Peanut in India: History, Production, and Utilization

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Oilseeds of India

Oilseeds -particularly coconut, sesame, mustard, cottonseed, linseed, castor, niger, safflower have been grown or used in India for many millennia. For example, archaeological excavations of cities of the great Indus Valley culture which spanned the period 2500 to 1500 BC have yielded charred seeds of sesame and mustard. As cloth and string made from *Gossypium arboreum* were found during the excavation, cottonseeds were also known at that time. While the above-mentioned eight oilseeds made their appearance in India at various points of historical time, they can all be regarded as prehistoric. The process of introduction of oilseeds has continued, and four oilseeds, namely, groundnut, soybean, sunflower, and oil palm have gained importance only during the present century (Achaya 1990).

All oilseeds used in India can be categorized into different groups depending upon their origin or use as given in the table 1.1 (see also Achaya 1990).

Table 1.1: Oilseeds of India

Groups	Oilseeds
Historical oilseeds	Coconut, sesame, mustard, cottonseed, linseed, castor, niger, safflower
Newly introduced oilseeds	Groundnut, soybean, sunflower, oil palm
Oil bearing materials that are byproducts of cultivated crops	Rice bran, tapioca seed, maize germ, tobacco seeds, rubber seeds, tung seeds *(Aleurites fordii)*, jute seeds, spent coffee grounds, tea seeds
Oilseeds with characteristic lipid associates	Neem, Karanja *(Pongamia pinnata)*, kusum *(Schleichera oleosa)*, Nahor *(Meusa ferrea)*, Undi *(Calophyllum inophyllum)*, Rayana *(Amoora rohituka)*
Oilseeds carrying vegetable hard fats	Mahua *(Madhuca indica)*, sal *(Shorea robusta)*, dhupa *(Vateria indica)*, kokum *(Garcinia indica)*, tamal *(Garcinia morella)*, phulwara *(Diploknema butyracea)*
Oilseeds bearing soap-making oils	Khakan-pilu *(Salvadora oleoides)*, pisa *(Actinodaphne hookeri)*, chirandi *(Litsea glutinosa)*
Oilseeds with oils of an unusual nature	Maroti *(Hydnocarpus sp.)*, *kamala (Mallotus philippinensis)*, pinari *(Sterculia foetida)*, Malkanguni *(Celastrus paniculatus)*
Oilseeds from shrubs	Ratanjyoti *(Jatropa carcuas)*, gokhru *(Xanthium strumarium)*, hurhur *(Cleome icosandra)*, somraji *(Vernonia anthelmintica)*, argemone *(Argemone mexicana)*

History of Groundnut Cultivation in India

Groundnuts, or peanuts, originated in South America. When groundnuts were introduced into India has been a matter of speculation and debate. Leiberherr (1928) states that "as far as India is concerned, it can be assumed as fairly correct that the credit for the introduction of the plant into this country belongs to the Jesuit Fathers who followed Vasco De Gama shortly after his first landing in India." The flora of Western India includes a large number of specimens of South and Central American origin, introduced by missionaries. The so-called 'indigenous' variety in modern India was likely of Brazilian origin. Since South America was discovered in early 1500 A.D., it is probable that the plant was introduced into India at the earliest by the first half of the sixteenth century (John, et.al., 1955). If this is true, such a useful plant could not have been hibernating in that region for nearly two centuries without becoming popular and widespread.

Badami (1936) is of the opinion that groundnut was introduced into India by the Magellan expedition around 1519. This is very unlikely as its introduction even into the Philippines by this agency is discounted. In Buchanan's travels through Mysore, South Kanara and Malabar written in 1800, the plant is referred to as being cultivated together with turmeric in Mysore (Buchanan, 1807). The largest area under groundnut was reported from South Arcot district of Madras State. From the description of 'indigenous' variety then in cultivation in Bombay, Mysore, and Madras, it is evident that they were one and the same. From an inspection of the herbarium specimens maintained at Kew, Badami (1936) found close resemblance between the indigenous groundnut in Mysore and those from South America, Philippines, China, and Java. It is therefore probable that peanut was introduced into India from one of these sources.

Since the area under groundnut was the largest in South Arcot about the middle of the nineteenth century, it may be assumed that the above introduction should have first occurred on the East Coast of Madras State. Further, the name '*Manilakottai*' (meaning Manila nut) for groundnut prevalent in South Arcot district probably refers to its from Manila in the Philippines (Sheshadri, 1962). Subba Rao (1909), therefore, states that "it is possible that the groundnut found its way, from the New World to India via the Philippines."

Watt (1892) mentions that according to Dr. Dymott, the groundnut reached India through China. From these literature, it can be assumed that groundnut must have been introduced into India from one of the Pacific Islands or China, where it was introduced either from Central or South America (Sheshadri, 1962). To further cloud the introduction issue, however, based on plant

type, it is also hypothesized that groundnuts entered India independently from Africa through the western seaboard.

By 1850, about 1000 hectares were under peanut cultivation in the Madras Presidency of India. This area doubled in the next decade and by the year 1895, about 70,000 hectares were sown with groundnuts mostly in the South Arcot District of Madras. At the same time, a French settlement and port of Pondicherry existed adjacent to this area. In his book, Watt (1889-1893) stated that "the groundnut trade between Pondicherry and France is in full swing, and has been so since the month of February (1884) … the groundnut trade is the most important in the chief town of the French Settlements in India … It is surprising how the South Arcot District can produce such an immense quantity of nuts."

A local businessman, Govindaiyer played a significant role in promoting the cultivation of groundnuts in the Madras province by introducing double cropping and establishing oil extraction units. In the Saurashtra region of Gujarat State, Maharaja Bhagvatsinhji pioneered the growing of groundnuts in his own dominion (Achaya 1990).

The triumphant growth of groundnuts until 1895, when 140,000 hectares were under the crop, was abruptly interrupted by the disease outbreak. Production dropped to half in 1897, and to a third the next year (Watt 1908). A new variety of groundnut was then introduced from Mozambique, and by 1902, the area under peanut cultivation has reached to the level as of 1895. This variety, subsequently named Coromandel, has since dominated the production of groundnuts all over India. In 1901-02, the Bombay Department of Agriculture brought in Coromandel from Pondicherry, Spanish and Virginia varieties from America, and Small and Bold Japan from Japan, which rapidly established themselves (Achaya 1990). Between 1910 and 1945, the crop spread from Madras to Gujarat, and gradually to a wide swathe of states all the way down to the south-west of India.

Cultivated Area of Groundnuts in India

India is a World leader in groundnut farming, with 8 million hectare of cultivated area in the year 2003 (FAO, 2004). Groundnut cultivation has increased from 6.8 million ha in 1980-81 to 8 million ha in the year 2002-03. Peanut is grown mostly in five states namely Andhra Pradesh, Gujarat, Tamil Nadu, Karnataka, and Maharashtra, and together they account for about 90 per cent

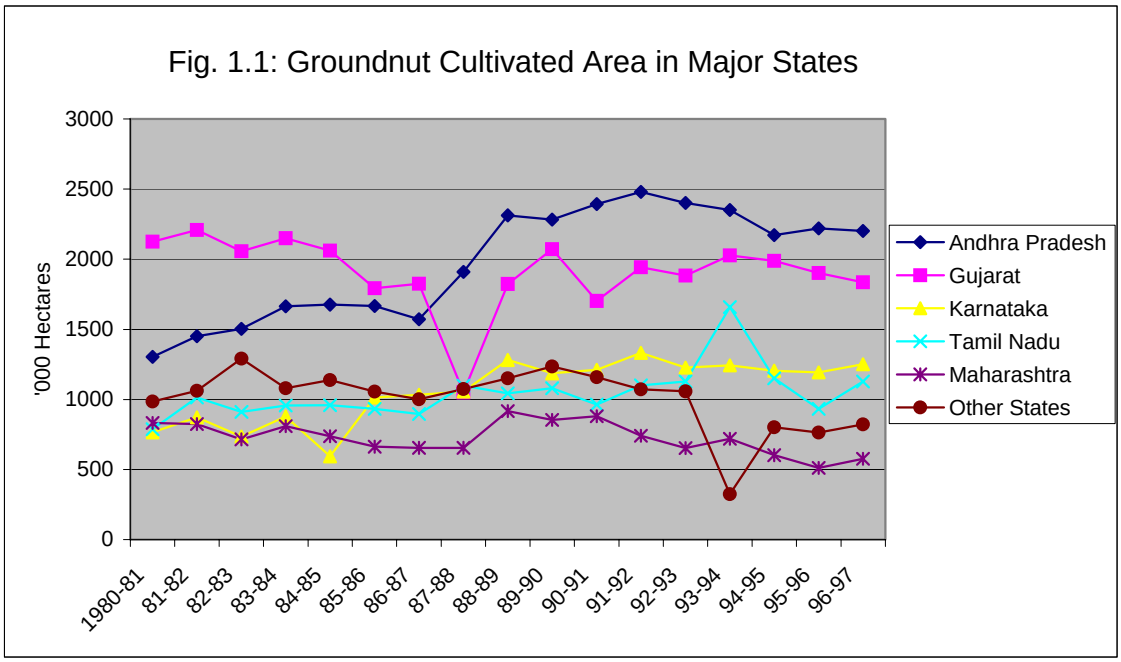
of the crop's total area. Two of these states (Andhra Pradesh and Gujarat) account for more than half of the cultivated area. Andhra Pradesh and Gujarat States share about 28 and 24 per cent of the total groundnut area respectively in the country. Tamil Nadu and Karnataka share about 15 per cent each of the total cultivated area. About 8 per cent of the total groundnut area is in the State of Maharashtra.

Over the years, cultivation of groundnuts in Andhra Pradesh has increased from 1.3 million ha in the year 1980-81 to 2.2 million ha by the year 1996-97. Among the major groundnut growing states (Andhra Pradesh and Gujarat), there has been consistent increase in area under peanut cultivation in Andhra Pradesh. However, in the State of Gujarat, cultivated area has declined from 2.1 million ha to 1.8 million ha between 1980-81 and 1996-97. Similarly, groundnut area has decreased in the State of Maharashtra. On the other hand, cultivated area of groundnut has increased in the southern States of Tamil Nadu and Karnataka.

In a recent study, a comparison was made between the trends of groundnut cultivated area before (mid-sixties) and after the green revolution in India. The study revealed that there was a decline in the cultivation of groundnut from the beginning of the green revolution in the northern states mainly because of the increased emphasis on cereal production, wheat, and rice (IEMR, 1993).

Table 1.2: Groundnut Area in the Selected States of India (x 1000 ha)

Year	Andhra Pradesh	Gujarat	Karnataka	Tamil Nadu	Maharashtra	Other States	All-India
1980-81	1304	2125	765	789	833	986	6802
81-82	1451	2208	872	1013	824	1061	7429
82-83	1504	2057	735	912	716	1292	7215
83-84	1665	2150	878	956	810	1080	7539
84-85	1676	2062	595	960	737	1138	7168
85-86	1666	1794	1013	932	664	1057	7124
86-87	1571	1825	1034	897	654	1002	6982
87-88	1911	1051	1056	1099	655	1073	6844
88-89	2312	1823	1281	1044	918	1150	8529
89-90	2282	2072	1187	1081	854	1234	8710
90-91	2394	1702	1212	963	881	1158	8309
91-92	2481	1942	1332	1099	742	1072	8668
92-93	2401	1884	1228	1129	652	1057	8351
93-94	2352	2026	1243	1658	719	324	8322
94-95	2171	1989	1206	1150	603	803	7922
95-96	2220	1903	1192	933	511	764	7524
96-97	2203	1835	1250	1129	576	821	7814



Groundnut Production

Groundnut is the single largest source of edible oils in India and constitutes roughly about 50 per cent of the total oilseed production. India grows about nine million tons of groundnuts (in shell) currently. From 5 million tons in the year 1980-81, the production has increased to about 9 million tons by the year 1996-97. From the year 1981-82, the production has been fluctuating between 7 and 9 million tons indicating the fluidity of production trend in groundnuts. With respect to the quantity of groundnut production in India, it has been a mixed bag of good and bad years.

Paralleling area under production, about ninety per cent of the production comes from the five major States in India. These states are Andhra Pradesh, Gujarat, Karnataka, Tamil Nadu, and Maharashtra. Andhra Pradesh and Gujarat alone contribute about fifty per cent of the total production in India. The individual share of production of Andhra Pradesh and Gujarat are 23 and 27 per cent respectively.

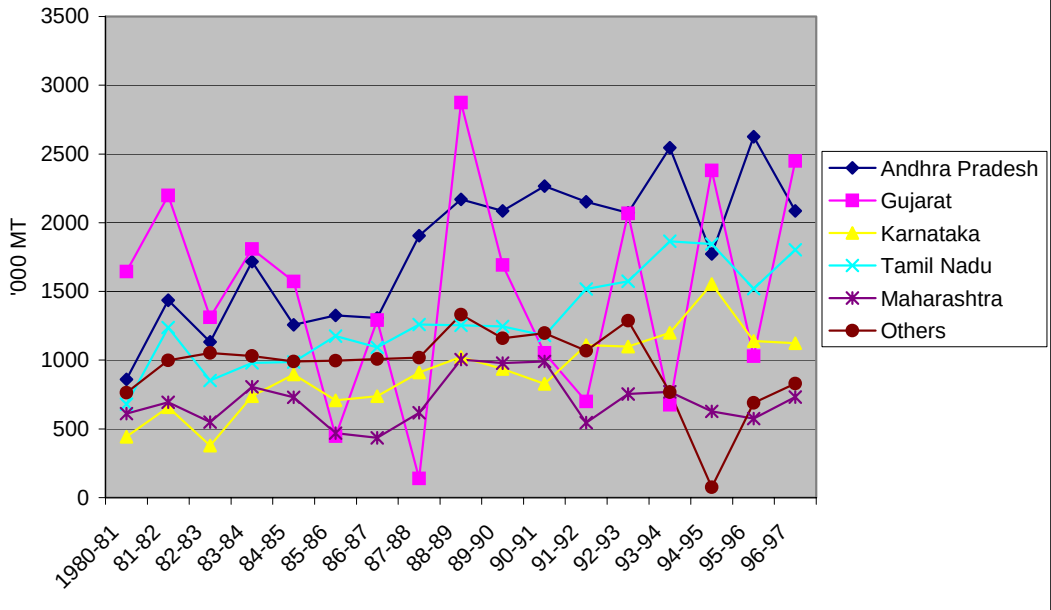
The production of groundnuts in the State of Andhra Pradesh has been more or less consistent over the years unlike in Gujarat. In fact, Gujarat being one of the major groundnuts producing states, volatility of production has been a major threat to the groundnut industry in the country. On the other hand, two southern States, Tamil Nadu and Karnataka have steadily picked up in the rate of production over the years. From about a million ton of production in the year 1981-82 in Tamil Nadu, it has reached about 1.8 million. Karnataka State has also gained about 2/3rd of a million tons in the same period. With consistently increasing production of groundnuts, these two states contribute to the stability of groundnut production in the country.

The State of Maharashtra has been poor performer all the way from the year 1980-81 without a significant increase from about 0.6 million tons of production.

Table 1.3: Groundnut production in the selected States of India ('000 MT)

Year	Andhra Pradesh	Gujarat	Karnataka	Tamil Nadu	Maharashtra	Other States	All-India
1980-81	861	1645	444	680	611	764	5005
81-82	1437	2198	658	1238	694	998	7223
82-83	1133	1312	379	853	551	1054	5282
83-84	1716	1810	739	982	807	1031	7086
84-85	1258	1572	897	986	731	991	6436
85-86	1325	448	707	1176	469	996	5121
86-87	1308	1292	738	1093	435	1010	5875
87-88	1906	140	911	1259	618	1020	5854
88-89	2170	2875	1023	1253	1006	1331	9659
89-90	2087	1693	936	1246	979	1160	8101
90-91	2267	1053	828	1179	991	1197	7515
91-92	2152	700	1110	1518	546	1069	7095
92-93	2071	2068	1098	1575	755	1287	8854
93-94	2546	677	1199	1866	769	768	7824
94-95	1773	2380	1554	1845	629	75	8255
95-96	2626	1028	1139	1520	576	690	7579
96-97	2086	2449	1123	1804	732	831	9024

Fig. 1.2: Groundnut Production in Indian States



Productivity of groundnuts

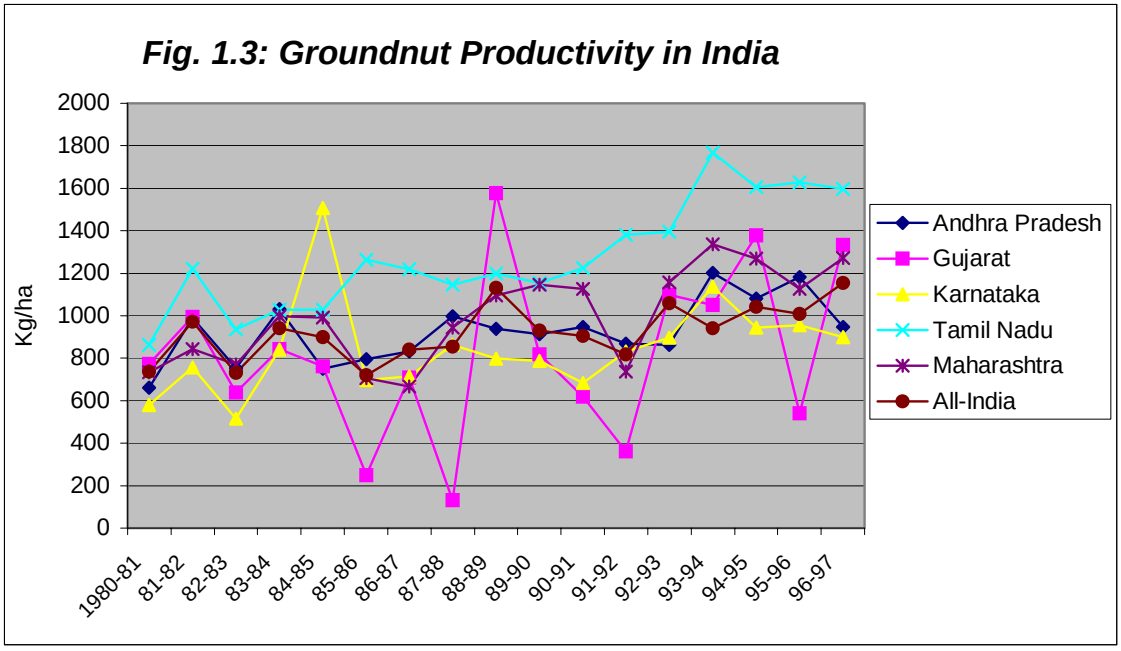
During 1980s, the average groundnut productivity in the World increased by 16.1 per cent over 1970s. Most gains in productivity were made by China and Myanmar. India, Indonesia, Senegal and USA also gained in productivity whereas many countries in Africa showed a decline. In India the recent gains have been in the order of 1.3 to 3.2 per cent year under rainfed cultivation. In India, on farm-demonstrations carried out, jointly by the Indian Council of Agricultural Research (ICAR) and ICRISAT, comparing local cultivars and local practices with improved cultivars and improved production technology, have contributed for increasing the productivity level of groundnuts (Nigam, et.al., 1994).

The current productivity of groundnuts in India is about a quintal per ha. About fifteen years ago, the productivity level was about 736 kg/ha. In comparison to other countries, the productivity level in India is deplorably low mainly because about 80 per cent of the crop is grown under rainfed conditions (with average productivity of 800 kg/ha), where drought takes a heavy toll apart from the yield loss due to a plethora of pests and diseases.

In contrast, winter/summer groundnut grown under irrigated/assured residual soil moisture gives almost double yield (1567 kg/ha). Among different States producing groundnuts, Tamil Nadu tops the list with about 1.5 quintals per ha, which is half a quintal more than the all-India average. Also the productivity of groundnuts has been consistent over the years in Tamil Nadu.

Table 1.4: Productivity of groundnuts in the selected States of India

Year	Andhra Pradesh	Gujarat	Karnataka	Tamil Nadu	Maharashtra	All-India
1980-81	660	774	580	862	733	736
81-82	990	995	755	1222	842	972
82-83	753	638	516	936	769	732
83-84	1031	842	841	1027	997	940
84-85	751	763	1508	1027	991	898
85-86	795	250	698	1262	706	719
86-87	833	708	714	1218	666	841
87-88	997	133	863	1145	944	855
88-89	938	1577	799	1200	1096	1132
89-90	914	818	788	1153	1145	930
90-91	947	619	683	1225	1125	904
91-92	867	360	833	1381	736	818
92-93	863	1098	895	1395	1158	1060
93-94	1202	1050	1138	1769	1335	941
94-95	1082	1379	944	1605	1270	1042
95-96	1183	540	955	1629	1127	1007
96-97	947	1335	898	1597	1271	1155



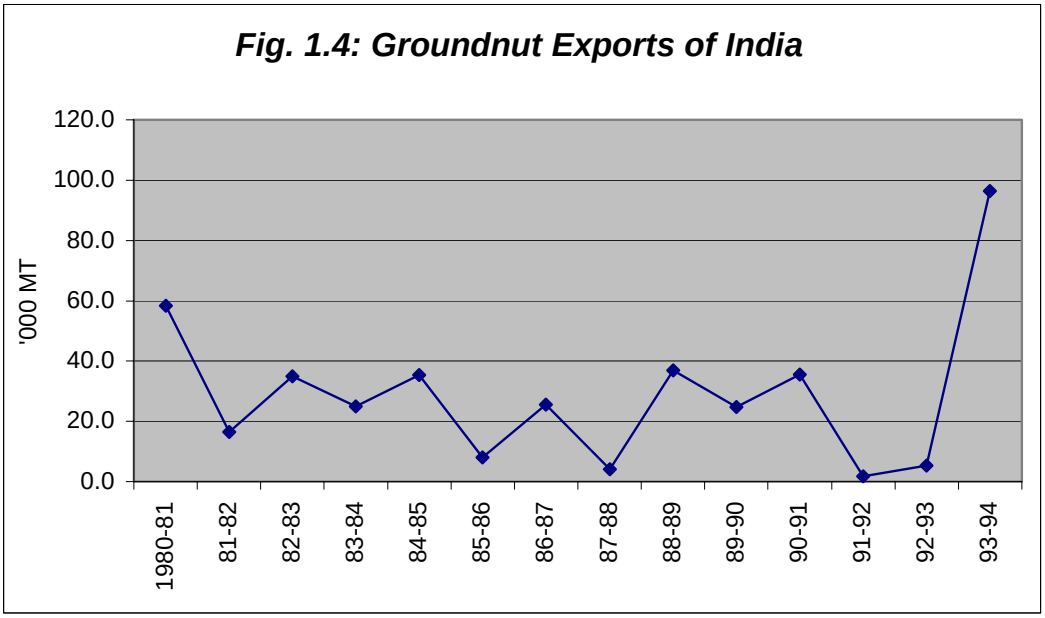
External Trade of Groundnut

Before the Second World War, groundnut was exported from India either in shells or as kernels. The average annual export of groundnut kernels during the triennium ending 1938-39 was over 10,00,000 tons or about 40 per cent of total production in the country. Limited exports were possible during the war. The exports fell considerably after the war.

Since October 1943 export trade in oilseeds and vegetable oils has been subject to administrative control. During the war, the system of international allocations under the International Emergency Council was adopted. Between 1946 and 1949, oilseeds were brought under the sphere of international allocation. Since then, export of oilseeds and vegetable oils has been controlled on quota basis. The main purpose of export control has been to ensure adequate supplies of oilseeds, oilcake and vegetable oil for domestic consumption. Export of groundnut was almost banned except for small quotas of handpicked selected (HPS) groundnut. Export of oilseeds was banned also to ensure adequate supplies of oilseeds for consumption by the oil milling industry (Planning Commission, 1963).

Table 1.5: Groundnut exports from India

Year	Quantity (000 MT)	Value (Million $)
1980-81	58.3	12.6
81-82	16.6	4.3
82-83	35.0	8.4
83-84	24.9	5.1
84-85	35.4	7.3
85-86	8.1	1.6
86-87	25.5	5.8
87-88	4.1	1.0
88-89	37.0	8.3
89-90	24.8	6.4
90-91	35.5	14.9
91-92	1.7	0.9
92-93	5.3	2.3
93-94	96.5	42.1



Although India does not have a consistent trend of exporting groundnuts over the years, export level reached a high of 96 million tons in the year 1993-94, earning to the tune of $42 million. The HPS varieties developed and released for cultivation in the country are—BAU 13, B 95, TKG 19A, and ICGS 49. It is also considered that India has a tremendous potential of exporting groundnuts to countries, mainly UK, Holland, Russia, Indonesia, Japan, New Zealand, and Australia.

Chapter - II

GROUNDNUT PRODUCTION ZONES

Groundnut Production Systems

There are four major groundnut production systems. In rainfed areas there is a need for short-and-medium-duration cultivars suitable for oil, food, and fodder use. In areas where supplemental irrigation is available, mostly medium-duration cultivars, while under high-input situations, medium-and long-duration cultivars are grown for confectionery and oil use. Under residual moisture production systems, the crop duration is short and uses are restricted to oil and food (Nigam, et.al., 1994).

Table 2.1: Groundnut Production Systems

Production Systems	Maturity Duration	Uses
Semi-Arid Tropics rainfed	Short, and Medium	Oil, food, and fodder
SAT with supplemental irrigation	Medium	Oil, and Confectionery
High-input	Medium, and Long	Confectionery, and Oil
Residual moisture	Short	Oil, and Food

Source: Nigam et al., 1994

2.2 Agro-ecological Regions of Groundnut Farming in India

About 75 percent of the groundnut area lies in a low to moderate rainfall zone with a short period of distribution. Though management practices of the crop have improved in recent years and the declining trend in yield has been arrested, there are wide fluctuations in yield due to rainfall-soil factors. Taking into consideration of the above factors the cultivation of groundnut has been demarcated into five zones based on soil factors, rainfall pattern, diseases and pest situations. A brief account of the various zones with soil and rainfall pattern is presented in the following table.

Table 2.2: Groundnut production zones in India

Zones	States	Characteristic features
I – Northern zone	Uttar Pradesh, Punjab, Haryana, Rajasthan	Sandy loam to loamy sandy soil; 600-900 mm rainfall per crop season
II – Western zone	Gujarat, Southern Rajasthan	Medium to black soil/ sandy loam; 500-700 mm rainfall per crop season
III – Central zone	Madhya Pradesh, Maharashtra	Medium black soil – sandy loam; 700-900 mm rainfall per crop season
IV – South-Eastern zone	Bihar, West Bengal, Orissa, Coastal Andhra Pradesh	Red loam – sandy loam; 900-1300 mm rainfall per crop season
V – Peninsular zone/ Southern zone	Karnataka, Andhra Pradesh, Southern Maharashtra, Tamil Nadu, Kerala	Medium black to red loam/ sandy loam; 600-1300 mm rainfall per crop season

2.3 Groundnut Producing States in India

Groundnuts are mainly produced in the states of Andhra Pradesh, Tamil Nadu, Gujarat, Karnataka, and Maharashtra. These five states accounted for 90 percent of India's total groundnut production and the total area under groundnut during the triennium ending in 1995-96. Andhra Pradesh is the largest producer of groundnuts in India. It accounted for a fourth of India's total groundnut production during the triennium ending in 1995-96. During the same period, the state had a share of 28 percent with regard to area.

Tamil Nadu is first in terms of productivity in groundnut cultivation. During the triennium ending in 1995-96, the state yielded 1,650 kilograms of groundnut per hectare. This was higher than the world average yield of 1,238 kilograms per hectare. Yields in Maharashtra and Orissa were higher than the all-India average (CMIE, 1997).

2.3.1 Andhra Pradesh

The major groundnut growing districts in Andhra Pradesh are Anantapur, Chittor, Kurnool, Cuddapah (together known as 'Rayalseema'), and Mahboobnagar. The soils of the 'Rayalseema'

region are predominantly red sandy loams with characteristic subsoil hard pan. Black soil patches are, however, present in the Cuddapah and Kurnool districts. In the Rayalseema region, about half of the groundnut area is covered by the Virginia Runner group, while the Spanish and Virginia Bunch cultivars account for the rest. Virginia bunch varieties are restricted to Chittor district while the other two varieties are grown in the entire region. 'Kadiri – 771-1' and 'Kadiri – 3' (both Virginia Runner type) and 'Kadiri – 2' (Virginia Bunch) are the improved varieties released from the Groundnut Research Centre at Kadiri for cultivation in this region.

In the 'Telengana' region, groundnut is grown both in medium black (Mahboobnagar and Nizamabad districts) and sandy loam (Nalgonda, Warangal and Karimnagar districts) soils. The Southwest monsoons which end by mid-September bring the region's only rainfall. Only early maturing Spanish type varieties are, therefore, under cultivation in this region.

In the Rayalseema region, 20-25 day-long droughts is a common feature. Drought during the pegging and pod formation stages is most critical since the yield losses are considerable. Loss of pods in the soil at the time of harvest is common in the existing Virginia Runner type varieties. It is therefore necessary to evolve varieties with stronger and shorter pegs to minimize such losses. In the 'Telengana' region the variety currently grown is Spanish improved. Selection of a more suitable variety and identification of the optimum date of showing for the Spring/Summer season are the major requirements for this tract (IEMR, 1993).

2.3.2 Tamil Nadu

The major groundnut growing districts in Tamil Nadu are North Arcot, South Arcot, Salem, and Coimbatore. There are also six other districts where groundnuts are grown quite extensively. Previously Virginia Runner type varieties were under large scale cultivation, but then there was a gradual shift to the Spanish types and currently most of the area is under Spanish varieties. These varieties are: TMV-2, TMV-9 and TMN-12. Out of these TMV-2 occupies about 75 percent area. In the western parts of Coimbatore district, monsoon season begins in March because of the peculiar terrain and the presence of the Annamalai hills. Sowing in this region is done in April, whereas sowing is done between June and July in the rest of the state. Generally, the *Kharif* (June-September) groundnut is grown as a mixed crop wherein the component crops are any of the following—Redgram, Pearl millet, Cowpea, Greengram, and Field bean. Ususally, the main and component crops are sown in a ratio of 10:1.

The soils in the entire Tamil Nadu are sandy loams. Drought is common in this region and occurs either immediately after sowing or at the pod formation stage. As a result, there is an urgent need to evolve a Spanish type variety possessing drought tolerance. Leaf miner is another serious problem affecting groundnut crop in this region. Red hairy caterpillar and white grub, however, are of minor importance even though white grubs thrive in sandy soils. Rusts and leaf spots are very serious diseases all over the state throughout the season (IEMR, 1993).

2.3.3 Gujarat

In Gujarat, about 85 percent of the total area is confined to the five districts in the Saurashtra region, Junagadh, Rajkot, Amreli, Bhavnagar, and Jamnagar. About 90 percent of the groundnut soils in the state are medium black. The rest of the 10 percent are sandy loams confined to the districts of Bhavnagar and Amreli (riverbed areas). About 80 percent of the total groundnut area is under Virginia Runner type varieties. Compared to the situation in Andhra Pradesh and Tamil Nadu, it is not a major summer oilseed crop in Gujarat.

Rust disease is a major problem of growing groundnuts in Gujarat. All the existing groundnut varieties are susceptible to this disease. There is a need for breeding rust-resistant varieties as quickly as possible because this disease has started devastating the crop in some areas. Segregating progenies of some crosses incorporating rust resistance are currently being screened at the National Research Center for Groundnut at Junagadh besides working on some chemical methods of control. Lack of seed dormancy in the Spanish type results in heavy yield losses if the crop is caught in the off-season late rains in October-November. Incorporation of fresh seed dormancy in J-II and GAUG-I will be needed to solve this problem (IEMR, 1993).

2.3.4 Karnataka

In the State of Karnataka, Dharwad, Belgaum, Bijapur, Raichur, Bellary and Bidar are the major districts where groundnuts are grown in abundance. In these districts, black soils predominate as compared to the red soils. About 70 percent of the crop is grown in black soil with the remaining 30 percent in red soil. All the districts grow both Spanish and Virginia Runner type varieties. On the whole, the proportion between the Spanish and Virginia Runner varieties is 60 to 40. The present popular varieties grown here are Spanish Improved, S-26, and recently released DH 3-30, and S-230.

In the Tungabhadra river project area of Raichur district, *Kharif* (June-September) groundnut area has increased considerably from the early 1980s. This is mainly due to the non-remunerative yields of cotton (Varalaxmi variety) which was the major commercial crop in the region until recently. Groundnuts are grown under the residual moisture in the West Coast of north and south Canara districts of Karnataka. Growing groundnut in the summer is also gaining importance in the State.

Except for variety S-230, no other improved variety exists in the Virginia Runner group. More varieties suited to different agroclimatic regions are urgently required. An early maturing special variety suited to summer irrigation and residual moisture conditions is desirable. Lack of seed dormancy in Spanish types is another varietal problem of this state. Leaf spots, rust, and sclerotial wilt are the major diseases. Quick loss of viability is a problem in the case of groundnut crop grown in Dharwad region under residual moisture. Proper drying and storage methods have to be developed to prolong viability for a period of at least nine months so as to enable the cultivators to use their own seeds.

2.3.5 Maharashtra

About 60 percent of the groundnut area in Maharashtra is under Spanish bunch varieties, which is confined to the northern parts of the state in the regions of Khandesh, Vidharbha, and part of Marathwada. Evolution of Spanish bunch variety with early maturity (because of the short monsoon rain) and tolerant to drought and rust is specially required for this region. In the Marathwada region, Osmanabad and Bhid districts Virginia Runner type varieties are grown because these two districts get rains from both southeast and northwest monsoons.

The groundnut soils in the State are light medium black. *Kharif* (June-September) groundnut is commonly grown as a mixture with redgram, sorghum or sunflower, particularly in Osmanabad district. The irrigated groundnut is taken up in two different seasons. In the major groundnut area (Khandesh, Vidharbha, parts of Sangli, and Satara), the crop is sown in the month of January and harvested by the end of May. In parts of Ahmednagar, Pune and Sholapur districts, however, the crop is sown in March/April and harvested in August. In Jayakwade command area (Aurangabad and Bhid district) only Virginia Runner varieties are preferred. In this region, a crop rotation of groundnut (March-October) and wheat (November-February) is practiced.

Drought is a common feature in the month of September which affects the pod development in the existing cultivars. Rust has become a serious problem. For evolving a rust resistant variety,

hybridization work has been initiated at the Groundnut Research Centre at Jalgaon. In the Marathwada region, the variety Karad 4-11 is encroaching upon the wheat season since it takes a longer duration to mature. There is an urgent need for evolving an early maturing (115 days) Virginia Runner variety for the *Kharif* belts of the State.

Chapter - III

GROUNDNUT PRODUCTION PRACTICES

3.1 Groundnut Varieties Grown in India

The new generation high yielding varieties developed and released for different zones are presented in the following table. Their potential yield and salient features are also indicated (Basu, 1995).

Table 3.1: Groundnut varieties recommended and grown in India

Zones	Recommended Area	Varieties	Yield (Kg/ha)	Salient Features of Varieties
I	Rajasthan, Punjab, Haryana, Uttar Pradesh	ICGS–1	2300	Spanish bunch type suitable for both monsoon and spring seasons.
		CSMG 84–1	2704	Virginia runner, tolerant to thrips, leafminers, pod borer and foliar diseases.
		DRG 17	2095	High yielding Virginia bunch type suitable for rainfed monsoon season.
		ICGS 5	2704	Virginia bunch type, tolerant to drought. High yielding Virginia runner with variegated kernel.
		MA 10	1500	High yielding Spanish bunch type, early maturing.
		G 201 Kaushal	1700	
II	Gujarat, Western Rajasthan, Madhya Pradesh	Somnath	1926	Virginia runner, early maturing (120 days).
		GG 20	2167	Virginia bunch, suited for rainfed monsoon.
III	Maharashtra, Madhya Pradesh	TAG 24	2000	Short statured Spanish bunch with high harvest index and tolerant to BND.
		J(E) 3	1900	Early variety for rainfed monsoon season.
IV	Orissa, Bihar, Coastal Andhra Pradesh, West Bengal	BAU 13	2556	Bold seeded for export purpose
		BG 3	2500	Virginia bunch variety with early maturity.
		GG 2	3100	High yielding Spanish bunch type suitable for acid upland soils.
V	Southern Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka	ICGS 76	1300	A Virginia bunch variety with tolerance to foliar diseases.
		ICGV – 86325	2500-3500	High yielding Virginia bunch type, tolerant to BND, suitable for rainfed conditions. Suitable for rainfed monsoon cultivation

	K 134	1919	with wider adaptability.
	VRI 2	1500	High yielding, early maturing Spanish bunch type.
	VRI 3	1688	Early Spanish bunch type suitable for rainfed.
	ICGV 86590	1785	Multiple disease and pest resistant coupled with high yield.
	Tirupathi - 2	2100	Spanish bunch, having high peg strength and tolerant to *Kalahasti malady* (nematode).

3.2 Production practices of Groundnuts

3.2.1 Sowing times and seed rate

In groundnut, sowing time is the most important non-monetary input influencing productivity. Delay in sowing by one week result in considerable yield losses. Results obtained from AICORP (All India Coordinated Research Projects) research revealed that in most parts of the country, sowing should be done between the first week of June and the last week of July.

Advancement of sowing by a fortnight with one pre-sowing irrigation was found to increase the yield substantially. The most common spacing recommended for bunch varieties is 30x10 cm, and 45x10 for semi-spreading /spreading varieties thereby maintaining a plant density of 0.333 and 0.222 million /ha respectively in both habit groups of groundnuts.

In the winter/summer season, bunch varieties grown at a seed rate of 150 kg/ha is optimum. The most common spacing recommended for Spanish bunch type is 30x10 cm; this is also recommended to establish a plant population of 440,000 per ha.

Optimum time for sowing groundnut in winter and summer seasons is presented in the following table.

Table 3.2: Winter and summer groundnut seasons in India

Situation	Optimum time
Winter-residual moisture	September-October (immediately after harvest of rice/ river beds
Summer season	Second fortnight of January to first fortnight of February
Spring season	Second fortnight of February to first fortnight of March

3.2.2 Fertilizer management in groundnut

Fertilizer schedules for different agro-climatic zones have been worked out based on the experiments and recommended to the farmers accordingly. About 10-20 Kg of Nitrogen, 25-50 Kg of Phosphorous (P_2O_5), and 0-50 Kg of Potassium (K_2O) per ha have been found adequate for *Kharif* (monsoon) groundnut. Ammonium sulphate for nitrogen and single super phosphate are the recommended fertilizers. Full doses of phosphorous and potassium and half of the nitrogen have been recommended for soil incorporation before sowing. The remaining half of the 'N' should be applied 30-40 days after sowing. Application of gypsum at the rate of 500 Kg/ha in all sandy loam soils irrespective of season shows positive yield response. A good response to micronutrient application has been observed in some of the major states. Application of different micronutrients, zinc (in Andhra Pradesh, Tamil Nadu and Punjab), Boron (in Tamil Nadu and Maharashtra), and Sulphur (in Rajasthan and Uttar Pradesh) have been found to improve yield significantly.

3.2.3 Inter-cropping and crop rotation

Some remunerative inter-cropping systems for different states have been recommended to increase the income obtainable per unit area and time. The most suitable companion crops are sorghum, pearl millet, maize (in case of cereals), red gram, black gram, green gram (in pulses or legumes), and sunflower, castor and sesame (in oilseeds). Groundnut based inter-cropping systems were evolved for different agroclimatic zones to minimize the risk factors associated with rainfed cultivation. Some of the widely adopted inter-cropping systems in different parts of the country are presented in the following table (Basu, 1995).

Table 3.3: Inter-cropping system of groundnuts

Inter-cropping System	Row proportion	States where adopted
Groundnut + Redgram	6:1	Andhra Pradesh, Karnataka, Maharashtra, Gujarat
Groundnut + Cotton	5:1	Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Gujarat
Groundnut + Pearl millet/ sorghum	6:1	Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Gujarat
Groundnut + Sunflower	1:1	Karnataka, Gujarat
Groundnut + Castor	5:1	Andhra Pradesh, Gujarat
Groundnut + Sesame	1:1	Tamil Nadu, Gujarat
Groundnut + Blackgram	6:1	Tamil Nadu

3.2.4 Water management and raised bed furrow system of cultivation

Providing life saving irrigation during a long dry spell at critical growth stages increase yield by 50 percent in the states of Gujarat and Rajasthan and thereby stabilize groundnut production in the country. Adoption of raised bed and furrow system of cultivation as developed by the ICRISAT (International Crops Research Institute for Semi-Arid Tropics) has been found advantageous over the flat bed system particularly in rain shadow areas. This orientation gave 8 percent pod yield over traditional flat bed system of cultivation. Paired row planting has also been found advantageous over wide row-set furrow cultivation system followed at Saurashtra region of Gujarat. This system also doesn't require any extra monetary input. Seeds required for one single row are distributed in two rows with a distance of 22.5 cm between two rows of a pair and 45 cm between pairs. It increases pod yield by 20-27 percent (Basu, 1995).

3.2.5 Pests and diseases and crop protection

Groundnut is prone to attack by various pests and diseases. Among the foliar fungal diseases, leaf spot (early and late) and rusts are economically important. Seed and soil borne diseases like collar rot, stem rot and dry root rot have also been identified as important. Among viral diseases, bud necrosis (BND), peanut mottle (PMV) and peanut clump (PCV) are important. With regard to insect pests, a wide range of pests like leaf miner, white grub, jassids, thrips, aphids, red hairy caterpillar and termite are known to cause serious damage to groundnut crop (Ghewande, et.al., 1987; Basu, 1995).

3.2.6 Integrated pests management (IPM) in groundnut

(a) Integrated pest control

(i) Chemical Control

Spraying 0.05 percent Monocrotophos or 0.05 percent Dimethoate can check major sucking pests like aphids, jassids, and thrips. Red hairy caterpillar can be managed effectively with Monocrotophos 40 EC spray at the rate of 1000 ml/ha. *Spodoptera* and *Helicoverpa* being nocturnal pests, control measures could be taken up in early morning hours or late evening. For control of these pests spraying of Quinolphos 0.05 percent at the rate of 400 ml/ha is highly effective. For control of leaf miner, Carbaryl 50 WP 0.2 percent spray is most economical. Treating the seed with

either chloropyriphos 20 EC or quinalphos 25 EC at the rate of 25 ml/kg seed can protect the groundnut crop sown with the onset of the monsoon season. The treated seed should be dried under shade and sown within 4-6 hours of treatment.

(ii) Cultural practices

It was observed that early sowing of groundnut (during the first week of June and mid July) reduced the incidence of leaf miner and *Spodoptera*. Inter-cropping of groundnut with castor, cowpea and soybean in the proportion of 11:1 recorded less infestation and leaf damage for major pests.

(iii) Biological control

Several bio-control agents have been tested for control of various pests and it was observed that for control of red hairy caterpillar, spraying of Nuclear Polyhedrosis Virus (NPV) formulations developed at Tamil Nadu Agricultural University, Coimbatore was found effective and economical. For the control of sucking pests like aphids jassids, thrips and the ladybird beetle *Coccinella septum punctata* was found effective. A natural plant product namely Margocide O.K 0.08 percent, alone or in combination with Monocrotophos 0.05 percent, has given better results in reducing major pests (Basu, 1995).

(b) Integrated disease control

Several resistant varieties, namely Tirupati 2 for nematodes, CSMG 84-1, ICGV 86325 have been evolved as tolerant to rust and leaf spots. Manipulation in sowing dates (early sowing in peninsular India and late sowing in northern India), close spacing, inter-cropping with millets etc. reduce the level of bud necrosis incidence. Leaf spots and rusts could effectively be controlled by spraying Carbendazium 0.05 percent + Mancozeb (Dithane M-45) 0.2 percent at 2-3 week intervals from 4-5 weeks after germination.

Some of the major Indian groundnut cultivars resistant to major disease and insect are presented in the following table (Nigam, et.al., 1994).

Table 3.4: Insect-pests resistant cultivars in India

Cultivar	**Year of release**	Attribute
Girnar 1	1989	Multiple resistance to foliar diseases, aflatoxin, jassids, and drought
ICG (FDRS) 10	1990	Resistant to rust, tolerant of late leaf spot and bud necrosis disease, moderately resistant to leaf miner, tolerant to drought
ICGV 86590	1991	Resistant to rust and tolerant to late leaf spot, bud necrosis disease and *Spodoptera litura*

Chapter - IV

POST-PRODUCTION ASPECTS OF GROUNDNUTS

Post-production aspects of groundnuts consist of: (1) Storage of groundnuts, (2) Marketing of groundnuts, oil and cake, (3) Processing of groundnuts, and (4) Utilization and consumption of groundnuts.

4.1 Storage of Groundnuts

Cultivators usually dispose of their groundnuts (apart from quantities retained by them for seed and edible use) within three or four weeks after harvesting. Only a few well-to-do cultivators store the nuts for longer periods extending up to three or four months awaiting favorable market conditions. Nuts used for sowing have to be stored for seven to eight months while those intended for edible purposes may be kept until the beginning of the next harvesting season.

Storage of groundnuts is invariably in the form of unshelled nuts. Nuts for sowing are generally stored in earthen pots, mud bins, bamboo baskets or other types of wickerwork receptacles which are often plastered with mud and cowdung. Gunny bags are also sometimes used especially when quantities to be stored are small. After the receptacles have been filled up with nuts, their mouths are not sealed. When bags are used, their mouths are either tied with rope or stitched and they are piled up. Nuts kept in bags are more liable to damage by dampness, rats and other storage pests compared to those kept in other types of containers. The nuts intended for sale are left on the threshing floor or drying yard for a few days or stored loose, but seldom kept covered. The floors of the rooms in which the produce is stored are generally made of hardened mud and sometimes of cement or stone slabs. The loss under such conditions is mainly through damage by rodents.

In the assembling markets, decorticating factories and oil mills, the produce is generally stored in the form of nuts, either loose or in bags. The period of storage may be very short (about a week or two) before being decorticated or it may be stored for several months in anticipation of better prices. Besides storage in godowns (storehouses), nuts are often loosely heaped or stacked out in the open in bags where the rainfall is not heavy. The stacks are covered with a tarpaulin or gunny bags. As kernels are more susceptible to damage than pods, nuts are decorticated only a week or two before they are actually required to be sent to mills for crushing or ports for exporting. The kernels are, therefore, stored for comparatively short periods and the total quantity of kernels kept in stock at a time is much less than nuts.

Conditions are different in the terminal markets and ports. At these centers, storage is in the form of kernels, which are most often packed in gunny bags. Kernels are rarely stored in bulk. The pile of bags in the godown is kept 4-5 feet below the roof to allow free circulation of air and matting is sometimes spread on the floor to prevent damage from dampness. Storing in big stacks in the open is also done when godown accommodation is limited and huge stocks are received from the assembling markets. This method is usually adopted in centers when the stocks have to be stored for a few weeks awaiting transit to terminal markets or shipping to other countries. It is done mostly on a sandy bed covered with gunny matting and protected by a tarpaulin. The period of storage of individual lots in most cases may not exceed two or three months. Sometimes, it is necessary to store kernels at ports for longer periods awaiting shipment. It is at these terminal markets and ports that maximum deterioration and damage to groundnut kernels occurs (Planning Commission, 1963).

4.2. Marketing of Groundnuts

The marketing or trade of groundnuts performs the function of assembly, transportation, brokerage, and sometimes storage in moving the produce to the mills. Trading practices of groundnuts in the early days (1930's and 40's) as well as today is presented in the following sections.

4.2.1 Marketing of Groundnuts in the Early Times

(a) Availability of groundnuts

Marketing practices of groundnuts in the early years pertains to the period when India was in the last stages of colonial rule, and moving towards its independence. From 1931 to 1940, the average annual production was 27.5 thousand tons in shell, and an average yield of 1,016 kg/ha. By 1940-41, production was 34.05 thousand tons, which was contributed by Madras Presidency (51.7%), Hyderabad State (18%), Bombay Presidency (17.6%), and Bombay State including Gujarat, western India, and Kolhapur (8.8%). Spreading varieties gave much higher yields than bunch varieties, and irrigation greatly raised output. Four types of groundnut were grown in India, though marketed under many names; e.g., Coromandel, Bold, Khandesh (or Peanuts), and Red Natal.

Producers retained about 15 percent of the seed produced, while 11 percent went for sowing, 2 percent for crushing in chekkus, and 1 percent for consumption. *Chekku* is an intermediate groundnut oil extraction technology which came into existence after the traditional animal driven *Ghani* technology but before the advent of modern power operated oil mills. Harvest labor was

paid in kind at one-tenth to one-sixth of the produce, but even this quantity was frequently sold in the market for cash. Market arrivals were October to January, and an average of 47 percent of all groundnut production was estimated to have been marketed for use in India between 1933 and 1938, to be utilized for oil extraction (42.5%), seed purposes (11.4%), edible use (6.7%), and export (39.4%). Nut prices were influenced by several factors. Coromandel fetched a higher price than Khandesh, and machine-decorticated units a better price than hand-decorticated material, the difference being as much as 24 percent in 1937-38. Peak prices were to be had in December and January and from June to August, and a deep harvest depression occurred from August to December, the spread being as high as 40 percent in certain markets (Achaya, 1990).

(b) Assembling of groundnuts for marketing

The marketable surplus, constituting about 85 percent of production, reached the market from producers (52% mostly in shell), village merchants (20%), and agents of wholesale merchants, decorticating establishments and oil mills (15%), the relative figure varying in different areas. Decorticating establishments in south India played an important role in the assemblage and distribution of groundnuts. As wholesale merchants, they bought and stocked nuts on their own account as commission agents, they stocked and sold, either as pods or nuts, material brought to them by producers and village merchants; and as processors, they decorticated on contract and also undertook drying and bagging.

Cultivators, deeply in debt, had little option but to sell to their creditors, who might pledge their crops even up to ten years in advance. Village merchants were small tradesmen (*Banias*) working in a confined radium, who often advanced loans to cultivators and bought produce on behalf of wholesale merchants. Landlords sold produce that they received from cultivators in lieu of rent. Agents of wholesale merchants, decorticating establishments and village merchants bought from villages, and the first two at their own premises from producers and village merchants, to whom they might lend bags to fetch produce (Achaya, 1990).

4.2.2 Current Trading Practices in Groundnuts in India

Although marketing channels differ somewhat from state to state, there are about five well-identified channels in existence (Srivastava, 1988). These channels are listed and discussed in the following sections.

- Producer to village trader who in turn sells either directly to mills or indirectly through wholesalers or commission agents.
- Producer to commission agents to millers either directly or through wholesalers
- Producer to broker who sells to millers directly or sometimes through wholesalers
- Producer to millers directly
- Producer to cooperative society to cooperative oil mills

(a) Village trader

The village trader procures groundnuts from the farmer at the farm or village itself, so the farmer does not have to bring the produce to market. All the marketing costs are borne by the trader. Sometimes farmers get loans from these traders. The normal procedure of payment to the farmer is after the produce is sold in the market. These traders sometime directly sell the seeds to the miller and sometime through a commission agent who in turn sells to a wholesaler, or directly to millers.

(b) Commission agent

The commission agent is a trader who buys or sells, or offers to buy or sell on an agreed commission. He offers to do anything necessary for completing and carrying out the transaction. The major portion of seeds is sold through the commission agent in a regulated market, which is called *Mandi* or an unregulated market area. The commission charge ranges between 0.75% and 1% of the total value of the pods sold. Charges of transporting from the farm to the market are born by the farmer and from market to the mill by the miller. In the regulated market the payment to the farmer is made on the sale day itself. The commission agent is supposed to recover payment from the miller within three days.

(c) Broker

In some of the states, processors or wholesalers recruit some people who work as their brokers in purchasing groundnut seeds. They directly purchase seed from the farmer on behalf of these people.

(d) Direct sale from producer to miller

In a direct sale to the miller, the price is not fixed at the time of sale. The parties mutually agree on a date for the price to be fixed and the sale to be recorded. The payment to farmers, therefore, is

made when the sale is recorded according to that day's prevailing price. Direct sales to the miller, however, account for a very small proportion of the sales. The bulk of the produce moves from the farmer to the miller for crushing through middlemen. Direct sales to millers account for just 13 percent. Nearly 82 percent of the produce moves only through middlemen.

(e) Sale through cooperatives

Sale through cooperatives is a recent phenomenon in groundnut trade. The cooperative acts as a commission agent. In this system, the farmer pays less commission. Transportation, loading and unloading expenses are borne by the farmer who is paid after the produce is sold. Cooperatives sometimes supply inputs to members on credit.

4.2.3 Marketing of Groundnut Oil and Cake

The bulk of the processed groundnut oil goes to the consumer in filtered form, and only a small portion is refined. Oil is sold in a family pack of 2-4 kg, and in a standard tin of 16 kg while the rest of it goes in drums for sale as loose oil. The small part of groundnut oil routed through refineries mainly goes through brokers. The channel is refineries-wholesalers-retailers-consumers. The bulk of the oil, which is only filtered, goes through the brokers-wholesalers-retailers-consumers for sale within the state. For outstation sales, the channel is broker-commission agent-wholesaler-retailers-consumers.

4.3 Processing of Groundnuts in India

4.3.1 Groundnut Processing in the Early Years

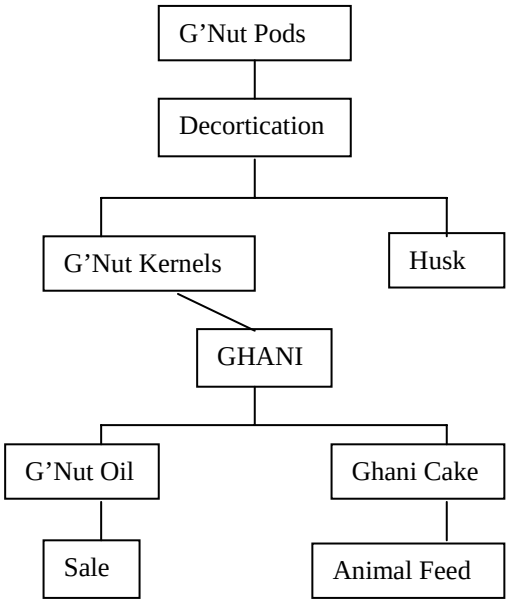
When groundnut production spurted in India after about 1850, the nuts were processed by the existing oil extraction technology called "*Ghani*." *Ghani* was an animal driven crusher. Crushing groundnuts in their pods was considered preferable to crushing kernels, and was also easier on the animal (Patel, 1958). By 1941, it was common to crush only groundnut kernels, but some times nuts in shell, or mixtures of these with kernels, were used. Mixed crushing was also in vogue in 1941, especially in Bombay and Hyderabad rather than in Madras. Niger seeds and groundnuts mixed in equal proportions were crushed in a village in the Pune district. In Belgaum (Karnataka), safflower seeds, groundnuts and sesame seed in a 7:3:1 ratio were noted as being crushed, and in Hyderabad, mixtures of groundnuts and safflower seeds were crushed. *Ghani* yields from groundnuts were 35 to 37 per unit of oil.

When the next big spurt in groundnut cultivation occurred between 1920 and 1930, modern expellers known as "chekkus" had appeared and were an alternative to traditional *ghanis*. In 1935-36, in Madras State, 73 percent of the groundnut production of 475,000 tons was crushed in chekkus. Of Bombay's 335,000 tons, however, only 17 percent was *ghani*-crushed, in Hyderabad state (125,000 tons) about 25 percent, and in the Bombay and Kathiwas States (also 125,000 tons) only 4 to 5 percent. Overall, some 45 percent of all groundnuts would seem to have been processed in *ghanis* in 1935-36 (Achaya, 1990).

The amount of groundnuts crushed using *ghanis* was estimated to be about 32 percent in the years 1949-50. *Ghani* crushing declined to 20 percent by 1955-56, reflecting increased processing by modern machinery. Also, the production of groundnuts was rising rapidly. By 1983, just 2.5 cent of groundnut oil was estimated to have been derived from traditional as well as improved power-driven *ghanis* (Achaya, 1990).

4.3.2 Current Scenario of Groundnut Processing

Groundnuts are processed by both organized and unorganized sectors in India. It is estimated that about one-seventh of the output is crushed by the unorganized sector. The traditional and modern technology in groundnut processing is illustrated in the following sections.



(a) Traditional Ghanies

Ghanies are driven by bullocks and these are mostly used in rural areas. They vary in size and detail of construction but in all cases the principle of operation is the same – a pestle rotating in a mortar. Oil is extracted within the mortar as a result of friction caused by the revolving pestle. The capacity varies from 8 kg to 25 kg per charge depending on the size of the mortar. It takes two to three hours to crush a charge and three to five charges can be handled in a day. Some of the improved *ghanies* can crush a charge (7 kg.) in less than one hour. Oil yield from *ghanies* is generally five percent of the weight of the seed crushed. Over the years, the number of *ghanies* in the country have decreased drastically.

(b) Oil Mills

Oil mills are very similar to *ghanies* but are operated by power. The usual capacity of a mill is 1 to 15 kg per charge, which is crushed in 20-30 minutes. An expeller consists of a flight of steel worms on a shaft revolving inside a steel cage. The worms are so arranged as to produce a gradually increasing pressure on seeds. Oil is expelled through perforation in the steel cage and the cake comes out from the opposite end.

4.4 Utilization and Consumption of Groundnuts

4.4.1 Utilization of groundnuts

Groundnuts produced in India are mostly utilized within the country. A small quantity of it is exported. The quantities retained in the country are utilized for three main purposes, namely, (i) seed, (ii) domestic use, and (iii) oil extraction. The estimated consumption in the years between 1950 and 1959 for the above-mentioned purposes as a percentage of the total production is presented in the following table (Planning Commission, 1963).

Table 4.1: Consumption of groundnuts

Years	Export (%)	Sowing (%)	Domestic (%)	Oil extraction (%)
1950-51	3.0	12	8.8	76.2
1955-56	0.7	12	7.6	79.7
1958-59	0.2	12	6.4	81.4

Different parts and or products of the groundnut plants used are kernel (seeds), oil, cake, and other products such as root, haulms and shell.

(a) Kernel

Groundnut kernels, which are plentifully produced in India, are widely acknowledged as a rich and cheap source of vegetable protein, and if included in the daily diet, will help decrease the protein deficiency economically. The following figures give the nutritive value of groundnuts as compared with other protein foods.

Table 4.2: Food value of groundnuts

Protein foods	Protein (%)	Carbohydrate (%)	Fat (%)	Caloric value
Milk (cow)	3.3	4.8	3.6	65
Eggs (fowl)	13.3	-	13.3	173
Mutton	18.5	-	13.3	194
Beef	22.6	-	2.6	114
Redgram	22.3	57.2	1.7	333
Groundnut	25.33	10.2	40.5	500-600

From a nutritional standpoint, groundnut is almost a class by itself amongst low priced food products. One gram of groundnuts supplies 5.8 calories of food. Compare this with 4 calories from sugar, 3.5 calories from whole wheat, 2.6 calories from bread, 2.3 calories from beef steak, etc. The high caloric value of the groundnut is due to its low moisture content. Groundnuts are rich in some vitamins, almost wholly lacking in others. In general, the members of the B-complex, especially thiamin, riboflavin and nicotinic acid are present in significant amounts. Groundnuts are also a good source of vitamin E, but amounts of vitamins A, C and D are negligible (Wrenshall, 1949).

Even though groundnut is recognized as a palatable "poor man's nut," and is eaten and relished by all classes of people, its consumption in India has not kept pace with the increase in its production. This is mainly due to the fact that there is no organized agency for the regular supply of edible groundnuts or for processing it for consumption. The per capita consumption of groundnuts in very low when compared to the level of consumption in countries such as the United States. Processed items such as peanut butter and/or peanut candies are not popular in India.

(b) Groundnut oil

Groundnut is extensively used as a cooking medium, especially in central and western India. Similarly, mustard oil is used as a cooking medium in the North.

(c) Oilcake

The residue left after the extraction of oil from groundnut kernels is called groundnut oil cake. Oil cakes are mainly used as cattle feed in India. Even today, a large number of farmers rely on the animal power for day-to-day farm operations. Of the various oil cakes that are used as cattle feed, groundnut cake ranks first as it is the cheapest of the oil cakes and contains good amounts of protein, which is necessary for the building of muscles (draught animals) and production of milk (milch animals). Other competing oil cakes are made of cottonseed and sesame.

(d) Other products of groundnuts

Groundnut roots left behind after the harvest, which contribute about 5 percent of the shoot's weight, are known to have a positive effect on fertility. Groundnut being a leguminous crop adds nitrogen to the soil through nitrogen fixation. A large number of farmers use groundnut in the crop rotation to take advantage of its ability to improve the fertility of the soil and enhance the yield of the following crop in the crop rotation. Groundnut haulms or vines are usually fed to cattle, both in green and dry form. Groundnut is also a richer feed than millets and cereals. Groundnut shells, the outer covering of the kernel, are mainly used as fuel, and sometimes as manure to improve soil conditions.

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