices (less than MSP).

Table 8.12: Access to improved technology and markets (%)

	Marginal	Small	Medium	All Farms
Use of HYV (%)				
Yes	100.0	100.0	100.0	100.0
No	0.0	0.0	0.0	0.0
Area under HYV (%)	100.0	100.0	100.0	100.0
Source of Seed				
State Department of Agriculture	42.4	34.9	40.5	40.8
Market	38.2	37.2	42.9	38.8
Progressive farmers	3.0	14.0	9.5	6.0
Other Sources	16.4	14.0	7.1	14.4
Awareness about MSP (%)				
Yes	0.0	0.0	0.0	0.0
No	100.0	100.0	100.0	100.0
Price realization (%)				
≥MSP	0.0	0.0	0.0	0.0
<MSP	100.0	100.0	100.0	100.0

Source: Roy and Khan (2013)

Marketing Pattern of Sesamum

Sesamum is produced mainly for supplying in the market, as more than 75 per cent of the sesamum production in the study area was supplied to the market without any significant difference among farmers of different farm categories. All of the sample farmers reported problems in marketing of the sesamum produce. Majority of the farmers sold their produce

to local village traders and processing units. However, there were variations in preferences for particular marketing agencies among different size-class of farms.

Table 8.13: Relative importance of different marketing channels and price paid to farmers

Marketing Problems/channel	***Marginal***	***Small***	***Medium***	***All Farms***
Marketing problems (%)				
Yes	100.0	100.0	100.0	100.0
No	*0*	*0*	*0*	*0*
Marketing Channels (%)				
Local Village Trader	45.4	50.7	16.4	36.2
Processing Unit	42.8	30.3	63.3	46.9
Commission Agent	11.8	19.0	20.2	16.9
Average distance to sale point (km)	0.78	1.05	1.74	*0.99*
Price Received (Rs./q)				
Local Village Trader	2693	2806	2750	2772
Processing Mill	2673	2688	2744	2686
Commission Agent	2700	2860	2760	2783

Source: Roy and Khan (2013)

The study result showed that over 63 percent of medium producers and 50 percent of the small farmers sold their produce to local processing units and to local village traders, respectively. This is because of the fact that small and marginal farmers often take advances/loans from the local village traders under the implicit condition that they would repay their loan in terms of output at prices largely determined by the local traders. Due to small volumes and low bargaining power, small and marginal farmers do not have any power in price decision and hence, they are price takers. The average price received was lower for the resource-poor marginal farms. The only advantage for the smaller farms in preferring local traders is that they do not have to transport their output to great distances. This has been substantiated by the fact that the average distance to sale point is the lowest for the marginal farms, followed by small and medium farms.

Factors Constraining Sesamum Production and Productivity in West Bengal

When farmers were asked to list and rank the major constraints faced by them in sesamum cultivation in the study area, agro-climatic factors were ranked as the most important constraint (3.16), followed by technological (3.01), and economic (2.86) factors (Table 8.14). Among various agro-climatic factors acting as constraints in sesamum cultivation, factors such as drought at critical stages of crop growth (3.65), excessive rains (3.64) and extreme temperature variations (3.01) were perceived as the major ones. Other factors like poor grain setting (2.98) and crop failure or yield variability (2.54) were also considered as important constraints in the cultivation of sesamum. As perceived by the farmers, it was observed that poor crop germination (3.85), followed by non-availability of suitable varieties of sesamum seeds (3.54), incidence of diseases, insect-pests and weeds were the major technological constraints, on the other hand, factors like lack of irrigation facilities (2.24) and poor soil quality (2.19) were considered relatively less important constraints in the cultivation of sesamum.

Among the various economic constraints, the important ones were low and fluctuating prices (3.70), shortage of human labour (3.22) and high input costs (3.20). Other economic constraints, as perceived by the respondents, included price risks, and sesamum cultivation considered to be more risky and less profitable compared to other competing crops.

The problem of timely availability of seeds stands out as the most important (3.64) institutional constraint in cultivation of sesamum. Other important institutional problems included inadequate knowledge about diseases, non-availability of institutional credit and quality inputs, lack of awareness about improved package of practices due to poor extension services and irregular supply of electricity/power.

The post-harvest management and marketing related constraints were perceived to be least important by the respondents. Exploitation by market intermediaries (middlemen) is perceived to be the single most important constraint (3.94%) by all categories of farmers. This is followed by lack of processing facilities in the area, inadequate storage facilities, high transportation costs, lack of information about prices, and poor roads, infrastructure and market access.

Table 8.14: Constraints faced by farmers in sesamum cultivation on sample households

Constraints	***Marginal***	***Small***	***Medium***	***All***
Technological	***3.04***	***2.86***	***3.05***	***3.01***
Poor crop germination	3.88	3.71	3.88	3.85
Non-availability of suitable varieties	3.50	3.43	3.81	3.54
Incidence of diseases	3.22	2.93	3.23	3.17
Incidence of insect pests	3.22	2.95	2.91	3.12
Infestation of Weeds	2.95	2.86	3.09	2.96
Lack of irrigation facilities	2.31	2.02	2.21	2.24
Poor quality of soils	2.22	2.10	2.19	2.19
Agro-climatic	***3.15***	***3.14***	***3.25***	***3.16***
Drought conditions at critical stage of crop growth	3.65	3.57	3.70	3.65
Excessive rains	3.61	3.67	3.72	3.64
Extreme variations in temperature	2.92	3.10	3.26	3.01
Poor pod/grain setting	3.00	2.90	3.00	2.98
Risk of crop failure/high yield variability	2.55	2.45	2.58	2.54
Economic	***2.89***	***2.80***	***2.83***	***2.86***
Low and fluctuating prices	3.73	3.50	3.79	3.70
Shortage of human labour	3.21	3.10	3.40	3.22
High input costs	3.32	2.88	3.07	3.20
High price risk	3.13	3.02	3.12	3.11
High production risks	1.99	2.14	1.86	2.00
Low profitability	1.93	2.17	1.74	1.94
Institutional	***2.53***	***2.34***	***2.53***	***2.50***
Problem of timely availability of quality seed	3.61	3.60	3.77	3.64
Inadequate knowledge about disease/insect-pests management	2.93	3.02	2.95	2.95
Non-availability of institutional credit	2.76	2.45	2.65	2.69
non-availability of quality inputs	2.66	2.21	2.53	2.56
Poor input quality	2.45	2.43	2.70	2.49
Lack of awareness about improved	2.23	1.81	2.09	2.14

package of practices				
Lack of extension services	1.96	1.98	2.14	1.99
Irregular supply of power/electricity.	1.60	1.21	1.40	1.50
Post-harvest Management & Marketing	***2.11***	***2.00***	***2.03***	***2.08***
Exploitation by market intermediaries	3.96	3.95	3.81	3.94
Lack of processing facilities in nearby areas	2.33	2.17	2.26	2.29
Lack of proper storage facilities	2.33	2.02	2.07	2.23
High transportation costs	1.98	1.93	1.86	1.95
Lack of information about prices and market	1.95	1.83	1.86	1.92
Lack of appropriate transport means	1.79	1.64	1.98	1.80
Poor road infrastructure	1.50	1.48	1.44	1.48
Poor marketing system and access to market	1.00	1.00	1.00	1.00

Source: Authors' calculations from Field Survey Data from Roy and Khan (2013)
Composite indices constructed based on weights (severe=4, moderate=3, minor=2, not important=1) and the number of households in each category.

Suggestions for Improving production and Productivity of Sesamum

Farmers reported that sesamum production is limited by diseases, unsuitable varieties of seeds, unfavourable weather conditions, competition from more profitable crops and market related problems.

A series of suggestions were made by the sample farmers in order to increase sesamum yields and production in the region. According to them, Timely supply of high yielding variety seeds (93.6%) of sesamum was considered to be the most important means of improving sesamum yields in the sesamum growing regions of the country. In addition to timely supply of seed, they also felt that there was a need for improved dissemination of available and new technologies and practices of crop cultivation (76.4%). About two-thirds of the respondents complained about unavailability of agricultural labour during sowing and harvesting, which hampered normal farming time-schedule. Other suggestions given by the respondents to increase sesamum production included the development of more stable

organized markets (52.8%), improving gross margins to growers by reducing costs or increasing yields, soil testing facilities (47.2%) for proper application of fertilizers, etc.

Table 8.15: Suggestions for improving production and productivity of oilseeds

Suggestion	*Marginal*	*Small*	*Medium*	*All Farms*
Supply of HYV seeds	98.8	95.4	71.4	93.6
Better Training and extension services related to oilseeds	74.6	67.4	92.9	76.4
Human Labour Availability/ Mechanization	64.9	60.5	66.7	64.4
Organized market	57.0	53.5	35.7	52.8
Soil Testing facilities	43.0	46.5	64.3	47.2
Farm mechanization	36.4	44.2	61.9	42.0
Organic fertilizer at low price	23.6	23.3	4.8	20.4
Better irrigation facilities	1.8	9.3	2.4	3.2

Source: Roy and Khan (2013)

Chapter 9

Performance of Safflower: Recent Trends, Prospects and Constraints

Safflower is grown in about 60 countries around the world, the primary producers of which are India, United States, Mexico, Kazakhstan, Argentina, China, Ethiopia and Australia. Safflower is considered to be a minor crop with less than 1 million hectares area and around six lakh tonnes of production a year. Because of its minor status, reliable production statistics is often not available. India is the largest producer of safflower in the world producing approximately half of the world's annual safflower production followed by the USA. Safflower acreage and production around the world as well in India is witnessing a steady decline and wide fluctuations since the last 2-3 decades.

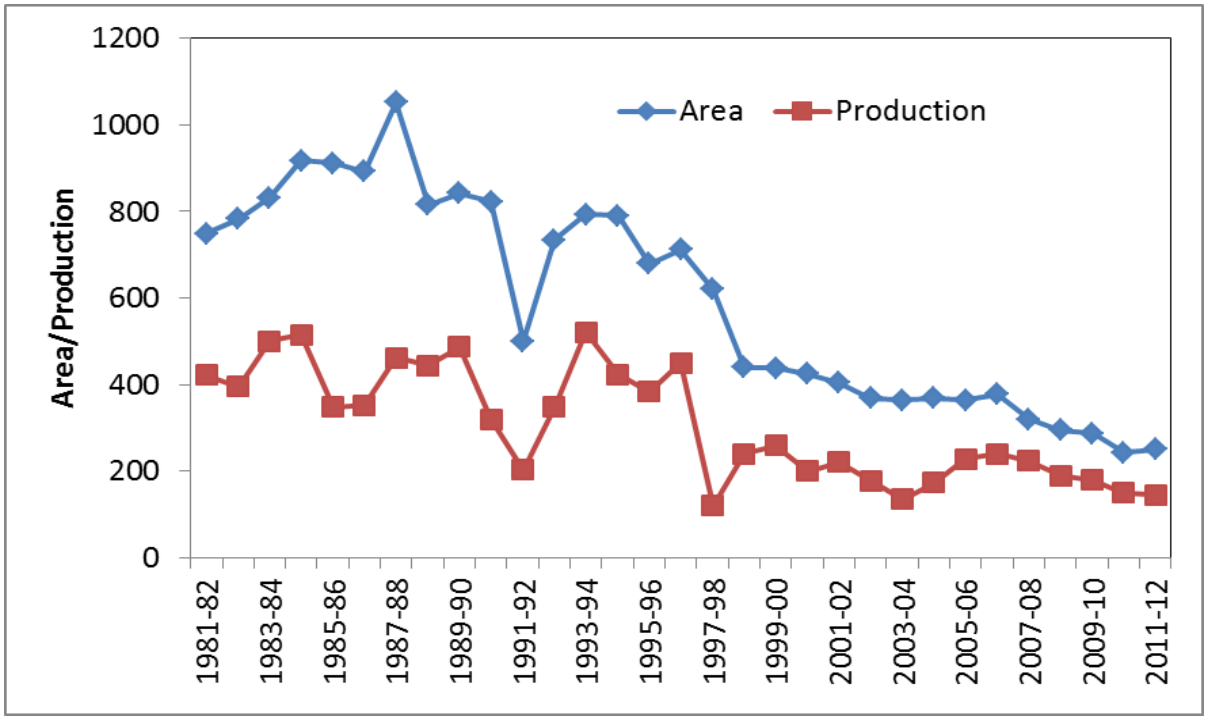
Trends in Area, Production and Yield

Estimates of area, production, and yield of safflower for the last three decades (1981-82 to 2011-12) are given in Figure 9.1 and Table 9.1. The area under safflower in the country was as high as one million hectare in 1987-88, however, it fluctuated between 243.8 thousand ha and 918 thousand ha in the subsequent years (Figure 9.1). Production of safflower, over the last three decades has followed similar trends as those seen in area. It hit a low of about 120,000 tonnes in 1997-98 and 145,300 tonnes in 2011-12. As is evident from the Figure, safflower acreage and production has been witnessing wide fluctuations and significant decline since the- late 1980s.

The area under safflower cultivation, which was about 787.3 thousand ha in the TE1983-84 declined to about 676 thousand ha in the TE1993-94 and reached its minimum at 260.7 thousand ha in TE2011-12. Safflower output, which was 439,400 tonnes in TE1983-84, declined to 375,500 tonnes in TE1993-94, and fell steeply to 158,200 tonnes in the next decade. However, productivity, witnessed a decline between TE1983-84 and TE1993-94,

and shown some improvement and increased from 513 kg per ha in the early-1990s to 606 kg per ha in the TE2011-12.

Figure 9.1: Trends in safflower area ('000 ha) and production ('000 tonnes) in India: 1981-82 to 2011-12



Source: GoI (2013c)

Safflower acreage and output have shown significant negative growth rates during the last three decades. The area under safflower, which recorded a significant positive growth rate (1.01%) during the 1980s, witnessed a significant decline during the 1990s (-5.15%) and 2000s (-4.74%). However, safflower production witnessed significant negative growth rates during all the decades, ranging from -1.17 per cent during the 1980s to -5.69 per cent during the 1990s. The average annual compound growth rate of safflower production was -3.80 per cent during the period 1981-82 to 2011-12. The performance of safflower in terms of yield has been consistently poor during the last three decades. Even though yields have increased, growth rates have either declined or stagnated. Safflower acreage and production has seen a significant decline since the last two decades. Moreover, variability in safflower production and acreage was also the highest during the 1990s. The above trends clearly show that the performance of safflower as an oilseed crop was the worst during the 1990s as there was a significant decline in area, production and even yield.

Table 9.1: Average area (million ha), production (lakh tonnes), and yield (kg/ha) of safflower in India: 1981-82 to 2011-12

	1981-82 to 1983-84	***1991-92 to 1993-94***	***1999-00 to 2001-02***	***2009-10 to 2011-12***
Area	787.3	676.1	422.5	260.7
Production	439.4	357.5	226.9	158.2
Yield	557	512	536	606
Compound annual growth rate (%)	***1980s***	***1990s***	***2000s***	***All Period***
Area	1.01***	-5.15***	-4.74***	-4.46***
Production	-1.17***	-5.69***	-1.60***	-3.80***
Yield	-2.16***	-0.57***	3.30	0.69
Coefficient of Variation (%)				
Area	10.0	24.4	16.5	41.0
Production	16.2	41.1	19.4	42.4
Yield	17.4	26.5	16.8	20.8

*** *Significant at 1, and 5 per cent level of significance, respectively*
Source: Authors calculations using GoI (2013c)

Shifts in Area and Production

Maharashtra is by far the largest safflower producer, with 161,300 ha of area planted under the crop and about 60 thousand tonnes of production during TE2011-12. The state accounted for 61.9 per cent of the total acreage in TE2011, down from about 71 per cent during the eighties and nineties. The share of production has also declined from about 74 per cent in early-1980s to about 57 per cent in TE2011-12. Karnataka is the second largest producer of safflower in the country with a share of 22.8 per cent in acreage and 27.6 per cent in production. Karnataka has been able to sustain its share in both acreage and production, over the years. While the share of Andhra Pradesh, which is the third largest producer of the crop, declined in planted area and production between TE1983-83 and TE2001-02, it marginally improved during the last decade. The share of other states has increased significantly, particularly during the last decade, and Gujarat has been a major contributor to this increase.

The share of safflower in total oilseeds acreage has declined from 4.3 per cent in TE1983-84 to 1 per cent in TE2011-12, while its share in total oilseeds production has declined from 3.8 per cent to 0.5 per cent during the same period. The share of safflower in oilseeds output is about half when compared to its acreage share, indicating low productivity level of the crop.

Table 9.2: Share of major states in area and production of safflower in India: TE1983-84 and TE2011-12

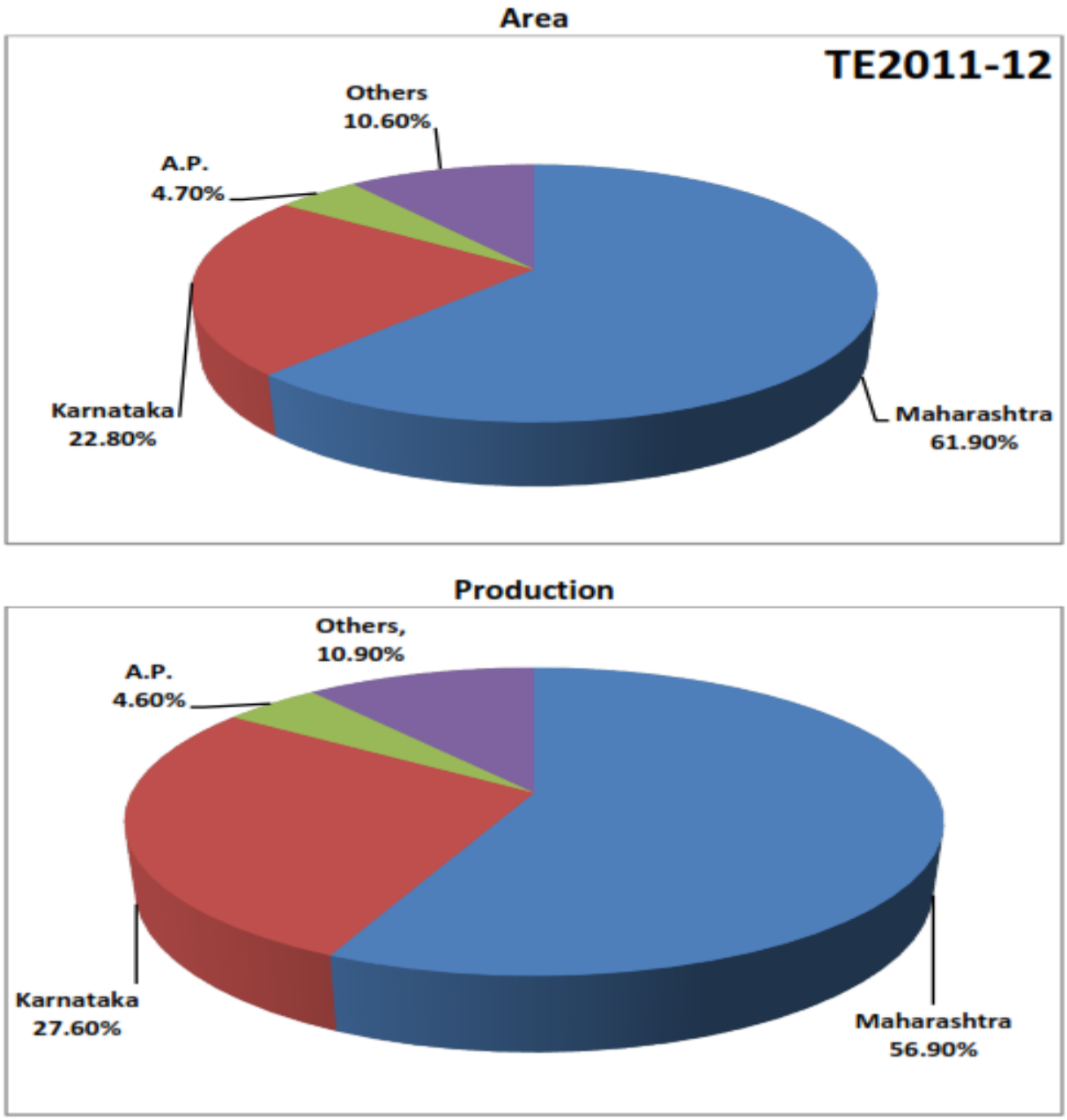
State	Share in all-India acreage/production				Share in edible oilseed acreage/production in state			
	TE1983-84	TE1993-94	TE2001-02	TE2011-12	TE1983-84	TE1993-94	TE2001-02	TE2011-12
Area								
Maharashtra	70.2	71.0	71.0	61.9	26.3	18.7	11.8	4.3
Karnataka	22.4	24.3	23.8	22.8	11.7	5.5	5.4	3.5
A.P.	6.5	3.2	4.2	4.7	2.5	0.7	0.7	0.6
Others	0.9	1.5	1.0	10.6	0.1	0.1	0.0	0.1
All India	*100.0*	*100.0*	*100.0*	*100.0*	*4.3*	*2.6*	*1.8*	*1.0*
Production								
Maharashtra	74.0	71.7	63.7	56.9	26.2	14.8	6.2	2.2
Karnataka	21.6	25.5	32.3	27.6	10.4	5.0	5.9	4.1
A.P.	3.7	1.8	2.9	4.6	1.1	0.3	0.4	0.5
Others	0.6	1.0	1.0	10.9	0.0	0.0	0.0	0.1
All India	*100.0*	*100.0*	*100.0*	*100.0*	*3.8*	*1.8*	*1.1*	*0.5*

Source: GOI (2013C) various sources.

In Maharashtra, the largest producer of safflower, the relative importance of safflower in terms of acreage has declined from 26.3 per cent in TE1983-84 to 4.3 per cent in TE2011-12. Production has shown more drastic decline from 26.2 per cent to about 2.2 per cent during the same period (TE1983-84 to TE2011-12). This is mainly due to an increase in area under soybeans. In Karnataka, the share in total oilseeds acreage has declined from 11.7 per cent

to 3.5 per cent between TE1983-84 and TE2011-12 and the production share has declined from 10.4 per cent to 4.1 per cent during the same period. Andhra Pradesh has also shown a similar trend. These results clearly indicate that the relative importance of safflower in oilseeds economy of the country has declined during the last 2-3 decades.

Figure 9.2: Share of major states in area and production of safflower in India: TE 2011-12

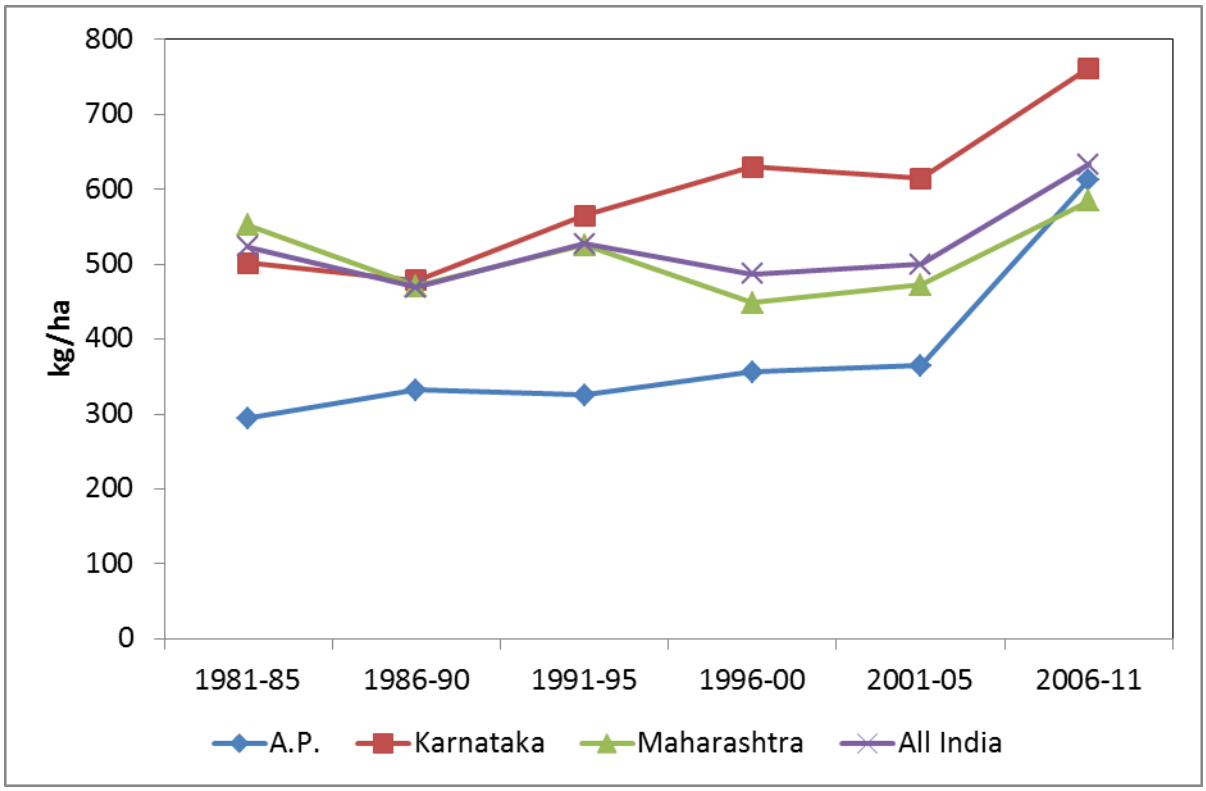


Source: GOI (2013C) various sources.

Yield Trends

The yield trends of safflower over the last three decades are depicted in Figure 9.3. The yield levels are much higher in Karnataka if we compare it with other states and with the all-India average. During the last decade, while productivity showed some improvement in almost all major safflower producing states, yields experienced wide fluctuations In Andhra Pradesh, average yield increasing from a low level of 325 kg per ha in early-1990s to 613 kg per ha in 2006-11, while in Maharashtra yields increased from 449 kg per ha in 1996-00 to 584 kg per ha in 2006-11. The fluctuations in yields have been generally higher than acreage fluctuations during the last three decade.

Figure 9.3: Changes in safflower yield by major producing states and all India average: 1981-2012



Source: GoI (2013c)

Growth Rates in Area, Production and Yield

The trends in compound annual growth rates (CAGRs) of area, production and yield of safflower during the last three decades are presented in Table 9.3. Unlike the improvement in area and production recorded for other oilseeds, safflowers performance has been dismal in both acreage and production. Two leading safflower producers, Maharashtra and

Karnataka, witnessed an increase in area under safflower in the 1980s, (Maharashtra's increase being significant). However, Maharashtra could not maintain the trend in the next two decades and reported a decline in acreage rate of growth. Maharashtra experienced significant positive growth rate in area under safflower during the 1980s, and thereafter crop acreage recorded an insignificant negative growth rate in the state. The growth rate worsened from -4.43 per cent during the 1990s to -6.54 per cent during the last decade. In case of Karnataka, crop area remained stagnant during the 1980s but declined significantly during the 1990s (-6.7%) and the 2000s (-5.37%). While, in Andhra Pradesh, CAGR in safflower acreage was negative during all the three decades and was significant during the 1980s and 2000s.

Almost a similar trend was observed in the safflower production for all India, which declined by 3.8 per cent during the period 1981-82 to 2011-12. The output growth for this period fluctuated between -1.17 per cent during 1981-1990 and -5.7 per cent during 1991-2000. Andhra Pradesh reported a negative and significant decline (-10.31 per cent) in production in the 80s. The 90s were not very promising for safflower production as well, since all major safflower-producing states reported stagnation. Maharashtra, the largest producer, reported an insignificant decline in production (-0.91 per cent) in the 80s and so did Karnataka (-1.06), the second largest producer. Andhra Pradesh witnessed a significant decline in production in the 80's at -10.31%, an insignificant decline in the 1990s and a positive stagnant growth in production in the last decade.

Safflower yields showed negative growth rate during the 1980s and 1990s but became positive during the last decade. The long term growth rate (during 1981-82 to 2011-12) shows that safflower yields have remained stagnant (0.69%). In the 80s, Maharashtra and Karnataka reported an insignificant decline in yield, at -2.53 and -2.32 per cent, respectively. Yield in Andhra Pradesh remained stagnant in the 80s and 90s and increased significantly in the last decade. During the 1990s, both area and yield declined significantly at all India level, and this shows a poor performance of safflower production in the country during the last 2-3 decades.

Classification of states on the basis of sign and statistical significance of area and production trends has been done in Table 9.4 and 9.5. The results of the classification of main safflower producing states on the basis of productivity and its growth shows that Maharashtra, with a

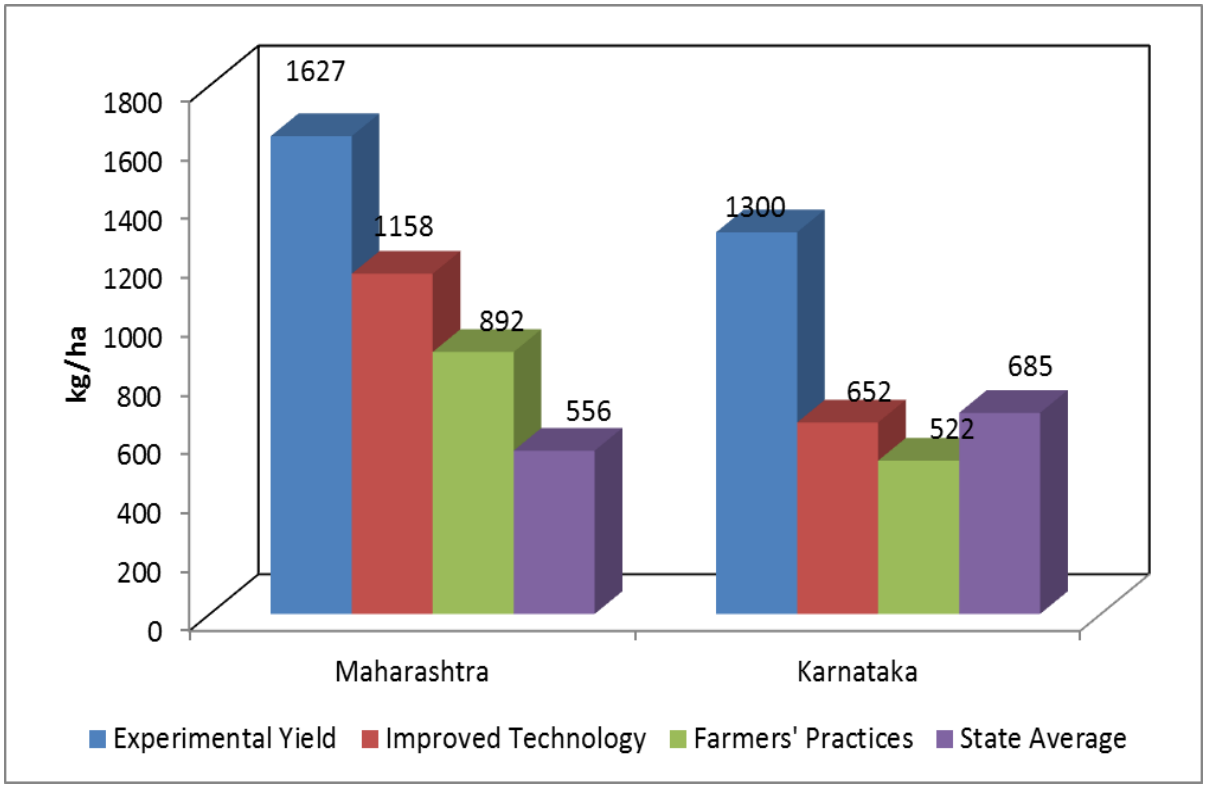
lower productivity than national average, reported a significant growth in yield in the entire period under study. The other two states, Andhra Pradesh and Karnataka, however showed positive but statistically non-significant growth rate. However, the picture in the sub-periods is different. In the 1980s, Maharashtra with high productivity and Karnataka with low productivity witnessed a decline in yield while in Andhra Pradesh, yield was positive. In the 1990s, Karnataka witnessed a positive growth rate in productivity as it shifted its position from low productivity to high productivity whereas Maharashtra, on the other hand, reported negative growth rate. During the last decade, in Maharashtra, yields were lower than the national average but it recorded a significant positive growth rate while the other two main producers showed positive but statistically non-significant growth rates. The crop yields are still lower compared to the world average and the potential yield in the country as is evident from Figure 9.4.

Table 9.3: Annual growth rates of safflower area, production and yield in selected states, 1981-82 to 2011-12

States	***1980s***	***1990s***	***2000s***	***All***
Area				
Maharashtra	1.66*	-4.43	-6.54***	-4.66***
Karnataka	1.29	-6.70*	-5.37***	-4.76**
A.P.	-10.69***	-3.73	-5.69***	-4.36***
All India	*1.01*	*-5.15**	*-4.74****	*-4.46****
Production				
Maharashtra	-0.91	-6.64	-3.67	-4.45***
Karnataka	-1.06	-4.07	-2.99	-3.21***
A.P.	-10.31***	-2.02	2.25	-2.12***
All India	*-1.17*	*-5.69*	*-1.60*	*-3.80****
Yield				
Maharashtra	-2.53	-2.31	3.07*	0.21
Karnataka	-2.32	2.82	2.52	1.63***
A.P.	0.42	1.78	8.43***	2.34***
All India	*-2.16**	*-0.57*	*3.30**	*0.69**

Source: Authors' computation using GoI (2013c) data

Figure 9.4: Potential yield and front line demonstration on-farm average yields of safflower in Maharashtra and Karnataka[32]: 2009-10 to 2011-12



Source: ICAR (2013c)

Table 9.4: Classification of states according to growth in area

	1980s	1990s	2000s	1981 to 2011
Significant positive growth in area	Maharashtra	-	-	-
Significant negative growth in area	Andhra Pradesh	Karnataka	Andhra Pradesh, Karnataka, Maharashtra	Andhra Pradesh, Karnataka, Maharashtra
Positive stagnant area	Karnataka	-	-	-
Negative stagnant area	-	Andhra Pradesh, Maharashtra	-	-

Source: Authors' computation using GoI (2013c) (2013) data

[32] *The data for Karnataka for FLD yields under improved technology and farmers' practices for 2010-11 were not available, so average includes 2009-10 and 2011-12.*

Table 9.5: Classification of states according to growth in safflower production

	1980s	1990s	2000s	1981-2011
Significant increase in production	-	-	-	
Significant decline in production	Andhra Pradesh	-	-	Andhra Pradesh, Karnataka, Maharashtra
Positive trend but statistically not significant	-	-	Andhra Pradesh	-
Negative trend but statistically not significant	Karnataka, Maharashtra	Andhra Pradesh, Karnataka, Maharashtra	Karnataka, Maharashtra	-

Source: Authors' computation using GoI (2013c) data, various issues

Table 9.6: Classification of states according to growth in safflower yield

	1980s	1990s	2000s	1981 to 2011
Significant positive growth in yield	-	-	Andhra Pradesh, Maharashtra	Andhra Pradesh, Karnataka
Significant negative growth in yield	-	-	-	-
Positive stagnant yield	Andhra Pradesh	Andhra Pradesh, Karnataka	Karnataka	Maharashtra
Negative stagnant yield	Maharashtra Karnataka	Maharashtra	-	-

Source: Authors' computation using GoI (2013c) data, various issues

Table 9.7 classifies states based on their growth performance in respect of area and yield. The classification of states based on growth rates in area and yield shows that between 1981-82 and 2011-12, none of the states were in the most preferred category, "AA". Andhra Pradesh and Karnataka were in BA category, and Maharashtra was in BC category.

Maharashtra was under AC classification for the period 1981-82 to 1990-91 and slipped to the CC category in the 90s and BA category in the 2000s. Karnataka, the second largest producer, was in the CC category in the 80s and moved to the BC category in the 1980s and remained in that category for the next decade. Andhra Pradesh shifted from BC category in the 1980s to CC category in the 1990s and jumped over to BA category in 2000s.

Table 9.7: Classification of states according to growth in area and yield of safflower in India

Type of association	1980s	1990s	2000s	1981 to 2011
AA	-	-	-	-
AB	-	-	-	-
AC	Maharashtra	-	-	-
BA	-	-	Andhra Pradesh, Maharashtra	Andhra Pradesh, Karnataka
BB	-	-		-
BC	Andhra Pradesh	Karnataka	Karnataka	Maharashtra
CA				-
CB	-	-	-	-
CC	Karnataka	Andhra Pradesh, Maharashtra	-	-

Source: Authors' computation using GoI (2013c) data

Classification of safflower producing states on productivity and growth in productivity is given in Table 9.8. Karnataka with high productivity and Andhra Pradesh with low productivity reported significant growth in yield in the entire period of study, while Maharashtra with low productivity witnessed a stagnant growth in yield. However, in the two decades of 1980s and 1990s, no state recorded a significant increase in yield. In the 80s, Maharashtra with high productivity and Karnataka with low productivity saw stagnation (negative growth rate) in yield while in Andhra Pradesh yield was stagnant with positive sign. In the 90s, Karnataka shifted its position from low productivity to high productivity and witnessed a positive but stagnant increase in productivity whereas; Andhra Pradesh remained at the same position as the last decade. Maharashtra again reported negative stagnant growth with a lower productivity. In the last decade, both Andhra and Maharashtra

reported significant increases in yield but at a lower productivity level. Karnataka, on the other hand had a non-significant increase in yield with a higher productivity.

Table 9.8: Classification of states according to productivity and growth in productivity

Yield Level	Significant increase in yield	Significant decline in yield	Stagnant yield with positive sign	Stagnant yield with negative sign
1981-82 to 1990-91				
High	-	-	-	Maharashtra
Low	-	-	A.P.	Karnataka
1991-92 to 2000-01				
High	-	-	Karnataka	-
Low	-	-	Andhra Pradesh	Maharashtra
2001-02 to 2011-12				
High	-	-	Karnataka	-
Low	Andhra Pradesh, Maharashtra	-	-	-
1981-82 to 2011-12				
High	Karnataka	-	-	-
Low	Andhra Pradesh	-	Maharashtra	-

Source: Authors' computation using GoI (2013c) data

The analysis clearly shows that area under safflower has declined significantly in last three decades and it is the increase in yield which has been a prime source of growth. Yield along with area played a significant role in contributing to output growth in Maharashtra in the 1970s. The good performance of Maharashtra and Karnataka in respect of area and/or yield is reflected in the national level performance because of their prominent positions in safflower economy. Unlike other edible oilseeds, where area was the primary source of growth in output, it was opposite in the case of safflower, where yield was the prime source of growth in output. However, current yield levels are much lower when compared to potential yields and yields of other oilseeds. This is because the crop is mostly rainfed and irrigation coverage if available, is very low.

Chapter 10

Summary, Concluding Observations and Policy Implications

Although agriculture contributes about 13-14 per cent of India's Gross Domestic Product (GDP), its importance in the country's socio-economic development goes well beyond this indicator as nearly half of the workforce (48.9%) is employed in agriculture. About 69 percent of the people live in rural areas, a large number of whom are poor and mainly depend on agriculture and allied sectors for their livelihoods. The Indian economy has undergone a significant transformation and contribution of the agricultural sector to GDP has continued to decline over the years, while that of other sectors (particularly services) has increased. The pace of structural transformation has accelerated in the post-reforms period.

The objective of agricultural policy in India, as in most of developing countries, has evolved from self-sufficiency and food security objectives to enhancing competitiveness of Indian agriculture. The country has achieved self-sufficiency in foodgrains production, in fact, it has become surplus in rice and wheat with mounting food stocks, but is facing serious shortages of oilseeds and pulses. India exported over 10 million tonnes of rice (basmati and non-basmati) and about 6.5 million tonnes of wheat during 2012-13, and became one of the largest exporters in the world. Although India is the 4th largest edible oil economy in the world and contributes about 10 per cent of the world oilseeds production, 6-7% of the global production of vegetable oil, and nearly 7 percent of protein meal, India is one of the largest importers of edible oils in the world. India imported over 11 million tonnes of edible oils during 2012-13, accounting for more than half of total consumption in the country. Oilseeds sector has an important position in the Indian agricultural sector, covering an area of about 26.5 million hectares (14.8% of gross cropped area) and total production of over 29 million tonnes in triennium ending 2011-12 (GOI, 2012). The oilseeds account for about 10 per cent of the total value of output from agriculture.

There are two major policy initiatives, which have significantly impacted the development of Indian oilseeds sector. One was the setting up of the "Technology Mission on Oilseeds" in 1986, which gave a thrust to Government efforts in augmenting production of oilseeds. This is evident by an impressive increase in the production of oilseeds from about 11 million tonnes in mid-1980s to 21.5 million tonnes in 1993-94. The other important feature which had a significant impact on edible oilseeds/oil industry has been the policy of liberalization and globalization in the early-1990s allowing free import of edible vegetable oils and reduction in import tariffs. This policy led to a significant increase in imports of edible oils and had some adverse impact on domestic production and remained stagnant at about 21-22 million tonnes. However, oilseeds production witnessed an increasing trend during the last decade and production went up from about 25 million tonnes in early-2000s to about 32.5 million tonnes in 2010-11, a record production. As per the 3rd advance estimates by Ministry of Agriculture dated May 15, 2014, the production of nine major oilseeds is about 32.4 million tonnes during 2013-14. Although, production of edible oilseeds has increased during the last decade, but share of imports in total consumption has also increased from about 33 per cent in 2005-06 to about 53.5 per cent in 2012-13. This has happened primarily due to rising demand for edible oils due to increasing income, changing food habits, etc. Given the rising demand for edible oils and need to reduce country's dependence on imports, there is a need to increase edible oilseeds production in the country. However, there are competing demands for agricultural land from various crops and scope for increasing area under oilseeds is very limited. Therefore, production of oilseeds can be increased only if productivity is improved significantly, and farmers get remunerative and attractive prices, better market access, technology and other infrastructure facilities. However, oilseeds farmers face various constraints as most of oilseeds are grown under rainfed conditions, and only 28 percent of the area under oilseeds is irrigated. Several biotic, abiotic, technological, institutional, and socio-economic constraints inhibit exploitation of the yield potential of crops and need to be addressed.

This study has tried to address some of the issues facing edible oilseeds sector by analysing performance of the sector, identifying major problems/constraints facing the sector and options for increasing oilseeds production in the country.

The study is based on both primary and secondary data pertaining to major edible oilseeds, namely, soybean, groundnut, rapeseed-mustard and sesamum. In order to study spatial and temporal trends and patterns of growth of edible oilseeds and sources of growth, and crop pattern changes, secondary data related to acreage, production and productivity of major oilseeds, were obtained from published sources. In order to identify major constraints in edible oilseeds production, primary data from households growing important oilseeds in the selected States (Madhya Pradesh and Maharashtra for soybean; Rajasthan, Madhya Pradesh and Uttar Pradesh for rapeseed-mustard; Gujarat and Andhra Pradesh for groundnut; West Bengal for sesamum and Karnataka and Andhra Pradesh for sunflower) were collected and analysed. The study uses household data collected by participating Agro-Economic Research Centres/Units from selected states. The study consists of about 2000 oilseeds growers, 490 soybean farmers, 316 rapeseed-mustard growers, 470 groundnut farmers, 250 sesamum farmers and 470 sunflower growers from selected states.

Findings

One of the most important changes observed in the Indian agriculture over the last three decades has been a change in cropping pattern. The most significant changes have been a shift of acreage from coarse cereals to rice, wheat and commercial crops, mainly fruits and vegetables and crop intensification. In relative terms, the share of cereals in the GCA has declined from about 59.6 per cent in TE1983-84 to about 51.7 per cent in TE2010-11. The share of oilseeds in GCA increased from around 10.5 per cent in TE1983-94 to 14.8 per cent in TE2010-11. The changes in area under oilseeds were more pronounced after the mid-80s owing to concerted efforts of the government. However, oilseeds acreage declined in the second-half of 1990s because of drought and falling edible oil prices due to cheap imports of palm oil from Malaysia and Indonesia. The share of pulses in total cropped area witnessed a declining trend during the last three decades, 13.3 per cent in TE1983-94 to 12.4 per cent in TE2010-11. The share of fruits and vegetables almost doubled from 2.2 per cent in early-1970s to 5 per cent in TE2010-11.

Decomposition of expansion in total cropped area (TCA) between TE1973-74 and 2010-11 shows that there was a marginal increase in the net sown area (NSA) during the 1970s and 1980s while during the 1990s and 2000s, the NSA declined. Irrigation expansion and

increased cropping intensity were major sources of growth in TCA indicating that most of the growth in TCA was due to crop intensification

An analysis of trends and patterns of growth in oilseeds throws up several interesting features. The area, production and productivity of oilseeds grew at an annual compound growth rate of 1.51 per cent, 3.06 per cent and 1.77 per cent respectively, during the period 1951-52 to 2010-11. Instability in area, production and productivity of oilseeds computed using coefficients of variation, showed that the highest variability has been observed in the case of production, followed by productivity and the lowest in area under oilseeds. However, performance of oilseeds during different decades provided quite interesting trends. Oilseeds production recorded the highest growth rate (5.8%) during the 1980s, followed by 2000s (4.89%) and the lowest (0.57%) during the 1990s. Almost a similar trend was observed in the case of variability in production. Yield variability has been a major factor for production variability during all decades, which is an indication of high yield risks associated with oilseeds. Yield appears to have been the primary source of growth in output of most edible oilseeds in the last decade compared to the area being the main source of growth prior to that. For example, acreage expansion was more important source of growth (55.7%) in oilseeds output than yield improvement (31.4%) between TE1983-84 and TE1993-94 but increase in yield contributed the most (60.3%), followed by area expansion (31.1%) to increase in oilseeds production during the TE2001-02 and TE2011-12. However, current yields of major edible oilseeds are much below the world average and potential yields and there are large variations in crop yields across different states/regions.

Soybean enjoys a dominant position both in terms of area and production as its share in output is over 40 per cent, followed by rapeseed-mustard being the second important crop with estimated share of 24.5 per cent of oilseeds output during TE2010-11. Groundnut, which was the predominant crop during the 1980s and early-1990s, lost its share and accounted for 23.7 per cent of total production and 20.6 per cent in acreage during TE2011-12. The share of kharif oilseeds has increased during the last two decades.

The top-four oilseed producing states, namely, Madhya Pradesh, Rajasthan, Gujarat and Maharashtra accounted for nearly 76 percent of the total production and over 64 per cent of oilseeds acreage in the TE2011-12. Madhya Pradesh alone accounted for 27.5 per cent of the total oilseed production in the country, with other three states contributing 48.3 per

cent. Madhya Pradesh, Rajasthan, Gujarat and Maharashtra have increased their share in oilseeds production during the last two decades while all other States have lost their share. Madhya Pradesh recorded the highest increase (11.7%) in its share, followed by Rajasthan (6.4%) and Maharashtra (5.3%) between TE1991-92 and TE2011-12. In the case of acreage shares, the situation is slightly different. Andhra Pradesh, which is the 5th largest producer of oilseeds in the country, accounted for 12.9 per cent acreage (second largest acreage) during TE1991-92 and 8 per cent (5th position) during the TE2011-12. Madhya Pradesh gained share in the area between TE1991-92 and TE2011-12 (from 16.4% to 27.6%). Other states like Rajasthan, Karnataka, Uttar Pradesh, Tamil Nadu, Odisha and Haryana lost their share in oilseeds acreage. Area expansion in Madhya Pradesh and Maharashtra has been primarily driven by soybean cultivation due to increase in exports of soymeal. Among the major states, Maharashtra, Rajasthan, Madhya Pradesh, Gujarat and West Bengal exhibited a healthy growth rate in the area, production and productivity during 1991-2011. However, there are wide variations in performance of different states during different time periods.

The growth in area and production of soybean has been unparallel during the last four decades, area has increased from 0.04 million ha in 1971-73 to about 9.8 million ha during the TE2011-12 while production has increased from about 30 thousand tonnes to 11.6 million tonnes during the period. Soybean productivity has also increased from 691 kg per ha in 1971-73 to 1186 kg in TE2011-12. Soybean crop has witnessed a phenomenal growth in production in the country during the last four decades, but growth has been driven majorly by area expansion, contributing about 80 per cent to increased production.

The analysis of relative profitability and risks associated with soybean farming vis-à-vis competing crops shows that average profitability of soybean is significantly higher than competing crops, which has led to an increase in area under soybean in major producing states during the last 2-3 decades. A yield gap analysis, which evaluates magnitude of the difference between crop yield potential and actual farm yields, shows that yield gaps between potential and achievable yields, between achievable and farmers' yields and total yield gaps between potential and farm level yields are quite high. Therefore, there is a need to understand reasons for extent of yield gaps and variations among different states/regions to suggest appropriate strategies for narrowing of such large gaps to help in increasing production of soybean in the country. The results of constraint analysis showed that

economic constraints were the most important constraints faced by soybean producers, followed by technological constraints, agro-climatic factors, institutional and post-harvest management and marketing related problems. Among technological constraints, incidence of insect pests, weed infestation, non-availability of suitable varieties, and poor crop germination were major constraints while risk of crop failure/yield variability due to biotic and abiotic stresses, poor grain setting, drought, and extreme weather conditions at critical stages of crop growth were important agro-climatic constraints. Poor extension services leading to lack of knowledge about insect pest and disease management, non-availability and poor quality of inputs and services including institutional credit were important institutional constraints being faced by soybean farmers. Among all constraints, incidence of insect pests and high risks were ranked as the most severe constraints in production of soybean.

Rapeseed-mustard is also an important oilseed crop in the country occupying the second position after soybean. The area under rapeseed - mustard increased from 3.46 million ha in 1971-73 to 4.03 million ha in 1981-83 and further to 6.34 million ha in 1991-93. During the 1990s, area under the crop declined and reached a level of 5.19 million ha in TE2001-02 but again increased during the last decade. Rapeseed-mustard acreage increased at an annual compound growth rate of about 1.82 per cent during the 2000s compared with a negative growth rate (-1.78%) during the nineties. Rapeseed-mustard production witnessed some decline during the nineties but picked up during the last decade. Rapeseed-mustard production, which recorded the highest growth rate (9.10%) during the eighties, could not maintain momentum and growth rate slipped to negative zone (-1.15%) during nineties but growth rate accelerated and production grew at 3.71 per cent during the last decade. The growth in production was mainly driven by productivity improvement during the eighties while both area expansion and productivity improvement contributed almost equally to the growth in production during the 2000s. Rajasthan accounts for 46.2 per cent of total rapeseed-mustard acreage and 48.5 per cent of production in the country and has increased its share significantly during the last 3 decades. Uttar Pradesh, Madhya Pradesh and Haryana are other major producers. The results of yield gap analysis show that yield of rapeseed-mustard can be increased by about 27-38 per cent by providing better technical support through effective extension services and provision of timely supply of quality inputs

and other services. The average profitability of rapeseed-mustard is significantly higher than competing crops. The average returns from rapeseed-mustard were the highest (Rs. 45,000/ha) in Uttar Pradesh, followed by Rajasthan (Rs. 39,198/ha) and the lowest (Rs. 11,7134/ha) in Madhya Pradesh. Despite rapeseed-mustard being more profitable compared to its competing crops, farmers still allocate less area to it, due to a high degree of risks in oilseeds cultivation. Institutional constraints are the most important constraints, followed by economic and technological constraints faced by the growers. Among institutional constraints, non-availability of quality inputs and services was the most important constraint. Further, dissemination of technologies and knowledge is an important instrument of bringing new technologies and knowledge to farmers but inadequate knowledge about disease and pest management and poor extension services were significant constraints being faced by farmers in the study area. Farmers suggested that assured supply of electricity, better irrigation facilities, availability of quality seeds, better market and production infrastructure and availability of quality inputs particularly plant protection chemicals would improve productivity and production of rapeseed-mustard.

The area under groundnut in the country has changed very little during the last 2-3 decades but there have been some regional shifts. Groundnut production is concentrated in relatively few states as more than 85 per cent of acreage is in five states, Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu and Rajasthan. Among major producers, Gujarat is the only state which has increased its share in groundnut acreage, while other producers like Andhra Pradesh, Karnataka, and Tamil Nadu have lost their share during the last two decades. Groundnut acreage in the country registered a significant increase during the 1980s, while groundnut acreage witnessed a significant decline in the nineties. The deceleration in growth in area under groundnut continued in the next decade and recorded a statistically significant negative growth rate. Groundnut production has remained approximately stagnant during the last three decades. While the aggregate national production and yields have increased marginally, there have been regional variations in the country. Groundnut cultivation is less profitable and more risky compared with competing crops and this has led to decline in area and production of groundnut in the country. Fluctuating yields and uneven growth in groundnut production is a serious problem in the country and farmers perceive economic constraints as the most important constraints in groundnut cultivation, followed

by technological, institutional and agro-climatic factors. Therefore, efforts are needed to address these constraints to increase production and productivity of groundnut in the country.

Sunflower has witnessed wide fluctuations in area and production in the country. Between 1991 and 1996 sunflower output was relatively stable at an average level of 1.2 million tonnes and acreage at 2.2 million but during the next five years, between 1996 and 2001, crop acreage declined to 1.5 million ha and production fell to 0.8 million tonnes. Production recovered during 2003-2007 but started declining in 2008-09 and reached the lowest level (0.52 million tonnes in 2011-12) in the last two decades. Sunflower is mainly grown in southern and western region of the country. Karnataka accounts for about half of the total area and has increased its share during the last one and a half decade. Top three states, namely, Karnataka, Andhra Pradesh and Maharashtra, account for about 90 per cent of total crop acreage and about 80 percent of production. Sunflower acreage, as well as production registered a significant decline during the last two decades. Post-harvest management and marketing related constraints were perceived as the most important constraints in sunflower cultivation. Exploitation by market intermediaries, lack of processing facilities, poor marketing system, lack of access to markets and reliable information about markets and price were identified as the main constraints by the respondents. Economic constraints ranked number two in terms of relative importance and high inputs costs was identified as the most important economic constraint, followed by low and fluctuating prices, shortage of human labour and low profitability of sunflower compared with competing crops. Inadequate knowledge about disease and pest management due to poor extension services, irregular supply of power for irrigation, non-availability of quality seed and poor quality of inputs were the major institutional constraints.

India is the second largest producer of sesamum in the world, accounting for about 18 percent of the world output and 22.9 per cent of the total acreage. The area under sesamum witnessed a consistent decline during the last four decades while production showed an increasing trend and production increase was primarily driven by yield improvements, even though Indian yield is among the lowest in the world. West Bengal, Rajasthan, Madhya Pradesh, Gujarat and Uttar Pradesh, top five producers account for over 80 per cent of the total sesamum production in the country. Agro-climatic factors were

ranked the most important constraints, followed by technological and economic constraints. Among various agro-climatic factors acting as constraints in sesame cultivation, factors such as drought at critical stages of crop growth, excessive rains and extreme temperature variations were perceived as the major ones. It was observed that poor crop germination, followed by non-availability of suitable varieties of sesame, incidence of diseases, insect-pests and weeds were major technological constraints.

Policy Implications

Edible oils constitute an important component of food expenditure in Indian households and accounts for about 6.7 per cent of food expenditure. The demand for edible oils in the country has shown a steady growth at an annual compound growth rate of about 5.5 per cent during the last decade. The per capita consumption has increased from about 12 kg per year in 2006-07 to 15.4 kg in 2012-13. The increase in demand for edible oils is attributable mainly to rising income levels and living standards and changing food habits. However, the current per capita consumption levels in India (at 15.4 kg/year) are lower than global averages (26.3 kg/year) and much lower than developed countries like USA (56.7 kg) and the EU (59.7 kg). In terms of volumes, palm oil, soybean oil and mustard oil are the three largest consumed edible oils in India, with respective shares of about 49.5 per cent, 15.8 per cent and 11.8 per cent, respectively in total oil consumption in 2012-13.

Demand for edible oils in India is expected to grow due to income growth, population increase, and changes in consumption patterns. However, there has been a significant gap between demand and supply of edible oils because of slow growth in domestic oilseeds production and shifting of acreage to other high-value crops. This gap was met through imports, which accounted for about 57 per cent of the total oil consumption in 2012-13. Domestic output has increased by about 2.7 per cent while imports have increased at an annual growth rate of about 9 per cent during the last decade. Given the positive macro and demographic fundamentals, edible oils have a favourable demand growth outlook over the medium-to-long term, but the obvious questions that arise are:

- Will India continue to be the largest importer of edible oils or will it achieve the goal of self-reliance in edible oils?

- What various policy options are available to policy makers to protect the interests of both oilseed producers through increased production and productivity and consumers through providing edible oils at affordable prices as well as meeting the growing demand?

As area under oilseeds has become almost stagnant during the last decade and there is little or no scope for extension of area, yield rates, although improved during the last decade but are much lower compared to world average and its potential, need to be stepped up. There are wide differences in yield rates across states and regions. Most oilseeds have not achieved their potential yields and there are large technology and extension gaps in the country. In many cases, actual yields are only about 40-50 per cent of the potential yield. There is a significant gap between the maximum attainable and the farm-level yields, which ranges from 10 to 30 percent. The scope for productivity enhancement in most of the oilseed crops is probably the highest among any group of crops and therefore, efforts must be made to enhance productivity.

The reasons for low yield and higher yield gaps are related to biophysical factors, socio-economic conditions, institutional and policy factors, levels of technology transfer and post-harvest management and market linkages. Lack of suitable varieties, high-costs and timely availability of inputs, incidence of diseases and insect pests, low and fluctuating prices, shortage of human labour, poor irrigation facilities, weak linkages between oilseed producers and processors and markets leading to exploitation by market intermediaries, poor extension services, are major constraints in increasing oilseeds production. Therefore, balanced and integrated crop nutrition, mechanization, and timely availability of quality inputs including seeds of improved varieties should be stressed for oilseed crops. Effective market interventions through the traditional market intervention tools like price support and effective procurement have to be complemented and strengthened through strengthening market infrastructure. Since the area under irrigation in oilseeds is very low (about 25%), efforts are needed to promote efficiency in water use through protective irrigation and increase area under irrigation. A well-functioning agricultural extension service is one of the critical inputs required for increasing productivity, improve income of oilseed producers and reduce poverty. It is, therefore, important to ensure that agricultural extension services are adequately funded, well-coordinated and regulated. Effective

linkages among research, extension and farmers involved in technology development and dissemination and provision of facilitating factors are essential.

Trade policy has a significant impact on the oilseed economy of the country including primary producers, processors, traders and consumers as more than half of the domestic requirement is met through imports. Price signals from international markets, as well as import tariff structure, play a key role in domestic price directions. There has been a debate about imports of oilseeds vs. crude or refined edible oils and the industry has been consistently arguing for liberal imports of edible oilseeds at lower import tariffs to overcome the problem of shortage of raw material being faced by the industry and low capacity utilization instead of refined edible oils. This proposal has merit but needs to be implemented carefully. Free import of oilseeds at low import duty, may have adverse impact on oilseed producers. We need to protect the interest of farmers and should ensure that the landed price (CIF) of oilseeds should not be lower than domestic prices; otherwise, this move might benefit the industry and to some extent consumers but the poor farmer would be the loser. Socio-economically equitable trade policy, which protects interests of both producers and consumers, with clear direction and continuity is needed to promote domestic production. Frequent changes and low tariff rates on edible oils during the last decade have created uncertainty for farmers in allocation of land for oilseeds cultivation.

The long-term strategy to make India self-reliant on edible oils should focus on technological change and effective extension system. New location-specific high yielding varieties, more coverage of oilseeds acreage under irrigation, appropriate pricing incentives, and institutional reforms would be the components of this strategy. Investment in oilseeds research and development is a key element and should be stepped up. The National Agricultural Research System (ICAR) should meet this challenge. Dissemination of technology is equally important and needs to be strengthened through effective agricultural extension system. Extending oilseed cultivation to non-traditional areas is worth considering. The potential of non-traditional edible oils like rice bran oil, corn oil, cottonseed oil, etc., needs to be exploited to boost India's oil output.

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Annexure I

Reviewer's Comments on Draft Report

1. Title of the Draft Study Report Examined:

Problems and Prospects of Oilseeds Production in India

2. Date of Receipt of the Draft Report: August 2014

(Report originally sent on June 19, 2014 for comments to IEG; Reminder sent on Aug. 11, 2014 and October 22, 2014)

3. Date of Dispatch of Comments: 27th October 2014

4. Comments of the Objectives of the Study:

Important and Appropriate

5. Comments of the Methodology:

Appropriate but explanation insufficient

6. Comments of the Presentation get up etc.

The topic addresses and important subject and deals with it adequately through secondary and primary data analyses. The report will be useful and the comments are merely suggestions for making the report more reader friendly, comprehensive and more useful

i. The presentation is neat, clear and commendable

ii. More justice can be done to the "Problems and Prospects" aspects of the name of the project by incorporating discussions ion trade in oilseeds/oils. The reviewer suggest addition and consolidation of a separate sub-section devoted to international trade in oil in chapter 3 with a few tables although imports may be of other substitute oils. Names of traded items and destination/source countries may be either mentioned or portrayed with pie diagram.

iii. The author may consider shortening the long paragraphs as in page 4-5 by sub-dividing them or editing them for easy reading.

iv. In chapter 3, the background is too long and talks about all crops. This is redundant, available in other sources and distracts attention. This part can be considerably condensed to maintain focus. The tables (general) are however useful and may be placed in the appendix.

v. Some repetitions or observed (as on page 56) and may be avoided.

vi. The methodology is rather incompletely explained. Apart from Chapter 2 where it is laid out, the method may be briefly reiterated or indicated by reference to chapter 2 wherever actually used.

vii. The concept of risk is not explained – whether variability as S.D., C.V. or the probability of lower yield (e.g. Table 4.1)

viii. The author may revisit the entire report and make sure that in each and every table, units are specified clearly (e.g. Table 4.8, 4.9, and many others), all required explanations provided in notes and the shares add up to 100% where relevant. In Table 3.15, data on production instead of yield could be more relevant along with decomposition of growth.

ix. Conversion of oils, sources of data and alternative uses may be specified in some detail in Table 3.8.

7. Overall View on Acceptability of the Report:

Acceptable after author makes the minor revisions

Annexure II

Action Taken Report on Reviewer's Comments

1. Title of the Draft Study Report Examined:

Problems and Prospects of Oilseeds Production in India

2. Date of Receipt of the Draft Report: August 2014

(Report originally sent on June 19, 2014 for comments to IEG; Reminder sent on Aug. 11, 2014 and October 22, 2014)

3. Date of Dispatch of Comments: 27th October 2014

4. Comments of the Objectives of the Study:

Important and Appropriate

5. Comments of the Methodology:

Appropriate but explanation insufficient

6. Comments of the Presentation get up etc.

The topic addresses and important subject and deals with it adequately through secondary and primary data analyses. The report will be useful and the comments are merely suggestions for making the report more reader friendly, comprehensive and more useful

Comment	***Action Taken***
i. The presentation is neat, clear and commendable	-
ii. More justice can be done to the "Problems and Prospects" aspects of the name of the project by incorporating discussions ion trade in oilseeds/oils. The reviewer suggest addition and consolidation of a separate sub-section devoted to international trade in oil in chapter 3 with a few tables although imports may be of other substitute oils. Names of traded items and destination/source countries may be either mentioned or portrayed with pie diagram.	Separate Section on Trade Patterns and Policies in Edible Oilseed Complex covering issues related to imports/exports of edible oils and oil meals and review of major trade policy interventions has been included in Chapter 3.
iii. The author may consider shortening long paragraphs as in page 4-5 by sub-dividing them or editing them for easy reading.	Sub-section has been added to make easy for the readers.

iv. In chapter 3, the background is too long and talks about all crops. This is redundant, available in other sources and distracts attention. This part can be considerably condensed to maintain focus. The tables (general) are however useful and may be placed in the appendix.	Main purpose of providing a comprehensive overview of performance of major crops was to understand cropping pattern shifts and identify factors underlying these changes at the all-India level as well as for major states. Oilseeds compete with other crops for acreage allocation, therefore it's important to understand this dynamics. In order to study performance of major oilseeds, trends in area, production and productivity have been analysed at all-India and state level.
v. Some repetitions or observed (as on page 56) and may be avoided.	We have gone through the report and edited properly.
vi. The methodology is rather incompletely explained. Apart from Chapter 2 where it is laid out, the method may be briefly reiterated or indicated by reference to chapter 2 wherever actually used.	Appropriate changes have been made in the respective chapters.
vii. The concept of risk is not explained – whether variability as S.D., C.V. or the probability of lower yield (e.g. Table 4.1)	The concept has been explained at appropriate places.
viii. The author may revisit the entire report and make sure that in each and every table, units are specified clearly (e.g. Table 4.8, 4.9, and many others), all required explanations provided in notes and the shares add up to 100% where relevant. In Table 3.15, data on production instead of yield could be more relevant along with decomposition of growth.	The report has been redone and every care has been taken to address the problems of units in the Table and component shares adding up to 100%. Production data has been included in the Table.
ix. Conversion of oils, sources of data and alternative uses may be specified in some detail in Table 3.8.	Sources of data and alternative uses of edible oilseeds mainly oil meals have been included in the Table.

7. Overall View on Acceptability of the Report:

Acceptable after author makes the minor revisions