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OILSEEDS IN INDIA

A SUCCESS STORY IN A MISSION MODE

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FAO REGIONAL OFFICE FOR ASIA & THE PACIFIC
BANGKOK

CONTENTS

FOREWORD

The Asia Pacific Association of Agricultural Research Institutions (APAARI), as an active regional forum aiming to promote and strengthen agricultural research and development (R&D), has been facilitating collaboration and cooperation in the region through various institutional, regional and global partnerships. Among its diverse activities, information dissemination, proactive role for adoption of suitable technologies by National Agricultural Research Systems (NARS) based on successes achieved by others in the region under similar situations and further linkages with other stakeholders together assume great importance.

In order that the NARS benefit from such inter-institutional and inter-regional cooperation through sharing of their R&D results, APAARI since its establishment in 1990 has published several success stories on diverse topics of wider interest and concern to the national programmes. Over a dozen such success stories on food and agriculture related topics have been already published and information widely disseminated to NARS and other interested institutions. Already many countries have followed these successes for tangible gains in their own agricultural production systems. On oilseeds alone, earlier APAARI had published two success stories namely, Palm Oil Industry in Malaysia and Groundnut in China, which were widely received and appreciated.

Oilseeds are among the priority crops of the Asia Pacific and APAARI has also given a high priority to this group in the regional context. Over 10 annual oilseed crops of food and industrial value are grown in the region, with more diversity in the South, the Southeast and the East Asia.

The region has a tremendous potential in research and development of oilseeds crops. Among the countries that have demonstrated considerable success in oilseeds R&D in the Asia-Pacific region, India assumes considerable importance. National focus on this area has received the desired thrust in a Mission Mode in the past few decades in India. Diversification of research has lead to development of improved varieties of several oilseeds suitable for various agro-ecosystems and their popularization resulted in a revolutionary impact on production.

This success story, "Oilseeds in India" underlines the unique production potential of oilseed crops under specific situations, over and above the depiction of their potential to sustain the overall agro-biodiversity in the farming systems. The "Yellow Revolution" in India has been achieved in the recent past in the oilseeds sector following the revolutions in the food crops (Green Revolution) and dairying (White revolution). APAARI has earlier projected these successes through publications of two success stories, *Transformation in Korean Farming* and *White Revolution in India*. In the present case, the collective success of production in 9 annual oilseed crops in India has shown tremendous potential and promise of adopting a system-wide approach, which the APAARI highly recommends to concerned NARS in the region for adopting under similar conditions.

I am sure that this publication will be of great use to the national programmes engaged in oilseed research in the region in diversifying their own programmes on oilseed crops grown under diverse agro-farming situations in different agro-ecosystems and accordingly benefit from the results and findings reported for India.

New Delhi
4 January 1999

(R.S. PARODA)

Introduction

The oilseeds production scenario in India has witnessed a dramatic turn. The country achieved a status of 'self sufficient and net exporter' during early nineties, rising from the 'net importer' state, with a mere annual production of nearly 11 million tonnes from the annual oilseed crops, uptil the year 1986-87. In a span of just a decade, an all time record oilseeds production of 25 million tonnes from annual oilseed crops was attained during 1996-97. This transformation has been termed as *"The Yellow Revolution"* and could be primarily attributed to the institutional support, particularly the set up of the Technology Mission on Oilseeds in 1986. Significant outcome of the Mission and

A vast mustard field

other related developments included the following; i) the improved oilseeds production technology, ii) the expansion in cultivated area, and iii) the price support policy. As a result, the gains made possible were none short of a revolution and were rightly named as the yellow revolution.

Single plant of soybean showing profuse bearing

The Yellow Revolution

India is among the largest oil economies in the region/world. The country also occupies a distinct position in terms of diversity in annual oilseed crops. The prevailing agro-ecological conditions have been favourable for growing several important annual oilseeds, including edible (namely, groundnut, rapeseed-mustard, soybean, sunflower, safflower, sesame and niger) and non-edible oilseeds (namely, castor and linseed). In addition, a wide range of other minor oilseeds and oil bearing tree species add to the diversity as well as oilseed production in the country. India contributes a large share to the global castor production (76.9 per cent) and also a substantial one to production of sesame (31.2 per cent) and groundnut (25.1 per cent). The country is the largest producer of castor and sesame and second largest producer of groundnut and rapeseed-mustard (next to China). A production jump from 4.9 million tonnes to 8.8 million tonnes in terms of oil

A mustard field nearing maturity

equivalent (Table 1) recorded a high annual growth of 6.9 per cent as against 5.0 and 3.4 per cent for the region and the world, respectively. The other countries in the region that showed substantial increase in production (oil equivalent) and growth were Indonesia (8.2 per cent) and Malaysia (6.4 per cent) which could, however, be attributed mainly to increased production in oilpalm, in both cases. China topped in production figures in 1995 (12.5 million tonnes) but recorded a low annual growth (3.1 per cent).

Table 1: *Production of oil crops (oil equivalent) ('000 MT)*

Region	Year		Average Annual Growth (per cent)
	1985	1995	
India	4919	8807	6.9
Asia-Pacific Region	26866	43014	5.0
World	64761	90595	3.4

Source: FAO RAP Pub. 1996/32

The Indian vegetable oil industry achieved domestic turn over of above US $10,000 million during 1996-97. Its international trade in oil and oil meals annually accounted for US $1,850 million. The country further produced over 7 million tonnes of compound feed per annum, with an annual growth rate of 8-10 per cent.

It is important to observe that with a record production of about 25 million tonnes of oilseeds from an area of nearly 27 million hectares and productivity of 931 kg/ha during 1996-97 (Table 2), the oilseeds area, production and productivity in India have increased nearly 2.5 times, 5 times and 2 times, respectively, since 1950-51. The role of technology in fostering and sustaining the production has been effectively realized. Further, the technology was economically viable and sustainable. It sustained the growth that was achieved in spite of different adverse factors, such as, the moisture and nutrient scarcity conditions, among others. Having achieved sustainability in growth is commendable particularly when the area under irrigation rallied

A sunflower demonstration plot

around 25 per cent and the annual vegetable oilseeds are grown mostly under such conditions.

Table 2: *Area, production and productivity of annual oilseed crops in India*

Year	Area (m ha)	Production (mt)	Productivity (kg/ha)
1950-51	10.73	5.16	481
1955-56	12.09	5.73	474
1960-61	13.77	6.98	507
1965-66	15.25	6.40	419
1970-71	16.64	9.63	579
1975-76	16.92	10.61	627
1980-81	17.60	9.37	532
1985-86	19.02	10.83	570
1990-91	24.15	8.61	771
1996-97	26.81	24.96	931

Source: Directorate of Economics & Statistics, Ministry of Agriculture, Government of India.

The phenomenal growth in all sectors related to production and productivity of diverse oilseed crops is a sure success. Other countries in the region may harness similar opportunities depending upon the respective situations and technologies available for transfer. Above all, this success signals an important message in favour of possibilities to combine results of agrobiodiversity, productivity and profitability.

Sunflower a successful introduction in annual oil seed crops

Historical Perspective

The Technology Mission on Oilseeds

The turning point was the year 1986. The annual production of oilseed crops was virtually stagnating at about 10 million tonnes over a span of more than 15 years in spite of a considerable increase in area under oilseed crops from 10.73 m ha in 1950-51 to 19.02 m ha in 1985-86. Till mid-eighties, the growth in output also lagged far behind the growth in demand, thus forcing the government to resort to large scale import of edible oils (to the tune of US $1,100 million during 1981-86) to bridge the demand-supply gap. Realising the fact, the Government of India appointed the Technology Mission on Oilseeds in May 1986, with the objective to create/manage conditions that would harness the best of production, processing and storage technologies to attain self reliance in edible oils in the foreseeable future. A target of producing 16-18 million tonnes of the nine annual oilseeds (groundnut, rapeseed-mustard, soybean, sunflower, safflower, sesame, niger, linseed and castor) was fixed to substantially cut down the imports by the year 1990.

The scope of the Mission and strategies to be adopted to achieve the objective were set well before the onset of the Mission in February 1986, which is elaborated in the excerpts from the then Prime Minister's speech as given below:

> *"One of our biggest problems today in the agricultural sector is oilseeds. We are setting up a thrust Mission for oilseeds production. When we talk of a Mission, we mean an exercise starting from the engineering of the seeds and finishing with the finished products of the vegetable oil (and the byproducts like oil meal) which could be delivered to the consumer. We would like to put one person*

in-charge of such a Mission with full funding, with no restrictions on him, whether bureaucratic or otherwise. The only limits will be certain achievements which must come within a certain time frame. This will cut across a number of ministries...."

The Mission started functioning as a consortium of concerned Govt. departments, namely, Agricultural Research and Education (DARE), Agriculture and Cooperation (DoAC), Civil Supplies (DoCS), Commerce (DoC), Science and Technology (DST), Biotechnology (DBT), Planning, Health, Irrigation and Economic Affairs. The Mission adopted a four-pronged strategy under the following Mini-Missions:

Mini-Mission-I: Improvement of crop production and protection technologies for realizing higher yields and profit to farmers.

Mini-Mission-II: 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.

Mini-Mission-III: 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.

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

The nodal departments, participating organisations and their respective functional areas under different Mini-Missions were clearly defined to enable a smooth interaction, efficiency and effective output.

Growth in Annual Oilseeds Production

Thanks to the Oilseeds Technology Mission, India witnessed a spurt in the annual oilseeds production (Fig. 1). A series of synergistic

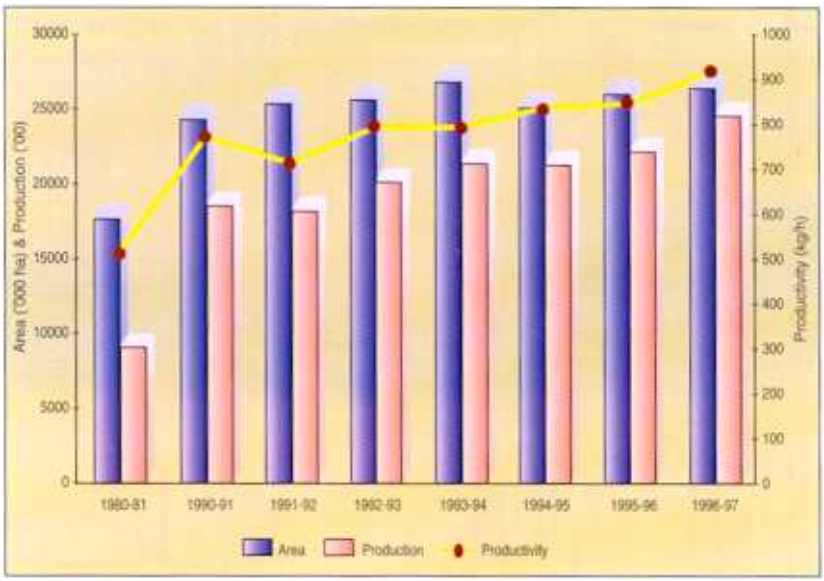
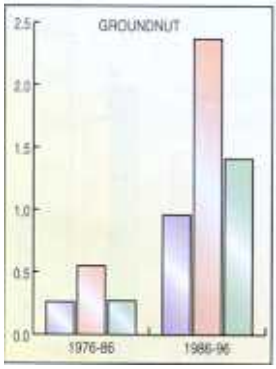


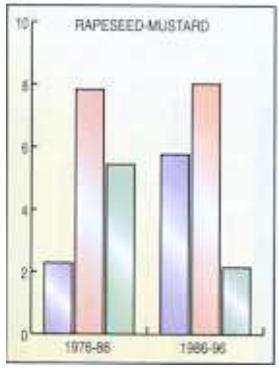
Fig. *Area, production and productivity of main annual oilseed crops in India*

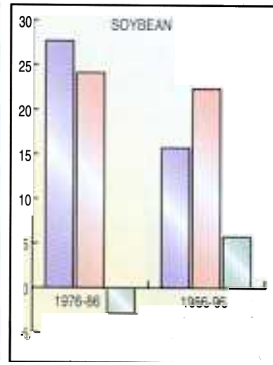
and farmer oriented programmes launched by the Mission along with better availability of crop production technologies, inputs, services and support price policy were together responsible for the achievements.

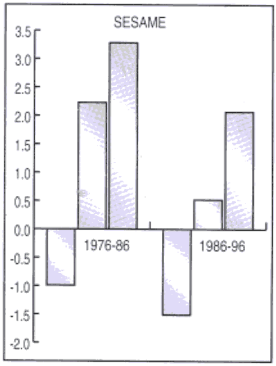
During the past decade, soybean registered the highest compound annual growth rate of production followed by castor, sunflower and rapeseed-mustard (Fig. 2). The simultaneous growth in area, production and productivity observed under rainfed crops has no parallel in the region/world. Presently, oilseeds occupy nearly 13 per cent of the gross cropped area and account for 5 per cent of the gross national product and 10 per cent of the value of all agricultural products.

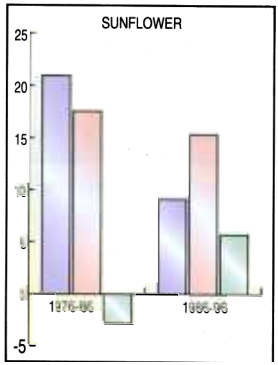
Among the oilseed crops, groundnut, rapeseed-mustard and soybean recorded a major share, in terms of both area (74 per cent) and production (84 per cent), of oilseeds in the country (Table 3). In terms of growth in productivity, castor topped the list followed by sunflower, soybean and safflower during 1985-86 to 1995-96.

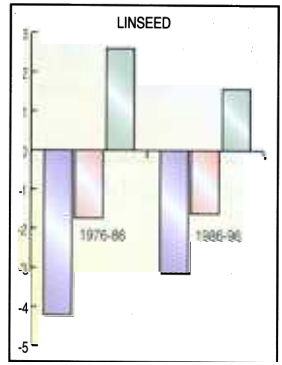


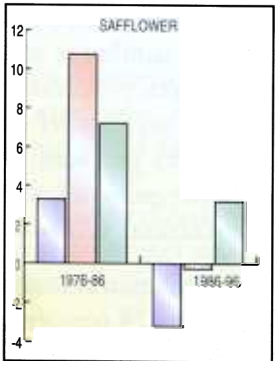


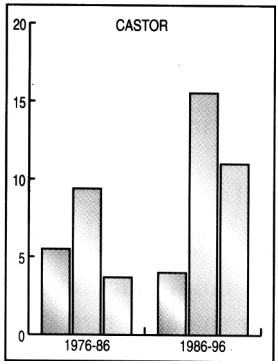












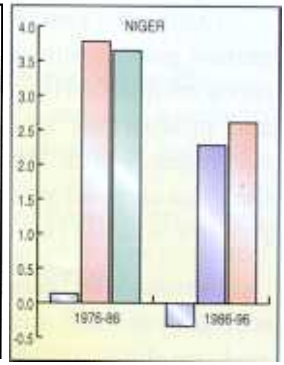


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Table 3: *Cropwise area, production and yield*

Crops		1980-81	1985-86	1990-91	1996-97
Groundnut	A	6801	7125	8309	7814
	P	5005	5121	7515	9024
	Y	904	719	1060	1155
Rapeseed-Mustard	A	4113	3980	5282	6856
	P	2304	2681	5782	6942
	Y	560	674	904	1013
Soybean	A	606	1340	2564	5227
	P	440	1024	2602	5202
	Y	726	764	1015	995
Sunflower	A	119	752	1624	1995
	P	663	281	873	1315
	Y	555	374	535	659
Sesame	A	2470	2217	2516	2060
	P	445	501	835	673
	Y	180	226	332	327
Linseed	A	1673	1424	1099	845
	P	423	376	332	325
	Y	253	264	302	384
Castor	A	498	637	810	748
	P	204	308	716	891
	Y	411	484	884	1192
Safflower	A	709	911	823	707
	P	246	348	320	432
	Y	476	382	389	611
Niger	A	599	635	611	559
	P	146	192	186	157
	Y	244	303	305	281
Total	A	17602	19020	24148	26811
	P	9067	10833	18609	24961
	Y	515	570	771	931

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-Yield in k

TKG-21 An improved variety of sesame

The annual per capita availability of edible oils and vanaspati (hydrogenated vegetable oils) increased from 4.0 kg during 1960-61 to 8.2 kg during 1995-96 (Table 4).

Table 4: *Availability of edible oils and vanaspati (hydrogenated vegetable oils)*
(kg/capita/annum)

Year	Edible oil	Vanaspati	Total
1960-61	3.2	0.8	4.0
1965-66	2.7	0.8	3.5
1970-71	3.5	1.0	4.5
1975-76	3.5	0.8	4.3
1980-81	3.8	1.2	5.0
1985-86	5.0	1.3	6.3
1990-91	5.5	1.0	6.5
1995-96	7.2	1.0	8.2

Source: Directorate of Economics and Statistics, New Delhi.

Oilseed Crop Production Zones

The annual vegetable oilseeds are cultivated in 14 states (Table 5) of which eight states, namely, Madhya Pradesh, Rajasthan, Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Uttar Pradesh and Tamil Nadu accounted for nearly 90 per cent of the oilseeds area and production in the country. Madhya Pradesh state showed the highest area and production, followed by Rajasthan, Andhra Pradesh and Gujarat. Among different oilseeds, rapeseed-mustard is represented as major oilseed crop in 7 states, groundnut in 4 states, and soybean, sesame and niger in one state each.

Varietal testing in groundnut to select improved types suited to specific areas

Table 5: *State-wise area, production, productivity and major oilseed crops*

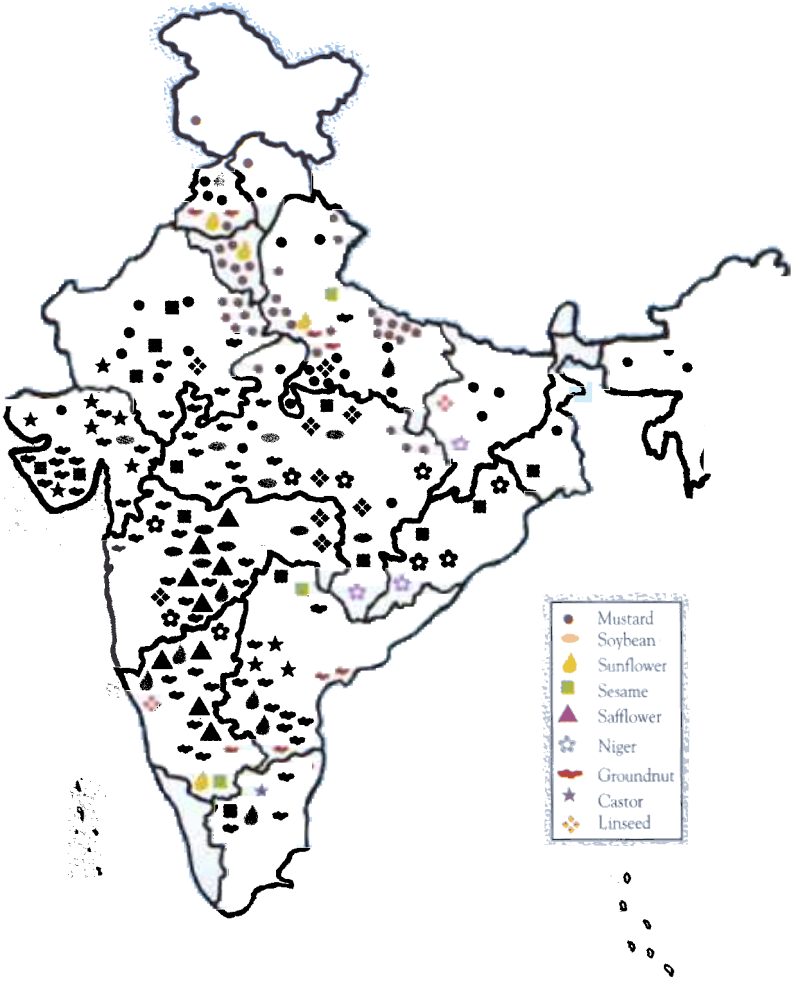
(Mean of Triennium ending 1995-96

State	Area (000 ha)	Production (000 t)	Yield (Kg/ha)	Major oilseed crops grown (Area-wise)		
				I	II	III
1. Madhya Pradesh	5334.7	4497.6	843	Soybean	Mustard	Linseed
2. Rajasthan	3612.8	2769.2	766	Mustard	Sesame	Soybean
3. Andhra Pradesh	3146.2	2616.5	832	Groundnut	Sunflower	Castor
4. Gujarat	2993.1	2481.2	838	Groundnut	Soybean	Mustard
5. Karnataka	2767.9	1740.1	629	Groundnut	Sunflower	Safflower
6. Maharashtra	2686.7	2047.1	762	Sesame	Groundnut	Soybean
7. Uttar Pradesh	1697.8	1424.0	839	Mustard	Linseed	Sesame
8. Tamil Nadu	1345.6	1961.6	1458	Groundnut	Sesame	Sunflower
9. Haryana	637.0	850.0	1334	Mustard	Sunflower	Sesame
10. West Bengal	532.0	415.0	780	Mustard	Sesame	Linseed
11. Orissa	491.0	259.0	527	Niger	Groundnut	Sesame
12. Assam	307.0	155.0	506	Mustard	Sesame	Linseed
13. Bihar	231.7	145.0	625	Mustard	Linseed	Niger
14. Punjab	205.0	258.0	1259	Mustard	Sesame	Linseed
First 8 States	23584.8 (90.1%)	19537.3 (89.8%)	828			
First 10 states	24753.8 (94.5%)	20802.3 (95.6%)	840			
All 14 states	25988.5 (99.2%)	21619.3 (99.4%)	832			
All India	26185.0	21750.3	831	Groundnut	Mustard	Soybean

Source: Directorate of Oilseeds Research, Hyderabad.

Note: Figures in parentheses indicate percentages to All India totals.

OILSEED PRODUCTION AREAS



Area under different crops not to scale

Oilseed Trade

The oilseed sector has made very important contribution towards foreign exchange earning. This was achieved from the export of soymeal, castor oil, oil cake/extractions, hand picked selection (HPS) groundnut and sesame seed. In addition, export of branded edible oil in small packs has also been done. A progressive increase in the value of exports of oilseeds, oilmeals and minor oils has been clearly observed (Fig. 3). The national export earnings from oilseeds crossed US $ 1,000 million during the year 1996-97 of which the contribution from exports of oil meals was US $ 900 million (Table 6).

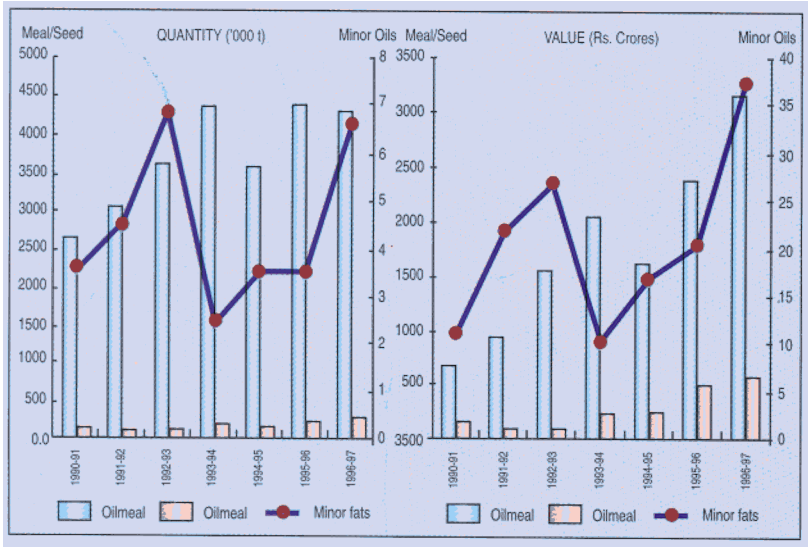


Fig. 3 Value of exports of oilseeds and other products

Table 6: *Exports of oilmeals, oilseeds and minor fats*

(Quantity in '000 Tonnes, Value in Million Rupees)

Items	1990-91 (April-March)		1996-97 (April-March)	
	Qty	Value	Qty	Value
I. **Oil Cakes/Extractions**				
a. Soybean Extractions	1352.6	4738.8	2550.0	24250.0
b. Groundnut Extractions	139.6	347.5	300.0	2100.0
c. Cotton seed Extractions	17.0	36.0	Nil	Nil
d. Rice Bran Extractions	455.7	534.9	317.6	960.0
e. Rapeseed Extractions	531.1	715.7	1000.7	3830.0
f. Sunflower Extractions	92.3	142.1	25.1	110.0
g. Sal seed Extractions	43.3	47.8	9.3	25.0
h. Sesame seed Extractions	7.7	21.6	–	–
I. Other Exts./Feeds	17.1	29.8	19.3	138.0
J. Castor seed Extractions	–	–	78.2	144.5
Total	2656.5	6614.2	4300.2	31557.5
II. **Oilseeds**				
a. Niger seed	NA	NA	NA	NA
b. Sesame seed	47.2	720.7	85.0	2381.1
c. HPS Groundnut	35.4	624.3	150.0	3300.0
d. Safflower seed	NA	NA	2.0	20.0
e. Sunflower seed	NA	NA	1.0	16.7
f. Rapeseed/Mustard	NA	NA	1.0	15.0
Total	82.6	1345.0	239.0	5732.8
III. **Minor Oils/Fats**				
a. Sal oil (Fat)	–	–	5.6	306.6
b. Mango kernel oil (Fat)	–	–	0.2	14.4
c. Kokum oil (Fat)	–	–	0.4	41.8
d. Neem seed oil	–	–	0.4	10.4
Total	3.5	108.0	6.6	373.2
GRAND TOTAL	2742.6	8067.2	4545.8	37663.5

Source: Central Co-ordination Office (CCO) of SOPA, SEA, GEEDA, IOPEA & AICOSCA; and also DGCI & S.

NA – Not available
Value : Rupees 42 = US $ 1.00

Mustard

Sesame

Groundnut

Soybean

Niger

nflower

Castor

Safflower

India contributes over three-fourth of global castor production

Government of India allowed free import of edible oils under Open General License (OGL) at 20 per cent import duty with effect from 23 July, 1996 as against the prevailing duty of 30 per cent for private trade and 20 per cent for state agencies. This arrangement affected an increased import of edible oil (Palmolein accounted for 80 per cent of the imports) touching around 1.75 million tonnes during 1996-97, which was mainly due to liberal import policies, lower external prices rather than low production/availability. The increased reqirement may be partly attributed to the increased economic access on part of the poor. Nevertheless, the tremendous growth in terms of oilseed production has been a very important national achievement.

Domestic Availability and Demand

The rate of growth of production of vegetable oils during the past decade was 6.9 per cent whereas the corresponding demand has been increasing at the rate of about 6 per cent per annum, touching 9.23 million tonnes during 1996-97 (Table 7). With this substantial growth in production, the domestic supply of vegetable oils reached 7.28 million tonnes and the gap of 1.95 million tonnes in demand was filled through imports. The increase in the demand for edible oils was mainly attributed to socio-economic factors, such as the rise in income (purchasing power) of people (vis-à-vis demand) and the high liberalised imports (vis-à-vis supply).

An array of oils in the domestic market developed from different oilseed crops

Table 7: *Estimated domestic availability of vegetable oils (1996-97 oil year)*

Sr.No.	Supply source	Quantity in million tonnes
A	**Oilseeds**	
1.	Groundnut	1.71
2.	Soybean	0.60
3.	Rape/Mustard/Toria	1.90
4.	Sunflower	0.42
5.	Sesame	0.29
6.	Castor	0.32
7.	Niger	0.06
8.	Safflower	0.11
9.	Linseed	0.13
10.	Cotton seed	0.47
11.	Copra	0.43
	Sub total (A)	6.44
B	**Secondary source**	
12.	Rice bran	0.48
13.	Rapeseed cake	0.11
14.	Sunflower seed cake	0.07
15.	Groundnut cake	0.07
16.	Cotton seed & others	0.06
17.	Minor oilseeds	0.05
	Sub total (B)	0.84
	Total domestic supply (A + B)	**7.28**
C	**Imported oil**	
15.	Edible oil	1.75
16.	Non-edible oil	0.20
	Sub total (C)	1.95
D	**Total Domestic Demand (A+B+C)**	**9.23**

Source: The Solvent Extractors' Association of India, Mumbai.

Supplementary Sources of Vegetable Oils

Minor Crops and Tree Origin Oilseeds

A considerable oil potential occurred in this category, which contribute about 16 per cent of the vegetable oil consumption in India. Oil has been obtained from rice bran, cotton seed, corn and oil cakes besides seeds of underutilized plants like jatropha, *tumba* etc. or of tree origin such as *sal*, mango kernel, *neem*, *mahua* and several others.

It has been estimated that the current level of availability of vegetable oils from these sources (1.38 million tonnes) could be further stepped up, given their tremendous potential (3.08 million tonnes) (Table 8). The production of rice bran oil, cotton seed oil, solvent extraction from oil cakes and the oils from minor crops and tree origin oilseeds has been estimated at 0.48 million tonnes, 0.45 million tonnes, 0.32 million tonnes and 0.13 million tonnes, respectively.

Tumba (Citrullus colocynthis) – an arid zone minor industrial oilseed crop

Table 8: *Supplementary sources of vegetable oils*

(Million tonnes)

Source	Potential	Current production	Gap
Rice bran	0.90	0.48	0.42
Cotton seed	0.88	0.45	0.43
Oil cakes	0.70	0.32	0.38
Minor & tree origin oilseeds	0.60	0.13	0.47
Total	3.08	1.38	1.70

Source: The Oils & Oilseeds Journal, Vol.49, No.7-12 (July-December), 1996.

Oil Palm – Another Prospective Source

Oil palm is an alternative and potential long term source of edible oil which is expected to contribute significantly towards meeting the growing edible oil demand. It can yield, on an average, four tonnes of vegetable oil per hectare as compared to less than half a tonne from other annual oilseed crops. Presently, the oil palm is cultivated in an area of 39,413 ha, as against the potential area of 0.8 million hectares spread across 11 states in the country. Nearly one million tonne of palm oil production is expected in near future that will be about 10 per cent of the country's demand. With the possible entry of oil palm in a big way, the cheapest oil source in the international market owing to its highest oil yield per unit area and low cost of cultivation, there is a likelihood of major changes in the market shares of different oilseeds. Nevertheless, an enhancement in the production of oil palm will further add to the success in oilseed/oil production in India, which may be an experience well shared with other countries in the region.

Factors Underlying Success

Research Set up and Breeders' Seed Production

India has the largest research network for the development of location specific oilseeds crop production technologies. It includes the All India Coordinated Research Project on Oilseeds (AICRPO) and the Directorate of Oilseeds Research (DOR) at Hyderabad (Andhra Pradesh), three National Research Centres, one each for soybean at Indore (Madhya Pradesh), groundnut at Junagadh (Gujarat) and rapeseed-mustard at Bharatpur (Rajasthan). Besides, the State Agricultural Universities, other ICAR institutes and private/corporate sector have also been involved in oilseeds research and development

Inspection of seed plot

programmes. A multitude of improved technologies have been generated and transferred on to farmers' fields over the time through this network.

The oilseed research set up in the public sector has about 500 well trained scientists engaged in research and technology generation purposes. Realizing the fact that quality seed is the most crucial, critical and vital input to enhance productivity of oilseed crops, separate breeders' seed production units in these crops were also established. Consequently the breeder seed production, as a basic input to quality seed production, increased 3.7 folds (Table 9).

Table 9: *Average annual production of Breeder Seed in different annual oilseed crops*

Crop	Year		
	1984-85	1985-86 to 1989-90	1990-91 to 1994-95
Groundnut	1428.58	3531.67	4327.06
Rapeseed-mustard	114.30	82.80	83.15
Soybean	495.12	1768.29	3242.27
Sesame	5.72	20.86	9.09
Sunflower	9.60	79.07	104.89
Linseed	14.96	45.52	33.94
Safflower	82.47	30.38	33.03
Castor	1.01	65.99	40.18
Niger	0.67	3.51	1.49
Total	2152.43	5628.09	7875.10

Source: Rai, Mangala. 1995.

Improved Crop Production Technology

During the past two decades, over 240 improved varieties/hybrids have been developed in annual oilseeds, which have shown 9 to 38 per cent yield superiority over the local cultivars. A further scope is envisaged to capitalize on this potential area with the development

of varieties/hybrids which can out yield 50 per cent more or even higher than the existing varieties under farmers' field.

Hybrids and Improved Varieties: Development of two safflower hybrids in India is recorded as the 'first' in the world. The safflower hybrid DSH-129, developed by the Directorate of Oilseeds Research, Hyderabad and released for commercial cultivation for all safflower growing areas in the country, has an average yield potential of 1750 kg/ha. It offered 22 per cent higher seed yield and 29 per cent higher oil yield over the presently grown varieties during *rabi*/summer season in black soils. The development and release of hybrids in castor namely, DCH-32 and GCH-4 and a high yielding variety DCS-9 (Jyoti) revolutionised castor production in the country. New hybrids in sunflower and castor that were brought out in series have provided new opportunities. A few more hybrids in rapeseed-mustard, are round the corner. Efforts are also on to evolve hybrid in sesame. Breeding efforts in oilseed crops to meet the objectives such as the oil content in the seed, resistance to biotic and abiotic stresses, reduced crop duration etc. have been quite successful. A list of important improved varieties and hybrids developed/released in various oilseed crops in the recent past is given in Table 10.

DCS-9 (Jyoti) – a high yielding variety of Castor

Table 10: *List of important varieties and hybrids developed recently*

Crop	Varieties	Hybrids
Groundnut	RSHY-1, TAG-24, TIRUPATI-2, ICGV-86590, CSMG-84-1, ICGS-5, BAU-13, TKG-19A, B-95, K-134, ICGV-86325, GG-3, DRG-17 (Manikya), DRG-12 (Mukta), TG-26	
Soybean	JS-79-81, NRC-2, NRC-12, PK-564, PK-1024, PK-1029, VLS-21, JS-335, MACS-57, MACS-124	
Rapeseed-mustard	YSBNC-1, PBR-91, PBT-37, PCR-7, BIO-902, GSL-2, PC-5, SHEETAL	PGSH-51
Sunflower	TNAUSUF-7, GAUSUF-15	PSFH-67, PKVSH-27, Jwalamukhi, KBSH-1, PAC-36, MSFH-17
Sesame	RT-54, TKG-21, RT-103, TKG-22, YLM-1, YLM-2 (Gautam), GUJTIL-2, TSS-6 (SVPR), RT-125, T-78	
Safflower		DSH-129, MKH-11
Niger	CIA-15 (Shiva)	
Linseed	Triveni, Nagarkot, Surabhi	
Castor	DCS-9 (Jyoti), AKC-1, 48-1	DCH-30, GCH-4, GCH-5

Source: Directorate of Oilseeds Research, Hyderabad.

Improved Packages of Cultivation Practices: To maximize yield gains from improved technology in terms of varieties/hybrids, agronomic packages for efficient crop management have been developed for different crops and situations, which assured better results.

Plant Genetic Resources: Sustained utilization of the genetic resources in different oilseeds augmented through collection/ introduction of native/exotic plant species and the genetic stocks developed by crop specific breeding programmes contributed effectively

towards breeding of improved varieties. The exotic oilseed crops/ varieties, particularly soybean and sunflower, have also helped produce good results.

Spaced planting to test the potential of improved genetic stocks

Support Price Policy

Considering the fact that oilseed crops being considerably influenced by market forces, are prone to wide fluctuations in prices of oilseeds, a positive view was taken by the government, which resulted in increased support price of oilseed as compared with other crops over the years (Table 11). The ruling open market prices had been about 20 per cent higher than the support prices during the harvest times

and about 50 per cent higher during the lean period. The announcement of support prices before sowing of crops provided the guaranteed market clearance and thereby geared up a switch over from cultivation of staple cereal crop(s) to market oriented non-food crops.

Table 11: *Minimum support prices of oilseeds – 1997-98*

(Rupees/quintal)

Year	Ground-nut	Soy-bean (Yellow)	Soy-bean (Black)	Sun-flower	Sesame	Niger	Rape-seed Mustard	Toria	Safflower
1980–81	206	198	183	183	–	–	–	–	–
1985–86	350	275	250	335	–	–	400	360	400
1990–91	580	400	350	600	–	–	600	570	575
1995–96	900	680	600	950	850	700	860	825	800
1996–97	920	700	620	960	870	720	890	855	830
1997–98	980	750	670	1000	950	800	940	905	910

Source: Reports of Economic Survey, GOI, 1997-98; Oils & Fats Review.

As a part of the Market Intervention Operations (MIO) by the National Dairy Development Board (NDDB), the imported oil (other than that released through the public distribution system) was channelised into the market and the vanaspati industry, and buying, stocking and selling of oilseeds/oils continued to be undertaken in the domestic market. The NDDB also introduced vegetable oil in the consumer packs under the brand name of 'Dhara', (meaning 'The Flow'), which not only narrowed the range of prices of different edible oils (thereby discouraging adulteration of costlier oils with cheaper ones, being an economically unattractive proposition) but also helped in popularising blended edible oils.

Extension and Training in Oilseeds Technology

Technology Transfer – Frontline Demonstrations: With a view to demonstrate under real farm situations the productivity potentials and profitability of a spectrum of improved oilseeds crop production technologies, evolved by the oilseeds research network in the country from time to time, on-farm demonstrations were organised through various technology transfer programmes of the Central and State Governments, State Agricultural Universities and voluntary organisations. Among the most successful of such programmes figured the "Frontline Demonstrations in Oilseeds" Project, a component of the Oilseeds Production and Development Programme (OPDP) of the Government of India that supplemented the Oilseed Technology Mission. During 1990-91 to 1996-97, more than 8,000 demonstrations were organised in different oilseed crops across various agro-ecological and crop growing situations. It has been unequivocally proved over years that the improved technologies offered yield advantage ranging from 24 per cent to 107 per cent over the prevailing farming practices, with the benefit:cost ratio varying from 1.35 to 3.33 across different crops, regions and situations. These demonstrations overwhelmingly convinced the farmers of the efficacy of improved technologies, thereby promoting their on-farm adoption.

Training and Education: Several short and medium term training programmes were organised and thousands of extension functionaries have been trained over the time by oilseeds research network involving ICAR, SAUs and other development organisations. The trainees included officials from the State Departments of Agriculture of different states, such as subject matter specialists, Joint/Deputy/ Assistant Directors of Agriculture, Project Officers of OPDP of State/ GOI, scientists from SAUs, extension personnel of other voluntary organisations and progressive farmers.

The untiring and sustained efforts by the oilseeds research and extension machinery to disseminate the knowledge on improved technology included, (i) publication and distribution of 'Package of cultivation practices for increasing production' for each of the oilseed crops in English, Hindi and regional languages; (ii) publication

DSH-129 A promising hybrid in Safflower

On-farm demonstration and training constituted an integral part of oilseeds mission

Linseed – a high value annual oilseed crop covers a sizeable area in India

Intensive and systematic breeding programmes yielded desirable results

and distribution of technical bulletins on specific weed/insect/disease management technologies, seed production and frontline demonstrations, (iii) use of mass media such as video films on improved crop cultivation practices, radio talks and television programmes by scientists, and (iv) organisation of field days/farmers' rallies etc., among others.

Institutional Support and Linkages

Besides linking the Commission for Agricultural Costs and Prices (CACP), the National Agricultural Cooperative Marketing Federation (NAFED), the National Dairy Development Board (NDDB), Oilseeds Growers' Societies (village level) and Oilseeds Growers' Federations (state level) for implementing the support price policy, projects to evolve and perfect new technologies for oilseeds and transfer these on to farmers' fields were initiated. A development project for groundnut was launched in 1980-81 and that for soybean in 1981-82. Also, a programme for distribution of minikits of improved seeds and fertilisers for oilseeds was started in 1980-81.

Indigenous annual oilseed crops like sesame have got adequate attention for varietal development and seed production

Exotic soybeans have also drawn particular attention of breeders and seed producers in India

In 1985-86, the National Oilseeds Development Project (NODP) was launched with a view to accelerating the production of four major oilseeds, namely, groundnut, rapeseed-mustard, soybean and sunflower. Under this programme, seeds of improved varieties, plant protection chemicals, fertilisers and rhizobium culture were made available to the growers at subsidised rates. The efforts of State Departments of Agriculture, ICAR institutes and SAUs were devoted towards demonstrating the potentials of improved technologies on farmers' fields. Initially, the efforts were concentrated in potential areas of 12 states, but later the project was extended to 180 districts of 17 states in the country.

While the interaction of remunerative prices and new technology started showing its positive impact on the production of oilseeds, the need for integrated efforts on harnessing the best of production, processing and management technologies of the oilseed economy was strongly felt. Towards this end, the Technology Mission on Oilseeds (TMO) launched in May 1986, "Oilseeds Production Thrust Project (OPTP)" initiated in 1987-88, covering 246 districts of 17 states and later extended to more areas, helped in attaining the developmental goals. To provide further operational teeth, in 1990-91, the NODP and OPTP were merged under one programme, namely, the Oilseeds Production Programme (OPP).

Secrets of Success

The following factors played their crucial role in bringing success to the oilseed mission and thereby the yellow revolution in India:

- Strong socio-economic and political will to become self-sufficient in vegetable oils.
- Biodiversity and the matching diversity in agro-ecology and farming situations for various annual oilseed crops, inspite of the paucity of more prospective oil crops such as the oilpalm.
- Economically viable and sustainable improved oilseeds production technologies generated with the help of strong and vibrant oilseeds research network coupled with encouraging financial and policy support to research.
- Attractive incentives to the farmers in terms of minimum support prices and input subsidies.
- Institutional support for the overall oilseeds research and development by public, corporate and private sectors, particularly the setting up of the Technology Mission on Oilseeds by the Government of India.
- Effective implementation, monitoring and periodical evaluation of the technology transfer programmes, especially the "Frontline Demonstrations in Oilseeds" Project.
- Integrated, effective, efficient and transparent functional farmer-research-industry-policy interface.

Epilogue

The achievement of self-sufficiency in vegetable oils in India that nullified the foreign exchange drain witnessed during eighties is a sure success. This could be an example to follow in the Asia-Pacific region whereby other countries may achieve similar results. The holistic approach in the form of mission mode adopted by the Government of India to tackle the problem of burgeoning import bill on edible oil front is worth commendation. However, since the oilseed crops are sensitive to market forces and are mostly grown in moisture and nutrition scarce conditions, sustaining the success in the long run is not so easy a task. Sufficient rethinking has to be done in several spheres to sustain and flourish.

Research funding by the Government needs to be continued/ strengthened for oilseeds research and development in the era of liberalised world trade. All the research priorities/activities need to be organised/refined in a matrix mode of operation. The support price policy needs to be continued and strengthened. The market mechanism of offering higher price for quality oilseeds with higher oil content and of better quality may have to be searched for. Quality consideration of oilseeds is desired as a matter of principle. This would encourage and provide a sense of direction to the oilseed growers and researchers alike. The "seasonally variable import duty" may have to be continuously followed to safeguard the overall interests of oilseed sector. Owing to wide intra and inter seasonal fluctuations in commodity prices of oilseeds and vegetable oils, the move to allow "futures trading" in these commodities needs to be hastened. Since oilseeds generally require less water as compared to many other

crops, irrigation water charges should be commensurate with the water used rather than on flat area basis.

India should strive to export value added products instead of exporting direct items like oilseeds, oil and oil cakes. Castor oil which forms the basis for many oleo-chemicals has a great potential. Hydrogenated castor oil, dehydrated castor oil, sebacic acid, undecylimic acid heptaldehyde are some important oleo-chemicals with high value and can earn larger foreign exchange. Similarly, mustard oil which is rich in erucic acid is a useful industrial raw material. Cultivation of varieties with low/zero levels of toxic constituents or adoption of some detoxification techniques can improve the export of some seeds and cakes. The existing farmer-research-industry-policy sectoral interface needs to be strengthened for achieving the overall development of the oilseed sector in terms of commercial exploitation of untapped yield reservoir, value addition to oilseeds and their products/byproducts, demand driven research agenda and congenial public policy environment.

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