DRAFT REPORT

ON

IMPACT OF WTO ON OILSEED GROWERS AND PROCESSORS IN INDIA: A CASE STUDY OF ANANTAPUR DISTRICT OF ANDHRA PRADESH

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Chapter-I

Introduction

Among all edible oilseeds groundnut seeds are having comparative advantage in India. While all other edible oilseeds and oil imports are rising, India remained as a consistence exporter of groundnut seed and groundnut oil and also the largest exporter of cake. India's oilseed and edible oil sector is experienced with many policy options to influence domestic demand and supply conditions. After a period of stagnation in oilseed production and high imports, yellow revolution during 1987-1993 increased oilseed production to such a level that India became self-sufficient by early 1990s. In the success of yellow revolution seed technology, policy of announcing minimum support policy and high import tariff structures play important role. However, this is not sustained for long period, our Resource Cost Ratio increased, and it leads to reduction in import tariffs and India is now importing about 5 Mt of edible oils annually. The uncertainty in the policy environment of oilseed sector adversely affecting even the groundnut sector, which is highly competitive as evidence from low NPC, ESR and DRC. Hence this study reviews the various policy options and their impact on producer, consumer, processor and government sector surpluses. Thestudy suggests that reducing tariffs on oilseed sector is having much positive influence on increasing efficiency in processing sector without much adverse effect on oilseed growers especially groundnut growers. However, the study suggests that, there is good scope for putting higher investment on Research and Development, improved seed production, availability of fertilizers and enhancing irrigated area under groundnut and increasing availability of raw material, improving road and other infrastructure in the groundnut growing areas to flourish groundnut processing sectors which will enhance the competitiveness of groundnut production and groundnut oil sector to sustain international competitiveness in the long run.

Out of 310 million tones of world production of edible oilseeds, India produces about 25 million tones with an area of 27 million hectors. Annual demand for oilseeds is about 27million tones. India's oilseed production is characterized by high-level fluctuations, mostly due to international competition. Oilseed sector in India is exposed to international trade since early 1990s. As a result of cheaper sources of edible oils like palm oil and soybean oil, India emerged as largest importer of edible oils in south Asia and in world in late 1990s and early 2000s. India's share of world imports is about 18% in palm oil and about 7% of soyaoil. South Asia as a whole is deficient in edible oils. Due to increasing population, high growth and increasing percapita incomes and ballooning middle class population demand surpasses the supply and in the coming years there is a growing gap between supply and demand(Table1.1).

India currently produces about 6 million tones of edible oil and annually it imports between 2 to 4 million tones of edible oils to meet its growing demand. It is projected that by the year 2010, India needs to import between 3.58 to 5.54 million tones of edible oils annually (Table 1.2). Table 1.3 reveals that Groundnuts are major source of edible oils followed by rapeseed and Mustard and Soybean. The minor oilseed crops like sunflower, sesame, niderseed and safflower contributes less than 5% each in total edible oil pool. However recently Ricebran oil(10%), coconut oil (7%) cotton seed oil(5.4%) and solvent extracted oils (4%) and tree and forest origin (1%).

Among all edible oils groundnut is foremost important in terms of area and production. Indian groundnut production is very competitive unlike many other oilseed crops. Hence this study focuses on in detail the problems in production, post-harvest management/processing and marketing of Ground Nut in the major groundnut growing district Anantapur with the following objectives

Table 1.1 Projected demand for edible oils in South Asian Region (1995,2000, 2015,2030)

(thousand tons)

year	Bangladesh	India	Nepal	Pakisthan	Sri Lanka	South Asia
Low income growth scenario						
1995	503	6684	85	1740	38	9063
2000	560	7421	99	2043	41	10178
2015	732	9428	145	3060	49	13438
2030	893	10807	192	4102	57	16084
High income growth scenario						
1995	507	6729	86	1752	38	9125
2000	573	7579	101	2088	41	10398
2015	771	9890	154	3218	50	14108
2030	951	11455	205	4362	59	17068
Low growth in per capita income						
1995	568	7341	102	1855	54	9934
2000	632	8151	118	2177	58	11153
2015	862	10355	174	3262	69	14712
2030	1009	11870	230	4373	80	17597
High growth in percapita income						
1995	572	7390	103	1868	54	10002
2000	646	8324	121	2226	59	11394
2015	870	10863	183	3431	72	15446
2030	1074	12581	246	4650	84	18673

Paroda and Kumar (2004)[1]

Table 1.2: Vegetable oil supply-demand gap 1985-2000

	2000	2005	2010	2015
high demand	9.97	12.10	16.17	20.16
low demand	9.81	11.55	14.83	18.16
supply(past trend)	6.05	7.30	8.30	9.30

[1] Paroda and Kumar(2004) Food Production and Demand Projections for South Asian Countries: Policy Implications for Indian Agriculture in (ed) Dorin and Jullien, Agricultural Incentives in India, Centre De Sciences Humaines.

gap				
High demand	3.92	4.80	7.87	10.86
low demand	3.76	4.25	6.53	8.86
Actual demand	10.20	11.70		

Source: NCAER (2005)

Table 1.3: Production Trends and sources of edible oils in India

(in lakh tonnes)

Name of oilseed	2002-03			2003-04		
	oilseeds	oils	% to total	oilseeds	oils	% to total
A. Primary Sources						
Groundnut	43.63	10.04	18.10	83.32	19.17	23.9
Rapeseed/Mustard	39.18	12.15	21.90	58.32	18.08	22.5
soyabean	45.58	7.29	13.14	78.54	12.57	15.7
sunflower	9.1	3	5.41	10.86	3.56	4.4
sesame	4.34	1.35	2.43	8.15	2.53	3.2
nigerseed	1.17	0.35	0.63	1.11	0.33	0.4
safflower	1.57	0.47	0.85	1.29	0.39	0.5
castor	4.28	1.71	3.08	8.04	3.22	4.0
linseed	1.73	0.52	0.94	1.79	0.54	0.7
Subtotal	150.58	36.88	66.47	251.42	60.39	75.3
B.Secondary Source			0.00			0.0
Coconut		5.5	9.91		5.5	6.9
Cottonseed		4.3	7.75		4.3	5.4
Ricebran		6	10.81		6	7.5
solvent extracted oils		2	3.60		3.3	4.1
tree & forest origin		0.8	1.44		0.8	1.0
sub total		18.6	33.53		19.9	24.8
total A+B		55.48	100.00		80.2	100.0
C. less Export and Industrial Use		8.2			9.2	
D.net availability of edible oils from all domestic sources		47.28			71	

Source: Ministry of Commerce Annual Report(2006)

I. Objectives

1. To estimate extent of adoption of High yielding varieties, improved agro-techniques and plant protection measures among groundnut farmers.
2. To assess efficiency in pre-harvest contracts, role of middlemen, post-harvest costs/practices from packing, loading, transportation and unloading
3. To identify market arrivals, marketing practices, market commission and price spread in major markets like Delhi, Calcutta and Mumbai and Hyderabad as well as international markets.
4. To assess economic viability of small-scale post-harvest infrastructure like processing facilities through public-private partnerships and oilseed grower/processor cooperative societies
5. To identify the best practices in contract farming systems in different states and its scope for adoption by groundnut farmers in the district.

Evolution of Government Policies and Price Trend

Pre-WTO scenario

In India demand for edible oils far exceed supply since early 1980s. Government imposes many trade restrictive policies to protect processors of edible oil sector. This led to the strategy of import substitution and infant industry protection. The restriction on oilseed exports until 1995 in fact hurt the growers and helped the processors (World Bank. 1997). Which resulted in higher Nominal Protection Coefficients for edible oils and which results in negative effect on the demand for oilseeds as the demand for oilseeds came from oilseed processing industry.

Transition period

With the opening up of trade the government fixed import duties on edible oils in order to protect the domestic industry. In practice the import tariffs are fixed at varying levels not exceeding the bound rate committed under the trade agreement. While high tariffs on import of edible oils are in the interest of the edible oil industry and perhaps oilseed growers, it could be at the expense of consumers who pay a higher price. The oilseed sector comes under the Essential commodities Act, which imposes legal controls on interstate movement and storage of oilseeds. This hindered the geographical specialization required for concentration of large scale processing plants. Further the small-scale sector reservation for the edible oils industry has been responsible for inefficiencies in processing sector especially for groundnut ghanies and expellers. Most (60-70 percent) of the crude edible oil refining units are small with capacity utilization as low as 40 percent (Chand, Ramesh. 2003).

Post-WTO scenario

In the recent years however, due to India's commitments made under the WTO, quantitative restrictions on import of edible oils have been removed and edible oils were put under open general license (OGL), which means that it can be imported without seeking any government approval. Recently duties have been reduced drastically on both refined and non-refined (crude) edible oil. Although India's share in world oilseed production is quite substantial and it is a big exporter of groundnuts and sesame it fails to meet the domestic consumption requirements of edible oils. The import duty rates on edible oils are revised periodically depending on the demand supply gap and the level of international prices to maintain domestic prices within specified range.

Recently the government has also permitted futures trading in several edible oils and oilseeds to manage the risks faced by processors and farmers. Traders as well as processors are expected to benefit from this measure. The importers of edible oils who are exposed to risks arising out of unprecedented price fluctuations in the international market can hedge their risk though the futures market. The wholesalers who buy from importers for distant deliveries can cover their risks against their forward purchases. The price discovery made in the futures markets can help farmers plan their sowing operations and decide on the commodity that will fetch remunerative prices. Crushers can hedge the oil by entering into forward purchases in the futures market and then make contract with the farmers based on the futures contract price of edible oils and oilseeds. As most of the futures markets are not reachable to small farmers, contract farming through crushers/processing units is a good option to pre-fix their harvest prices. Further Futures trading will bring in stability in prices, which would help in reducing the government's burden of price stabilization.

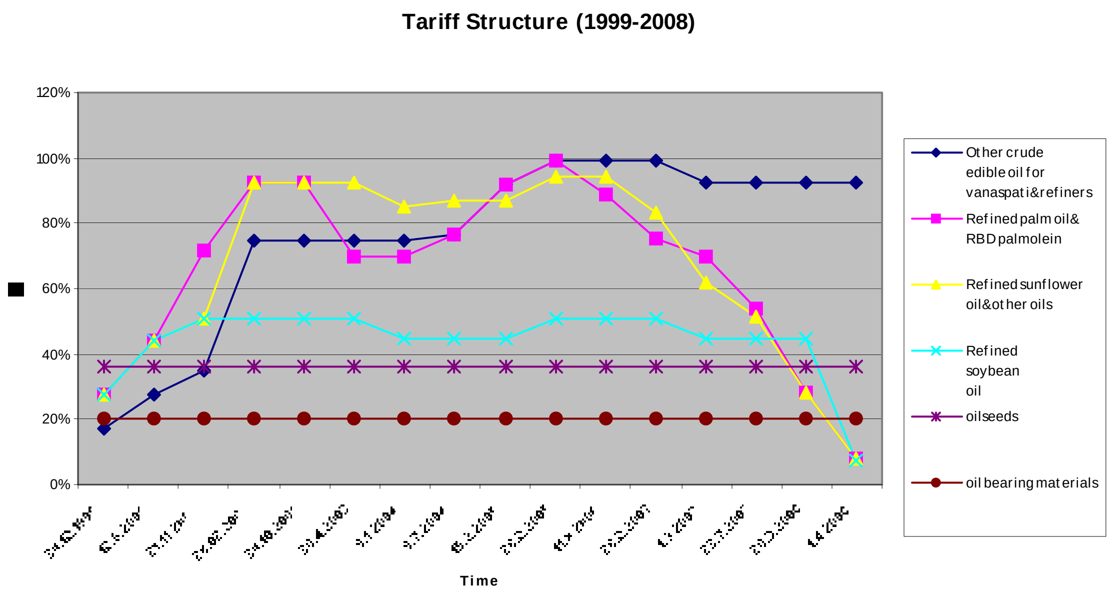
Table 1.4: Time line of liberalization of oilseed sector

Edible oils	
April, 1994	Import of RBD Palmolein Placed on OGL with 65% Import Duty.
March, 1995	Import of all edible oils (except coconut oil) placed on OGL with 30% Import Duty.
1996-97 (In Regular Budget)	Further Reduction in Import Duty to 20% + 2% Surcharge. Another Surcharge of 3% was Later Imposed Bringing the Total Import to 25%
July, 1998	Import Duty Further Reduced to 15%
1999-2000 (Budget)	Import Duty Revised to 15% (Basic) + 10% (Surcharge) =16.5%.
December, 1999	Import Duty on Crude Oils Raised to 25% (Basic)+10% (Surcharge) = 27.5% In Addition 4% SAD Levied on Refined Oils.
June, 2000	Import Duty on Crude Oils to 25% (Basic) + 10% (Surcharge) = 27.5% and on Refined Oils Raised to 35% (Basic) +10% (Surcharge) + 4% (SAD) = 44.04% Import Duty on Crude Palm Oil (CPO) for Manufacture of Vanaspati Retained at 15% (Basic) + 10%(Surcharge) = 16.5%.
November, 2000	Import Duty on CPO for Manufacture of Vanaspati Raised to 25% and on Crude Vegetable Oils Raised to 35%. Import Duty on CPO for other than Vanaspati Manufacture Raised to 55%. Import Duty on Refined Vegetable Oils Raised to 45% (Basic) + 4% (SAD) = 50.8% Import Duty on Refined Palm Oil and RDB Palmolein Raised to 65% (Basic) + 4% (SAD) = 71%.
March, 2001	Import Duty on Crude Oils Raised to 75% Except Soybean Oil. The Duty on Refined Oils Including RDB Palmolein Raised to 85% (Basic) Except in the Cases of Soybean Oil and Mustard Oil Where the Duty is Placed at 45% (Basic) SAD Levied on Refined Oils.
October, 2001	Import Duty on Crude Palm Oils and Its Fractions, of Edible Grade, in Loose or Bulk form Reduced form 75% to 65%.
November 2001	Import duty on crude sunflower oil or safflower oil reduced to 50% upto an aggregated of 1,50,000 MTs(TRQ) of total imports of such goods in a financial year subject to certain condition Import duty on refined rape, cozla or mustard oil reduced to 45% upto an

	aggregate of 1,50,000 MTs(TRQ) of total imports of such goods in a financial year subject to certain condition
March 2002	Status quo on import duty structure of vegetable oils/edible oils maintained. Import of vanaspati from Nepal be levied SAD four percent
27th August 2002	SAD four percent on import vanaspati from Nepal with withdrawn
30.4.2003	Custom duty on RBD palm oil and RBD pallmolein reduced from 85% to 70% and SAD four percent on these oils withdrawn
6.6.2003	NDDB, STC, NAFED, STCL, CWC and State Co-operative marketing Federation/Civil Supplies Corporation have been designed under TRQ for import of crude sunflower seed or safflower oil or fraction there of and refined rape, cozla or mustard oil at confessional rates. In addition to CWC, STC have also designed to import of vanaspati from Nepal under TRQ.
10.7.2003	In addition to agencies projects and equipment corporation of India Ltd. (PEC) have also been designed to import crude sunflower seed or safflower oil or fraction there of and refined rape, colza or mustard oil at concessional rates.
1.8.2003	For import of crude palm oil @ 65% duty specification has been prescribed as having an acid value of two or more and total carotenoid (as beta carotene) in the range of 500-250 mg/kg, in loose or bulk form
23.10.2003	CWC has been divested of its role as an agent for importing duty free vanaspati from Nepal under TRQ. STC is the sole agency for the same
8.10.2004	SAD abolished in commodities including edible oils and oilseeds imports
16.01.2004	Duty on non-edible grade oils reduced from 30% to 20% for the manufacture of soaps
12.5.2004	Procedure announced for imports under TRQ of 1,50,000 tonnes each of crude sunflower seed or safflower oil or fractions thereof and refined rape, cozla or mustard oil at the confessional duty of 50% and 45% respectively. The imports have to be completed before march 31 of each financial year.
23.06.2004	For import of vanaspati at zero percent duty from Nepal, at the date has been extended for three months for the year 2003-04 i.e., upto 5.9.2004 and for 2004-05 the period will be from 6.9.2004 to 5.3.2005. The STC will be the sole agency to make imports of vanaspati up to the quantity of 1lakh MTs on annual basis
8.7.2004	In the annual budget Govt. the duty on refined palm oil/palmolein has been increased to 75%. The excise on food grade hexane has been reduced from 32% to 16%. An education cess has been levied on excise and customs duty
4.2.2005	For import of crude palm oil @65 % the specification of carotene value revised to 250 mg/kg to 2500 mg/kg and acid value four
15.2.2005	Import duty on crude palm oil and its fraction and refined palm oil. RBD palmolein have been increased from 65% to 80% and 75% to 90% respectively
28.2.2005	Addition of SAD 4% on all edible oils(including refined and crude)
11.8.2006	Reduction of duty from 80% to 70% on crude palm oil, 90% to 80% on refined palm oil
oilseeds	
December 1992	Exports of safflower seed allowed subject quantitative ceiling of 2500 tonnes
March 1993	Export ceiling enhanced to 7500 tonnes for safflower seed
May 1993	Ceiling raised to 50000 tonnes for safflower seed
August 1993	Export of rapeseed-mustard allowed subject to quantitative ceiling
October 1993	Export of sesame seed allowed subject to quantitative ceiling
Union budget 2000-2001	Free import of all oilseeds at 35% import duty has been allowed without any quantitative licensing requirements
	Import of oilseed (other than seed quality), such as soybean, groundnut (kernel), linseed, rape/cozla seed, mustard seed, sunflower seed, palm kernel, cottonseed, sesame seed, mango, kernel, niger seed made free. Quarantine restrictions apply on import rape/cozla seed, sunflower seed
	Import of copra allowed through STC

	Import of flours and meals of oilseed including soybean (but other than those of mustard) made free
	Import of rice bran, groundnut oil cake, soybean oil cake, cotton seed cake (decorticated), sunflower seed, oil cake, rape/cozla/mustard oil cake, copra oil cake, sesame oil cake, maize bran etc., made free
	Import duty on oilseeds, such as, soyabean, groundnut (inshell), groundnut (kernel), linseed rape/cozla seed, mustard seeds, sunflower seed, palm kernel, cottonseed, sesame seed, mango kernel, niger seed levied @30% (basic) and four percent (SAD) which is equal to 35.2%.
	Import copra levied @70%+four percent SAD=76.8%
	Import duty on rice bran, soybean oil cake, groundnut oil cake, cotton seed oilcake(decorticated), sunflower seed oil cake etc levied at the rate of 15%
08.01.2004	SAD abolished in import of commodities including oilseeds
8.7.2004	In the UPA government budget, the two percent education cess has been levied on import of oilseeds, which makes the total duty on oilseeds 36.1%

Figure 1:



Outline of the Report

The first chapter describes the problem and objectives, the second chapter deals with Technological Growth and investment in R&D of groundnut production and processing, third chapter deals with Technical efficiency of production and processing sector in Anantapur District, fourth chapter deals with Market Integration of Groundnuts, oil and cake and fifth chapter deals with simulations and policy options to increase competitiveness of groundnut oil complex.

Table 1.5: Structure of import tariffs as on March 2008

VIII. Edible Oils (Crude)	Actual		Bound
Soyabean Oil	40		45
Palm Oil (for manufacture of vanaspati)	45		300
Groundnut Oil	85		300
Sunflower/ Safflower	40		300
Coconut Oil	85/100		300
Rapeseed Oil	75		75
Colza or Mustard Oil	75		75
Castor Oil/ Tung Oil	85/100		100
Other Oils	85/100		300
Safflower	75		300
IX. Edible Oils (Refined)			
Soyabean Oil	40		45
RBD Palmolein	52.5		300
Palm Oil	52.5		300
Groundnut Oil	85		300
Sunflower/ Safflower	50		300
Coconut Oil Edible grade	85		300
Coconut Oil Other	100		300
Rapeseed Oil	85		75
Colza or Mustard Oil	85		75
Castor Oil/ Tung Oil	100		100
Safflower	85		300
Other Oils edible grade	85		300
Other Oils other than edible grade	65		100/300
With effect from 1.3.2007,All edible oils have been exempted from additional duty of customs of 4%.			
Department of Revenue , Ministry of Finance.			

Chapter-II

Trends in Production and Area: Sources of Growth

Among all oilseeds, India has comparative advantage in production of ground nut oil, which is known from its continuing performance as frequently exported commodity (including seed, oil and cake) even during the periods of surge in edible oil imports after liberalization. Groundnut occupies about 28% of total area under oilseeds and 32% of production of total oilseeds in India. Groundnut oil is a close substitute for other oilseed crops like soyaoil, palm oil. Due to cheap imports of soyaoil and palm oil in post-WTO period sequentially in many years, volatility of prices for groundnut oil increased which negatively affected both groundnut cultivators and processors in India.

High volatile prices may also results in reluctance of farmers in adoption of high cost modern technology, reduces investment in up gradation of processing units, resulting in increased inefficiency in both production and processing of edible oils. But on the other hand, being traditionally competitive crop in India, there is scope for copping with this new challenge by increasing efficiency of both producers and processors through contract farming, technology development and adoption, risk coping and risk sharing strategies taking advantage of growing market by increasing market share for both domestic and export purpose (Srinivasan, 2004).

Production trends and competitiveness

With the inception of Technology Mission on Oilseeds (TMO), production of oilseeds in India increased significantly, from 11 Mt in 1986 to 25Mt in 1988. But from late-1990s, this production has been highly unstable-it declined to 20 mt in 1999 and further to nearly 15 mt in 2002, but regained to 1998 level of 25 mt in 2003-04. This had consequences to evolve appropriate policies for meeting the domestic demand of edible oilseeds. India meets about 40% of its total edible oil demand (10 mt) every year through imports.

Increased oil demand and fluctuating production of oilseeds after mid-1980s, low TFP growth due to intermittent withdrawal of some of the components of Technology Mission on Oilseeds(TMO) and more dependent on area expansion increased dependence on imports. The growth in production of total oilseeds was robust (7.6%) during 1986-95. it was due to both area expiation (4.3) and yield increase (Table 2.1). However, growth in production did not sustain during 1996-2005 and turned out to be negative due to decline in both area and yield. The decline in production of oilseeds is due to low international edible oil prices coupled with implementation of WTO rules regarding tariffication and elimination of non-tariff barriers and high domestic prices, results in surge of imports from world market at cheaper rates.

Table 2.1: Annual compound growth rates of oilseeds in India

		Groundnut	Rapeseed/mustard	Soybean	Sunflower	Total oilseeds
1950-65	Area	3.9	3			2.7
	Prod.	4	3.4			3.3
	Yield	0.1	0.4			0.6
1968-80	Area	-0.1	0.9	29		0.1
	Prod.	1.2	0.8	34		1.1
	Yield	1.3	-0.2	5		0.9
1986-95	Area	2.2	6.9	15.8	12.9	4.3
	Prod.	3.9	9.2	20.7	17.4	7.6
	Yield	1.7	2.6	4.1	4	3.1
1996-05	Area	-3.1	-4.2	4	-5.8	-2.1
	Prod.	-3.9	-3.1	2.8	-7.1	-2.1
	Yield	-0.8	1.1	-1.1	-1.4	0.1

Decomposition of growth

The study has revealed that area-effect dominated over yield effect in increased production of oilseeds during 1987-94 (Table 2.2). However during 1996-05 area effect became negative for two major oilseeds viz. groundnut and rapeseed/mustard after mid-1990s. This resulted in a negative area and yield-effect in total oilseeds production. Interestingly, these two oilseeds contribute about 60 to total oilseeds production.

Data has shown positive yield growth in both the periods, largely due to the residual effect of TMO. Bringing additional area under oilseeds that belongs to marginal and non-irrigated conditions for cultivation of short duration oilseeds and bridging large yield gaps by promoting improved management practices and supplying high-yielding quality of oilseeds are the ways to increase both yield and area under oilseeds.

Table 2.2: Sources of Growth in Production of Various Oilseed Crops (1987-1993-94) during TMO

Crop	Increase in Production (%)	Area Effect	Yield Effect	Interaction Effect
Groundnut	34.35	53.21	39.56	7.23
Rapeseed and Mustard	92.08	68.37	19.41	12.22
Soybean	266.03	65.04	12.81	22.16
Sunflower	230.53	70.90	11.04	18.05
All	71.72	52.63	34.39	12.93

Source: Gulati, Sharma and Kohli(1996) Self-sufficiency and allocative efficiency: case of edible oils, EPW, March 30, 1996

Table 2.3: Sources of Growth in Groundnut Production State wise (1975 to 2004)

		1975-1984	1985-1990	1991-2000	2001-2004
AP	Growth In Output	30.8	29.2	-16.5	-13.3
	Area Effect	-2.2	-0.1	-21.7	-12.5
	Yield Effect	33.7	29.7	6.2	-0.8
	Interaction Effect	-0.7	-0.4	-1.0	0.1
Bihar	Growth In Output	-15.3	22.5	38.8	120.4
	Area Effect	-28.3	4.8	11.3	109.2
	Yield Effect	18.1	17.9	25.2	6.5
	Interaction Effect	-5.1	-0.2	2.3	4.7
Chattishgarh	Growth In Output	20.0	293.8	-50.5	61.5
	Area Effect	2.6	96.9	41.3	-2.7
	Yield Effect	17.0	195.8	-73.7	65.5
	Interaction Effect	0.4	1.1	-18.2	-1.3
Gujarat	Growth In Output	166.7	-27.7	40.2	66.6
	Area Effect	29.8	-0.7	-26.5	20.2
	Yield Effect	105.5	-27.1	75.6	42.8
	Interaction Effect	31.4	0.2	-8.9	3.6
Haryana	Growth In Output	106.3	58.6	53.0	33.4
	Area Effect	15.4	-2.5	8.1	14.1
	Yield Effect	78.8	61.7	43.7	18.6
	Interaction Effect	12.1	-0.6	1.2	0.7
Jharkhand	Growth In Output	84.0	-14.8	11.4	131.5
	Area Effect	25.4	-5.6	-28.5	42.6
	Yield Effect	46.7	-9.2	46.9	70.3
	Interaction Effect	11.9	0.0	-7.1	18.6
Karnataka	Growth In Output	13.4	4.9	25.8	-51.3
	Area Effect	5.9	1.1	0.4	-15.9
	Yield Effect	7.1	3.8	25.3	-39.4
	Interaction Effect	0.4	0.0	0.1	4.0
Kerala	Growth In Output	-9.1	-30.1	-23.2	-1.9
	Area Effect	-16.5	-18.9	-22.6	-6.9
	Yield Effect	8.8	-11.0	-0.7	5.8
	Interaction Effect	-1.4	-0.3	0.2	-0.7
MP	Growth In Output	10.6	5.0	9.1	14.4
	Area Effect	-19.7	-7.1	0.1	7.2
	Yield Effect	37.8	12.4	9.0	6.9
	Interaction Effect	-7.5	-0.3	0.0	0.3
Maharastra	Growth In Output	40.6	49.8	-46.1	-23.5
	Area Effect	8.6	2.6	-14.5	-11.4

	Yield Effect	29.4	47.6	-34.6	-13.0
	Interaction Effect	2.5	-0.4	2.9	0.9
Orissa	Growth In Output	76.7	72.5	-7.7	36.2
	Area Effect	14.6	6.8	-36.4	0.6
	Yield Effect	54.2	66.2	36.3	35.4
	Interaction Effect	7.9	-0.4	-7.6	0.2
Punjab	Growth In Output	85.7	56.5	23.8	22.9
	Area Effect	31.5	7.6	8.5	7.7
	Yield Effect	41.2	49.1	14.7	14.8
	Interaction Effect	13.0	-0.2	0.5	0.4
Rajasthan	Growth In Output	102.6	12.0	62.7	101.5
	Area Effect	13.4	-0.3	19.0	9.4
	Yield Effect	78.6	12.4	40.2	88.9
	Interaction Effect	10.5	-0.1	3.5	3.2
TN	Growth In Output	31.1	9.7	13.9	-106.3
	Area Effect	8.6	-11.9	-10.3	-44.8
	Yield Effect	20.7	22.0	25.9	-79.7
	Interaction Effect	1.8	-0.4	-1.7	18.2
UP	Growth In Output	87.5	6.0	42.6	37.1
	Area Effect	11.6	-14.9	2.6	3.7
	Yield Effect	68.0	21.3	39.6	33.0
	Interaction Effect	7.9	-0.4	0.4	0.5
Uttaranchal	Growth In Output	287.1	280.1	3.2	33.7
	Area Effect	247.2	-4.5	-18.2	17.4
	Yield Effect	11.5	284.9	22.2	15.7
	Interaction Effect	28.4	-0.3	-0.8	0.6
WB	Growth In Output	17.7	31.4	19.2	15.2
	Area Effect	-6.7	6.9	1.6	2.1
	Yield Effect	26.1	24.6	17.5	12.9
	Interaction Effect	-1.8	-0.2	0.2	0.1
Assam	Growth In Output	28.1	16.9	6.4	-44.3
	Area Effect	14.6	1.3	0.2	17.9
	Yield Effect	11.8	15.7	6.2	-57.8
	Interaction Effect	1.7	-0.1	0.0	-4.4
HP	Growth In Output	-0.4	34.0	2.4	-141.4
	Area Effect	3.1	-2.7	-3.0	-141.4
	Yield Effect	-3.4	37.0	5.6	9.4
	Interaction Effect	-0.1	-0.4	-0.1	-9.4
J&K	Growth In Output	10.3	7.3	7.7	-19.2
	Area Effect	8.1	0.8	0.9	0.0
	Yield Effect	2.1	6.6	6.7	-19.2
	Interaction Effect	0.2	0.0	0.1	0.0
Kharif	Growth Of Output	-23.8	13.6	-13.2	
	Area	-7.7	3.5	-7.7	
	Yield	-18.5	9.3	-6.5	

	Interaction	2.3	0.9	1.0	
Rabi	Growth Of Output	6.3	10.3	-8.9	
	Area	6.1	9.4	-6.2	
	Yield	0.1	0.5	-3.7	
	Interaction	0.1	0.4	1.0	
Total	Growth Of Output	-17.5	23.9	-22.2	
	Area	-3.9	8.5	-12.7	
	Yield	-14.4	13.2	-11.3	
	Interaction	0.8	2.2	1.9	

Table 2.4: All-India area, output and yield of groundnut in-shell

		1986	1997	2006
Area (000Ha)	Kharif	1178	728	877
	Rabi	24	22	22
	Total	1202	750	899
CV(Area)	Kharif	44.9	46.7	42.9
	Rabi	107.8	97.3	111.1
	Total	115.8	92.7	42.0
Yield (Ha)	Kharif	780	917	900
	Rabi	818	1081	1191
	Total	765	890	879
CV(Yield)	Kharif	33.1	35.2	25.2
	Rabi	15.2	18.3	27.1
	Total	32.7	34.7	25.2
Production(000t)	Kharif	919	667	789
	Rabi	20	24	26
	Total	919	668	790
CV(production)	Kharif	39.0	41.0	34.1
	Rabi	61.5	57.8	69.1
	Total	74.3	63.7	33.6

Table 2.3 and Table 2.4 confirms that overall growth in output is positive in 1985-90, while growth during the 1990s shaded at all India level both for kharif and rabi, while

decelaration is higher in case of kharif, area than yield. However, even though overall output change is negative, some states shows positive changes in output during 1990s and upto 2005. In both the periods, Bihar, Haryana, Punjab, Rajasthan, Uttar Pradesh and West Bengal showed positive effect in both area and yield, while Gujarat, Jharkhand, Madhya Pradesh, Orissa, and Uttaranchal showed positive effect of yield in both the periods i.e, 1990-2000 and 2001-2005. These figures indicates that, yield and area under Groundnut is expanding in North India compared to south India, it may be due to that the price escalation of imported groundnut edible oil/groundnut in the hinter lands of north India, which makes the domestic production more competitive than the imported one (it is also confirmed from the geographical price indices, which confirms the hypothesis of less than one Nominal Protection Coefficient (NPC) for states like Uttar Pradesh, West Bengal, Haryana and Bihar.

Area Adjustment Model

Given that the area effect (53%) is higher for expansion of production (34%) of groundnut at all India level during the technology mission on oilseeds, we tested the influence of different price and non-price factors on expansion of area in Anantapur district from 1961-2005. We have adopted the Nerlovian adjustment model to study the impact of various factors on acreage allocation decisions for this crop.

The model consists of two structural equations

$A^*_t = b_o+b_1(RP)_{t-1}+b_2(RY)_{t-1}+b_3I_t+b_4(\sigma P)_t+b_5(\sigma Y)_t+b_6T+U_t$-----------------(2.1)

$A_t-A_{t-1}=C_1(A^*_t-A_{t-1})+C_2W_t$---(2.2)

The first equation is a behavioural relationship stating that the desired groundnut acreage (A^{*}_{t}) depends on relative farm prices of groundnut (lagged one year-$(RP)_{t-1}$) , relative yield(lagged one year $(RY)_{t-1}$ irrigation I_t relative yield variability $(\sigma Y)_{t,}$ relative price variability $(\sigma P)_t$ and time trend(T). the second equation is a partial area adjustment equation. According to this actual change (A_t-A_{t-1}) is the sum of the partial realization of the desired change ((A^{*}_{t}-A_{t-1}) and the change brought about by the uncontrolled factors like rainfall (W_t). Here C_1 is the coefficient of adjustment and C_2 measures the effect of rainfall on acreage change.

From (1) and (2) we get the estimating equation:

$$A_t = b_oC_1+b_1C_1(RP)_{t-1}+b_2C_1(RY)_{t-1}+b_3C_1It+b_4C_1(\sigma P)_t+b_5C_1(\sigma Y)_t+b_6T+(1-C_1)A_{t-1} + C_2W_t +C_1 U_t$$

$$A_t = a_o+a_1(RP)_{t-1}+a_2(RY)_{t-1}+a_3I_t+a_4(\sigma P)_t+a_5(\sigma Y)_t+a_6T+a_7A_{t-1}+ a_8W_t+ V_t \text{-------------}(2.3)$$

$a_1 = b_1C_{1,}$ $a_2 = b_2C_{1,}$ $a_3 = b_3C_{1,}$ $a_4 = b_4C_{1,}$ $a_5 = b_5C_{1,}$ $a_6 = b_6C_{1,}$ $a_7 =(1-C_1)$ and $a_8 = C_2$

$v_T =C_1U_2$ is the error term

The variables appearing in the estimated equations are presented below:

A_t =area under the groundnut crop in thousand hectares

$(RP)_{t-1}$= ratio of the farm harvest price of groundnut crop to that of competing crop with a lag of one year

$(RY)_{t-1}$= ratio of yield of groundnut crop to that of competing crop with a lag of one year

I_t= gross area irrigated/ratio of total irrigated area to total cropped area in the current year

σP_t= price variability for year t, viz., ratio of coefficient of variation of groundnut prices to the coefficient variation of competing crop prices over the preceding three years (t-3, t-2, t-1). It is a measure of price risk.

σY_t= yield variability of year t i.e, ratio of co-efficient of variation of groundnut yield to co-efficient of variation of competing crop yield over the preceding three years, t-3, t-2, t-1. It is a measure of technical uncertainty

T= trend variable which takes the values 1,2,…n. T variable has been interpreted to represent technology variable in some cases.

A_{t-1} = lagged area i.e, area in period (t-1)

W_t= weather referring to rainfall in millimeters during specific period of time in the current year

The model assumes that relative price and relative yield influences relative profitability. Irrigation and rainfall also included in the model. As most of the area under groundnut is rainfed, and sowing decision mostly depend on rainfall in the month of June and July, we have included amount of rainfall in (June+July). We expect the rainfall and irrigation coefficient to be positive and relative variability of price and yield to be negative.

The adjustment model assumes only a fraction of the intended levels to be realized during a given short period. Further we assume that the prices prevailing in the last three years influence farmer's decision in current years acreage

Estimation results

The model fitted for three sub periods (i) from 1961-1985, 1986-1995 and 1996 to 2005. the explanatory variables are significant in all the periods, with R^2 ranging from 0.7 to 0.93.

Notations used in acreage adjustment model

RPGJ=relative price of groundnut to jowar

RYGJ=relative yield of groundnut to jowar

t-1= lag of one year

A_{t-1}= groundnut acreage with a lag of one year (000ha)

T=Time trend

Linear regression results of acreage response functions for groundnut in the anantapur district

1961-1985

$$A_t=34.5 - 31.0(RPGJ)_{t-1}+17.9(RYGJ)_{t-1}-6.8(\sigma P)_t+0.9(\sigma Y)t-13.2T+0.58A_{t-1}+ 1.5W_t$$

(1.6) (1.6) (1.8) (0.3) (1.8) (2.1) (1.3) (2.2)

1986-1995

$$A_t= 50.5+ 8.67(RPGJ)_{t-1}+ 5.9(RYGJ)_{t-1} +5.8(\sigma P)_t+1.8(\sigma Y)t+1.9T+0.21A_{t-1}+ 2.5W_t$$

(2.2) (0.9) (2.1) (0.7) (0.8) (1.1) (3.2) (2.62)

1996 to 2005

$$A_t= 44.5+ 21.0(RPGJ)_{t-1}+12.9(RYGJ)_{t-1}-1.7(\sigma P)_t - 2.1(\sigma Y)t-1.6T+0.77A_{t-1}+ 0.5W_t$$

(0.6) (1.3) (1.4) (0.3) (1.3) (2.1) (2.3) (2.2)

The results indicate that the importance of relative price is increased in1996-2005 over 1961-1985. Price and yield variability are having negative sign but not significant, previous year area is having positive association. While rainfall in June and July having significant positive association in all the periods. The results indicate that overall groundnut area response to profitability indicators (namely relative price and price and yield variability) is increasing and there is still much dependence on the rainfall in the sowing period mainly June and July on area planted to groundnut. Hence rather than the technological parameters like yield, market parameters having higher influence on area even during the TMO period and still more in the recent period.

Table 2.5: Yields of oilseeds in selected countries kg/ha
(1978, 1886, 2007)

	Israil	China	India	Argentina	Nigeria	South Africa
1980	3922 (100)	1296 (100)	**798** **(100)**	1272 (100)	858 (100)	1063 (100)
1985	4782 (122)	1790 (138)	**852** **(107)**	1882 (148)	920 (107)	638 (60)
1995	6003 (153)	2385 (184)	**969** **(121)**	2398 (189)	1089 (127)	991 (93)
2005	6707 (171)	2930 (226)	**1082** **(136)**	2382 (187)	1548 (180)	1464 (138)
Cost/t		100	80	170		

Among competing countries, India is the low cost producer, followed by china.

International comparison of groundnut yields is presented in Table 2.5. The table indicates that, India is the lowest in groundnut yields and it continues to be the lowest yield country despite much talked about TMO. The Index number of yield increased from 100 in 1980 to 171 in 2005 in Israel, 226 in China, 187 in Argentina, 180 in Nigeria and 138 in South Africa, while it increased only to 136 in India despite much talked about Technology Mission on Oilseeds and other incentive programs. Which indicates underperformance of India in enhancing its major oilseed crop through under investment in Research and Development and other support structures.

Cost of cultivation and production of ground nut

The estimated costs of kharif season crops for the last three years TE 2006-07 have been given in Table 2.6. The A2+FL (all paid out costs + imputed family labour cost) cost of production for groundnut averages at Rs.1377 per quintal for Andhra Pradesh, Rs. 779 for Gujarat, Rs. 1422 for Karnataka, Rs. 1615 for Maharastra and Rs. 1321 per quintal for Tamil Nadu. The C2 (full cost) cost of the production for these states work out of Rs. 1881, Rs.1045, Rs.1845, Rs.1990 and Rs.1725 per quintal respectively. The weighted average cost for groundnut works out to Rs. 1105 per quintal on A2+FL basis and Rs.1460 on cost C2 basis. Among all states Gujarat is most comparative, which is also confirmed by higher contribution of TFP growth in output growth (chapter-III). The table also indicates that the MSP is higher than full cost (C2) by about 4%, while it is lower by 2% for Tur and 24% for Jowar. It indicates that in recent years the price policy shifted once again in favour of oilseeds than coarse cereals and pulses to encourage oilseed cultivation and to cut import bills on edible oils, however, the bargaining power of rice and wheat farmers across all the states resulted in higher MSP for paddy and wheat compared to groundnut, hence in the short run there is no scope for expansion of area under groundnut at the cost of paddy and wheat.

Table 2.6: Cost of production GN and competing crops (TE2006-7)

Crop	State	AP	GUJ	KNK	MHR	TN	MEAN	MSP	% of MSP over C2
GN	(A2+FL)/Q	1377	779	1422	1615	1321	1105	1520	4.1
	C2/Q	1881	1045	1845	1990	1725	1460		
Tur	(A2+FL)/Q	1000	1113	1514	892		953	1410	-1.8
	C2/Q	1609	1531	2025	1295		1436		
Jowar	(A2+FL)/Q	607		587	486	457	521	530	-24.5
	C2/Q	965		746	643	680	702		

(A2+FL)= paid out cost of production+ family labour
C2=Full cost including imputed vale of owned land

The same results are presented for all India for the year 2002 in Table 2.7 which compares the costs and returns for quintal of grain among different crops. It shows that for paddy and wheat MSP is higher by about 19* and 27% respectively, while for Groundnut it is 7% and for Jowar and Barley it is negative, means for groundnut costs have been covered by MSP, while for Jowar and Barely even paid-out costs plus family labour costs have not been covered by MSP. Hence in the short run there is good scope for replacing Jowar, Barely and Bajra, which require similar agro-climatic conditions. These all figures indicate the importance of price policy in acreage adjustment towards Groundnut as against other competing crops.

Table 2.7: COMPARISON OF MSP FIXED AND COSTS OF PRODUCTION 2002

	(Rs/quintal)		State with highest	States with lowest		
Crops	MSP	C2	A2+FL		% MSP over C2	% MSP over A2+F highest state
Wheat	610	479	455	365	27	32
Paddy	560	472	457	394	19	22
Tur	1320	1155	1097	953	14	19
Rapeseed/	1200	1076	1018	835	12	17
Gram	1100	1059	1014	747	4	8
Cotton	1875	1838	1745	1643	2	7
Groundnut	**1340**	**1255**	**1282**	**1191**	7	5
Soyabean	885	865	864	681	2	2
Bajra	485	512	492	442	-5	-1
Urad	1320	1372	1371	1060	-4	-4
Sunflower	1185	1283	1260	1056	-8	-6
Safflower	1200	1285	1285	877	-7	-7
Jowar	485	523	548	532	-7	-12
Barley	500	583	582	432	-14	-14
Moong	1320	1574	1597	1285	-16	-18
Maize	485	559	588	533	-13	-18
Sesamum	1400	2375	2402	2291	-41	-42

Chapter-III

Technological Growth and Investment in Research on Groundnut

TFP Growth Rate and its contribution to output growth

We have calculated Total factor productivity growth rates for groundnut from 1970s onwards for six states, for which time series data on costs and returns are available. These six states contribute to about 90% of area and production of groundnut in the country.

The trend in TFP growth indicating that the growth rate was much higher during the 1985 to 1990 than before and after periods which may be the direct fallout of TMO(table 3.1). However, this period also signifies the rapid growth of input utilization as indicated by growth in input index. With increase in intensive input use and technological progress, the output index changed significantly.

Table 3.1: TFP growth since 1980

	1980-85	1986-90	1991-95	1996 -00	2001 to 06
Output Index	1.37	13.86	-11.75	0.07	1.23
Input Index	4.62	8.71	-3.48	-1.33	1.12
TFP	-3.25	5.15	-8.27	1.42	0.11
Area (000ha)	7295	7875	8106	7102	6308
Yield kg/ha	**852**	**933**	**969**	**1029**	**1082**
Production (000t)	6215	7345	7850	7308	6827
Export of Groundnut (000USD)	0.57	1.11	2.45	10.86	46.2
Export GN Oil (000USD)	0.00	2.20	14.20	47.40	13226.78
GN Cake Export Value(000USD)	43683	37444	43456	23985	17783
NPC (Seed)	1.19	1.34	0.77	0.76	0.85
EPS (Seed)	1.07	1.21	0.69	0.69	0.76
DRC (seed)	0.81	0.91	0.52	0.52	0.58
NPC (Edible oil)	0.97	1.20	1.03	0.95	0.96
NPC (Oil Cake)	0.75	0.60	0.75	0.89	0.77

Author's computations based on methodology followed in Chand (2004)

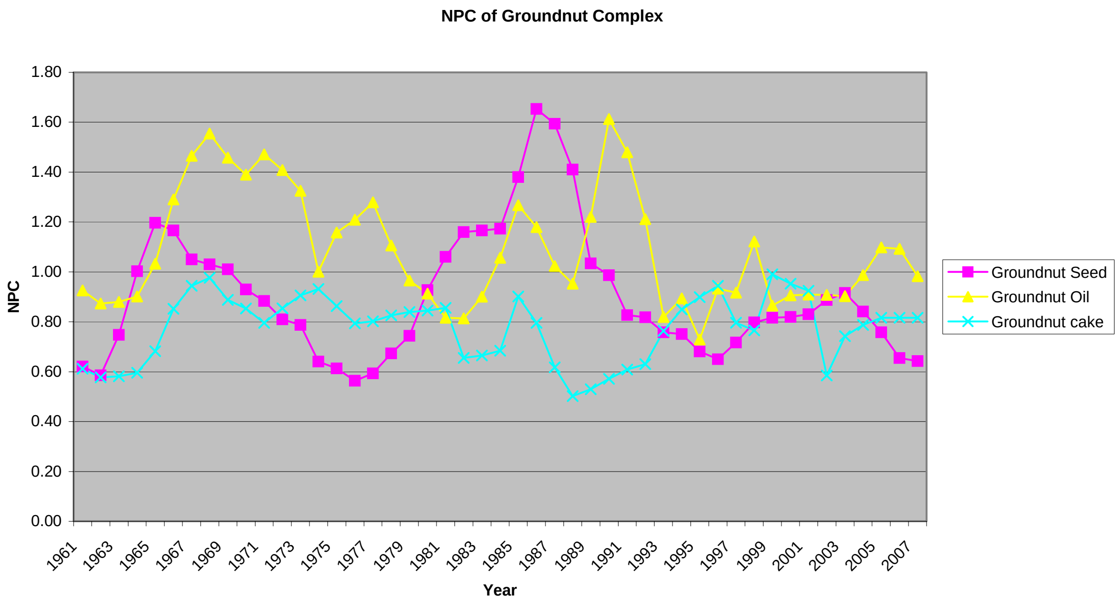


Table 3.2: Contribution of TFP growth to output growth in oilseeds

State	Contribution of TFP growth to output growth		Estimated Value of Marginal Product of investment in Research (Rs.)	Marginal Internal rate of Returns (%)
	1986-95	1995-02		
Andhra Pradesh	3.4	-37.8	17	77
Gujarat	274.0	26.8		

Source: Chandel B.S.(2005) Impact assessment of Oilseeds Research in India, national Acadamy of Agricultural research management, Hyderabad, India

The contribution of TFP growth to groundnut production is positive prior to mid-1990s, but the trend reversed afterwards. The contribution of TFP growth to output growth turned negative in the case of Andhra Pradesh during late-1990s. However, in the case of Gujarat it contributes to about 26% of growth in output. It further justifies the need for enhancing the efficiency and technological progress in Andhra Pradesh to sustain growth of Groundnut production.

Chandel(2003) reported that the estimated value of marginal product was Rs.17 per every rupee investment in groundnut research and the marginal internal rate of return is 77% for groundnut research in India (table 3.2). Which justifies the further more investment in groundnut research, for which international comparative yields are lower than most of the countries even though indias cost of production is lowest in the world.

TFP decomposition

The various factors responsible in TFP growth are technology improvement, infrastructure development, weather, price policy and human capital. The TFP for all-India has been calculated by weighted average of the area under the groundnut crop for the four states, namely AP, Gujarat, Maharastra and Tamil Nadu during 1980 to 2003. Thus, TFP index was decomposed against eight explanatory variables related with these factors namely (i)RES: Research(research stock t-5, t-6, t-7, t-8, t-9,t-10,t-11,t-12 and t-13 with weights 0.4, 0.5, 0.6, 0.6, 0.6, 0.5, 0.4, 0.3, and 0.2), Research stock under groundnut crop has been taken from Chandel(2005). (ii)INFRA: infrastructure development index of CMIE, (iii) PRICE: price policy (Weighted wholesale Price of groundnut for major markets in previous year), (iv) WEA1: weather_1(July rainfall) (v) WEA2: overall rainfall, (vi) LIT: literacy (% literacy) and (vii) TIME: time and (viii) RABI: % area under Rabi.

The results indicate that research stock, wholesale price index of previous year, overall rainfall, literacy rate and % area under rabi season are having positive and significant influence on TFP growth. % area under rabi season is also an indicator of influence of irrigated groundnut in TFP growth rate(Table 3.3).

Table 3.3: Decomposition of TFP growth for Groundnut (1980 to 2003)

Variable	Parameter Estimates	t-ratio
Intercept	-0.140*	-2.79
Research Stock	0.043*	3.21
Infrastructure Index	0.039	1.67
Wholesale price index (t-1)	0.021*	2.43
July rainfall	0.0003	1.21
Overall rainfall	0.0001*	3.70
Literacy (%)	0.032*	2.18
Time Trend	-0.005*	3.57
% area under Rabi	0.042*	4.81

All variables are specified in logarithms, except those variables defined in percentages

Returns Research and Development

The investment in oilseed research increased in both current and real prices during the last decade. The overall growth rate in the last decade is about 6% per annum. The growth rate in real investment is higher than the growth rate in the oilseed production. In the TMO period, certain crops were given priority in research investment in different periods. Soybean and Groundnut during 1985-90, rapeseed and mustard during 1990-95 and sesame during 1995-00(table 3.4).

Research investment priority changed from groundnut to rapeseed and mustard, the later account for one-forth of the research investment among oilseeds during the last decade. The percentage of share in total oilseed research investment declined for all crops except rapeseed and mustard and sesame. The research investment particularly for groundnut to be doubled based on its share in value of production among oilseeds. The lowest research intensity and lower growth rate in research investment for groundnut, warrants re-look in research allocation to meet the dual objective of attaining efficiency in research investment and harness exports of groundnuts, groundnut oil and cake.

Table 3.4: Crop-wise share (%) in oilseed research investment at constant prices(Rs. In lakhs)

Crop	**1983**	**1989**	**1995**	**2000**	**2005**
R&M	38.62 (20.21)	44.36 (18.76)	**104.59 (27.60)**	152.18 (25.88)	177.38 (27.06)
GN	43.77 (22.91)	**59.92 (25.34)**	79.92 (21.09)	114.41 (19.46)	127.90 (19.53)
Soybean	32.47 (16.99)	**63.65 (26.92)**	71.3 (18.82)	71.5 (12.16)	89.24 (13.63)
Sunflower	19.29 (10.10)	23.4 (9.90)	33.44 (8.83)	35.6 (6.05)	41.71 (6.37)
Sesame	10.63 (5.56)	22.3 (9.43)	22.47 (5.93)	**82.06 (13.95)**	82.86 (12.65)
Safflower	9.75 (5.10)	9.42 (3.98)	12.38 (3.27)	12.01 (2.04)	13.18 (2.01)
Others	36.53 (19.12)	13.4 (5.67)	54.81 (14.47)	120.31 (20.46)	122.55 (18.71)
Total	191.06 (100)	236.45 (100)	378.91 (100)	588.07 (100)	654.82 (100)

Note: figures in parentheses are in %
Source: Annual Reports of Indian Council of Agricultural research(ICAR)

Efficient Allocation of Research Investment

The research priority within oilseeds for each crop should be based on its share in value of product of total oilseeds. Most widely used concept in the literature in measuring the research allocation is Congruence Ratio (CR). The CR for each crop is the ratio of share in total research investment to share in the value of product . The CR ratio below one is under-investment and above one is over investment. Here the objective is that the share of a crop in total research investment should be in proportionate to its share in total value of production of oilseed. Resource shift from high CR ratio to lower CR ratio leads to efficient allocation of available resources.

The CR ratio for Groundnut is 0.49, against 1.0 for R&M, 3.67 for sesame, 1.56 for safflower and 1.4 for sunflower (table 3.5). The lower CR ratio indicates that, research investment for GN is to be doubled, to make allocation of research funds efficient. It has to be reduced in sesame, safflower and sunflower.

Table 3.5: Congruence ratio for oilseed crops (2005)

Crop	Share in Value of Product (%)	Share in Research Investment (%)	Congruence Ratio
R&M	27.04	27.06	1.00
GN	39.85	19.53	0.49
Soybean	18.68	13.63	0.73
Sunflower	4.55	6.37	1.40
Sesame	3.45	12.65	3.67
Safflower	1.29	2.01	1.56
Others	5.24	18.71	3.57

Technology in Groundnut Processing Sector

About 80% of groundnut produced in India undergoes processing to utilize as oil or cake. Groundnut processing mainly comprises two processes ie., seed crushing and solvent extraction. Seed crushing industry may be divided into four categories.

Village Ghanies or bullock driven kolhus: The use of inefficient village *ghanies* has been gradually reduced and replaced by improved Wardha ghanies. These *ghanies* has a mortar and a wooden pestle, where the pestle is rotated by a bullock going around in a circle. These *ghanies* are not cost effective and mostly used for processing of groundnuts for home consumption or sales within villages, in our field surveys we found that most of these village ghanies are either closed down or used only for household consumption.

Rotaries or power operated ghanies: Rotary mills which are an adaptation of ghanies are also popular in the area, as electricity is available in most of the places. The extraction through Rotary mills is better than country ghanies and yield 1 to 2 percent higher.

Expellers: the mechanization for extraction of oil came with introduction of hydraulic press by the end of the eighteenth century. This was replaced by screw press or expeller towards the end of last century. It consists of a cylindrical cage in which a helical worm shaft moves. The cage contains openings for the drainage of the expelled oil. The flake and cooked material adjusted to moisture content 2 to 5 percent is fed at one end and subjected to increasing pressure by the screw, which expels the cake through a constricted opening at the far end of cage. Modern expellers can reduce the oil content in the pressed cake to about 4 to 8 percent. The average yield of oil by expellers is comparatively higher than village ghanies or rotary mills.

The solvent Extraction: This is the most modern and widely used method. Solvent extraction industry is complementary to seed crushing industry in the sense that it recovers a major portion of oil left in oil cake coming from Ghanies, rotaries and expellers. The basic techniques is to dissolve oil in a volatile solvent (N-Hexane) and then to distill the extract recovering solvent and oil separately. The SE(solvent extracted) Groundnut oil is in the refined and purified form and can be stored for longer period.

Indias oilseed processing industry is a mix traditional and highly sophisticated oil mills. Most of the traditional ghanies are closing down and new factories are coming up with vertically integrated expellers and solvent extraction units along with refining capacity. The existing structure of oilseed processing industry has been given in Table 1.22. Which comprises about 1,31,600 cottage industry (ghanies), 20,000 expellers mostly for groundnut, 761 solvent extraction units, 130 independent oil refiners and 145 hydrogenation units with refining facilities (table 3.6). The field survey team find out that the most of the ghanies and expellers are old and outdated about 60% of them are closed down and the capacity utilization of the remaining units are about 20%. In most of the cases they work for only two months of peak harvest season.

Table 3.6: Processing industry in India (2005)

Segment	No. of units	Total capacity (Million tons)	Average capacity (t)	Capacity utilisation	Output (Million tons)	% of total edible oil output
1. Mechanical crushing						
a. Cottage industry	131600	2	18 (60 kg/Day)	10%	0.2	
b. Expellers	20000	53	2650 (9t/day)	30%	16.0	58%
2. Solvent extraction	761	28	36800 (123 t/day)	34%	9.5	31%
Oil refining	130	1.2	7692 (26 t/day)	50%	0.6	
Hydrogenation	145	2.45	16900 (56 t/day)	37%	0.9	

Notes:

a. According to industry sources of the given number of solvent extraction units, 100 are closed; of the given number of vanaspati plants, 31 are closed. All hydrogenation plants have refining facilities integrated in the plant. In 1993-94, the vanaspati factories produced about 50000 tons of refined oils. The exact use of refinery capacities (whether stand-alone or otherwise independent of vanaspati plants) is not known, but may be judged from industry estimates that about 400000 tons of soybean oil and 100000 tons of safflower, cottonseed and sunflower oils are refined.
b. Capacities are expressed as tons/year (of seed for expellers, of cake and seed for solvent extraction units, and of oil for refining and vanaspati units, respectively), and are given on a 24 hours/day, 300 working days per year, basis.

The regional distribution of supply raw material (oilseeds and oil bearing material) is depicted in Table 1.23. It indicates that there is excess capacity in every region in case of mechanical expulsion, while in case of solvent extraction northern region is deficient of about 50% and eastern region is deficient to the extent of 40%. Which may be due to rapid increase in area and production of Mustard and Groundnut in Gujarat, Rajasthan and Uttar Pradesh (table 3.7).

The reliable data is available only for solvent extraction units across states on number of plants and capacity utilization, which is depicted in Table 1.23. The daily capacity varies from highest in MP(526t/day) to lowest in Orissa (95t/day). The highest capacity is exists in Madhya Pradesh (24% of all India), followed by Gujarat(15%), Maharastra(13%) and Andhra Pradesh (13%). However the highest number of plants recorded in AP(43), followed by Gujarat(42), Maharastra(40) and MP(31). These four states together account for 65% of all India solvent extraction capacity (table 3.8).

Table 3.7: Comparison of processing capacity & availability of raw materials (million tons)

Segment	West	North	East	South	Centre	Total
Mechanical expulsion	11.1	13.8	6.2	13	9	53.1
Oilseeds available for crushing	3.27	11.67	1.07	3.64	5.6	25.25
Excess capacity	70.5	15.4	82.7	72.0	37.8	52.4
Solvent extraction	7	5.2	0.5	6.5	9.3	28.5
Oil cakes and seeds for extraction	2.9	7.8	0.7	2.9	4.3	18.6
Excess capacity	58.6	-50	-40	55.4	53.8	34.7

Notes: SEAI, India and Authors estimates

1. The quantity of oilseeds available for crushing is assumed to be 85% of production, after allowing for sowing, wastage and direct consumption
2. In these estimates, only soybean and oilseed cakes from conventional oilseeds (assumed to equal 60% of the quantity of oilseeds) are assumed to be processed in these solvent extraction plants; thus materials such as cottonseed cake and rice bran are excluded.

Overall 60% of production of edible oil is coming from processing units, which are outdated, and with lower oil recovery %. Only about 30% of units are vertically integrated (on consensus basis), however there is a past growth in the vertically integrated units across India, which is mainly growing due to the past growing retail boom in the country and preference for refined oil for many middle and high income consumers

Table 3.8: Statewide Solvent Extraction Units and Processing Capacity as on August 18,2004

State	No. of solvent extraction units	Overall oilseed/oilcake processing capacity			
		Daily	Annual (300 days) MT	Unit Capacity (Tonnes/day)	% of capacity
MP	31	16325	4897500	526.6	23.7
Gujarat	42	10235	3070500	243.7	14.8
Maharastra	40	9000	2700000	225.0	13.1
AP	43	8790	2637000	204.4	12.7
Karnataka	31	4335	1300500	139.8	6.3
Rajasthan	15	3810	1143000	254.0	5.5
UP	20	3785	1135500	189.3	5.5
TN	17	2805	841500	165.0	4.1
Punjab	18	2490	747000	138.3	3.6
Chhatisgarh	13	1995	598500	153.5	2.9
WB	13	1570	471000	120.8	2.3
Haryana	11	1175	352500	106.8	1.7
Uttaranchal	7	975	292500	139.3	1.4
Kerala	6	735	220500	122.5	1.1
Pondichery	1	400	120000	400.0	0.6
Orissa	4	380	114000	95.0	0.6
Assam	1	150	45000	150.0	0.2
nepal	1	80	24000	80.0	0.1
Grand total	315	69035	20710500	219.2	100.1
Total in India	314	68955	20686500	219.6	100.0

Source: Solvent Extraction Association of India

Chapter-IV
Technical Efficiency in Oilseed Production and Processing in Anantapur District

Sampling Design

A multi-stage sampling design will be followed in the selection of district, mandals, villages and farmers. Anantapur district was purposively for study, as in this district area under Ground Nut is high and is ideal for drawing conclusions of the impact of WTO. All mandals in the district have been ranked based on the area under Ground Nut. Total eight mandals with highest area under Ground Nut has been selected for intensive study. Further due care has been taken to include out of eight mandals, four mandals are agriculturally developed and remaining four mandals are underdeveloped.

In the second stage, from each mandal, four villages were selected based on the principle of maximum area under Ground Nut. Villages have been post-classified into “villages near to road/market” and “remote villages”. At the third and the last stage, from each village, 10 farmers have been selected randomly representing different farm size groups. In addition, 2 middle-men/commission agents, 2 traders were selected randomly from the same village/mandal. Hence, a total of 320 farmers, 64 middlemen, and 64 traders were selected for intensive field survey. The total number of blocks, villages, farmers, middlemen and traders are 8, 32 and 320, 64 and 64 respectively for Ground Nut. The data collection pertained to the agricultural year 2007.

The study employed a stochastic frontier production to estimate the technical and allocative efficiencies of resource use in oilseed production and processing. The model was specified as eqation-4.1.

(4.1) $Y_i = X_i\beta + (V_i - U_i)$ --- i=1...N,

where Y_i is the production (or the logarithm of the production) of the i-th firm;

x_i is a k×1 vector of (transformations of the) input quantities of the i-th firm;

β is an vector of unknown parameters;

the V_i are random variables which are assumed to be iid. $N(0,\sigma_V^2)$, and independent of the

U_i, which are non-negative random variables, which are assumed to account for technical inefficiency in production, and are often assumed to be iid.

$|N(0,\sigma_U^2)|$.

The efficiency will be calculated as exp $(-U_i)$ for the production function where the dependent variable is logged form.

$TE_I= f(X_I, \beta) EXP(V_i - U_i)/ f(X_I, \beta) EXP(V_i)$--------------------(4.2)

$0<TE<1$

Y_i attains its maximum value of $f(X_I, \beta) \exp(V_i)$ and TE =1 if $U_I =0$. otherwise U_I is not equal to 0 provides the shortfall of observed output from the maximum potential (frontier) output. The farm is allocatively inefficient if it operates off the least cost expansion path and can be expressed formally as equation (4.3)

$MP_{IJ}/MP_{IL} = P_J/P_L\, EXP(W_{IJ})$

J=2,3,,m

Where MP_{ij} is the marginal product of the jth input and pj is the price of the jth input and w_{ij}(j=2,3,--m) represents allocative inefficiency.

The farm is scale inefficiency if it fails to equate the marginal cost (MC) with the output price, which can be modeled as equation (4.4):

$\delta C_i/\delta Y_i = P_y \exp(S_i)$-----------------------(4.4)

where S is the scale inefficiency parameter. w_{ij}(j=2,3,--m) are identically and independently distributed normal variates with m and a variance –covariance matrix, $\sum$ and S is an identically and independently distributed normal variate with zero mean and a finite variance , σ^2. the parameters of the model can be obtained by maximizing the concentrated likelihood function after substituting the stochastic terms with non-stochastic counterparts.

Model estimation:

The stochastic frontier production function used to analyse resource use efficiency in groundnut production is given by equation---4.5

$\ln Y_i = \beta_0 + \beta_s \ln S + \beta_L \ln L + \beta_F \ln F + \beta_I \ln I + V_i - U_i$---------(4.5)

Where

Y= actual output of the ith farm measured in quintal/ha

S= seeds used in kg/ha

L=standard labour days /ha

F=standard fertilizer (N+P+K) used in kilograms/ha

I = Irrigations(cm/ha)

The cobb-douglas production function estimated for groundnut processing units is given in equation(4.6)

$\ln Y_i = \beta_0 + \beta_L \ln L + \beta_E \ln E + \beta_R \ln R + V_i - U_i$---------(4.6)

Y= Value of the ith processing unit, Rs/year

L= standard labour days /year

E=value of energy (electricity/diesel) Rs/year

R=value of raw material Rs/year

The frontier production function and derived systems of equations relating to allocative and scale inefficiencies discussed above were estimated using maximum likelihood method.Determinants of Technical efficiency

To analyse determinants of technical efficiency of groundnut seed production, a a simple linear regression of the form fgiven in equation (4.7) was estimated using ordinary least squares technique.

$TE=\beta_0+ \beta_1AGE+\beta_2EDU+ \beta_3FARMSIZE+ \beta_4HYV+\beta_5SOIL+U_i$---------(4.7)

WHERE

B_1= (i=1,2,3—N) are coefficients

TE=the level of technical efficiency obtained from the estimation made in the previous section

AGE=age of farmer

EDU=education of farmer

FARMSIZE=farm size(ha)

HYV= HYVseed=1, else=0

SOIL=red soil=1, else=0

The determinats of technical efficiency in groundnut processing plants were estimated as follows

$TE(processing)=\beta_0+ \beta_1MACP+\beta_2RMA+ \beta_3DIST+ \beta_4OILR+\beta_5INT+U_i$---------(4.8)

B_1= (i=1,2,3—5) are coefficients

TE(processing)=the level of technical efficiency in the processing unit i

MACP=machine power in KW

RMA=raw material availability(t)/annum

DIST=distance from nearest market (km)

OILR= Oil recovery(%)

INT= vertical integrated=1,else=0

Economic efficiency in groundnut production and processing

Technical efficiency is defined as ability of a farmer to produce maximum potential output(Y_{max}) given the technology and level of input use. Thus, the farm-specific technical efficiency is the ratio of the output obtained on the farm, Y_i to maximum potential output Y_{max}. The allocative efficiency is related to least cost combination of inputs and scale efficiency refers to optimal level of output selection. The estimates of technical, allocative and scale efficiencies (constituents of economic efficiency) have been discussed below.

The mean technical efficiency (TE) is ranged from 0.81 to 0.69 for large and small farmers. The mean technical efficiency is about 73%, while large farmers the TE is higher (81%) followed by small farmers (73%) and least in the case of medium farmers (69%) (Table 4.1). Considerable inefficiencies were also recorded in the optimum use of different inputs and selection of input levels in groundnut cultivation. The critical input like seed, fertilizers and irrigation are underutilized and varies from 45% to 67% (Table 4.2). The underutilization of inputs may be due to poor resource base and non-availability of inputs in time and lack of credit facilities. Since the allocative inefficiency indicates operating off the expansion path, it increases total cost for given output, otherwise decreases profits for given cost (resources). Human labour was overutilised to the extent of 20 to 44%, the level of output is suboptimal to the extent of 8 to 21%. The over utilisation of labour and underutilization seed, irrigation and fertilizers is due to the small resource base of the farmers. For mean level of over utilization of labour is 37%, while underutilization of seed is 45%, underutilization of fertilizers is to the extent of 48% and under utilization of irrigation is highest to the extent of 67%. As it is indicated that the number of farmers who use fertilizer and pesticides is very low among sample farmers (Table 4.6)

Table 4.1: Technical Efficiencies in Groundnut Production by farm size group

	Number of farms	Mean	SD	Minimum	Maximum
Small	160	0.749	0.040	0.470	0.910
Medium	120	0.690	0.190	0.510	0.850
Large	40	0.810	0.112	0.410	0.780
All	320	0.735	0.105	0.410	0.910

Table 4.2: Allocative and scale inefficiencies in groundnut production

	Seeds	Labour	Fertilizer	Irrigation	Scale Inefficiency
Small	0.524	-0.441	0.531	0.628	0.210
Medium	0.342	-0.347	0.465	0.712	0.190
Large	0.328	-0.209	0.393	0.727	0.079
All	0.456	-0.377	0.489	0.672	0.150

Besides the inefficiencies in groundnut production, considerable inefficiencies (technical, allocative and scale) existed in groundnut processing. The mean technical efficiency in oil production varied from 27% for ghanies to 45% in case of oil expellers with a minimum of 12% and maximum of 67% in ghanies, a minimum of 27% and a maximum of 87% in case of expellers (Table 4.3). These figures indicate that there is considerable scope to increase efficiency of oil processing units with existing technology.

Labour is overutilized to the extent of 10% in expellers and to the extent of 25% in case of ghanies, while all other inputs electricity and raw material are underutilized, especially raw material shortage is serious to the extent of 89% for ghanies and 85% for expellers (Table 4.4). It is also confirmed in our field visits that most of the ghanies and expellers are closed down due to low margins and competition from solvent extractors. The scale of oil production was less than optimum by the ganies to the extent of 67%, while in expellers it is less than optimum to the extent of 87%.. therefore, there is a possibility of significant improvement in productivity and profitability of groundnut processing units through better capacity utilization and improving scale efficiency in both ghanies and expellers.

Table 4.3 : Technical Efficiencies in Groundnut Production by farm size group

	Number of units	Mean	SD	Minimum	Maximum
Ghanies	45	0.270	0.040	0.120	0.670
Expellers	27	0.450	0.190	0.270	0.870
All	72	0.338	0.096	0.120	0.870

Authors Computations

Table 4.4: Allocative and scale inefficiencies in groundnut production

	Number of units	labour	Electricity	Raw material	Scale efficiency
Ghanies	45	-0.250	0.680	0.890	0.973
Expellers	27	-0.100	0.730	0.850	0.935
All	72	-0.194	0.699	0.875	0.959

Authors Computations

Determinants of technical efficiency in groundnut production and processing

As expected age of the farmer is influences TE positively, adoption of high yielding varieties, and higher farm size also having positive influence on TE of groundnut production, positive influence of farm size can be explained to some extent by resourcefulness of the large farmers in adopting scientific methods. As expected red soil type is having positive influence of TE. In the case of oil processing units, raw material supply side factors like market arrivals and distance from nearest market is having positive and significant influence (Table 3.5). Processing units with vertical integration also exhibited positive influence on TE (processing), which may indicates the technological superiority of vertically integrated plants than the independent units.

The efficiency study indicates that there is higher scope of saving costs by processing units by increasing efficiency in processing than the oilseed production sector.

Table 4.5: Determinants of technical efficiency in groundnut production and processing

	Groundnut production (TE)		Oil production (TE)
Constant	0.696* (2.45)	Constant	0.371 (3.1)
Age	0.004* (2.89)	Machine power	0.085 (1.7)
Education	0.009 (1.7)	Market arrivals	0.042* (3.19)
Farm size	0.012* (3.1)	Distance from nearest market	0.08* (4.1)
Seed	0.007* (4.1)	Oil recovery	0.021 (1.3)
soil	0.005* (2.6)	Vertical integration	0.07* (3.8)
R2	.67		0.87

Authors computations

Table 4.6: Distribution of cultivators using manures and fertlilizers

Farms	Fertilizer	Manures	Both	None	Pesticide	Weedicides
Irrigated	22	7	67	4	47	20
Unirrigated	13	25	40	22	26	9

Chapter-V
Spatial Cointegration of Groundnut Markets in India

The performance of any agricultural commodity markets is assessed by spatial and temporal market integration. Markets are integrated when prices in different markets move together in response to changes in demand, supply and other factors. Weak market integration indicates markets are not efficient. In the case of the oilseed complex, market integration has been tested separately for oilseed, meal and oil. Both short run and long run market integration is tested by using Error Correction Models.

The paper assessed the market cointegration among Indian Groundnut market. Month end price of Groundnut for the period 1996 to 2000 has been considered for the study. All-important markets in Andhra Pradesh, Maharastra, Tamil Nadu, Uttar Pradeh, Madhya Pradesh, Gujarat, Karnataka, West Bengal, Orissa and Delhi has been covered. Out of 11 Groundnut markets, only four markets are cointegrated. Hyderabad, Bangalore and Nandyala are exogenous to all markets; hence major source of price formation in Indian Groundnut markets. While Kanpur, Hapur and Chennai markets are dependent on many markets including faraway markets like Rajkot, Gulbarga, Kandwa, Vallipuram and Hyderabad. It indicates that in groundnut pod, the price information flows from production centers located in Andhra Pradesh, Karnataka, Gujarat and Tamilnadu rather than the import centers like Mumbai and Chennai.

In case of groundnut oil out of ten markets 4 are cointegrated, while in case of oil cake only two markets are cointegrated out of 5 markets for which data is available. In case of groundnut oil major consuming markets like Mumbai, Delhi, Calcutta and Chennai are major sources of price formation. Especially Mumbai is not dependent on any other market, but which influences all major markets. Hence we may conclude that in the case of groundnut oil import centers like Mumbai and Chennai are major sources of price formation and prices in all other markets are dependent on Mumbai and these prices are in proportion to the transport cost from Mumbai to the respective market.

In case of groundnut cake again Mumbai is the source of price formation, but other market prices are lower than the Mumbai market price to the extent of transport and other transaction costs. Which also confirms strong export hypothesis. As Mumbai is the entry and exit point of most of the imports and exports and price of imports/exports play a major role in domestic prices of oil and cake as India imports significant quantity of Groundnut oil and exports significant quantity of oil cake to/from international markets. Error correction terms indicate that the process of adjustment of short-term changes in prices to long run equilibrium is very slow. Overall there is evidence of cointegration among Groundnut markets in India and domestic market is more or less insulated from international markets in the case of groundnuts, while incase of oil and cake import/export prices play a key role in price formation.

General Condition of Groundnut Markets in India

There are two types of markets exists for Groundnut. They are terminal markets and secondary/primary markets. In terminal markets (Delhi, Mumbai, Chennai, Calcutta) Groundnut traded are mainly from major Groundnut growing regions and these oil export/import centres. Primary/secondary markets are those where the Groundnut traded is mainly from domestic Groundnut producing regions in India. Market intermediaries play a key role in Groundnut trade. Interstate trade of Groundnut is growing due to removal of interstate movement restrictions. Groundnut is sold in primary or secondary wholesale markets directly by the producer to a broker, commission agent, and middlemen. The bulk of Groundnut from brokers and commission agents are sold to oil millers/primary wholesalers who in turn sell to millers and processors of groundnuts or to secondary wholesalers. A proportion of the oil from oil millers and primary wholesalers goes to secondary wholesalers, and is then sold to consumers as oil through the retailer. Some whole Groundnut from secondary wholesalers are sold to frying mills. Puffed or roasted Groundnut move to consumers via retail markets.

Indian government removed import levy on Groundnut in the late 1990s. Until now, Groundnut trade in India is subject to many restrictions such as regulation under the

Essential Commodities Act of 1955, compulsory levies on millers, stocking limits for private traders, milling reserved for only small scale industries, occasional restriction of interstate movements and prohibition of future trading. Most of these restrictions are lifted in the recent past. Now there is no direct government regulation in Groundnut marketing in India with small exceptions. Minimum support price (MSP) announced by the government for Groundnut at the beginning of the season is another major government intervention in free Groundnut market. However, over the years, for oilseeds including Groundnut, the MSP has generally remained below the market price, and therefore has had no noticeable impact on the price and demand for Groundnut in India.

Overall Groundnut markets in India are functioning under less restriction by government and market price is more or less determined by supply and demand situation under free competitive environment.

The data used in the cointegration exercise consists of monthly wholesale prices of Groundnut for 11 markets, for groundnut oil 10 markets, and 5 markets for oil cake for the period from January 1996 to Dec 2000. The data relating to the Groundnut prices quoted in different market centers are compiled from various issues of Agricultural Situation in India, a monthly journal published by the Ministry of Agriculture, Government of India. All these centers were located in major Groundnut producing and consuming centers, even though the choice of the states and the market centers from each state was constrained by the availability of consistent data for the period under consideration. The descriptive statistics of the markets and wholesale prices have been given in table 5.1.

Two markets are considered to be spatially integrated if, in the presence of trade between them, the price in the importing market (P^i_t) is equal to the price in the exporting market (P^e_t) plus the transport and other transfer costs involved in moving goods between them (T_t^{ei}). This happens because of spatial arbitrage condition given by $P^i_t=P^e_t+T_t^{ei}$. Market integration does not, however, necessarily imply that markets are competitive. The spatial arbitrage condition and market integration are fully consistent with competitive pricing as well as oligopolistic pricing practices.

Table 5.1: Descriptive statistics of price series.

Market	Item	Price	Difference
Mumbai	Pod	1916	0
Hyderabad	Pod	1862	-54
Chennai	Pod	1803	-113
Villupuram	Pod	1750	-166
Hapur	Pod	1738	-178
Kanpur	Pod	1597	-319
Khandwa	Pod	1365	-552
Nandyal	Pod	1356	-560
Rajkot	Pod	1323	-593
Gulbarga	Pod	1252	-664
Bangalore	Pod	982	-934
Calcutta	Oil	5518	1726
Delhi	Oil	4929	1137
Cuttack	Oil	4452	660
Rajkot	Oil	4184	392
Hyderabad	Oil	3955	163
Bangalore	Oil	3873	81
Pollachi	Oil	3807	15
Mumbai	Oil	3792	-1
Nadyal	Oil	3673	-119
Chennai	Oil	3631	-161
Chennai	Cake	793	50
Mumbai	Cake	743	0
Rajkot	Cake	731	-12
Hyderabad	Cake	656	-87
Calcutta	Cake	640	-103

Test for unit roots

Before conducting cointegrating tests, we need to examine the univariate time-series properties of the data and confirm that all the price series are non-stationary and integrated of the same order. This is performed by visual examination of price series as well as by using the Augmented Dickey Fuller (ADF) Test developed by Dickey and Fuller (1981) and Phillips-Perron(PP) test.

By visual examination of the groundnut price series we infer that the price of Groundnut in different locations ranged between Rs.1000 and Rs.2000 during the study period and there is an upward movement of prices during the period. The first difference of price series has been taken and it seems that the series is stationary in first difference. To make objective judgment about unit roots, the ADF and PP tests have been conducted.

Dickey-Fuller (DF) test: The Dickey-Fuller (1979) test can be applied for the first-order auto-regressive model that includes the drift and linear time trend(t), viz.,

$$\Delta x_t = \beta_0 + \beta_1 x_{t-1} + \beta_2 t + \varepsilon_t \text{----------(5.1)}$$

To test for the presence of unit root in the equation 5.1, one should test the null hypothesis H_0:B_1=0, against H_0:B_1<0, with the left-sided critical region and referring to the critical values provided in the DF tables.

Augmented Dickey-Fuller (ADF) test: The Augmented Dickey-Fuller (1981) test controls for serial correlation by adding lagged first-differences to the DF equation. The application of ADF test has been discussed for problems arising due to the deterministic part of regression and selection of appropriate lag lengths. As a result, the application of a sequential procedure has often been suggested while implementing the ADF test. In this study, we have used the sequential testing procedure, which involve step-by-step testing procedure by considering three different equations, viz.,

$$\Delta x_t = \beta_0 + \beta_1 x_{t-1} + \beta_2 t + \sum_i \gamma_i \Delta x_{t-i} + \varepsilon_t \text{--------(5.2)}$$

$$\Delta x_t = \beta_0 + \beta_1 x_{t-1} + \sum_i \gamma_i \Delta x_{t-i} + \varepsilon_t \text{-------------(5.3)}$$

$$\Delta x_t = \beta_1 x_{t-1} + \sum_i \gamma_i \Delta x_{t-i} + \varepsilon_t \text{------------------(5.4)}$$

To examine the presence of unit root, we test the null hypothesis H_0:B_1=0, in all the three equations by using the ADF test statistics.

Table 5.2: Results of the Augmented Dickey-fuller tests for the order of Integration

	ADF test with 1 lags	
	In level	In First difference
	I(1) vs. I(0)	I(2) vs. I(1)
Mumbai	-2.095	-5.154*
Hyderabad	-2.791	-4.797*
Chennai	-2.349	-4.960*
Villupuram	2.269	-4.436*
Hapur	-2.305	-4.757*
Kanpur	-1.891	-4.687*
Khandwa	-2.117	-4.484*
Nandyal	-1.882	-4.535*
Rajkot	-2.023	-4.409*
Gulbarga	-2.301	-4.707*
Bangalore	-1.955	-4.599*

Notes: * indicates significant at 1 percent level. For n=82, 1 per cent and 5 per cent critical values for ADF statistics are –4.0052 and –3.4611 respectively. ADF is calculated with the assumption of constant and time trend.

Phillips-Perron Test: One possible weakness in the ADF tests has been that their underlying distribution theories assume that residual errors are statistically independent and have a constant variance, which may not be true for many time series data. Phillips and Perron (1988) developed a non-parametric test statistics, which involves less-restrictive assumption on the error process. In this case, the hypothesis: H_0:B_1=0, is tested by using Γ_r-statistics and referring to the critical values of DF tables. The 1 lag length has been selected on the based on maximum Akaike information criteria.

Table 5.3: Philips and Perron test for unit roots for first difference of price series.

	test with 1 lag	
	p-stat	alpha
Mumbai	-6.2993*	-0.6359
Hyderabad	-5.3138*	-0.5262
Chennai	8.2616*	-0.9323
Villupuram	-4.9279*	-0.451
Hapur	-9.4093*	-1.112
Kanpur	-9.0506*	-0.9408
Khandwa	-8.3489*	-0.9169
Nandyal	-11.2554*	-1.0572
Rajkot	-7.3119*	-0.7299
Gulbarga	-6.7018*	-0.7333
Bangalore	-6.4575*	-0.7252

Note: critical value are –3.4391,-2.9152 and –2.5841 at 1%,5% and 10% level of significance. * indicates significant at 1% level of significance.

Given that all the price series are integrated of the same order (order one) both by measuring ADF and PP tests, we may now proceed to conduct the cointegration tests. By choosing the comparable varieties of Groundnut across the regions and states, we assume that price variability is due to spatial and seasonal effects and not due to the presence of variety differences. Similar results were obtained for both groundnut oil and groundnut cake.

Johansen test

The results of the Johansen multivariate cointegration tests are reported in Table 5.4.

Table 5.4: Johansen cointegration results for spatial integration of Groundnut markets in India.

Groundnut					
Maximum Rank	Farms	LL	Eigen value	t Statistic	5 % Critical Value
0	143	-3918.2	0.9	435.27*	295.99
1	164	-3854.2	0.7	307.33*	250.84
2	183	-3851.7	0.6	230.21*	208.97
3	200	-3788.2	0.5	175.25*	170.8
4	215	-3766.6	0.4	132.01	136.61
5	228	-3750.2	0.4	99.26	104.94
6	239	-3735.5	0.3	69.78	77.74
7	248	-3723.9	0.3	46.62	54.64
8	255	-3714.3	0.3	27.41	34.55
9	260	-3705.6	0.2	10.01	18.17
10	263	-3701.1	0.01	1.03	3.74
11	264	-3700.6			
Groundnut Oil					
Maximum Rank	Farms	LL	Eigen value	t Statistic	5 % Critical Value
0	120	-3909.31		337.27*	250.84
1	139	-3867.57	0.76	253.78*	208.97
2	156	-3838.33	0.63	195.3*	170.8
3	171	-3814.25	0.56	147.14*	136.61
4	184	-3791.87	0.54	102.38	104.94
5	195	-3771.24	0.51	61.12	77.74
6	204	-3760.14	0.32	38.91	54.64
7	211	-3752.78	0.22	24.19	34.55
8	216	-3746.33	0.19	11.3	18.17
9	219	-3743.37	0.09	5.37	3.74
10	220	-3740.68	0.09		
Groundnut Cake					
Maximum Rank	Farms	LL	Eigen value	t Statistic	5 % Critical Value
0	110	-1389.86		111.71*	77.74
1	119	-1363.95	0.61	59.89*	54.64
2	126	-1346.53	0.47	25.06	34.55
3	131	-1337.74	0.27	7.47	18.17
4	134	-1335.09	0.09	2.16	3.74
5	135	-1334	0.04		

On the whole, our results of cointegration tests (both from Engle and Granger and Johansen methods) indicates that regional Groundnut markets are integrated in the long run, as four markets are cointegrated out of 11 for groundnuts, and 4 out of 10 for groundnut oil and 2 out of 5 markets for oil cake.

Error Correction Model and Causality Tests

Since the series show long-run relationships, the ECM was applied to investigate further on the short-run interaction causality between variables and also to know the speed of adjustment of short-run disequilibrium to the long-run equilibrium. The error correction model for a three variable case can be expressed as follows:

$$\Delta P_{1t} = \alpha_0 + \varphi_0 \mu_{1t-1} + \sum_{i=1}^{m} A_i \Delta P_{1t-i} + \sum_{j=1}^{m} B_j \Delta P_{2t-j} + \sum_{k=1}^{m} C_k \Delta P_{3t-k} + \upsilon_{1t} \text{-----(5.5)}$$

$$\Delta P_{2t} = \alpha_0 + \varphi_1 \mu_{2t-1} + \sum_{i=1}^{m} D_i \Delta P_{1t-i} + \sum_{j=1}^{n} E_j \Delta P_{2t-j} + \sum_{k=1}^{m} F_k \Delta P_{3t-k} + \upsilon_{2t} \text{--- (5.6)}$$

$$\Delta P_{3t} = \alpha_0 + \varphi_2 \mu_{3t-1} + \sum_{i=1}^{m} G_i \Delta P_{1t-i} + \sum_{j=1}^{n} H_j \Delta P_{2t-j} + \sum_{k=1}^{m} L_k \Delta P_{3t-k} + \upsilon_{3t} \quad \text{---(5.7)}$$

where P_1, P_2 and P_3 denote the price series in different markets. The error correction terms are μ_{t-1}, that are the residuals obtained from the cointegrating equation of cointegrating price series. The number of error correction terms in each equation depends on the number of cointegrated vectors in the price series. The past values of error term in the equation has an impact on the changes of variables P_{1t} , P_{2t} and P_{3t} . The υ_{1t},, υ_{2t} and υ_{3t} are stationary random processes capturing other information not contained in either lagged value of P_{1t} , P_{2t} and P_{3t}. Finally, the *m* is the optimal lag order to be determined by using the final prediction error procedures using Akaike information criteria.

There is a strong connection between cointegration and causality in that at least one granger causal relationship must exist in a cointegrated system. Causality from P_2 to P_1 and from P_1 to P_2 (there may be bi-directional causality) may be tested using the equation 5 to 7 of the error correction model, as in Alexander (1993). Rejection of the joint hypothesis:

B_1=….. B_m =0

(by standard F-tests) implies causality from P_2 to P_1 because lagged P_2 provides a better prediction of current changes in P_1 once lagged P_1 has already been accounted for by the error correction term (μ_{t-1}) . Similarly rejecting

$D_1 = \ldots D_m = 0$ (through F test) indicates granger causality from P_1 to P_2.

Error correction model (short term adjustment)

In fact when we attempt to work out the ECM estimates, the coefficient of the error correction terms (ECTs) turn out to be negetive in most of the cases for all markets. These coefficients apparently reflect the short-run deviations of the system from the long run equilibrium level; thus, the speed of adjustment of any disequilibrium towards the long-run growth path is generally interpreted from these coefficients. In the present case, the negetive ECTs would indicate that the short-run disequilibrium adjustment process might lead the system to stable long-run prices in most of the locations. Further, the results convey that the short-run influences of many of the ECTs are statistically significant in explaining the price changes in the many of the locations.

Overall short-term integration of Groundnut market in India is noticeable, further in many cases error correction terms tends to be negative which shows the short term changes in the prices in many locations may lead to long-term equilibrium in the system. Interstate causality appeared to be exiting among Groundnut markets to large extent, which indicates that state barriers are not influencing Groundnut markets and information passes through interstate markets to large extent. In general groundnut markets are integrated both in the long run and short run, even though thinly traded.

Table 5.5: VECM_ Dependent Variable for groundnut seeds																					
Independent series	ΔMumbai		ΔNandyal		ΔHyderabad		ΔRajkot		ΔBangalore		ΔGulbarga		ΔKhandwa		ΔVillupuram		ΔChennai		ΔKanpur		ΔHap
	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta
ΔMumbai (t-1)	-0.114	-0.79	0.0825	0.32	0.0069	0.03	0.1092	0.37	-0.027	-0.19	0.0235	0.18	0.2788	1.34	0.1144	0.51	0.1863	0.71	0.587*	2.83	0.281*
ΔNandyal (t-1)	0.05	0.57	0.0268	0.17	0.1311	1.07	0.0452	0.26	-0.053	-0.62	0.0636	0.79	0.0183	0.14	-0.019	-1.09	0.0378	0.24	0.0134	0.11	0.0968
ΔHyderabad (t-1)	0.0084	0.06	0.0732	0.31	-0.2278	-1.22	0.1896	0.7	-0.289	-0.22	-0.1154	-0.94	-0.1878	-0.98	-0.464	-0.22	0.4563	1.87	0.1258	0.66	0.0547
ΔRajkot (t-1)	-0.0948	-1.23	0.0274	0.2	0.395*	3.68	-0.1045	-0.67	0.012	0.16	-0.0216	-0.31	-0.099	-0.89	-0.0963	-0.81	0.0436	0.31	0.0611	0.56	0.269*
ΔBangalore (t-1)	0.0884	0.62	-0.2139	-0.84	0.2869	1.43	-0.2912	-1	-0.322*	-2.28	0.0863	0.66	0.1675	0.81	0.2429	1.09	-0.3712	-1.42	-0.2719	-1.32	-0.2079
ΔGulbarga (t-1)	0.1447	0.79	0.2787	0.86	1.116*	4.38	0.3296	0.89	-0.2918	-1.63	0.2858	1.71	-0.8428	-0.32	-0.66*	-2.35	-0.425	-1.28	0.3442	1.32	0.1018
ΔKhandwa (t-1)	0.0983	1.06	-0.1281	-0.78	-0.404*	-3.14	0.184	0.99	-0.0195	-0.22	-0.1007	-1.19	0.1917	1.44	-0.1176	-0.82	0.412*	2.44	-0.2268	-1.71	-0.239*
ΔVillupuram (t-1)	-0.0273	-0.25	-0.1478	-0.77	0.201*	1.33	0.474*	2.17	-0.1232	-1.16	-0.0172	-0.17	-0.0614	-0.39	-0.0807	-0.48	-0.1091	-0.55	0.334*	2.15	0.0609
ΔChennai (t-1)	-0.551*	-1.9	0.2048	1.2	0.400*	3.01	0.746*	3.86	0.0891	0.95	-0.1437	-1.64	-0.2577	-1.87	-0.1102	-0.74	-0.2083	-1.2	-0.0627	-0.46	0.192*
ΔKanpur (t-1)	-0.192*	-2.28	-0.061	-0.41	-0.1106	-0.94	0.387*	2.27	-0.205*	-2.49	-0.8679	-1.12	-0.2119	-1.75	0.4589	3.51	-0.1544	-1.01	-0.0147	-1.22	0.309*
ΔHapur (t-1)	-0.1669	-1.45	-0.3446	-1.68	-0.1007	-0.63	-0.811*	-3.49	0.0608	0.54	0.267*	2.53	0.471*	2.84	0.349*	1.95	-0.1106	-0.53	0.2891	1.76	-0.344*
ECT1	-0.085*	-3.03	0.0252	1.48	-0.0027	-0.11	-0.0082	-0.55	0.058*	2.11	0.0165	0.47	0.0284	1.58	-0.049*	-2.29	0.0071	0.38	-0.0819	-5	-129
ECT2	0.250*	3.04	-0.0753	-1.51	0.01	0.13	0.0241	0.55	-0.1*	-2.11	-0.5905	-0.57	-0.0821	-1.56	0.143*	2.32	-0.0202	-0.37	0.242*	5.03	0.0363
Constant	12.187	0.52	1.8738	0.13	-0.3787	-0.02	-0.7264	-0.06	11.05394	0.48	-2.6218	-0.09	2.3121	0.15	-3.1999	-0.18	1.8721	0.12	-3.3113	-0.24	9.7983

* Indicates significant at 5% level.

Table 5.6: Results of VECM for Groundnut Oil

Independent series	ΔNandyal		ΔHyderabad		ΔRajkot		ΔBangalore		ΔMumbai		ΔCuttack		ΔChennai		ΔPollachi		ΔCalcutta	
	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat
ΔNandyal (t-1)	-0.0263	-0.17	0.2105	0.86	0.0033	0.01	0.2158	1.89	0.0025	0.01	-0.2517	-1.24	-0.3025	-0.84	-0.2877	-0.54	0.0052	0.02
ΔHyderabad (t-1)	-0.1632	-1.82	-0.0387	-0.28	0.2077	1.25	0.235*	3.57	0.3894	1.78	0.0403	0.34	0.3128	1.51	-0.5958	-1.93	0.234	1.64
ΔRajkot (t-1)	0.1405	1.19	0.2025	1.1	-0.48*	-2.23	0.0454	0.53	0.3319	1.16	-0.0558	-0.36	0.4067	1.5	-0.3373	-0.83	-0.487*	-2.6
ΔBangalore (t-1)	0.0989	0.48	0.2275	0.7	0.2659	0.69	0.394*	2.59	-0.1041	-0.21	0.1736	0.64	1.22*	2.55	-1.61*	-2.26	0.0469	0.14
ΔMumbai (t-1)	0.063	0.91	-0.0028	-0.03	-0.0299	-0.23	-0.0244	-0.48	0.2012	1.2	-0.0754	-0.83	-0.263	-1.65	-0.0504	-0.21	0.0718	0.65
ΔCuttack (t-1)	0.1312	0.95	0.0905	0.42	0.215	0.84	-0.051	-0.51	0.0245	0.07	0.0784	0.44	-0.4958	-1.56	-0.0307	-0.06	-0.0681	-0.31
ΔChennai (t-1)	0.0988	0.92	0.325*	1.94	-0.134	-0.68	0.279*	3.56	0.1358	0.52	0.0607	0.44	-0.0633	-0.26	-0.2649	-0.72	-0.588*	-3.46
ΔPollachi (t-1)	-0.0947	-1.34	0.1763	1.6	0.0382	0.29	0.149*	2.88	0.1381	0.8	0.017	0.18	0.1558	0.96	-0.50*	-2.06	-0.0779	-0.69
ΔCalcutta (t-1)	-0.0605	-0.79	0.1157	0.96	0.312*	2.19	0.0534	0.95	0.1756	0.94	0.0171	0.17	-0.0138	-0.08	-0.4872	-1.84	0.3686	3.02
ΔDelhi (t-1)	0.0607	1.34	-0.0198	-0.28	0.0052	0.06	0.0331	1	0.20008	1.81	0.0435	0.74	-0.266*	-2.55	0.0939	0.6	0.069*	0.96
ECT1	0.0114	0.4	0.0487*	2.96	0.0136	0.63	-0.107*	-2.82	0.025*	1.98	0.0219	0.87	0.0012	0.06	0.0236	1.82	0.052*	3.69
ECT2	-0.4328	-1.67	-0.687	-4.6	-0.2317	-1.18	-0.5177	-1.5	-0.257*	-2.24	0.0543	0.24	-0.5161	-1.9	-0.333*	-2.84	-0.44*	-3.44
Constant	-11.4906	-0.21	2.9075	0.09	1.13	0.03	3.2484	0.05	3.4012	0.14	-13.4924	-0.28	-6.2255	-0.17	-1.3764	-0.06	5.0929	0.19

* Indicates significant at 5% level.

Table 5.7: VECM for Groundnut Cake

Independent	ΔHyderabad		ΔRajkot		ΔMumbai		ΔChennai		ΔCalcutta	
series	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat	beta	t-stat
ΔHyderabad (t-1)	-0.298*	-1.98	-0.512*	-3.6	0.86*	4.04	-0.1665	-0.79	-0.0069	-0.05
ΔRajkot (t-1)	0.0429	0.26	0.0475	0.3	0.60*	2.53	-0.144	-0.61	-0.03473	-0.25
ΔMumbai (t-1)	-0.1489	-1.46	-0.1061	-1.1	0.44*	3.05	-0.0259	-0.18	0.02006	0.23
ΔChennai (t-1)	-0.1436	-1.46	-0.1275	-1.36	0.34*	2.41	-0.0417	-0.3	-0.1242	-1.49
ΔCalcutta (t-1)	0.2422	1.43	0.0354	0.22	0.0195	0.08	-0.3127	-1.32	-0.1218	-0.86
ECT1	0.1425	1.8	0.185*	2.1	0.31*	5.69	0.11*	1.95	-0.0032	-0.04
ECT2	0.73*	3.87	-0.89*	-4.23	0.1423	1.11	0.2084	1.68	-0.1373	-0.65
Constant	-0.2358	-0.03	-1.3458	-0.15	-0.4397	-0.08	4.5457	0.89	13.9406	1.59

* Indicates significant at 5% level.

Even though prices are integrated across major markets for all groundnut seed, oil and cake, the high variability of domestic prices is a major problem in India. Many countries have some sort of price stabilization policies. The lessons from the experiences in other countries indicate that price stabilization point to several implementation problems. Most of the price stabilization schemes ended up as price support programs, loosing objective of neutral price stabilization program. India almost following full-trade liberalization in respect of edible oils and oil cakes, however there are some restriction in import of groundnut seed . Table 5.8 indicates that variability of world prices in rupee terms are less than the domestic price, hence due to liberalization there will be reduction of domestic price variability, as it is also confirmed by the less price variability during 1995-05 when compared to 1960-95. The world price variability in rupee terms is still low in the case of groundnut oil and cake, hence liberalization will not have any adverse impact on domestic prices.

Tale 5.8: Instability index for oilseed and vegetable oil prices

Commodity	**1960-95**		**1995-2005**	
	Coefficient of variation (%)	Standard % Deviation from Trend	Coefficient of variation (%)	Standard % Deviation from Trend
Domestic prices Groundnut (Rs/q)	71.0	35.0	57.0	28.9
World prices Ground nut (Rs./q)	61.0	25.0	14.0	9.0
GN Oil World Price (US$/T)	46.0	24.0	26.9	12.1
GN meal World Price (US$/T)	35.0	43.0	18.9	17.2

Marketing Channels

The mostly used marketing channels have been reported below.

I. Producer-oilmiller-wholesaler-retailer-consumer
II. Producer-merchant-commission agent –oil miller-retailer-consume
III. Producer-merchant-commission agent-wholesaler-oil miller

IV. Producer-merchant-commission agent-oil miller-wholesaler-retailer-consumer
V. Producer-merchant-commission agent-oil miller-wholesaler-retailer (for kernels)

The study team finds that Channel (II) is most widely used channel and is also cost effective channel among the sample farmers. Village merchant and commission agent takes about 2-3% of sale value as commission above market rate in the Mandi. More or less all the marketing channels are functioning efficiently at village level.

The policy support in terms of Minimum Support Prices is not in favour of groundnut when compared to its competing crops since 1991, however in recent years 2004 onwards again there is a favourable environment as index number increased by 21 for groundnut, where as it is increased only by 19 for Maize and Jowar and 10 for paddy (Table 5.9)

Table 5.9: Index number of Minimum support price for groundnut and competing crops

	Groundnut	Maize	Bajra, jowar, ragi	Paddy
1991	100	100	100	100
1995	148	161	156	166
1996	155	172	167	176
1997	159	178	172	185
1998	169	200	200	202
1999	179	217	217	215
2000	199	231	231	239
2001	210	247	247	249
2002	231	269	269	259
2003	237	272	272	268
2004	241	281	281	268
2005	259	292	286	273
2006	262	294	294	273
2007	262	300	300	278
Change over 2004	21	19	19	10

Source: Computed from Ministry of Agriculture

Table 5.10 indicates that market arrivals are mostly concentrated in 1st and 2nd quartiles during 2003.about25% market share is coming from Karanataka, 22% from Andhra Pradesh, 19% from Gujarat, 15% from TN and 11% from Maharastra. Overall 35 market arrivals came during Oct-Dec, while24% during Jan-March during 2003, while during 1969-74 45% market arrivals came during Oct-Dec and about 25% during Jan-March. It indicates that the market arrivals are spreading over all the seasons and hence there is decrease in variability in prices.

Table 5.10: Groundnut arrival from villages in selected villages in regulated markets (2003)

	Oct-Dec	Jan-March	April-June	July-Sept	Total	% Share
Andhra Pradesh	29 (31.7)	44 (29.7)	17 (25.2)	10 (13.4)	100 (1650)	22
Gujarat	34 (66.4)	20 (18.9)	31 (10.4)	16 (4.3)	100 (1447)	19
Haryana	100 (90.9)	0 (9.1)	0	0	100 (4)	0
Karnataka	36 (37.1)	22 (24.3)	30 (23.8)	11 (14.8)	100 (1905)	25
Madhya Pradesh	51 (61.5)	21 (27.1)	21 (8.3)	7 (3.1)	100 (140)	2
Maharastra	31 (58.5)	7 (21.7)	33 (12.1)	29 (7.7)	100 (828)	11
Punjab	57 (82.0)	41 (11.8)	0 (3.3)	2 (2.9)	100 (6)	0
Rajasthan	78 (58.2)	16 (26.9)	3 (9.9)	3 (5.0)	100 (374)	5
Tamil Nadu	23 (30.2)	17 (14.0)	36 (28.5)	23 (27.3)	100 (1120)	15
Uttar Pradesh	62 (53.9)	35 (41.6)	1 (3.1)	2 (1.4)	100 (173)	2
All-India	35 (45.2)	24 (24.5)	26 (18.0)	15 (12.3)	100 (7647)	100
	2662	1838	2026	1130	7655	7655

Note: in parenthesis are figures for 1969-1974 (Source: Ministry of Agriculture, GoI)

The monthly price index for the year 2003 is depicted Table 5.11. It indicates that prices are lower in the month of November and December and gradually raised up to august and then resided up to November. However, the difference between the maximum and minimum prices is just 13%, which may not be sufficient to cover storage cost and interest on working capital. However there is scope for storage from the month of April to August(four months) for which the price raised by more than 10%, which may be the good return for the investment.

Table 5.11: Month wise seasonal price index and Market arrivals

Month	Seasonal price index	% Change in monthly price index from the least price month	% Share
October	99.02	4.22	49.18
November	95.53	0.55	
December	95.01	0.00	
January	96.90	1.99	24.09
February	96.91	2.00	
March	97.66	2.79	
April	96.95	2.04	16.24
May	99.19	4.40	
June	103.05	8.46	
July	105.99	11.56	10.49
August	107.66	13.31	
September	106.07	11.64	

Chapter-VI

Simulation of gains from Efficiency in Production and Processing

In this chapter we review the different policy scenarios and their impact on groundnut sector and groundnut oil and cake sector. Among all edible oilseeds groundnut seeds are having comparative advantage in India. While all other edible oilseeds and oil imports are rising, India remained as a consistence exporter of groundnut seed and groundnut oil and also the largest exporter of cake. India's oilseed and edible oil sector is experienced with many policy options to influence domestic demand and supply conditions. After a period of stagnation in oilseed production and high imports, yellow revolution during 1987-1993 increased oilseed production to such a level that India became self-sufficient by early 1990s. In the success of yellow revolution seed technology, policy of announcing minimum support policy and high import tariff structures play important role. However, this is not sustained for long period, our Resource Cost Ratio increased, and it leads to reduction in import tariffs and India is now importing about 5 Mt of edible oils annually. The uncertainty in the policy environment of oilseed sector adversely affecting even the groundnut sector, which is highly competitive as evidence from low NPC, ESR and DRC. Hence this chapter reviews the various policy options and their impact on producer, consumer, processor and government sector surpluses. The chapter suggests that reducing tariffs on oilseed sector is having much positive influence on increasing efficiency in processing sector without much adverse effect on oilseed growers especially groundnut growers. However, the chapter suggests that, there is good scope for putting higher investment on Research and Development, improved seed production, availability of fertilizers and enhancing irrigated area under groundnut and increasing availability of raw material, improving road and other infrastructure in the groundnut growing areas to flourish groundnut processing sectors which will enhance the competitiveness of groundnut production and groundnut oil sector to sustain international competitiveness in the long run.

India imports annually about 5 MT of edible oils, which costs heavily on the foreign exchange and also disturbs livelihood opportunities for many marginal and small farmers who are resource poor. Government is using different policy instruments in the agricultural sector in general and oilseed sector in particular either to help farmers against risk of low prices or consumers against high prices and also some times to help the oilseed processing sector. Important policy variables, which used in agricultural sector, are public investment in agricultural research and extension for adoption of high yielding varieties to increase productivity, investment in irrigation and subsidy for electricity, fertilizer subsidies, announcement of minimum support prices, and changes in tariff structure to protect farmers from international competition. The above policy variables are very crucial in the case of oilseeds, as response of oilseed sector to policy variables are highly elastic as observed in wide variation in year-to-year production, prices, and imports in the long-run.

However the debate over which policy variables to be suitable under the post-WTO scenario is still going on even though some of the papers Srinivasan(2005) and Mruthyunjaya (2005) discussed them in two different approaches first one is advocated more open edible oil sector which will increase producer and consumer surplus, on the other hand the later paper discussed about the increasing efficiency of oil seed production and processing through different measures like R&D, optimum utilization of fertilizers and irrigation etc.

This chapter reviews effectiveness of different policy options with the objective of (i) how competitiveness of oilseed production changes overtime ? what are the policy variables contributed for the change? (ii) which policy variables are effective in increasing competitiveness of oilseed processing sector and (iii) effectiveness of minimum support price versus increase in tariffs on edible oils on producer, consumer and processor economic surplus

Competitiveness of oilseed and edible oil production in India

It is well known that India's oilseed productivity is less than half of that of major exporters; hence low yields are the major source of inefficiency in the edible oil sector. Area under irrigation is just 28%, as against 56% for paddy and 90% for wheat. As

demand for oilseed is derived from the demand from oilseed processing industry, problems of oilseed sector are accentuated with the inefficient oilseed processing sector in India. Most of the processing plants in India are operating at a low capacity (below 30% as against about 70% in case of many developed countries), hence their inefficiency costs will be either passed on to the producers in terms of low price to oilseeds or to the consumers in terms of higher consumer prices and ultimately less demand for oilseeds.
One way this problem can be solved with a reduction or elimination of tariff barriers on oilseeds which results in increased availability of oilseeds allowing processing plants to operate at a higher level. This would reduce unit costs and may lead to an outward shift in the crush demand schedule in the medium to long run. Thus, a reduction in the price of domestic oil due to decrease in oilseed tariffs need not reduce the prices for oilseed farmers if there is a compensating change in the crushing efficiency. For a given oil demand curve if the supply curve shifts outward it increases the derived demand for oilseeds and hence their prices other things remaining constant.

Technological Options

On the other hand we can increase availability of oilseeds by increasing domestic production through various policy options, like increased investments in agricultural research and development, increasing subsidies on fertilizer and pesticides, and increasing irrigation facilities without affecting the competitiveness of oilseed sector in international market. Until early 1980s, there is little technological progress in oilseed sector, with consequent stagnation in the oilseed production. Higher technological progress in the paddy and wheat and favourable policy environment to these crops for food security reasons shifted supply curve of these crops right side and which negatively effected supply of oilseeds. Consequently, India imports about 5MT of edible oils annually in the early 1980s. Keeping in to above situation, government of India initiated Technology Mission on Oilseeds in the year 1986/87 with spectacular results know what is widely known as yellow revolution. The increase in production of oilseeds during the period 1985-86 to 1994-95 was spectacular - 26.96% in the groundnut, 111.50% in rapeseed-mustard, 420.50 % in soybean and 74.12% in the total oilseed crops. This resulted in saving of large part of foreign exchange being spent on the import of edible oil. In 1993-94 foreign exchange worth Rs 24633.5 million was earned through the export of oilmeal and oilcake. More than 300 modern varieties and hybrids of different oilseed crops have been released to the farmers. The objectives of technological mission were achieved with complementary policy of higher Minimum Support Prices, higher import tariffs which is supplemented by higher international prices. Some of the irrigated area has been shifted even from wheat to oilseeds like mustard. This has been reflected in the high supply elasticity of oilseeds to own price and incomes.

Stagnating productivity and competitiveness

However, the empirical evidence shows that the competitiveness of oilseed is not improved despite the Technological Mission on Oilseeds. Hence this higher production could not sustained for long beyond late 1990s, consequent regime of low international prices and low import tariffs on edible oils gives raise to once again a surge in edible oil imports. Consequently the thrust upon oilseed production faded away. Again there is a need to look at this problem in the light of growing edible oil imports and increasing domestic demand for oilmeal and cake due to increased derived demand from growing livestock sector. Spectacular growth in edible oil production during 1982-1991 (5.45%) reduced to meager 0.76% during 1991-2002 (Table 6.1). Once again share of imports has been increased to about 40% of domestic consumption of edible oils in India due to low world prices. As a result of more emphasis on input intensive technology and policy push oilseed production is increased even in unfavourable areas, which results in increase in Resource Cost Ratios (RCR) for almost all oilseeds across the states (Table 6.2). Which otherwise indicates that to save one rupee of foreign exchange by import substitution through oilseed production one should spend about Rs. 1.29 on sunflower, Rs.144 on rapeseed and mustard, however, only Rs. 0.89 required to save one Rs. of foreign exchange. Which shows exorbitant costs to the countries domestic resources.

Table 6.1: Growth rate in prices and output of selected agricultural commodities

	Cereal	Pulses	Edible oils
Real prices			
1981-82 to 1990-91	-0.93	3.37	1.95
1990-91 to 2000-02	1.12	1.4	-4.74
Growth rate in Output			
1981-82 to 1990-91	2.85	1.49	5.45
1990-91 to 2000-02	2.11	-0.25	0.76

Probable outcomes of changes in MSP vrs changes in import tariffs

Many farmers in India do seek to maximize returns from the resources available to them, particularly under conditions where input and output markets are operating reasonably efficiently and where food security objectives have been met. If farmers are indeed governed by profitability considerations to a large degree, then with every profitability shift from crop ‘x’ to crop ‘y’ (due either to a rise in the price of commodity ‘y’ or fall in the price of ‘x’, or a reduction in the costs of production of ‘y’) we would expect to see a shift in acreage in favour of ‘y’. It follows that changes in per unit production cost, through changes in crop technology and relative prices, determine the crops relative profitability and hence, its competitiveness over time.

In the context of crop profitability, the frequently used policy variable to influence demand and supply of particular crop in our country is a periodical enhancement of minimum support prices before the cropping season. This has been effectively used in the case of both paddy and wheat, which is proved very successful in making India self-sufficient in food grains. However, the policy outcomes in respect of oilseeds is not convincing enough for continuation of such policy. This policy may influence resource allocation which may not be optimal in the sense of resource use efficiency. For example, if crop area changes are induced by raising crop prices above their import parity prices and comparatively to other competing crops, it enhances inefficiency in resource use or distortions in cropping pattern. The decline in the area under coarse cereals and the rise in the area under oilseeds during 1987 to 2003 may be due to the relative increase in

MSP for the oilseeds compared to coarse cereals. However, loss of area of oilseeds in favour of paddy and wheat also attributed to the higher MSP for later crops.

The other way in which demand and supply of edible seeds domestically is through changes in tariff structure of edible oils. After realizing that, the so called yellow revolution is not successful in augmenting the supply of oilseed, to bridge growing mismatch between supply and demand for edible oils and also inline with the WTO commitments, government announced a series of policies which reduced/eliminated tariff and non-tariff barriers in edible oil sector. They have been listed in Table 6.3

Probable outcomes of increasing MSP for oilseeds (Table 6.4)

1. It increases oilseed farmers income without effecting the consumer price for edible oil
2. However, the raise in MSP should be within the limits so that processors can absorb with their increased efficiency.
3. The extent of hike in MSP essentially depends on the profit margins of the processing sector.

Probable outcomes of increase in import tariffs on edible oil

The same outcomes may also get from the increase in tariffs on edible oils, which protects domestic oil sector from fall in prices, which indirectly enhances derived demand for oilseed within country.

1. however, if our domestic supply is inelastic, high oil tariffs results in higher prices and which slows consumption
2. high oil tariffs that increases capacity utilization of oilseed processing plants and reduces crush cost
3. In case of increase in MSP, government has to bear not only the difference between free market price and MSP, but also has to incur administrative costs in terms for its market operations which are exorbitant in the case of oilseeds because of scattered, thin and wide spread production.

Table 6.4: Scenario results for increase in oil tariffs and equivalent increase in Minimum Support Price.

variable	10% increase in oil tariffs	Equivalent increase in oilseed MSPs
	% change from baseline	
Oilseeds		
Production	2.0	2.0
Price	2.9	2.9
Oil		
Consumption	-2.5	0.0
Price	4.5	0.0
imports	-6.7	0.0
Processing		
Crush cost	-1.5	-1.5
Utilization	2.4	2.4
Quasi-profits 1/	3.1	3.1/ -29.9

1/ government pays / processor pays
Source: Persaud and Landes

Probable outcomes of decrease in import tariffs on edible oil

A similar study by Srinivasan (2004) also concludes that higher import tariff on edible oil reduces consumer surplus, increases producer, processor and government surplus. Overall it results in net loss to the economy. On the other hand government subsidy in cash (higher MSP) may increase consumer, producer and processor surplus, while it reduces government surplus. In both the scenarios, i.e., increases in tariffs on edible oils (scenario-I) or increase in MSP (scenario-II) the total change in surplus is lower than the scenario-III, i.e, the reduction in the tariffs on edible oil imports. In the case of scenario-III (reduction in the edible oil imports) there is significant increase in consumer surplus, while all others (producer, processor and government) will loose.

Probable outcomes of decrease in import tariffs on oilseeds (Table 6.5)

The other policy option left with the government is liberalising oilseed imports through lower tariffs and moderate standards for SPS and GM issues. The possible outcomes are listed below.

1. It will probably reduce prices of oil to consumers through increase in efficiency in both oilseed production and processing
2. Processing sector benefit mostly by increasing capacity utilization, lower processing costs, economics of scale and higher exports of oil meal/cake.
3. Windfall gains for oilseed processing units can be shifted to farmers or consumers through appropriate instruments
4. Oilseed production may not fall, because demand from oilseed processing industry for domestically produced oilseeds may not fall due to the difference in c.i.f import parity price (including fright rates) and domestic price is narrow. However, there is a possibility of stiff competition from low priced imports, if our oilseed production technology is not coped with.
5. In this scenario big gainers are processing industry without negatively effecting either farmers or consumers.

Oilseed industry is also having the opinion that, to overcome oilseed shortage Government may consider to facilitate import of oilseeds by reducing the customs duty from present 30% to 15% and relax stringent quantitative conditions and follow the international practice of accepting the phyto-sanitary certificate from exporting countries as is done by Japan, China, Taiwan, Pakistan etc. for import of oilseeds. This would help the oilseed crushing & processing industry to import oilseed at commercial parity without any barrier to overcome the problem of raw material shortage to some extent, ease the shortage of fodder in the country and maintain our export share of oilmeals in international markets. However, to satisfy the Ministry of Agriculture to safeguard the interest of domestic farmers and to meet quarantine requirements, the Government may allow such imports under "actual user" condition to crushers and processors and may fix CIF price higher than MSP and also permit it during the lean season i.e. April-September so that farmers interests are fully protected.

Table 6.5: Scenario: oilseed import liberalisation

variable	Major oilseeds and products
	% change from baseline
Oilseeds production	1.4
Oilseeds price	1.6
Oilseeds imports (mil. Tons)	8.7
Oil consumption	0.0
Oil imports	-25.9
Meal exports	237.5
Processing crush cost	-28.2
Processing utilisation	72.9
Processing quasi-profits	21.5

Source: Persaud and Landes

Another study by Gulati and Kelly(1999) estimated supply and demand conditions for oilseeds and edible oils under different scenarios based on estimates of supply elasticities for oilseed and demand elasticities from NSSO consumer expenditure data (Table 6.6). Under scenario 1 they estimated supply and demand conditions under free trade conditions by setting domestic price equivalent to import parity price for edible oils; under scenario II: supply elasticities have been calculated with 50% increase in irrigation water charges plus scenario-I conditions; under scenario III, supply elasticities have be calibrated with 29% increase in fertilizer prices (reducing fertilizer subsidy by 50%) plus scenario-II; Scenario IV: scenario II plus 58% increase in fertilizer prices (reducing subsidies by 100%).

The study concludes that under the free trade scenario, if we align our domestic prices with international prices, our domestic prices will fall by 38% for edible oils, supply of oilseeds will reduce by about 10%, variations in irrigation and fertilizer prices will not have much impact on the domestic supply of oilseeds. Overall prices comes down, domestic demand will increase with consequent increase in import of edible oils.

Table 6.6: Exports and imports and changes in supply and demand of selected oilseeds/edible oils

scenario	% change in				
	Price due free trade (import Parity Price)	Supply	Urban demand	Rural demand	Imports (M tons)
I	-37.64	-9.96	19.88	24.19	1.25
II	-37.64	-10.09	19.91	23.76	1.24
III	-37.64	-11.35	20.06	23.88	1.33
IV	-37.64	-12.61	20.21	24.00	1.42

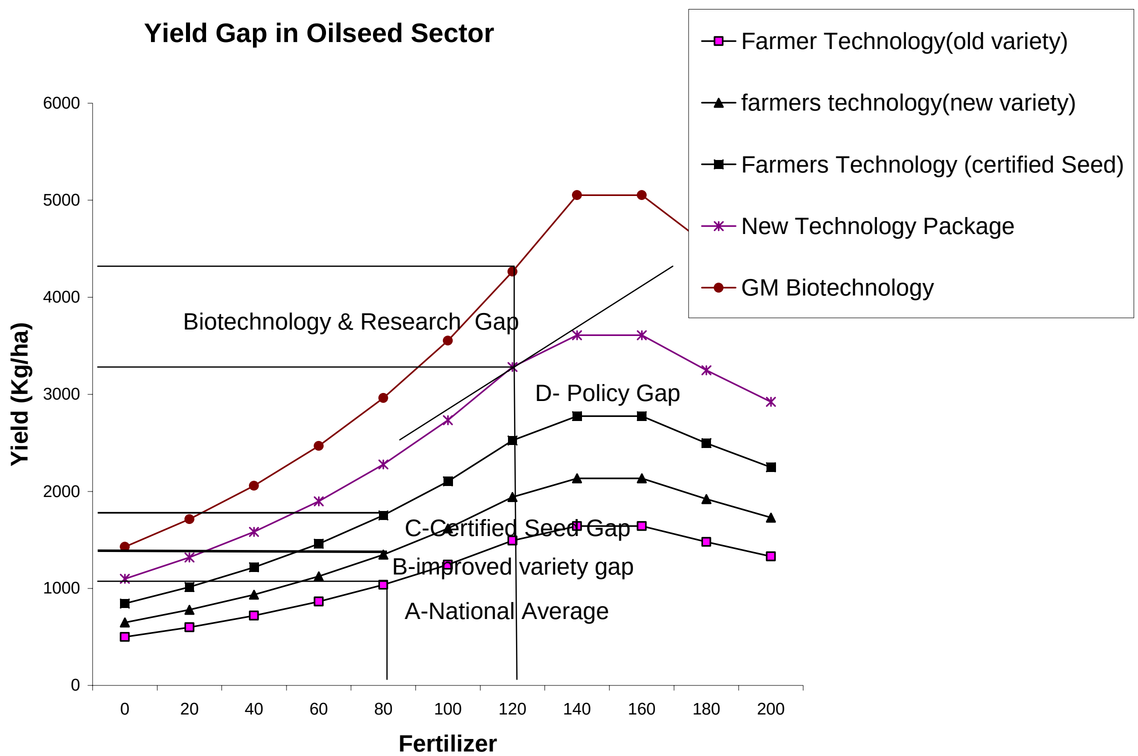
Scenario 1: import parity price for edible oils; Scenario II: scenario I plus 50% increase in irrigation water charges; Scenario III: scenario II plus 29% increase in fertilizer prices (reducing fertilizer subsidy by 50%); Scenario IV: scenario II plus 58% increase in fertilizer prices (reducing subsidies by 100%)
Source:Gulati and Kelly (1999)

Technological Options and its Probable Outcomes

The current stagnation of yield of oilseeds in India is a result of neglect of public expenditure on agricultural research in general and oilseeds on particular. Our wheat and rice farmers got big boost in the early years of green revolution from the externalities generated through international rice and wheat research in International Rice Research Institute (IRRI) and CYMMIT. The same type of international externalities have not been available in the case of oilseeds, as there is little focus in this regard by international agencies. And further more the improved varieties adopted during the period of yellow revolution (1987-93) require more inputs like fertilizer and pesticides in adequate quantities to reach its potential yield. However, most of the oilseed farmers are either resource poor or rainfed. Moreover improved varieties loose vigour with time. Newer varieties have to be developed periodically to compensate and expand production possibilities. Also, the lack of success of our research establishment in introducing improved varieties for the rainfed areas especially in pulses and oilseeds is a matter of great concern.

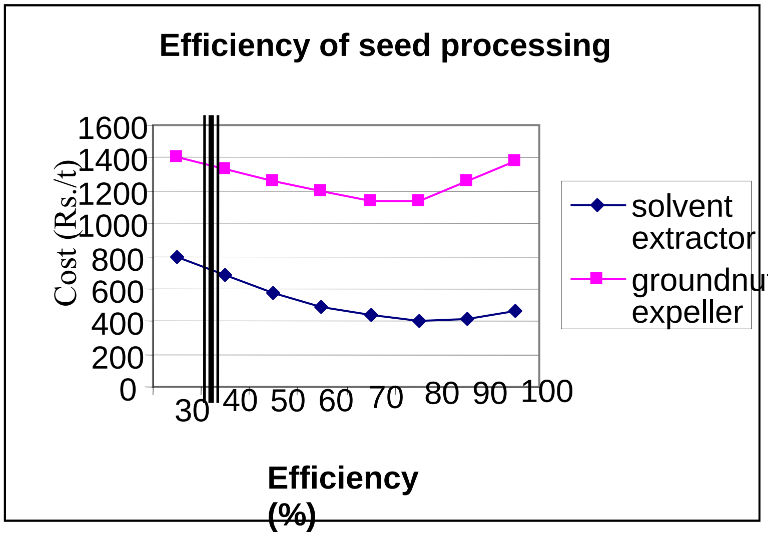
The following diagram illustrates the possible increase in yield under different scenarios. It decomposes the total potential yield gap in oilseed sector into improved variety gap, certified seed gap, policy gap and biotechnology and research gap. By adoption of improved seed, multiplication and distribution of certified seeds through the mass production of improved and certified seeds we can eliminate first two gaps. Wider adoption of certified seeds increases demand for other inputs and application, which ultimately reduce policy gap. This itself is enough to reduce our Resource Cost ratio (RCR) from the 1.44 in some states near to one, which makes our oilseed production to withstand international competition. The high marginal rate of returns to agricultural extension (45%), public sector research (90%) and high yielding varieties (imported) (55%) and private R&D (35%) also emphasizes the strength of R&D and supply side factors.

Another area of increasing competitiveness of edible oil sector is increasing scale efficiency in the processing sector, which is already discussed above (Table 6.7). The table 6.8 depicts comparision of Indian expellers with international standards, which shows that the scope for increasing efficiency of our processing sector by about 47% in electricity, 40% in steam, 90% hexane. With the above two measures we can have competitive oilseed and edible oil sector in India, which can with stand the international competition under WTO regime, without much cost to the government in terms of foreign exchange or to domestic economy.



Source: Field Survey

Figure 5: Capacity Utilisation and scale economies in Oilseed processing industry



Source: Based on Field Survey

Table 6.7: Probable gains from technology

Groundnut Seed Production Sector	Marginal rate of return (%)		
Extension	44 to 45		Existing efficiency
Research (public)	82 to 91	Oilseed processing sector	33%
	Inefficiency	Capacity utilization in processing sector	30%
Oilseed production sector	73%		
Input	Underutilization of Resources	Input	Underutilization of Resources
HYV Seed	45%	Electricity	69%
Fertilizer	48%	Raw Material	87%
Irrigation	67%		
Scale Inefficiency	15%	Scale inefficiency	95%

Table 6.8: Comparison of Indian Efficiencies and International norms in Integrated groundnut seed expellers a

			US performance as % of Indian Average	
Input	Units	India	International Norm	International Best
Capacity	Tonnes/Day	233	2000	3000
Electric Power	Kwh/Tonne	76	66%	53%
Steam	Kgs/Tonne	415	72%	60%
Hexane	Kgs/Tonne	6.7	19%	10%

Source: India: The Indian Oilseed Complex: Capturing Market Opportunities, 1997, World Bank

Gains from efficiency in production and processing

The efficiency gains have been incorporated in the simple simulations along with free trade. Under simulations have been carried out for the period from 1991 to 2000 and compared with the baseline scenario of 20% tariff on edible oils. Base line scenario: free edible oil import for all other edible oils and palm oil substitution effect. Scenario-I= Best practice oil extraction (44% instead of 41%), scenario-II= scenario-I+ processing cost saving due to increase in efficiency, scenario-III= scenario-II+ no discount for meal quality, Scenario-IV= scenario-III+ lower export cost.

The simulated efficiency gains suggest that the largest gains would come from improved processing methods, which includes costs saving in the processing sector by increasing capacity utilization and updation of machinery to save in energy and hexane and other working costs and increase scale efficiencies which are very low. This resulted in lowering of crushing margins, vertical integration. The largest gainers will be the groundnut growers as reducing inefficiency in processing plants will enhance the demand for groundnut seed and reduces crushing margins without effecting the profitability of either processors or growers.

Table 1.24: Simulation of gains from liberalization and increase in efficiency in processing sector

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
actual domestic prices USD/T	Seed price	457	388	283	264	311	329	367	324	321	298
	Meal	95	97	100	115	113	186	188	165	162	189
	Oil	1683	1316	988	1099	1220	1150	1043	1103	1020	912
	crushing margin	294	213	183	256	258	254	173	227	194	188
free edible oil import for all other edible oils and palm oil substitution effect	seed price	381	328	238	215	256	277	318	274	274	256
	decline in seed price	76	60	45	49	55	52	48	50	47	42
	oil price	1515	1184	889	989	1098	1035	938	993	918	821
Scenario1: Best Practice oil Extraction (44% recovery)	implied oilseed price	424	361	262	241	286	302	341	299	297	275
	increase in seed price	43	33	24	26	30	25	23	25	23	19
	% oilseed price change	11	10	10	12	12	9	7	9	8	7
Scenario 2:Scenario 1+Processing Cost Savings USD/t	processing cost savings	20	18	19	18	18	20	18	19	18	18
	implied oilseed price	444	379	281	259	304	322	359	318	315	293
	increase in seed price	63	51	43	44	48	45	41	44	41	37
	% oilseed price change	16	15	18	21	19	16	13	16	15	14
Scenario 3: scenario 2+ no meal quality discount	implied meal price	114	128.04	138	128.8	99.44	223	248	227	182	166
	implied oilseed price	454	396	301	267	297	342	391	351	326	281
	increase in seed price	73	67	63	52	40	66	73	78	51	25
	% change in oilseed price change	19.1	20.5	26.5	24.0	15.7	24	23	28	19	10
Scenario 4: Scenario 3+ Lower Export Cost	Export Cost Saving	18	18	18	18	18	18	18	18	18	18
	Implied Oilseed Price	464	405	311	276	306	352	401	361	335	290
	Increase in Seed Price	83	77	73	61	50	75	83	87	61	34
	% oilseed price change	21.7	23.5	30.6	28.6	19.5	27	26	32	22	13

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Appendix 1: Input (cost) structure of Groundnut (selected States)													
	1981-84			1996-98			2000-2004					factor bias	factor bias
Cost Item	Gujarat	AP	TN	TN	Gujarat	AP	TN	MH	KNK	Gujarat	AP	98 over 83	2004 over 1998
Human Labour	19.9	21.9	19.6	32.4	25.7	26.9	32.7	32.7	24.2	24.8	27.1	7.9	0.0
Bullock Labour	11.8	10.4	6.7	11.1	8.5	5.3	7.4	13.7	11.9	9.6	6.4	-1.3	1.5
Machine	3.1	0.2	0.7	1.6	9.3	7.2	4.7	4.5	3.5	6.2	3.1	4.7	-1.6
Seed	19.7	20.0	23.1	18.8	13.4	12.5	11.7	14.1	20.5	17.5	17.6	-6.0	1.4
Fertilizer	8.3	5.3	2.6	3.9	6.1	5.7	3.5	3.2	6.8	5.4	5.2	-0.1	-0.4
Manure	4.8	3.8	1.2	5.5	3.2	3.7	3.2	5.4	3.2	3.4	2.3	0.9	-0.6
Insecticide	1.6	0.2	0.3	0.2	1.4	1.3	0.9	0.0	0.5	1.6	0.9	0.3	-0.2
Irrigation	3.5	1.6	6.6	0.8	2.7	1.6	2.8	2.2	1.5	2.1	2.7	-2.2	0.5
Interest On WC	2.2	1.8	1.8	1.8	1.7	1.7	1.7	1.9	2.0	1.7	1.7	-0.2	0.0
Rental Value	18.6	29.4	26.4	18.5	21.6	27.1	20.4	14.4	18.9	21.5	24.6	-2.4	-2.5
Land Revenue	0.3	0.2	0.3	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.0	-0.2	0.0
Depreciation	0.9	1.4	0.9	1.7	1.0	1.6	1.6	1.7	2.0	1.2	2.0	0.4	0.3
Interest On Fixed Capital	5.4	3.9	9.8	4.5	5.2	5.3	9.4	6.0	5.2	4.9	6.6	-1.4	1.4
Total Cost	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	0.0
Total Cost	3317	2619	3530	13112	11617	12558	24525	21125	10766	15165	15103	9273.6	4907.8
Total Value Of Output	3665	2583	3884	14582	15038	11538	59808	38094	25270	34748	25585	4534.4	22981.3
Yield	7.2	6.7	11.2	9.7	9.8	9.5	17.1	10.9	7.2	9.9	7.3	1.3	0.8

Source: Computed from CCS, Ministry of Agriculture

Appendix 2: Cost Structure in India and America (2007)

Cost Item	AP	USA PER HA
Human Labour	4093 (27.1)	8973 (13)
Bullock Labour	966 (6.4)	0.0 (0)
Machine	468 (3.1)	12644 (19)
Seed	2658 (17.6)	6653 (10)
Fertilizer	785 (5.2)	5182 (8)
Manure	347 (2.3)	0.0 (0)
Insecticide	135 (0.9)	9729 (15)
Irrigation	407 (2.7)	55 (0)
Interest On Working Capital	256 (1.7)	547 (1)
Rental Value Of Owned Land	3715 (24.6)	5571 (8)
Land Revenue And Taxes	0 (0)	1738 (3)
Depreciation On Implements And Farm Buildings	302 (2.0)	12727 (19)
Interest On Fixed Capital	996 (6.6)	2680 (4)
Total Cost	15103 (100)	0.0(0)
Total Cost	15103	66499
Total Value Of Output	25585	56425
Yield	7.3	3147Pounds/Acre

Source: Computed from CCS, India and USDA

Appendix 3: Structural Change in Agricultural Income -Oilseeds

Structural Change In Agricultural Income - Oilseeds

State	1970-75	1975-80	1980-85	1985-90	1990-95	1995-2000
KERALA	29.58	26.67	28.45	28.38	30.6	26.9
GUAJRAT	19.65	24.23	25.26	25.64	28.17	25.38
RAJASTHAN	9.14	7.55	12	17.75	18.85	24.16
TN	16.6	14.4	18.1	19.78	20.76	21.71
MP	7.17	5.97	8.75	8.44	10.07	19.94
AP	13.67	9.41	12.52	17.48	19.35	17.57
KARNATAKA	12.53	11.7	16.15	19.34	20.01	14.18
HARYANA	3	2.29	3.88	6.72	8.01	10.6
MH	9.13	8.34	9.55	10.04	11.46	9.25
ORISSA	5.58	8.57	11.03	12.84	13.16	5.19

Source: computed at constant prices

Appendix 4: State-wise quantity of groundnut kernel and pods graded and estimated value, during 2003-04 (quantity: in tones and value : in lakh Rs)

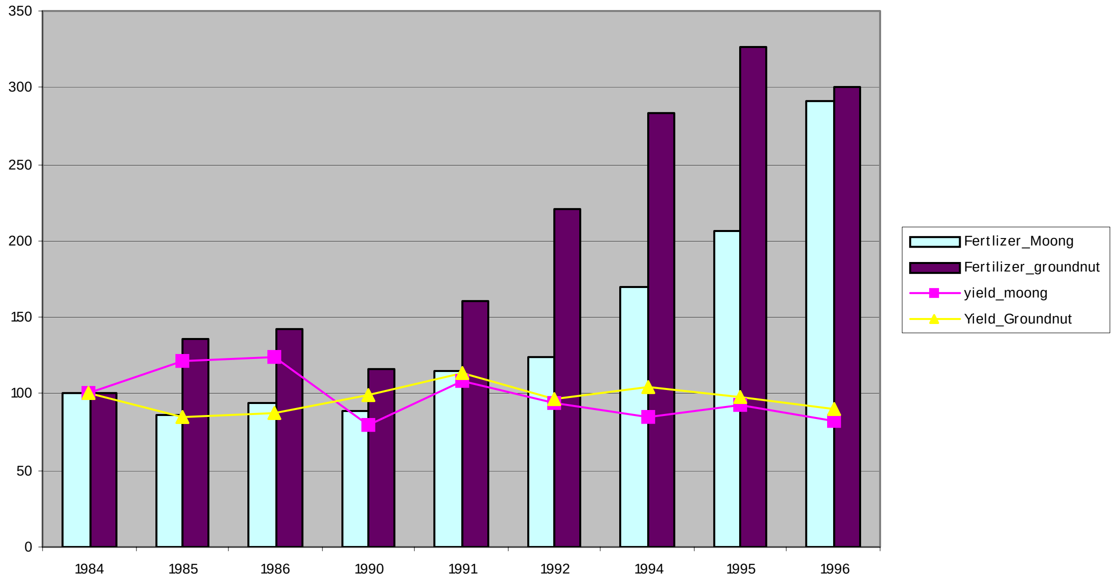
State	Groundnut kernels		Groundnut pods	
	Quantity	Value	Quantity	Value
A.p.	97893	17480.41	20591	3446.0
Gujarat	16591	2854.65		
Karnataka	76503	12586.36		
Maharastra	4520	760.75		
Rajasthan	1268	209.11		
t.n.	89143	18536.84	64825	5672.31
u.p.	6326	1232.92		
Total	292244	53661.04	85416	9118.31

Source: AGMARK, India

Appendix 5: Cost Benefit Analysis crops (2007)

Crop	Irrigation	Season	Grain Yield (Qt/Ha)	Gross Income	Cost	Net Income	Benefit Cost Ratio
Sugarcane_Y2	Irrigated		1000	91500	65600	25900	1.39
Arhar(Late_K)	Irrigated	K	25	40000	17700	22300	2.26
Arhar(Early_K)	Irrigated	K	20	32000	16700	15300	1.92
Groundnut®	Irrigated	R	25	45000	30300	14700	1.49
Bengal Gram®	Irrigated	R	15	27000	12900	14100	2.09
Field Pea®	Irrigated	R	20	28000	14998	13002	1.87
Maize(Summer)	Irrigated	S	37.5	37500	25200	12300	1.49
Blackgram(Summer)	Irrigated	S	12	24000	13600	10400	1.76
Green Gram, Summer	Irrigated	S	12	24000	13600	10400	1.76
Sugarcane_Y1	Irrigated		1000	91500	82200	9300	1.11
Early& Medium® Paddy	Irrigated	R	60	41850	32700	9150	1.28
Sunflower_Hyb	Irrigated	R	20	32000	23100	8900	1.39
Wheat®	Irrigated	R	30	30000	22100	7900	1.36
Ragi(K)	Uniirigated	K	30	27000	19200	7800	1.41
Sesa_Irri	Irrigated	R	12	24000	16300	7700	1.47
Field Cowpea(Pre-Summer)	Irrigated	Pre-S	20	24000	16400	7600	1.46
Horsegram®	Irrigated	R	15	19500	12100	7400	1.61
Medium&Late(K) Paddy	Irrigated	K	50	35450	28100	7350	1.26
Irri_Rapeseed	Irrigated	R	15	27000	19700	7300	1.37
Maize(K)	Uniirigated	K	30	30000	23000	7000	1.30
Black Gram(K,Pre-Rabi)	Uniirigated	K	10	20000	13300	6700	1.50
Green Gram, K, Pre-Rabi	Uniirigated	K	10	20000	13400	6600	1.49
Barely®	Irrigated	R	30	27000	20600	6400	1.31
Safflower®	Irrigated	R	10	20000	13700	6300	1.46
Field Cowpea(K)	Uniirigated	K	17.5	21000	14700	6300	1.43
Sunflower_HYV	Irrigated	R	16	25600	19400	6200	1.32
Jowar(K)	Uniirigated	K	25	22500	17200	5300	1.31
Sesa_Non_Irri	Uniirigated	K	9	18000	12900	5100	1.40
Bajra(K)	Uniirigated	K	25	22500	17500	5000	1.29
Cotton(K_Hyb)	Uniirigated	K	18	34200	29200	5000	1.17
Non_Irri_Rap	Uniirigated	K	10	18000	13400	4600	1.34
Cotton_Hyb®	Irrigated	R	20	38000	33600	4400	1.13
Ragi(K)	Uniirigated	K	20	18000	13700	4300	1.31
Early(K) Paddy	Uniirigated	K	35	23825	19700	4125	1.21
Niger(Un_Irri)	Uniirigated	K	10	18000	13900	4100	1.29
Extra Early (K) Paddy	Uniirigated	K	30	20550	17300	3250	1.19
Cotton®	Irrigated	R	18	34200	31600	2600	1.08
Cotton(K)	Uniirigated	K	15	28500	26300	2200	1.08
Groundnut(K)	Uniirigated	K	15	27000	25500	1500	1.06

Appendix 6: trade in oilseeds and oilseed products : 2004-05						
Particulars	Export			Import		
	Quantity (000t)	Value (Rs.crores)	unit price(Rs./q)	Quantity (000t)	Value (Rs.crores)	unit price(Rs./q)
Oil Cake/Oil Meal	3516.09	3100.75	882	67.35	48.06	714
Oils			4963			7490
Palm Oil	0.41	2.04	4976	3561.96	7877.38	2212
Soybean Oil	7.51	33.48	4458	1048.04	2841.95	2712
Sun/Saf/Cotton Seed Oil	0.33	1.33	4030	38.33	109.86	2866
Castor Oil	260.64	1032.55	3962	26.53	96.58	3640
Coconut Oil	5.95	29.44	4948	12.71	39.49	3107
Olive Oil	0.64	3.24	5063	0.87	14.37	16517
Linseed Oil	0.6	3.33	5550	0.51	1.92	3765
Sesamum Oil	2.28	13.94	6114	0.04	0.59	14750
Groundnut Oil	45.82	215.06	4694	0.003	0.07	23333
Rape/Colza/Mustard Oil	0.44	2.57	5841	0.02	0.04	2000
Total	324.62	1336.98	4119	4689.013	10982.25	2342
Oil Seeds			2588			2087
Sesamum Seed	156.67	662.45	4228	1.49	5.8	3893
Rapeseed/Mustard/Cozla	16.12	26.88	1667	2.27	5.23	2304
Groundnut In Shell/Unshelled	177.11	503	2840	0.001	0.002	2000
Linseed	0.05	0.25	5000	0.55	0.99	1800
Copra	0.76	1.29	1697	1.14	1.74	1526
Sunflower	2.95	9.19	3115	0.01	0.01	1000
Niger Seed	24.6	61.14	2485			
Safflower	6.22	12.72	2045	0.002	4.51	
Soybean	2.06	3.45	1675		0.002	
Castor Seed	1.34	3.19	2381			
Cotton Seed	0.73	0.97	1329			
Total	388.61	1284.53	3305	5.463	18.284	3347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Fertlizer_Moong
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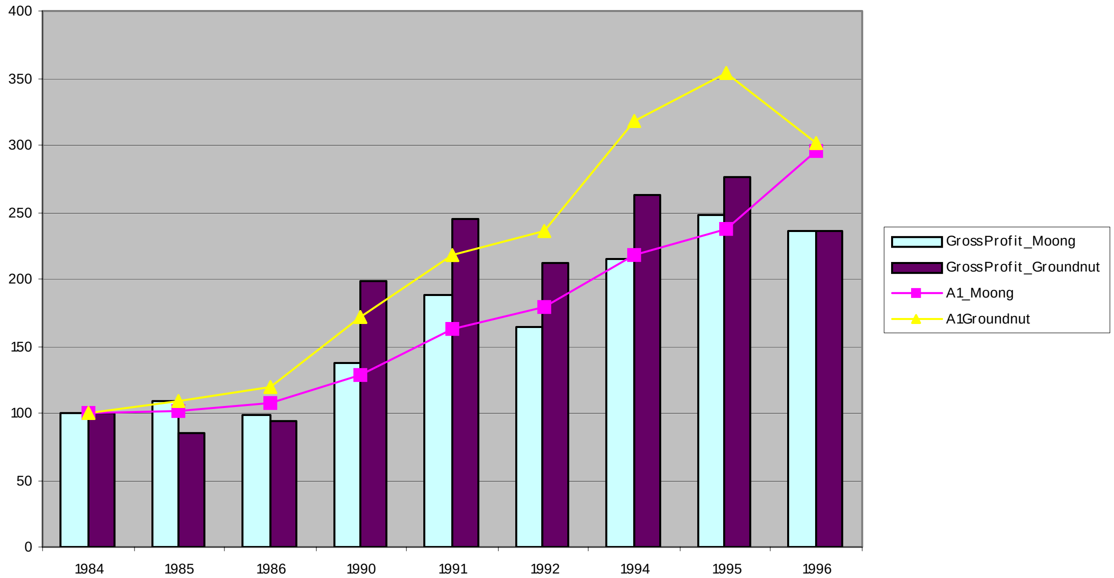
yield_moong
Yield_Groundnut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A1_Moong
A1Groundnut

ANNEXURE: Trends in groundnut production technology in Anantapur district (Results from Participatory Rural Appraisal)

Groundnut production technology, 1980

Variety: TMV2
Sowing: Behind the country plough or animal drawn seed drill.
Fertilizer application:20N,40P2O5, 40K2O kg/ha
Water management: Mostly rain fed, watershed concept introduced
Weed management: Hand weeding, inter cultivation with animal drawn implements
Pest management: Practices are available but farmers did not practice
  Seed treatment: Negligible per cent of farmers
  Root grub: Phorate granules @10 kg/ha
Disease management: Late leaf spot is major problem
Harvesting: Hand pulling, and hand stripping.

Groundnut production technology, 1985

Variety: TMV2. Introduction of new varieties like TMV10, M13, J11.They were not popular with farmers, and seed of new varieties is not available
Sowing: Behind the country plough or animal drawn seed drill.
Fertilizer application:20N,40P2O5, 40K2O kg/ha
Water management: Mostly rain fed, watershed concept popularized. Improved dry land practices were recommended
Weed management: Hand weeding, inter cultivation with animal drawn implements
Pest management: Practices are available but farmers did not practice
  Seed treatment: Negligible per cent of farmers
  Root grub: Phorate granules @10 kg/ha
  Farmers did not practice due to high cost, yield loss occurred due to root grub
Disease management: Late leaf spot is major problem. Spraying of mancozeb was recommended.
Harvesting: Hand pulling, and hand stripping.

Groundnut production technology, 1990

Variety: TMV2,Tirupati1, K134
Sowing: Behind the country plough or animal drawn seed drill. Animal drawn seed cum fertilizer drill was developed.
Fertilizer adoption increased.Placement of fertilizer recommended.
Water management: Mostly rain fed, Watershed programmes initiated, moisture conservation practices implemented. Negligible impact on crop production.

Weed management: Hand weeding, inter cultivation with animal drawn implements. Chemical weed management with fluchloralin and pendimethalin were recommended

Pest management : Seed treatment with chloripyriphos @6ml/kg of seed recommended for the management of root grub
Disease management: Spraying of mancozeb was recommended..
Harvesting : Hand pulling, and hand stripping.

Groundnut production technology, 1995

Sowing: Animal drawn seed cum fertilizer drill was developed. Tractor drawn mechanical seed drill were developed
Fertilizer application: Placement of fertilizer recommended. Fertilizer adoption increased.
Water management: Mostly rain fed, Watershed programmes initiated, moisture conservation practices implemented. Negligible impact was observed on crop production.
Weed management: Hand weeding, inter cultivation with animal drawn implements. Chemical weed management with fluchloralin and pendimethalin are recommended
Pest management:Seed treatment with chloripyriphos @6ml/kg of seed recommended for the management of root grub

Groundnut production technology, 2000

Groundnut + redgram in 7:1 ratio was recommended. Farmers adopted wider row ratio of 15:1 Sowing: Animal drawn seed cum fertilizer drill was developed. Tractor drawn mechanical seed drill were developed
Fertilizer application: Placement of fertilizer recommended. Fertilizer adoption increased. Gypsum application recommended.
Weed management: Hand weeding, inter cultivation with animal drawn implements.Chemical weed management with fluchloralin and pendimethalin were recommended
Pest management: Red hairy caterpillar, leaf webber are the major pests
Pest management : Seed treatment with chloripyriphos @6ml/kg of seed recommended for the management of root grub recommended The recommendation became popular..
Disease management: Bud necrosis and stem necrosis became serious problem. Management practices for stem necrosis developed and popularized.
Harvesting : Mechanical threshers were introduced

Groundnut production technology, 2005

There are five important recommendations based on our review of production technology specific to Anantapur District

1. Reduction in fertilizer cost with soil testing in groundnut in the arid shallow Alfisols of Anantapur

The farmers are used to apply diammonium phosphate (DAP) or 20 : 20 NP.

Phosphorus is applied without any regard to its availability in soil. On soil testing, it was found that there was phosphorus built up to the level of high. The soil analysis results of the groundnut area gave a strong indication that there was a built up of soil phosphorus to high level with the farmers method of fertilizer application. The on-station research results indicate that there is no need to apply phosphorus fertilizer for at least 7 years when soil test value is very high. The following schedule of phosphorus and potassium is recommended groundnut crop in this region.

Phosphorus (P2O5 kg/ha)		Potassium (K2O kg/ha)	
Available in the soil	To be applied	Available in the soil	To be applied
< 20	40	< 150	40
20 – 40	20	150 – 250	20
> 40	Nil	> 250	Nil

On large scale it was found that the yield advantage was around 10% with cost reduction in the fertilizer input. Soil test based fertilizer application was found beneficial in reducing the cost of fertilizer to the extent of 50%, additional yield advantage of 50 kg/ha and a net benefit of Rs. 1600/- per ha.

	Groundnut (yield kg/ha)	Saving on cost of fertilizer (Rs/ha)
Farmers' method	760	---
Improved method	815	1020

2. Cost effective and speedy post harvesting processing of groundnut using threshers in Anantapur district

Farmers after harvesting, stack the produce for some period for separating groundnut pods from haulms as per labour availability. The practice is time consuming, labour intensive and thus delaying the marketing of the groundnut. Groundnut pods can be separated with mechanical threshers from third day onwards after harvesting without stacking the produce. This helped early post harvest processing, reduction in labour cost and increased the efficiency of the threshers. Thus enabled the farmers to market the produce early and get more price.About 20% of the groundnut farmers in the district adopted the improved method by using mechanical threshers on custom hiring.

3. Intercorpping of gorundnut + pigeon pea (11:1) for insurance against risk in arid alfisols of Anantapur

Farmers are very much used to sow groundnut as pure crop. However, to lesser extent intercropping with pigeon pea is also practiced with groundnut + pigeon pea row ratios of 20 : 1 to 40 : 1.The AICRPDA centre at Anantapur has over years optimized groundnut + pigeon pea row ratio as 11 : 1. During the year 2001, the risk management with intercropping was realized as the groundnut crop failed due to terminal drought and pigeon pea realized good yields due to extended monsoon having rains in October.

4. Minimizing the cost of cultivation in groundnut crop through seed size selection

Seed cost is more thereby increasing the cost of cultivation in groundnut. It is necessary to minimize the cost of cultivation, besides increasing the net returns of the crop through seed size selection in groundnut.

Treatment	Net returns (Rs./ha)	
	2001	2002
Assorted	6105	- 228
Bold	7032	- 1678
Medium	8014	- 395
Small	7100	1100
Shrivelled	6576	1657

The results suggested clearly that even small and shriveled groundnut seed can be used for sowing which will help in reducing the cost of cultivation of groundnut.

5. Influence of supplemental irrigation drought stress in groundnut crop

Groundnut crop generally fails due to lack of one rain at pod development stage. Minimum amount of irrigation water to be supplied for survival of crop during drought stress.Providing supplemental irrigation during drought stress increases the yield by 255 evean with 10 mm of irrigation. Water can be harvested and stored in farm ponds lined with soil and cement in 6:1 ratio.

2. Yield gap analysis

The yield gap between yields obtained with improved technology and farmers practice during different periods are presented.

Table1. Yield gap analysis from 1980 to 1985

Practice	Traditional	Improved	Change (%)
Field preparation	Normal	Contour	5
Nutrient management	No fertilizers	Fertilizers	10
Pest management	No pest management	Pest management for red hairy caterpillar	12
Disease management	No disease management	Late leaf spot management with mancozeb	10

Table2 . Yield gap analysis from 1985 to 1990

Practice	Traditional	Improved	Change (%)
Cropping system	Mono cropping with groundnut	Groundnut with intercropping system in 7:1 ratio	10
Field preparation	Normal	Deep ploghing	5
Variety	TMV2	TMV10, M13	10
Nutrient management	No fertilizers	Placement of fertilizers	8
Water management	Normal	Dead furrows, or compartmental bunding	12
Pest management	No pest control measures	Control of leaf webber with chloripyripos	15

Table3 . Yield gap analysis from 1990 to 1995

Practice	Traditional	Improved	Change (%)
Variety	TMV2	Tirupati1,Tirupati2, K134	15
Nutrient management	No gypsum	Application of gypsum @500kg/ha	14
Water management	No mulch	Mulching with groundnut shells @5t/ha	20
Disease management	No management	Management of late leaf spot and rust with carbendazim and manocozeb	15
Harvesting	Harvesting with blade harrow	Harvesting with Asha guntaka	10

Table 4. Yield gap analysis from 1995 to 2000

Practice	Traditional	Improved	Change (%)
Variety	TMV2	K134	10
Nutrient management	Fertilizer application	Soil test based fertilizer application	Cost reduction
Disease management	No disease management	Management of late leaf spot and rust with carbendazim and manocozeb	15
Harvesting	Manual stripping of pods	Mechanical threshing with groundnut threshers	Cost reduction

Table 5. Yield gap analysis from 2000 to 2005

Practice	Traditional	Improved	Change (%)
Variety	TMV2	Narayani,ICGV91114	10
Sowing	Sowing with assorted seed	Sowing with small and partially shriveled seed	Cost reduction
Nutrient management	Fertilizer application	Soil test based fertilizer application	Cost reduction
Water management	Rainfed	Supplemental irrigation with harvested water	20
Disease management	No disease management	Removal of Parthenium weed for the control of stem necrosis disease	15
Harvesting	Manual stripping of pods	Mechanical threshing with groundnut threshers	Cost reduction

3. Sources of yield gaps and scope for reducing the yield gaps

Sources of yield gaps
1. Pest management

2. Disease management

3. Rain water management

4. Variety

5. Farm implements

Scope for reducing the yield gaps

1. Pest management
Educating the farmers on identification of pest and management of pests.

2. Disease management
Educating the farmers on identification of pest and management of pests
3. Rain water management

Educating the farmers on water harvesting structures , and water delivery systems

Providing support to constructing and maintaining water harvesting structures

4. Variety

Production of breeder seed, foundation seed

Suppying seed in time to the farmer

5. Farm implements

Manufacturing of tractor drawn seed drills

Supplying them to farmers at subsidized rates

4. Impact of technology mission on groundnut cultivation

The Technology Mission on Oilseeds was launched by the Central Government in 1986 to increase the production of oilseeds to reduce import and achieve self-sufficiency in edible oils. One Centrally Sponsored Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize (ISOPOM) during the 10th Five year Plan which is being implemented with effect from 1 April 2004. The scheme is being implemented in 14 major oilseeds and pulses growing States for oilseeds and pulses and 15 major maize growing states for Maize and in 10 states for oil palm.

The components of mission are:

a. Improvement of crop production and protection technologies for realizing higher yields and profit to farmers.

b.Improvement of processing and post harvest technology to minimise the losses and increase the oil yield from both traditional and non-traditional sources of oil.

c. Strengthening the input support system to ensure availability of right kind of seed, fertilizers, pesticides, irrigation, credit, etc. and to bring awareness among farmers about the potential of the farm worthy technology through massive transfer of technology programmes.

d. Improvement of post harvest operations for effective procurement, handling, disposal including price support system to farmers and financial and other supports to processing industry.

New components of ISOPOM included during 10th Plan are:1.Inclusion of HDPE pipes,Publicity,2. Innovative measures and additional components,3.Training of Officers/Extension workers .The Technology Mission laid emphasis on development of Post Harvest Technology (PHT) with the following objectives:1. Optimising oil recovery from oilseeds by developing efficient modern oil expellers. 2.Developing value added products in respect of oilseeds, pulses and maize so that farmers are able to get a better/remunerative price.3.Dissemination of the R&D Technologies developed through demonstration programmes.

Among all the components price support and input supply made significant improvement in increase in area and production. Technology in general reduced the loss in productivity and cost of cultivation.

5. Suggestions for increasing competitiveness in international market with technological perspective

The natural resources ,irrigation facilities and soco economic conditionof Anantapur distict are briefly presented.

Soils :

- Alfisols – 76%, Vertisols – 24%
- Shallow depth (10 – 15 cm)
- Rolling topography (2.5%)
- Poor water holding capacity (40 mm/30cm soil depth)

Climate :

1. Mean annual rainfall : 550mm
2. Prolonged dry spells
   → Longest dry spell – 65 days
   → Number of dry spells during crop season : 2 – 4
3. Delay in onset of monsoon
   July sowings : 40% of year
   August sowing : 60% of year
4. Early withdrawal – By October 15
5. High frequency of drought years

Irrigation :

- Rainfed area :: 8.5 lakh ha
- Irrigated area :: 2.1 lakh ha
  → Tanks :: 40000 ha
  → Canals :: 35000 ha
  → Borewells :: 124000 ha

Characterisation of irrigation

Canals :: release of water

→ Release of water delayed

→ Once in 5 years – no release

Tanks

→ Filled once in 4 years

→ Insufficient water

Borewells

→ Decrease in water yield

→ Drying of wells

Cropping pattern

Cultivated area	::	9.5 lakh ha
Groundnut	::	7.5 lakh ha
Rice	::	0.4 lakh ha
Orchards	::	0.4 lakh ha
Bengalgram	::	0.4 lakh ha
Sunflower	::	0.3 lakh ha
Jowar	::	0.3 lakh ha

Socio – economic conditions :

- Small and marginal farmers :: 47.09%
- Number of cattle pair :: 29 for 73 farm facilities
- Literacy in farmers :: 42.15%
- 63 farmers are in debts out of 73 farmers
- The debt range Rs. 10000/- to Rs. 100000/-

→ Upto 10000/- :: 04 farmers

→ 10000 to 25000 :: 20 farmers

→ 25000 to 50000 :: 30 farmers

→ 50000 to 100000 :: 09 farmers

Unprofitable agriculture :

- Cost of cultivation of groundnut Rs.10000/ha
- Yield ranges from 200 to 1000 kg/ha
- Gross returns :: 3000 to 15000 kg/ha
- Net returns :: Frequent negative net returns

Reasons for indebtedness

- Frequent crop failures
- Higher interest rates from money borrowers – 24 to 60%
- Loss incurred due to annual purchase and sale of cattle pair
- Increased educational and health cost
- Sonking of borewells
- High cost of groundnut seed

Suggestions for development of agricultural sector

- Provision of crop loans at lower interest rates
- Dissemination of cost reduction technology
- Risk management technology should be developed and disseminated
- Research and extension support should be strengthened

Cost reduction technology

- Soil test based fertilizer application
- Use of own seed
- Use of small and shriveled seed
- Sowing with mechanical seed drill

Risk management technology

- Water harvesting and supplemental irrigation
- Efficient use of irrigation water through micro irrigation
- Management of red hairy caterpillar, Stem necrosis disease and late leaf spot
- Alternate crops – Ber, Anola, Tamarind