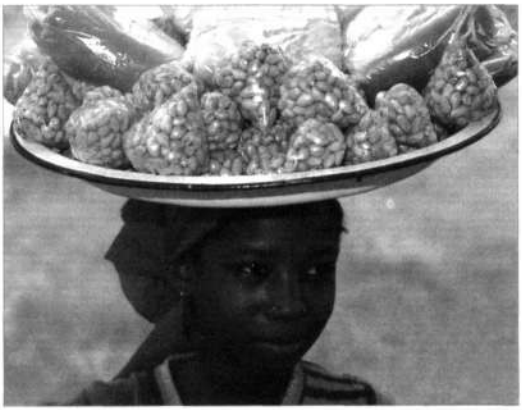

The world groundnut economy

Facts, trends, and outlook

International Crops Research Institute for the Semi-Arid Tropics

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Cover : Home-processed groundnut snack foods on sale in Nigeria - *Photograph by* G. *Venkataramani*

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ICRISAT
International Crops Research Institute for the Semi-Arid Tropics
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1999

Contents

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Executive Summary

Groundnut (Arachis hypogaea L.), also known as peanut, is one of the world's principal oilseed crops, widely grown in areas ranging from latitude 40°N to 40°S. The nuts are eaten in a variety of forms, or crushed to provide vegetable oil for human consumption and protein-rich meal for livestock. The haulms are an important source of fodder in developing countries. Developing countries account for nearly 95 percent of world production, and Asia for about 70 percent. The major producers are India, China, and the USA, which together account for over two-thirds of global output. Other important producers are Nigeria, Senegal, Sudan, and Argentina.

In most countries in Africa and Asia, the crop is grown in semi-subsistence systems by smallholder farmers with no irrigation and almost no inputs other than land and labor. Yields average about 700 kg ha^{-1} with substantial variation from year to year. In contrast, in the USA, Australia, Argentina, Brazil, China, and South Africa groundnut is produced on a commercial scale using improved varieties and modern crop management practices, irrigation, and purchased inputs. Yields are therefore considerably higher (2-4 t ha^{-1}) and more stable than in semi-subsistence systems.

Groundnut is currently grown on nearly 23 million ha worldwide, up from 19 million ha in 1979-81. During the past two decades, groundnut area has expanded in Africa and Asia, increased marginally in developed countries, and declined sharply in Latin America and the Caribbean. Yields currently average 1.3 t ha^{-1} globally, about 30 percent higher than in 1979-81. However, this overall picture conceals large differences between low-input semi-subsistence systems and high-input commercial systems. There has been little or no improvement in productivity in semi-subsistence systems. In contrast, yields have risen significantly in commercial systems in some countries, notably China and Argentina, as a result of widespread adoption of new varieties and improved crop management methods.

Demand, prices, and trade

Demand for groundnut products has been driven by several factors. In Africa, population growth has been the primary factor. In Asia, demand has grown due to a combination of population growth, growth in per caput income, and urbanization—higher incomes, higher opportunity cost of time, and therefore greater demand for convenience foods. Another important factor is substitutability. Vegetable oil can be obtained from a number of oilseeds including groundnut, soybean, sunflower, and rapeseed. Similarly, groundnut meal must compete with meal from other oilseeds and also with cereal-based products such as maize gluten. Consequently, relative prices between these various alternatives will influence demand, while relative profitability will determine how much area producers allocate to groundnut. For example, groundnut area fell by 40 percent during the 1980s in Latin America, largely because producers in Argentina and Brazil shifted to more profitable soybean.

Groundnut is widely traded in domestic markets wherever it is produced. At the international level, trade in oil and meal has fallen substantially over the past two decades, while trade in confectionery groundnut has increased. Various factors are involved, one of them being concerns over aflatoxin contamination, which have led buyers to set strict tolerance limits for aflatoxin for both food and livestock feed. Broadly speaking, exports are concentrated in developing countries—with the exception of the USA in confectionery groundnut—while Europe dominates the import market for all groundnut products, although it is gradually losing market share to fast-growing Asian economies.

International prices of groundnut meal and oil have fluctuated widely over time. But over the long term, meal prices have fallen gradually while oil prices have increased. A significant proportion of the price variability is caused by the thin market with a small number of exporters. Another factor is substitutability between different vegetable oils and oilseed-based meals. As a result, groundnut oil and meal prices correlate closely with those of the major substitutes, e.g., sunflower, soybean, rapeseed.

A common feature in all major groundnut producing countries is government intervention through price and marketing policies that directly influence prices, costs, and/or producer income. However, the patterns of intervention are sharply different in developing and developed countries. In general, government price and marketing policies in developing countries discriminated against the groundnut sector by directly suppressing producer prices, although reforms in recent years have partly reversed this trend. In developed countries government policies protected the sector through various price support policies and quantitative restrictions on imports (e.g., quotas) that protected domestic production.

Future priorities, medium-term outlook

Notwithstanding successes in a few countries, groundnut productivity has been stagnant in much of the developing world. Adoption of improved varieties and crop management methods remains poor, particularly in Africa. Future work must therefore focus on increasing adoption rates. A key constraint to variety adoption is non-availability of seed. Research institutes, NGOs and other development organizations, private seed companies, and the public sector will therefore need to work closely together to strengthen seed production and distribution systems. New crop management methods are available that can substantially improve productivity, especially in drier areas. But adoption has been poor because management recommendations are often too costly in terms of investment, knowledge, or labor requirements. Resolution of this problem will require greater farmer participation in technology development and testing, in conjunction with new tools such as simulation modeling. Such an approach will help identify and develop practical, inexpensive crop management options that farmers are likely to adopt.

Breeding strategies for the future will depend on the nature of the production system. Strategies for smallholder systems must continue to focus on stability of production with a view to ensuring at least moderate yields every season, rather than aiming to maximize potential yield. In commercialized, high-input systems, research on crop quality (especially for confectionery varieties) and aflatoxin control is likely to be the priority.

Technologies are available, or likely to become available, to resolve many farm-level production constraints in developing countries. But past experience shows that adoption lags are considerable, particularly in smallholder systems in semi-arid areas. It is therefore important to focus on the socioeconomic and policy factors that limit adoption of improved technologies. Technology adoption can be encouraged by developing a more favorable policy environment; for example, providing more diversified marketing opportunities, improving marketing efficiency and reducing the farmgate prices of inputs by reducing transaction costs involved in marketing and distribution. Equally important are interventions that will stabilize product prices, especially immediately after the harvest.

In the medium term, i.e., the period up to 2010, groundnut production and consumption is likely to shift increasingly to developing countries. Production will grow in all regions but most rapidly in Asia. Per caput consumption will grow sharply in Asia, slowly in sub-Saharan Africa, and decline in Latin America. Utilization will continue to shift away from groundnut oil toward groundnut meal and especially confectionery products.

Both area and yield are projected to grow considerably faster than they did in the 1970s and 1980s. As a result, while production of other oilseeds will grow, the share of groundnut in total oilseeds production is expected to remain stable. But ultimately, the potential for sustained production growth will depend on the effectiveness of research efforts to develop and disseminate improved varieties that will raise groundnut productivity.

Introduction

Groundnut (Arachis hypogaea L.), also known as peanut, is one of the world's principal oilseed crops. The plant originated in South America but is now widely distributed throughout tropical, sub-tropical, and warm temperate areas in Asia, Africa, Oceania, North and South America, and Europe. The nuts are eaten in a variety of forms, or crushed to provide vegetable oil for human consumption and protein-rich meal for livestock. The haulms are an important source of fodder, especially in developing countries. In addition, groundnut helps improve soil fertility through biological nitrogen fixation, and can thus contribute to significant improvements in the sustainability of cropping systems.

Groundnut is largely a smallholder crop, grown under rainfed conditions in semi-arid areas. In these areas it is simultaneously a food and a cash crop, providing smallholder families with dietary protein and high-grade fat as well as cash income from sale on local markets. However, groundnut is also grown on a commercial scale using high levels of inputs; and groundnut oil, meal, and other products are extensively traded, particularly in domestic markets.

Developing countries account for over 95 percent of world groundnut area and about 94 percent of total production. Production is concentrated in Asia and Africa, with Asia accounting for about 60 percent of global area and 70 percent of production (Table 1, Figs. 1 and 2). Within Asia the major producers are India, which accounts for 35 percent of global area and 28 percent of total output; and China, 1 7 percent of area and 34 percent of output. Africa accounts for 35 percent of global groundnut area but only 21 percent of output, concentrated mainly in Senegal, Nigeria, and Sudan. Other major producers are the USA and Argentina.

Differences in productivity reflect wide variations across and within regions in the use of inputs and improved agricultural technologies. In developing countries groundnut is grown largely by resource-poor smallholder farmers operating under a number of constraints—lack of irrigation, relatively infertile soils, low-yielding, late-maturing varieties, and very limited use of modern inputs. Production is generally more intensive in China, where high-yielding varieties and fertilizer are widely used. Pockets of intensive irrigated production are found in Senegal, Sudan, Egypt, India, and Vietnam. In the USA, Argentina, Brazil, and South Africa groundnut is cultivated intensively under high-input conditions on commercial farms.

Groundnut cropping systems fall under two broad categories:

- Low-input systems. In most countries in Africa and Asia, groundnut is grown by resource-poor smallholder farmers under rainfed conditions, with no inputs other than land and labor. It is a semi-subsistence crop, grown primarily for food, but small quantities are sold for cash after meeting household consumption requirements. The crop is often subjected to severe drought stress due to inadequate and highly variable rainfall; and to high levels of pest and disease infestation. Average yields are about 700 kg ha^{-1} and can vary substantially from year to year.
- High-input systems. In the USA, Australia, Argentina, Brazil, China, and South Africa groundnut is produced on a commercial scale using improved varieties, modern crop management practices, irrigation, and high levels of inputs such as fertilizer, herbicides, and pesticides. Farm operations are generally mechanized. Yields in these systems are considerably higher (2-4 t ha^{-1}) and more stable than in semi-subsistence systems.

Because groundnut is usually a tradable crop, data on production, trade, and utilization are generally good, particularly in countries where production is commercialized. Data are less accurate for countries where it is grown as a subsistence or semi-subsistence crop.

Groundnut is used in various forms. Part of the harvest is consumed directly on the farm; boiled, roasted, fried, or as ingredients in other foods. Surplus over household requirements is sold as a cash crop, in turn for three main uses—oil, meal, and confectionery products. The nuts are shelled and crushed to obtain vegetable oil used for cooking. Groundnut meal, a by-product of crushing, is used as a protein supplement in livestock feeds. Confectionery products—snack nuts, peanut butter, cookies, etc—are made from high-quality nuts, with large seed size being important in some markets. Both smallholder systems and high-input systems provide groundnut for all three forms of utilization. High-input systems are likely to provide greater consistency in quantity and quality. Output from smallholder systems may vary from year to year, depending on area sown, rainfall, pest and disease incidence, and market conditions.

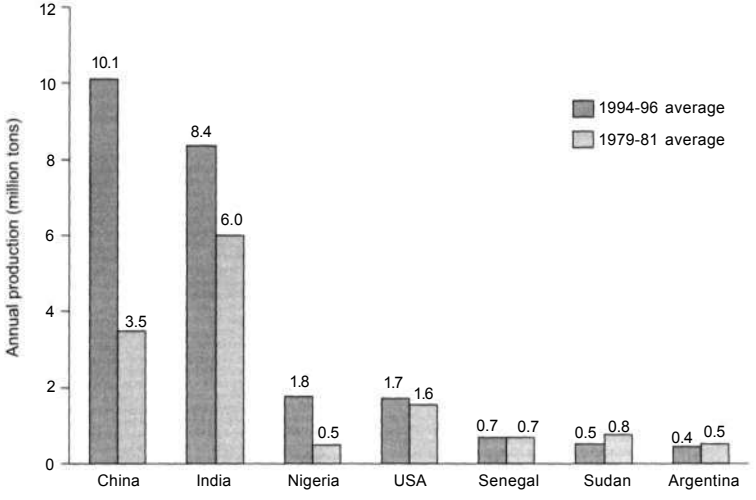

Figure 1. The world's major groundnut producers.

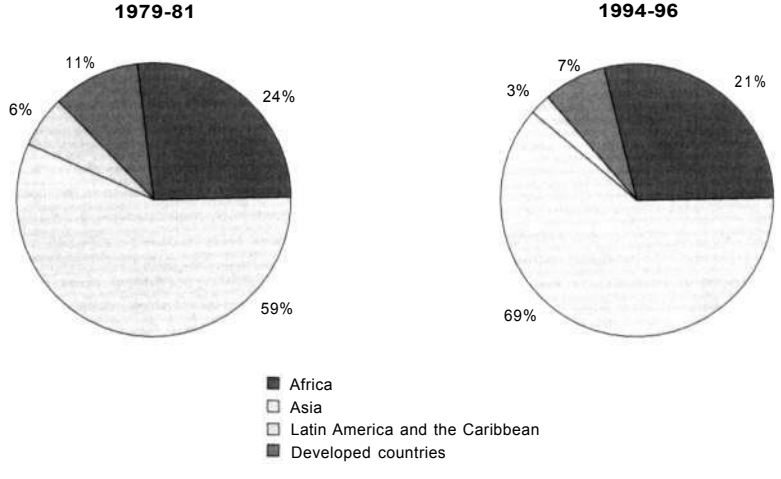

Figure 2. Groundnut (in shell) production.

Table 1. Groundnut (in-shell) area, yield and production by region[1].

	Area ('000 ha)			Yield (t ha^{-1})			Production ('000 t)		
	1979-81	1989-91	1994-96	1979-81	1989-91	1994-96	1979-81	1989-91	1994-96
Developing countries	17,793	19,410	21,763	0.9	1.1	1.3	16,523	21,124	28,078
Africa	6,087	5,684	7,923	0.7	0.8	0.8	4,233	4,523	6,401
Eastern and Southern Africa	2,134	1,481	2,011	0.7	0.6	0.7	1,447	824	1,350
Mozambique	350	342	256	0.4	0.3	0.4	131	113	98
Sudan	960	332	972	0.8	0.6	0.8	760	173	756
Tanzania	91	110	113	0.6	0.6	0.6	54	62	72
Uganda	109	185	192	0 7	0.8	0.7	80	149	137
Zimbabwe	183	192	148	0.6	0.6	0.4	101	108	66
Western and Central Africa	3,905	4,159	5,748	0.7	0.9	0.8	2,710	3,613	4,717
Burkina Faso	129	181	261	0.4	0.3	0.8	70	121	215
Chad	168	186	305	0.7	1.1	0.8	93	164	233
Congo, Dem. Rep.	477	028	739	0.7	0.8	0.8	334	520	594
Mali"	166	188	204	0.9	1.0	0.9	141	163	180
Nigeria	572	920	1,868	0.9	1.2	0.9	503	1,083	1,770
Senegal	1,053	857	863	0.7	0.9	0.9	690	757	686
North Africa	48	44	70	1.6	1.4	2.3	74	64	161
Egypt	12	13	43	2.1	2.2	2.9	26	27	124
Morocco	28	22	17	1.2	0.9	1.4	34	20	21
Asia	10,887	13,226	13,374	1.0	1.2	1.6	11,134	15,828	20,871
East Asia	2,358	2,960	3,777	1.5	2.1	2.7	3,513	6,104	10,117
China	2,293	2,911	3,770	1.5	2.1	2.7	3,416	6,011	10,103
South Asia	7,707	9,217	8,437	0.8	0.9	1.1	6,483	8,162	9,025
India	7,132	8,562	7,797	0.8	0.9	1.1	5,999	7,570	8,359
Myanmar	489	523	493	0.8	0.9	1.0	390	456	508
Pakistan	49	84	101	1.2	1.1	1.1	60	89	112
Southeast Asia and the Pacific	783	1,009	1,109	1.4	1.5	1.4	1,060	1,466	1,605
Indonesia	496	628	691	1.5	1.7	1.6	754	1,039	1,073
Thailand	103	116	100	1.2	1.4	1.5	128	160	148
Vietnam	106	207	257	0.9	1.1	1.3	94	218	329
West Asia	39	40	51	2.0	2.4	2.4	78	96	124
Syria	10	11	14	1.8	2.0	2 1	18	22	30
Turkey	23	23	31	2.2	2.5	2.4	52	58	73
Latin America and the Caribbean	819	500	466	1.4	1.5	1.7	1,156	773	806
Argentina	289	166	176	1.6	2.1	2.5	451	34 5	432
Brazil	282	85	89	1.5	1.7	1.8	433	142	162
Mexico	66	87	71	1.1	1.3	0.9	73	110	61
Paraguay	29	36	33	1.0	1.1	1.1	28	39	34
Developed countries	920	913	925	2.2	2.3	2.1	2,011	2,145	1,979
Australia	32	20	20	1.5	1.6	1.7	48	31	33
Bulgaria	4	12	11	1.3	1.0	0.9	6	12	10
Greece	4	2	1	2.8	3.9	3.6	11	7	3
Israel	5	3	4	4 4	6.6	5.9	22	20	24
Japan	33	18	14	1.9	2.0	2.2	01	36	30
South Africa	245	120	118	1.2	1.1	1.3	297	131	158
USA	595	738	609	2.6	2.6	2.8	1,550	1,893	1,719
World	18,713	20,323	22,688	1.0	1.1	1.3	18,534	23,269	30,057

1. Each figure is a 3-year average for the respective period, e.g., 1979-81

Source: FAO

The relative importance of oil, meal, and confectionery products can vary considerably across countries, depending on consumer preferences, relative prices of groundnut versus oilseed substitutes, domestic policy, and international trading conditions. For example, 80 percent of the groundnut produced in India, and over half in China, is crushed for oil. In the USA, 65 percent is used in confectionery products; only small quantities are crushed into oil, and these are mainly lots that do not meet grading standards for the confectionery market.

Crop Distribution

Groundnut is grown in Asia, Africa, Oceania, North and South America, and Europe, in environments that range from tropical to warm temperate (latitude 40°N to 40°S, Fig. 3). In Africa, it is widely distributed throughout the continent although Sudan, Nigeria, and Senegal together account for half the total production. In Western and Central Africa groundnut is cultivated in semi-arid areas of the Sahel, Sudan, and the northern half of the Northern Guinea Savanna. These areas span a range of conditions—length of growing season 75-150 days, annual rainfall 300-1200 mm. In Southern and Eastern Africa groundnut is grown under a similarly wide range of agroecological conditions (altitude sea level to over 1500 m, rainfall 300-1000 mm) but production is concentrated in areas with low and highly variable rainfall.

In Asia, India and China, the world's largest producers, together account for 88 percent of regional production. Smaller producers include Indonesia, Myanmar, Bangladesh, and Vietnam. Although production in these countries is small in absolute terms, the crop occupies a large proportion of national legumes area. In India, about 80 percent of the groundnut area is rainfed, grown in southern, western, and parts of central India during the southwest monsoon. The remaining 20 percent is irrigated, grown in the postrainy season (mostly in rice fallows) and in summer in in southern India, Orissa in eastern India, and the central Indian states of Gujarat and Maharashtra. In China, spring- and summer-groundnuts are grown in rotation with wheat and maize. The major growing area is Shandong province in northern China, which accounts for over one-fourth of national production. However, groundnut is grown throughout the country, under diverse conditions; rainfall ranging from 400 to 2000 mm, and number of frost-free days per year ranging from 150 to 300.

Argentina and Brazil together account for two-thirds of the groundnut produced in Latin America and the Caribbean. The crop is grown mainly in semi-arid regions; the major production areas are Cordoba province in Argentina and Sao Paulo state in Brazil.

Developed countries produce about 7 percent of the world's groundnut—most of this in the USA, the world's third largest producer. In the USA, production is concentrated in three main areas—the southeast (Alabama, Florida, Georgia, South Carolina), the Virginia-Carolina area (Virginia, North Carolina), and the southwest (Texas, Oklahoma, New Mexico). This broad classification is made on the basis of environmental conditions, and the cultivar type commonly grown in a region. In Europe, growing conditions are unsuitable in most areas, and groundnut is grown only in Bulgaria and small parts of Greece, Spain, and Yugoslavia.

Trends in Area, Yield, and Production

Area. Groundnut is currently grown on 23 million ha worldwide (Table 1). During the past two decades, groundnut area has expanded in Africa and Asia, increased marginally in developed countries, and declined sharply in Latin America and the Caribbean (Fig. 4). Overall, global groundnut area increased by 1.3 percent per annum between 1979 and 1996 (Table 2). In Africa, area declined from the mid 1970s to the mid 1980s, but this trend was reversed by an expansion in Sudan, Egypt, Nigeria, and several countries in Western Africa. In Asia the expansion was led by China, where groundnut area increased by almost 60 percent between 1979 and 1996. In contrast, groundnut area fell drastically in Latin America. In Argentina and Brazil, the main producers, area declined by over 50 percent during the 1980s, as farmers shifted from groundnut to soybean due to higher relative profitability from soybean cultivation—lower production costs, generally lower pest and disease pressure, and more stable markets. In Argentina, groundnut area declined from 289 000 ha to 166 000 ha during the 1980s, while soybean area increased from 1.8 to 4.5 million ha.

Groundnut area increased slightly in the developed countries. This was due to increases in the USA, which in turn resulted from price support and

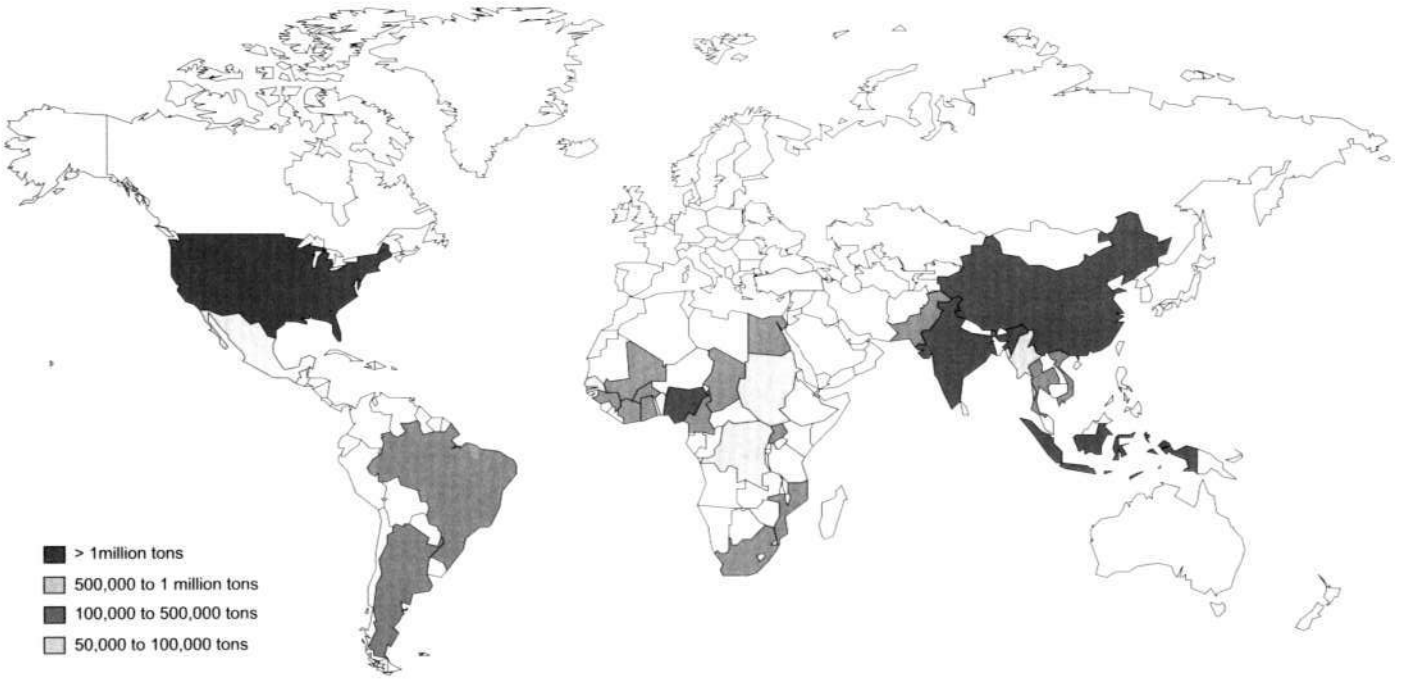

Figure 3. Annual groundnut production, 1994–96 average.

Table 2. Groundnut growth rates (percent per year), 1979-96.

	Area	Yield	Production	Per caput production
Developing countries	1.4	2.1	3.5	1.4
Africa	1.3	1.1	2.4	-0.5
Eastern and Southern Africa	-0.7	0.0	- 0.7	na
Mozambique	-1.8	0.0	-1.8	-3.9
Sudan	-1.4	0.0	-1.4	-3.7
Tanzania	1.5	0.3	1.8	-1.4
Uganda	3.8	0.2	4.1	0.9
Zimbabwe	-1.2	0.3	-0.9	-3.9
Western and Central Africa	2.4	1.3	3.7	na
Burkina Faso	4.3	2.9	7.2	4.4
Chad	5.4	1.7	7.1	4.9
Congo, Dem. Rep.	3.0	1.1	4.1	0.7
Mali	2.3	0.1	2.4	-0.6
Nigeria	7.4	1.3	8.7	5.8
Senegal	-1.4	1.3	-0.1	-2.8
North Africa	2.3	2.3	4.6	na
Egypt	7.7	2.0	9.7	7.4
Morocco	-3.8	0.4	-3.4	-5.5
Asia	1.5	2.5	4.0	2.1
East Asia	2.9	4.5	7.4	na
China	2.9	3.5	6.4	5.0
South Asia	0.9	1.6	2.5	na
India	1.0	1.7	2.7	0.7
Myanmar	-0.3	0.6	0.3	-1.6
Pakistan	4.7	-0.9	3.8	0.7
Southeast Asia and the Pacific	2.3	0.4	2.4	na
Indonesia	2.5	-0.1	2.5	0.7
Thailand	-0.6	1.2	0.6	-1.0
Vietnam	5.3	2.3	7.6	5.5
West Asia	1.8	1.2	3.0	na
Syria	2.5	0.8	3.3	0.0
Turkey	1.9	0.6	2.5	0.4
Latin America and the Caribbean	-3.7	1.7	-2.0	-3.9
Argentina	-2.5	3.3	0.8	-0.6
Brazil	-8.3	1.4	-6.9	8.7
Mexico	0.3	-3.2	-2.9	-0.6
Paraguay	0.4	0.6	1.0	-1.9
Developed countries	-0.4	0.7	0.2	-0.4
Australia	-4.0	1.7	-2.3	-3.7
Bulgaria	7.9	-2.9	5.0	5.3
Greece	-9.6	1.9	-7.7	-8.2
Israel	-1.9	2.3	0.4	-1.0
Japan	-6.1	0.9	-5.2	-5.9
South Africa	-4.8	2.5	-2.3	-4.6
USA	1.0	0.1	1.1	-0.1
World	1.3	1.9	3.2	1.5

na = data not available

Source: FAO

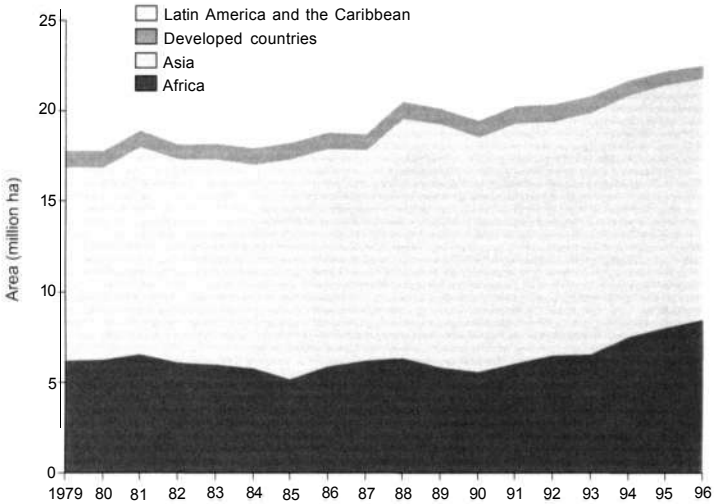

Figure 4. Global trends in groundnut area, 1979 to 1996.

quota policies that assured domestic producers of high prices and protected the domestic groundnut industry. Groundnut area increased during the 1970s and early 1980s but declined around the mid 1980s due to reductions in quota allocations and crop rotation.

Yield. Groundnut yields increased worldwide by 1.9 percent per annum between 1979 and 1996. Productivity improved in all regions (Fig. 5) and especially in Asia and Latin America and the Caribbean—yields in China and Argentina grew by over 3 percent per annum. Yield improvement in Africa was much lower, but even the 1.1 percent annual growth rate during 1979-96 represented a major improvement over the negative levels of the 1970s. Within this overall picture of increased productivity, trends in semi-subsistence and high-input systems are sharply different. In the semi-subsistence systems found in much of Africa and Asia, farmers generally grow low-yielding, late-maturing varieties. The crop is cultivated on marginal land with no irrigation and minimal inputs, and average yields have remained essentially unchanged (0.8-1.0 t ha^{-1}) for several decades. In contrast, yields of up to 4 t ha^{-1} have been obtained in high-input systems in parts of Senegal, Sudan, Zimbabwe, and Egypt where the crop is produced by commercial enterprises under irrigation. Yields in India vary widely depending on the production system. Rainfed groundnut, which occupies about 80 percent of groundnut area, yields roughly 0.9 t ha^{-1}, while the irrigated crop yields about 1.6 t ha^{-1}.

Yields in high-input production systems are high due to widespread adoption of improved varieties and management practices such as organic and inorganic fertilizer, crop rotation, plastic film mulch, pest and disease control. Adoption of new technologies has led to large productivity increases in developing countries, notably Argentina in the 1970s and China in the 1980s. Between 1979-81 and 1994-96 yields increased from 1.6 to 2.5 t ha^{-1} in Argentina and from 1.5 to 2.7 t ha^{-1} in China.

During the same period, yields in the USA increased from 2.6 to 2.8 t ha^{-1}. This relatively slow growth was due to several reasons. First, technology adoption (e.g., the introduction of runner varieties in the 1970s) and large-scale commercialization had already taken place earlier. Second, weather variability, including drought in some parts, generally reduced yields and increased fluctuations in yield. Third, public concern over the effects of high levels of

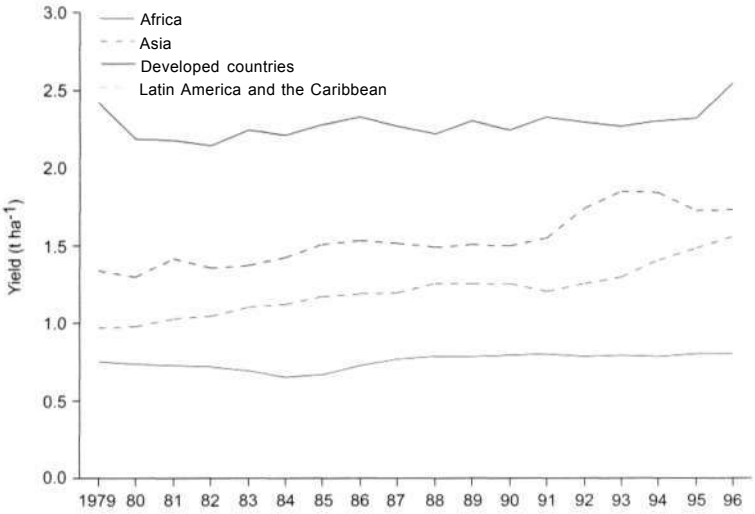

Figure 5. Global trends in groundnut yield, 1979 to 1996 (3-year moving average).

fertilizer and pesticide use on environmental and human health led to reductions in the use of agro-chemicals during the 1980s, thus slowing down yield growth.

Production. World groundnut production increased from 19 million tons in 1979-81 to 30 million tons in 1994-96, an annual growth rate of 3.2 percent. By comparison, the oilseeds sector as a whole grew by 4 percent; since 1979, production growth has been slower in groundnut than in alternative oilseeds such as soybean, oil palm, sunflower, and rapeseed.

In the developing countries, production increased at 3.5 percent per year, and per caput production at 1.4 percent per year between 1979 and 1996. However, this increase conceals important regional variations—production grew rapidly in Asia, slowly in Africa, and declined in Latin America and the Caribbean (Table 2, Fig. 6). Correspondingly, per caput production increased substantially in Asia but declined in Africa and Latin America and the Caribbean.

In the low-input systems found in most countries in Asia and Africa, production growth remained sluggish although the general performance was mixed. In many African countries production growth rates increased from negative rates in the mid 1970s to about 3 percent per annum by the mid 1980s. This increase was mainly due to area expansion in Sudan, Nigeria, and several countries in Western Africa. In contrast, groundnut area in Malawi, earlier a major producer, declined considerably in the late 1980s as government pricing and marketing policies, which effectively taxed groundnut producers, led farmers to shift land to maize, beans, and other crops. Production in India grew at 2.7 percent per annum during 1979-96, with much of this increase coming from area growth. Other Asian producers such as Indonesia, Vietnam, and Myanmar recorded production growth during much of the period 1979-96.

In high-input systems in USA, South Africa, China, and Argentina, production trends were driven by several factors, the most important of which was higher productivity as a result of technological change. In some countries, productivity increases compensated for or reduced the effect of area loss. In others, higher productivity combined with area expansion resulted in large production increases. In Argentina and Brazil, area fell by more than 50 percent during the 1980s (Table 1), but productivity increases partly compensated for this loss. In China, production nearly tripled from 3.4 million

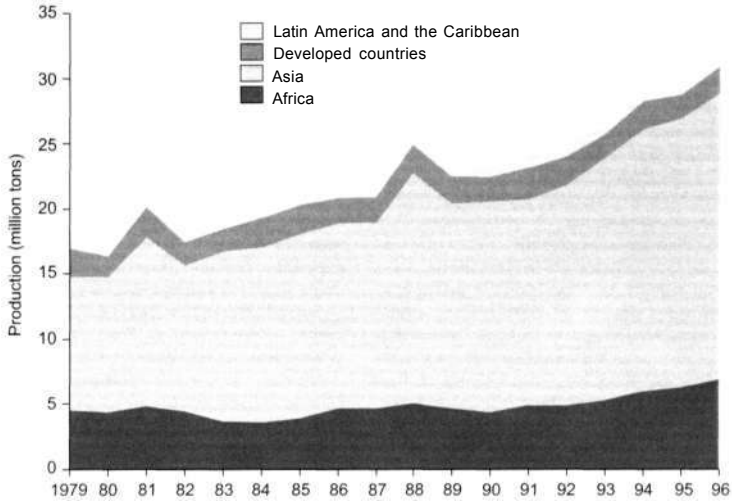

Figure 6. Global trends in groundnut production, 1979 to 1996.

tons in the late 1970s to 10.1 million tons in the mid 1990s. This increase was due to a combination of area expansion and productivity growth, induced by technological change and a favorable policy environment. Policy reforms included a price support system, greater incentives for groundnut farmers, relaxation of market controls, and improvement of marketing facilities.

In the USA, in contrast to these countries, technology change played only a minor role in the 1980s. Widespread adoption of new technologies had already occurred earlier; the major factors influencing production were domestic policies, which largely governed area and production, and weather variability, which caused large yield fluctuations during this period. Production increased by about 1 percent per annum during 1979-96.

Production Constraints

Productivity improvement in groundnut is constrained by a number of biotic and abiotic stresses such as insect pests, diseases, drought, and low soil fertility. Smallholder farmers are particularly affected, because they may lack resources or access to currently available technology to overcome these stresses. In addition, low producer prices and limited marketing opportunities reduce incentives for producers—especially smallholders—to invest in productivity-enhancing technologies such as improved seed, fertilizer, and pesticides. Consequently, yields on smallholder farms in semi-arid areas are much lower than on large-scale commercial farms.

In low input intensity production systems in Africa, all field operations from land preparation to harvesting are done by hand. Lack of labor and draft power causes delays in sowing and weeding, further reducing yields. In many countries in Africa and Asia, pressure on arable land limits the extent of fallowing and crop rotation. As a result soil nutrients are rapidly depleted and most often are not replaced by application of inorganic fertilizer. Continuous cropping without rotation and delayed sowing at low plant populations also increase the severity of diseases (e.g., bacterial wilt and viral diseases) and insect pests. Moisture stress at critical periods of crop growth substantially reduces yield and quality, while end-of-season drought increases the labor requirements for harvesting as well as the probability of aflatoxin contamination.

One major constraint is the lack of improved varieties adapted to the various agroecologies found in semi-arid areas in Africa and Asia. The majority of smallholder farmers still grow traditional landraces that are adapted to local environments but have low genetic yield potentials and are, in many cases, susceptible to drought, pests, and diseases. Even when improved, high-yielding, disease-resistant varieties are available many smallholders, especially in Africa, do not have access to seed at affordable prices. This limits the adoption of improved varieties and increases variability in area sown to groundnut.

Because seed is costly and effective multiplication and delivery systems are lacking, many smallholder farmers retain seed from previous harvests for use in subsequent seasons. Poor storage conditions and low use of seed-treatment chemicals further reduce the quality of the seed. Private seed companies are now more active as a result of market liberalization. However, the private sector has little or no incentive to invest in groundnut seed multiplication and distribution because the crop has high seed requirements and a low multiplication factor, and because the seed is bulky (difficulties in storage and transportation) and loses viability relatively quickly. Private seed companies therefore tend to focus on crops and varieties that have high effective demand and are profitable to produce. Public seed companies that dominated the seed industry in Africa for much of the 1970s and 1980s have not invested in groundnut either, tending to focus on a few crops, particularly maize and wheat, mostly for farmers in accessible areas with relatively high rainfall.

Diseases are a major constraint in most developing countries. A large number of fungal, viral, nematode, and bacterial diseases have been reported. Most are widespread but not all are economically important. Bacterial wilt causes considerable yield losses in East and Southeast Asia. Foliar diseases such as rust, early leaf spot, and late leaf spot can occur either individually or in combination, and cause important—but variable—economic consequences in large parts of Asia and Africa. Early leaf spot *(Cercospora arachidicola)* is the most destructive groundnut disease in Southern and Eastern Africa—epidemics occur in many countries, causing yield losses of up to 50 percent in some regions. Late leaf spot (*Phaeoisariopsis personata)* is also widely distributed, mainly in low-altitude areas, but it is economically important only in some countries in the region, where it usually occurs together with rust (*Puccinia arachidis).* In Western and Central Africa early and late leaf spots are particularly severe in the Sudan Savanna and the Sudan Guinean regions, where they frequently reduce yields by up to 50 percent. Rust first appeared in Western Africa in the 1970s but is spreading rapidly, and now occurs sporadically in many areas of the Sahel.

Groundnut rosette, a viral disease transmitted by the aphid Aphis craccivora, is another major constraint but is restricted to Africa. Disease epidemics are sporadic but can cause considerable yield loss when they do occur. In Asia, the major viral diseases are peanut bud necrosis in South Asia and peanut stripe virus in Southeast Asia.

Several insect pests also cause considerable yield losses in some areas. The tobacco caterpillar (Spodoptera litura), gram pod borer (Helicoverpa armigera), and the groundnut leaf miner (Aproaerema modicella) are economically important pests but are mainly confined to Asia. Foliage and stem feeders as well as root and pod feeders cause severe losses in parts of Africa. Aphids, thrips, and jassids are important pests over much of Africa; the former two groups not only cause direct damage by feeding on leaves, but also act as vectors for viruses. Soil pests such as termites and white grubs are important in Southern and Western Africa and in parts of Asia; termites are particularly destructive under drought conditions.

Aflatoxin contamination of groundnut by the fungi Aspergillus flavus and A. parasiticus is an important constraint affecting the quality of groundnut in most producing countries in Africa and Asia. It is also important in the USA in years of drought, e.g., in Alabama in the early 1990s. Aflatoxin contamination is a major health risk for both humans and livestock, and importing countries place strict restrictions on acceptable aflatoxin levels in groundnut (see box). The weevil Caryedon serratus causes substantial losses in storage; in addition, weevil damage provides the means for A. *flavus* to penetrate groundnut pods.

In addition to these non-price factors, domestic policies over the past three decades in many producing countries, especially in Africa, have hampered development of the groundnut sector. Following independence, many African countries expanded the role of the public sector in groundnut pricing and marketing. Parastatal marketing boards—with a monopoly over procurement and export—fixed producer prices and prevented the private sector from engaging in groundnut trade. Proceeds from export prices were, for the most part, used to cover marketing costs and losses by the marketing board, while

the producer share in the export price steadily declined. In effect, these policies represented a direct tax on groundnut producers, while trade restrictions and other macro-economic policies—especially those that caused real exchange rates to appreciate—represented an indirect tax. The combined effects of direct and indirect taxation greatly reduced incentives to grow groundnut, leading many producers to shift to other crops such as maize. Liberalization of groundnut marketing, which began in the late 1980s, has reduced the role of parastatals and encouraged competitive pricing. Exchange rate reforms implemented during the same period increased competitiveness and the incentives to grow export crops such as groundnut, especially in Western Africa. However, many parastatals, such as the Agricultural Development and Marketing Board (ADMARC) in Malawi and Societe Nationale de Commercialisation de Oleagineux (SONACOS) in Senegal, continue to dominate the market and fix prices using their extensive marketing infrastructure. This practise is seen particularly in rural areas, where alternative procurement and marketing systems are weak.

Utilization

Slightly over half of world groundnut production is crushed into oil for human consumption or industrial use. Protein meal, a by-product of crushing, is an ingredient in livestock feeds. Groundnut is also consumed directly and is used in processed food and snacks; about one-third of world production is used in these "confectionery" products. Table 3 shows the major forms of groundnut utilization in different regions. Groundnut, like most oilseeds, can provide both oil and meal, but contributes only a minor share of global utilization of these products. In 1994-96 groundnut oil ranked fifth (7 percent) in world production of vegetable oils, behind soybean oil (31 percent), palm oil (26 percent), rapeseed oil (16 percent), and sunflower oil (14 percent). Groundnut meal ranked fifth (4 percent) in world production of oilseed protein meals, after soybean (65 percent), rapeseed (12 percent), cottonseed (9 percent), and sunflower (8 percent).

Utilization of oil, meal, and confectionery groundnut are all increasing, along with a gradual shift away from oil and meal into confectionery use (Fig. 7). Globally, the shares of oil, meal, and confectionery products in total utilization have not changed substantially during the past two decades. However, during this period there has been a significant shift towards confectionery use in some areas, notably in Latin America and the Caribbean.

Groundnut oil

Demand for groundnut oil is determined by a variety of factors including relative prices of competing vegetable oils, income levels, demographic trends, and cultural preferences. Between 1979-81 and 1994-96 world consumption of groundnut oil increased from 2.8 million to 4.3 million tons, despite rising international groundnut prices. The share of developing countries in this consumption increased from 83 to 93 percent (Table 4) due mainly to rising demand in Africa and Asia. This increase in demand was due mainly to population growth in Africa, and to a combination of population growth, growth in per caput income, and urbanization (and hence greater demand for convenience foods) in Asia.

In India, demand increases were driven by population growth, although the increase was moderated by rising prices. About 80 percent of Indian groundnut is crushed for oil, and groundnut oil remains the preferred vegetable oil; but its share in the vegetable oil market is declining as consumers shift to cheaper alternatives such as rapeseed, sunflower, and imported palm olein. In China, demand for groundnut oil has increased steadily for the past two decades, driven by economic and population growth as well as urbanization. Increases in domestic supply and a gradual easing of import restrictions are resulting in lower prices, which in turn are expected to further boost demand. In other developing Asian economies, population and economic growth have similarly led to substantial increases in groundnut oil consumption.

Groundnut oil has traditionally been an important dietary component in several countries in Western Africa. In some countries—Nigeria, Gambia, and Senegal—oil extraction has been an important rural cottage industry for many years. Industrial processing facilities now exist in some countries in the subregion, but the dominant form of extraction continues to be at village level. In Eastern and Southern Africa, per caput consumption of vegetable oil is small, and oil extraction, whether at village level or on a commercial scale, is limited.

Groundnut oil usually forms only a small part of the diet or the calorie supply, but consumption increases rapidly as incomes rise. Urbanization is another factor, increasing the opportunity cost of time and thus the demand for convenience foods. Corre-

Table 3. Groundnut utilization by type and region (in-shell equivalent, '000 t).

	Total availability	Confectionery	Processing[1]	Other uses[2]	Per caput food supply (kg per year)
1979-81 average					
Developing countries	16,005	4,556	9,187	2,262	1.4
Africa	3,937	1,382	1,699	855	4.6
Asia	10,855	2,918	6,649	1,288	1.1
Latin America and the Caribbean	1,008	196	735	77	1.1
Developed countries	2,466	1,528	808	129	1.3
Australia	41	33	5	3	2.2
CIS[3]	74	54	18	2	0.1
Europe (EC)	577	247	327	2	0.5
South Africa	243	37	177	29	1.3
USA	1,204	889	233	82	3.9
World	18,472	6,085	9,995	2,392	1.4
1989-91 average					
Developing countries	20,644	6,441	11,521	2,689	1.6
Africa	4,341	1,538	2,008	795	4.0
Asia	15,495	4,561	9,127	1,806	1.2
Latin America and the Caribbean	621	263	299	59	1.0
Developed countries	2,714	1,913	656	145	1.5
Australia	48	40	5	3	2.4
CIS	111	81	23	6	0.1
Europe (EC)	579	410	164	3	0.9
South Africa	108	14	80	15	0.4
USA	1,489	1,054	322	113	4.1
World	23,358	8,355	12,177	2,835	1.6
1994-96 average					
Developing countries	26,956	9,024	14,442	3,511	2.1
Africa	6,011	1,999	2,670	1,342	4.4
Asia	20,062	6,629	11,360	2,073	1.4
Latin America and the Caribbean	606	251	316	57	0.9
Developed countries	2,746	1,825	769	153	1.4
Australia	41	34	4	3	2.0
CIS	11	0	9	2	0.0
Europe (EC)	589	390	196	3	0.9
South Africa	144	14	116	13	0.3
USA	1,477	950	401	126	3.6
World	29,703	10,850	15,211	3,663	1.9

1. Processing is largely into oil and meal, and very small quantities for industrial products

2. Other uses include feed, seed, and waste

3. Commonwealth of Independent States of Eastern Europe. Until 1991, area of the former USSR

Source: FAO

spondingly, per caput supply of groundnut oil increased slightly in Asia between 1979 and 1996 due to income growth and urbanization, but declined in Africa as per caput incomes stagnated or fell. Per caput consumption also declined in Latin America, reflecting a shift toward cheaper substitutes such as soybean and sunflower oil.

The share of developed countries in global consumption of groundnut oil declined from 17 percent in 1979-81 to 7 percent in 1994-96. One important reason for this decline was a change in European Community agricultural policy in the 1980s. Under the new policy, the Community provided support to encourage cultivation and oil production from oil-

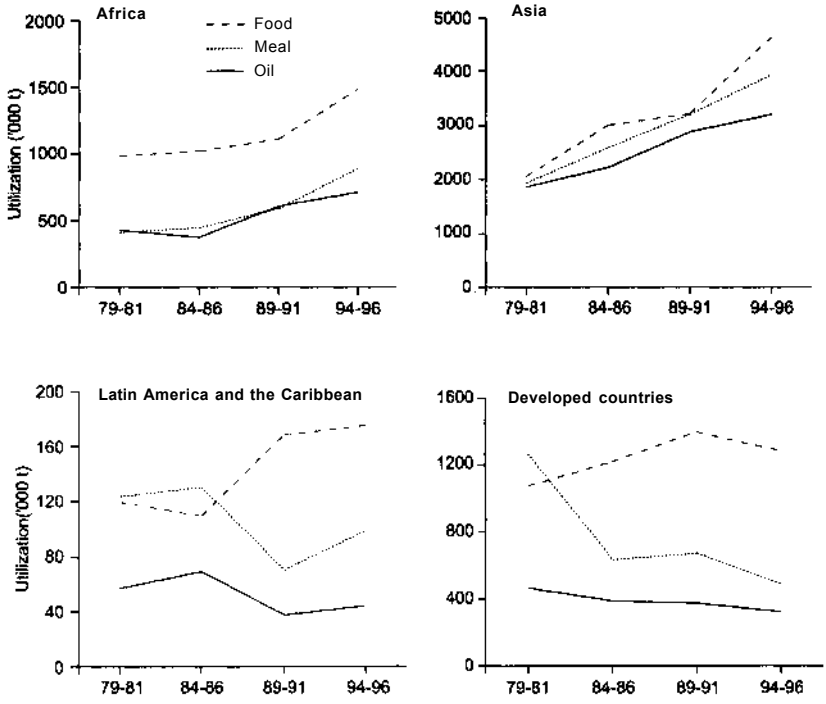

Figure 7. Groundnut utilization, 1979-96 (shelled equivalent).

seeds such as sunflower and rapeseed, which were produced within the Community. In addition, consumer preferences were changing due to health concerns—sunflower and rapeseed oil are perceived to be healthier than groundnut oil. This combination of factors caused a decline in demand.

Groundnut meal

Groundnut meal is used primarily as a protein supplement in livestock feed rations. The supply of groundnut meal is directly influenced by demand for groundnut oil, the primary product from crushed groundnut. Thus, production and price trends of meal are similar to those of oil, but with smaller fluctuations across years. There is a high level of technical and economic substitutability in the market for oilseed meal; all meals can be used as livestock feed although the protein contents are different. Soybean, followed by cottonseed, is considered to be superior in terms of digestibility, energy value, and palatability to livestock. Consequently, demand for groundnut meal depends largely on relative prices; between oilseed meals and cereal-based substitutes on one hand, and between competing oilseeds on the other.

World utilization of groundnut meal increased by 45 percent between 1979-81 and 1994-96 (Table 4). This increase was concentrated in developing countries in Asia, where consumption of meal almost doubled despite rising prices. As incomes rose in Thailand, Indonesia, and some other rapidly developing Asian countries, consumption of meat and livestock products increased, generating demand for

Table 4. Annual utilization of groundnut oil and meal by region ('000 t).

	Vegetable oil	Meal	Per caput supply of groundnut oil (kg per year)
1979-81 average			
Developing countries	2,353	2,499	0.7
Africa	401	374	1.3
Asia	1,851	1,961	0.6
Latin America and the Caribbean	54	123	0.4
Developed countries	466	1,261	0.4
Australia	2	2	0.1
CIS[1]	6	77	0.1
Europe (EC)	317	810	0.0
South Africa	30	67	0.1
USA	60	63	0.3
World	2,819	3,760	0.6
1989-91 average			
Developing countries	3,468	3,884	0.9
Africa	508	565	1.0
Asia	2,898	3,217	0.6
Latin America and the Caribbean	35	69	0.2
Developed countries	373	665	0.3
Australia	2	2	0.1
CIS	4	22	0.2
Europe (EC)	232	384	0.5
South Africa	19	32	0.5
USA	69	115	0.3
World	3,840	4,549	0.7
1994-96 average			
Developing countries	4,017	5,003	0.9
Africa	716	868	1.0
Asia	3,228	3,832	0.6
Latin America and the Caribbean	41	98	0.1
Developed countries	322	496	0.2
Australia	2	2	0.1
CIS	3	3	0.2
Europe (EC)	192	252	0.5
South Africa	20	59	0.5
USA	59	148	0.2
World	4,338	5,499	0.8

1. Commonwealth of Independent States of Eastern Europe. Until 1991, area of the former USSR

Source: FAO

oilseed meals, including groundnut, as a livestock feed supplement. Utilization of groundnut meal remained fairly static in Africa mainly due to the availability of grazing land in some countries and relatively low use of feed supplements. Consumption in Latin America and the Caribbean is not significant, accounting for only 2 percent of global consumption in 1994-96. In Argentina and Brazil, the two major groundnut producers in the region, only limited quantities of oilseed meal are used in stockfeeds because good grazing land is available and cattle are largely pasture-fed.

Consumption of groundnut meal in the developed countries declined by 60 percent between 1979-81 and 1994-96, mainly because of developments in the European market. The share of the

European Community in global utilization of groundnut meal fell from 22 percent in 1979-81 to 5 percent in 1994-96. This decline was due to several factors. Rising groundnut meal prices led to substitution by soybean meal, compound feeds in general became more costly than alternative feed sources, and reductions in the livestock herd reduced overall demand for feed. In addition, policy changes increased the competitiveness of cereals relative to oilseeds; the proportion of oilseed meals in livestock feed was reduced, with feed producers moving to cheaper protein sources such as maize gluten. Interestingly, the bovine spogniform encephalopathy (BSE) scare increased the demand for oilseed meal—production shifted from cattle toward highly feed-intensive pork and poultry; and new restrictions on the use of meat and bone meals, the major protein supplements in cattle feed, lifted demand for oilmeals. However, it was soybean rather than groundnut that benefited from the increased demand. In the Commonwealth of Independent States of Eastern Europe, poor economic growth since the 1990s has caused significant reductions in the consumption of livestock products, and demand for groundnut meal has fallen steadily.

Confectionery groundnut

Worldwide, demand for groundnut for direct food consumption increased by nearly 80 percent between 1979-81 and 1994-96 (Table 3). Developing countries accounted for much of this increase—utilization of confectionery groundnut nearly doubled in these countries, and their share of global utilization increased from 75 to 83 percent. However, there were considerable variations in consumption growth between regions. Utilization of confectionery groundnut in Asia more than doubled between 1979-81 and 1994-96, and Asia now accounts for two-thirds of global utilization, up from one-half in 1979-81. Consumption grew most rapidly in China and other fast-growing Asian economies (Table 5), where rising per caput incomes and urbanization led to structural shifts in consumption patterns toward packaged and processed foods.

Utilization of confectionery groundnut also increased in Africa and in Latin America and the Caribbean. In Africa groundnuts are not generally consumed in packaged or processed forms, unlike the case in developed or fast-growing developing countries. The main forms of utilization in Africa are roasted groundnut, boiled or raw groundnut, and groundnut paste. Relatively simple technologies are used to roast or boil groundnut and they are popular snacks in many urban areas in Africa. However, snack groundnut tends to have a relatively short shelf life, and must be consumed within a short period after processing because packaging materials are mostly rudimentary. In many parts of Western Africa and Sudan partially defatted or full-fat groundnut paste is one of the most common forms of utilization. Partially defatted groundnut paste, produced after the oil has been extracted, is used to make several food products; for example, kuli-kuli in Nigeria and coura-coura in Burkina Faso. Full-fat groundnut paste is a common ingredient in many dishes in Western Africa, Sudan, and Southern Africa. The paste is normally prepared and consumed at home using traditional technologies, but small-scale commercial processing is also common, and the paste is sold widely in both rural and urban markets. Partially defatted groundnut flour is also used in many semi-arid areas of Africa as an ingredient to improve the nutritional quality of various cereal-based products such as gonfa (millet-based) and epo-ogi (maize-based).

In Argentina and Brazil large quantities of confectionery groundnut are consumed as roasted nuts or in packaged form as snack foods such as peanut candy. Demand growth in these countries is driven mainly by growing urbanization and rising incomes.

Utilization of confectionery groundnut in developed countries increased by 19 percent between 1979-81 and 1994-96, compared to a 98 percent increase in developing countries over the same period. As a result the share of developed countries in global utilization declined from 25 percent to 17 percent. Among the developed countries, utilization is highest in the USA, the world's largest producer of confectionery groundnut. Nearly three-fourths of US production is used in confectionery products, mainly peanut butter, packaged snack nuts (salted, unsalted, flavored, and honey-roasted), and peanut candies. Peanut butter accounts for about half of all processed groundnut in the USA in most years. Packaged nuts account for another one-third. Small quantities of groundnut are crushed to produce peanut granules and flour. Although the USA is still the most important consumer, its share of developed-country utilization of confectionery groundnut has gradually declined from 58 percent in 1979-81 to 52 percent in 1994-96, while the share of the European Community has risen from 16 to 21 percent. There are two likely explanations for the continued decline

Table 5. Growth rates (percent per year) of groundnut utilization by type and region, 1979-96.

	Confectionery	Oil	Meal	Per caput food supply
Developing countries	4.2	3.6	4.5	2.4
Africa	2.7	4.1	5.4	-0.3
Eastern and Southern Africa	-1.3	-2.2	-1.8	-3.5
Mozambique	-0.6	-0.2	3.0	-2.7
Sudan	-1.2	-4.1	-6.2	-3.8
Tanzania	-0.5	4..9	4.9	-3.7
Uganda	4.1	3.9	4.0	1.3
Zimbabwe	-1.7	7.8	5.0	-4.7
Western and Central Africa	3.6	6.4	7.2	1.0
Burkina Faso	7.3	7.3	7.3	4.5
Congo, Dem. Rep.	4.3	4.2	4.3	0.8
Mali	3.0	2.0	3.0	-0.8
Nigeria	3.4	11.7	11.9	0.4
Senegal	17.4	8.0	21.0	-0.9
North Africa	4.3	3.8	4.9	-6.0
Algeria	0.0	12.2	26.9	-2.0
Morocco	0.0	-2.1	-2.5	-2.0
Asia	5.0	3.6	4.6	1.4
East Asia	6.4	5.5	5.9	2.6
China	6.4	5.8	5.9	4.9
South Asia	2.8	2.9	3.2	-2.4
India	3.0	3.0	3.4	1.2
Myanmar	0.4	1.4	0.2	-1.7
Pakistan	3.6	3.7	3.8	0.0
Southeast Asia and the Pacific	2.6	4.3	13.5	0.6
Indonesia	3.1	4.1	16.8	2.0
Thailand	1.7	0.1	19.7	0.4
Vietnam	3.4	9.3	8.0	0.7
West Asia	4.0	3.3	1.1	2.0
Turkey	3.2	3.6	3.8	1.0
Latin America and the Caribbean	3.3	-3.6	-2.9	2.6
Argentina	11.4	-6.4	-2.2	-2.0
Brazil	5.4	-0.8	-6.3	6.8
Mexico	3.5	5.3	9.0	1.0
Developed countries	1.2	-2.5	-5.3	0.2
Europe (EC)	3.4	0.0	-6.3	1.6
South Africa	-4.3	-4.0	0.0	-7.0
USA	0.3	-0.1	6.5	-0.5
World	3.6	2.9	2.6	1.7

Source: FAO

in US utilization—price rises that followed production shortfalls in the 1990/91 season, and a change in consumer preference away from high-fat foods. In addition, the US government gradually reduced purchases of groundnut for domestic nutrition programs.

Other uses

Oil, meal, and confectionery products are the dominant forms of groundnut utilization. However, large quantities of groundnut are retained on-farm for seed, especially in Africa and Asia, where farmer-

saved seed is the dominant source of seed supply. In Africa and parts of Asia, groundnut haulms are a key source of livestock fodder in smallholder production systems, while the shells are used as fuel by rural households and small-scale industrial enterprises. Groundnut shells are also used as filler material in stockfeeds. Small quantities of products derived from groundnut are used for bird feed in Europe and for industrial purposes, e.g., in the production of detergents, plastics, and bio fuels, especially in developed countries.

Stocks

Few countries hold large stocks of groundnut oil, meal, or confectionery nuts, partly because groundnut does not store very well for long periods. Average annual stock changes during 1994-96 were estimated at 18,000 tons of oil, 5000 tons of meal and 102,000 tons of confectionery nuts. Stocks of groundnut oil increased in the early 1980s but declined by the mid 1990s. The bulk of oil stocks is held in developing countries although the number of countries holding stocks has declined progressively since the 1980s. In 1994-96 only India and Argentina held inventories of groundnut oil. The pattern of reduced global stocks, concentration of stocks in a few countries, and wide variations in stocks over time is similar for groundnut meal—only Argentina, the Gambia, and Sudan held significant inventories in 1994-96. Many more countries hold stocks of confectionery groundnut, but usually in small quantities. India had the largest stock of confectionery nuts in 1994-96. As with groundnut oil and meal, stocks of confectionery nuts have varied widely over time.

While official inventories may be small, a significant proportion of the global stocks is not officially recorded. Farmers in developing countries hold large stocks of groundnut (normally as shelled nuts) for household consumption, seed, and cash needs. Because production levels are relatively low, these stocks often do not last for more than one season, and stock levels are highly variable. One bad season can cause farmers to draw down these stocks considerably, even using seed stocks to meet household consumption and cash requirements. After such periods seed availability becomes a major problem, especially for new varieties that are often supplied in small quantities; and farmers are forced to rely on the market or relief supplies for fresh seed.

Trade

Over half the groundnut harvested worldwide is crushed into oil and meal. Consequently, a substantial volume of groundnut trade worldwide is in the form of oil and meal. Large quantities of confectionery groundnuts are also traded. Of these three products, trade is dominated by groundnut meal, partly because many of the major producers (e.g., India, Argentina, Senegal) do not use large quantities in their domestic markets. Also, the growth of the livestock sector, particularly in Asia, has increased the demand for all oilseed meals including groundnut meal.

Over the past two decades trade volumes have increased substantially for confectionery groundnut but fallen for groundnut oil and meal. One reason for the decline is that groundnut oil and meal have gradually lost competitiveness in relation to substitutes. Another is that international trade has been impeded by concerns over aflatoxin contamination in groundnut products. These concerns, reflected in phytosanitary regulations, have caused buyers and importing countries to set strict tolerance limits for aflatoxin for both food and livestock feed.

The trade data report some exports from the Netherlands for oil, meal, and confectionery groundnut. However, this is really re-export of groundnut products that enter Rotterdam port and are then distributed to other European countries.

Groundnut oil

Groundnut oil is thinly traded in international markets because the major producers (China, India, USA) consume substantial quantities in their domestic markets, thereby reducing the quantities available for export. Global exports of groundnut oil currently represent about 1 percent of total trade in vegetable oils, a decline from 5 percent in 1979-81. Most of this trade is concentrated in developing countries, which currently provide about two-thirds of world exports. The export trade in developing countries is concentrated in Africa, with Senegal and Sudan accounting for one-third of global exports. Among the developed countries, the USA (13 percent of world exports) is the only significant exporter of groundnut oil.

Worldwide, exports of groundnut oil declined by 34 percent between 1979-81 and 1994-96 from 434,000 tons to slightly under 288,000 tons (Table 6). Most of the reduction was due to declining exports from developing countries. African exports fell

Aflatoxin Contamination in Groundnut

In the early 1960s, it was discovered that strains of fungi belonging to the *Aspergillus flavus* group could produce a toxic substance when they grew on groundnut. Since then aflatoxin contamination has led to public health concerns, significantly influencing groundnut trade worldwide. Groundnut can be contaminated with aflatoxin at various stages—before harvest, during field drying and curing, and in storage. Incidence is highest in years when a short rainy season leads to terminal drought or when rainfall continues into the harvest, preventing pods from being properly dried in the field. Pre-harvest contamination is most often caused by drought, intermittent moisture stress, and insect damage to pods. Infection at harvest occurs when mature pods are lifted from the soil before being properly cured and dried. Groundnut can be invaded by *A. flavus* when storage conditions are poor—high relative humidity, e.g., due to rainwater leakage or condensation, high temperature, and insect attack, particularly from storage pests.

Many countries have established regulations controlling the maximum permissible levels of aflatoxin in imported groundnut for both human consumption and livestock and poultry feeds (see table).

		Maximum permissible level ($ng\ g^{-1}$), 1995	
Country	Aflatoxin type	Foodstuffs	Livestock feed
Belgium	B_1	5	20
France	B_1	1	20
Germany	B_1	2	20
Ireland	B_1	5	20
Italy	B_1	5	20
The Netherlands	B_1	0	20
Sweden	$B_1B_2G_1G_2$	5	10
UK	$B_1B_2G_1G_2$	4	20
USA	$B_1B_2G_1G_2$	20	20

Management of aflatoxin contamination requires both preventive and curative approaches. The preventive methods include the use of appropriate crop management practices and chemicals to protect crops during growth and storage, and proper handling during post-harvest, transportation, and processing. The curative methods involve isolation and segregation of toxic groundnut and various systems of detoxification. Resistant varieties are a desirable component of any integrated aflatoxin management system. Research efforts to reduce aflatoxin contamination need to focus on:

- Developing and disseminating relevant, practical, affordable production and post-harvest practices for smallholder farmers
- Integrated management of *A. flavus* infection and aflatoxin contamination using host-plant resistance and cultural practices
- Detoxification of groundnut and groundnut products
- Better understanding of the determinants of fungal invasion
- Mechanism(s) and genetics *of* resistance

It may be impractical to control aflatoxin to zero tolerance levels using conventional approaches. However, biotechnology methods, in combination with concerted efforts to improve farmers' management options, could help reduce contamination to levels that would no longer be hazardous to public health.

Table 6. Annual exports and imports[1] of groundnut oil ('000 t).

	1979-81	1989-91	1994-96
Exports of groundnut oil			
Developing countries	324.9	247.0	184.0
Africa	118.2	141.3	107.0
Eastern and Southern Africa	24.0	17.3	19.9
Sudan	21.7	15.9	19.8
Western and Central Africa	94.2	124.0	88.1
Mali	6.0	4.9	7.6
Nigeria	0.0	0.0	2.3
Senegal	77.7	114.1	75.7
Asia	41.1	54.4	26.0
China	31.2	35.8	15.7
Hong Kong	1.5	4.8	6.9
India	4.0	0.0	0.0
Latin America and the Caribbean	165.6	51.2	50.1
Argentina	82.1	40.3	41.2
Brazil	83.5	10.6	8.4
Developed countries	108.8	81.4	103.7
South Africa	23.7	18.8	7.6
USA	14.4	12.5	37.4
Europe	70.5	50.0	58.2
France	14.2	11.6	15.5
Netherlands	21.4	12.1	14.8
World	433.7	328.4	287.8
Imports of groundnut oil			
Developing countries	57.2	65.5	54.2
Africa	14.7	2.7	2.3
Eastern and Southern Africa	3.0	0.5	0.2
Western and Central Africa	11.0	1.9	1.4
Nigeria	5.5	0.0	0.0
Asia	37.4	60.4	51.8
China	0.0	11.4	11.2
Hong Kong	27.4	31.9	29.4
India	1.3	0.4	0.1
Latin America and the Caribbean	5.1	1.5	0.4
Venezuela	3.5	0.0	0.0
Oceania	2.2	2.3	2.3
Developed countries	391.3	274.6	240.7
Europe	384.3	266.1	229.6
France	210.1	114.8	81.5
Germany	35.1	22.0	18.2
Italy	36.0	52.4	42.7
Netherlands	25.8	17.5	19.3
Switzerland	16.8	5.5	15.2
UK	14.7	10.0	3.9
North America	4.9	7.0	8.5
Canada	4.9	5.5	4.8
USA	0.0	1.5	3.7
World	448.5	340.1	294.9

1. Each figure is a 3-year average for the respective period, e.g., 1979-81

Source: FAO

by 19 percent between 1979-81 and 1994-96 mainly because of declining production by the major producers. One factor was poor rainfall in Sudan and other production areas. More important, however, domestic sectoral and macroeconomic policies in Western Africa (particularly the Gambia, Senegal, and Nigeria) directly and indirectly taxed export crops such as groundnut from the late 1960s to the end of the 1980s, leading to a decline in production. In Asia export volumes declined by 37 percent during the same period, due primarily to increases in domestic market requirements in China and India. The Latin America and Caribbean region recorded the largest decline in export volumes—70 percent—attributed to substantial reductions in groundnut area in the 1970s and 1980s and a shift in production from oil to confectionery groundnut in Argentina and Brazil. Market shares have also changed significantly during the past two decades, with Latin America and developed countries (excluding USA) losing market share to USA and Africa.

Groundnut oil imports fell by 34 percent between 1979-81 and 1994-96, from 450,000 to 300,000 tons (Table 6). An important reason for the decline was falling demand from traditional import markets in Europe, particularly France, Germany, the Netherlands, Spain, and the UK. Between 1979-81 and 1994-96 European imports declined by 40 percent in response to high international groundnut prices and changing consumer preferences away from high-fat vegetable oils. Imports into Africa weakened considerably because of substantially higher production, and therefore lower imports, by Nigeria, the most populous country in the region. Asian imports increased by 39 percent between 1979-81 and 1994-96 as domestic production, despite substantial increases, failed to keep pace with demand growth. Hong Kong remains the most important importer in Asia, but Chinese imports have been increasing rapidly from virtually zero in the late 1970s to 11,000 tons in the mid 1990s.

Despite these trends, however, imports are still concentrated in Europe, which currently accounts for nearly 80 percent of world imports of groundnut oil. Imports by developing countries, although growing in market share, are still relatively minor except for Hong Kong, the world's third largest importer.

Groundnut meat

Trade in oilseed meal is overwhelmingly dominated by soybean—groundnut meal accounted for only 2 percent of world oilseed meal exports, compared to 5 percent in 1979-81. Global exports of groundnut meal declined by 40 percent from 1979-81 to 1994-96 (Table 7) because of reduced shipments from developing countries, particularly Argentina, Brazil, Sudan, and Senegal. Asian exports also fell, but not as steeply; large reductions in Indian exports in the 1980s were partly compensated by a temporary surge in exports from China.

As is the case with groundnut oil, developing countries account for the bulk (about 90 percent) of export trade in groundnut meal. But this trade is extremely concentrated; India is the world's largest exporter of groundnut meal, followed by the Gambia, Sudan, and Senegal. Together these countries account for three-fourths of world exports. Again, similar to the groundnut oil trade, the USA is the major exporter among developed countries.

Global imports of groundnut meal fell by 45 percent between 1979-81 and 1994-96 (Table 7). This decrease reflected falling demand (a drop of nearly 75 percent during this period) in traditional European markets due to high relative price of groundnut meal compared to alternative oilseed meals and competing cereals as well as reductions in livestock herds. Europe's share of global groundnut meal imports declined from 93 percent in the late 1970s to 43 percent in the mid 1990s, with substantial reductions by almost all the major importers.

During the same period imports increased sharply in developing countries, although this increase could not compensate for the shortfall from Europe. The substantial growth in developing-country imports was driven by growing demand for livestock feed from a booming livestock industry in Asia. Asia's share in imports increased from 5 percent in the late 1970s to 54 percent in the mid 1990s. Despite rising international prices, imports rose substantially in Indonesia and Thailand and to a lesser extent in Malaysia and China, due to demand for meal from the growing livestock sector. Groundnut meal imports into Africa and Latin America and the Caribbean were relatively insignificant because of the predominant extensive grazing systems and relatively underdeveloped livestock feed sector. However, imports into Mexico increased from almost zero in 1979-81 to 12,000 tons in 1994-96.

Confectionery groundnut

International trade in confectionery groundnut grew steadily from the late 1970s to the mid 1990s.

Table 7. Annual exports and imports[1] of groundnut meal ('000 t).

	1979-81	1989-91	1994-96
Exports of groundnut meal			
Developing countries	962.5	684.4	552.6
Africa	284.1	240.7	155.6
Eastern and Southern Africa	130.1	51.8	74.2
Sudan	115.0	51.3	73.5
Western and Central Africa	154.0	188.9	81.2
Gambia	11.5	6.5	7.0
Mali	9.5	0.9	2.4
Nigeria	0.6	0.0	1.6
Senegal	128.4	178.9	69.7
Asia	494.2	393.2	355.2
China	1.0	139.4	33.1
India	471.5	240.5	300.1
Indonesia	0.0	0.5	13.9
Myanrnar	7.4	5.6	7.1
Latin America and the Caribbean	184.2	50.4	42.0
Argentina	104.7	46.1	41.6
Brazil	78	3.6	0.0
Developed countries	59.8	44.5	60.0
Europe	28.0	21.6	37.6
France	9.5	3.0	4.4
Netherlands	5.6	9.6	23.0
North America	31.8	22.9	22.5
USA	31.8	22.9	22.4
World	1,022.3	728.8	612.6
Imports of groundnut meal			
Developing countries	76.0	343.5	353.8
Africa	16.4	3.5	15.9
Eastern and Southern Africa	7.4	0.0	0.2
Western and Central Africa	9.0	1.8	0.4
Nigeria	8.2	0.1	0.0
Asia	52.4	329.9	323.2
China	0.0	13.1	18.1
Hong Kong	0.0	5.3	3.8
Indonesia	0.0	103.5	147.6
Malaysia	22.7	44.7	19.6
Thailand	7.6	158.3	131.3
Latin America and the Caribbean	7.2	10.1	14.7
Mexico	0.0	0.0	11.6
Developed countries	1,009.5	459.3	259.9
South Africa	0.0	1.6	15.3
USA	0.0	0.5	0.8
Europe	940.4	445.2	243.5
France	309.0	249.4	149.1
Germany	139.2	13.0	4.3
Ireland	49.9	7.1	1.1
Netherlands	21.1	14.6	21.5
Poland	132.6	63.6	0.7
UK	111.1	3.1	19.8
World	1,085.4	801.2	601.1

1. Each figure is a 3-year average for the respective period, e.g., 1979-81

Source: FAO

Table 8. Annual exports[1] of confectionery groundnut (shelled equivalent, '000 t).

	1979-81	1989-91	1994-96
Developing countries	371.0	640.2	842.4
Africa	114.7	64.1	62.1
Eastern and Southern Africa	70.0	31.6	20.1
Malawi	16.9	0.8	1.0
Sudan	44.3	14.4	6.0
Western and Central Africa	44.2	32.5	42.0
Gambia	30.0	10.4	23.0
Senegal	4.9	14.1	11.1
Asia	189.4	469.9	603.4
Hong Kong	15.7	34.3	7.3
India	28.4	27.6	102.7
Singapore	12.2	31.0	22.0
Vietnam	11.4	62.7	112.3
China	116.5	311.8	355.3
Latin America and the Caribbean	67.6	106.2	179.1
Argentina	50.8	96.3	155.8
Brazil	11.7	0.3	0.8
Nicaragua	0.0	1.4	17.5
Developed countries	307.6	296.5	366.8
South Africa	42.2	30.1	31.2
USA	242.4	206.8	189.3
Europe	17.6	58.3	141.0
France	0.3	0.8	13.3
Netherlands	11.2	46.8	112.4
World	678.6	936.7	1,209.2

1. Each figure is a 3-year average for the respective period, e.g., 1979-81

Source: FAO

Global exports increased by 78 percent from 700,000 tons in 1979-81 to about 1.2 million tons in 1994-96 (Table 8). During this period there has been an increasing shift in export trade from developed to developing countries. In the late 1970s developing countries accounted for 55 percent of global exports but this share rose to 70 percent by the mid 1990s. Most of the increase in export share was concentrated in Asia, particularly in China, Vietnam, and India, which together currently account for almost half of world exports. Export shares increased slightly in Latin America and the Caribbean due primarily to increased shipments from Argentina, which now accounts for 13 percent of world exports. In contrast, export volumes from Africa declined by about one-third between the late 1970s and mid 1990s due to reduced shipments by the major producers of confectionery groundnut; Malawi, Mozambique, Sudan, and Guinea Bissau. Among the developed countries, the USA remains the major exporter of confectionery groundnut; in recent years confectionery exports have surpassed exports of groundnut oil, as exporters target the price premiums caused by value addition. However, the share of the USA in world exports fell from 35 percent in the late 1970s to 16 percent in the mid 1990s, with much of this lost share going to Asian producers.

Worldwide, imports of confectionery groundnut increased by 83 percent from 1979-81 to 1994-96 (Table 9). This rise was fuelled by increased imports from developing countries, particularly in Asia. Developing countries tripled their share of global imports from 13 percent in 1979-81 to 39 percent in 1994 -96 with shares rising in all regions; Africa, Asia, and Latin America and the Caribbean. Asia recorded the largest increase, from 10 percent of global imports in the late 1970s to 27 percent by the mid 1990s. Much of this increase was due to increased imports from Indonesia, Singapore, Philippines, and Malaysia. Mexico also increased its imports substantially. Confectionery groundnut imports in develop-

Table 9. Annual imports[1] of confectionery groundnut (shelled equivalent, '000 t).

	1979-81	1989-91	1994-96
Developing countries	90.6	272.0	485.4
Africa	17.4	16.0	84.4
Eastern and Southern Africa	12.0	10.0	16.7
Angola	11.6	4.0	2.5
Mozambique	0.0	5.0	10.3
Western and Central Africa	5.1	10.0	37.6
Nigeria	0.0	0.0	12.5
Senegal	0.1	0.0	18.2
Asia	64.7	232.4	338.5
Hong Kong	21.0	41.0	13.9
Indonesia	7.0	53.0	153.9
South Korea	0.0	11.0	11.9
Malaysia	7.0	23.0	30.0
Philippines	0.0	32.0	47.3
Singapore	20.9	64.0	62.0
China	0.0	0.9	2.0
Latin America and the Caribbean	8.3	23.4	62.0
Mexico	2.7	12.0	43.5
Developed countries	593.9	668.0	769.7
Australia	1.0	14.0	7.1
Japan	61.3	46.0	41.4
Europe	423.4	464.0	581.6
France	104.9	30.0	56.3
Germany	49.5	88.0	69.9
Netherlands	66.5	138.0	219.5
Switzerland	21.3	23.0	0.6
Spain	20.7	16.0	22.1
UK	81.1	109.0	102.5
North America	59.6	69.0	107.5
Canada	59.2	67.0	82.4
USA	0.4	2.0	25.1
World	684.5	940.0	1,255.1

1. Each figure is a 3-year average for the respective period, e.g., 1979-81

Source: FAO

ing countries are thus concentrated in fast growing economies, with Indonesia, Singapore, Philippines, Mexico, and Malaysia accounting for the bulk of developing-country imports. Despite a slowdown in the early 1990s, these four countries still account for 27 percent of world imports and about 70 percent of developing-country imports.

Notwithstanding this increase in developing countries, developed countries dominate the import market for confectionery groundnut; their share has declined gradually from 87 percent in the late 1970s to slightly over 60 percent in the mid 1990s. Europe remains the chief importer, with the Netherlands currently accounting for 17 percent of world imports. Outside Europe, only Canada and Japan import significant amounts; together they account for 10 percent of world imports. The USA imports confectionery groundnut and groundnut paste representing close to 10 percent of domestic consumption. Groundnut paste comes primarily from Canada, which purchases confectionery nuts from all parts of the world to process into paste.

International Oil and Meal Prices

Groundnuts are thinly traded in international markets—exports accounted for only 1-2 percent of world production of groundnut oil and meal in 1994-96. The major groundnut producers (China, India, USA) are also the major consumers, utilizing about

two-thirds of global production in their domestic markets. In these countries the groundnut market is driven primarily by domestic policy considerations. Until recently both China and India imposed quantitative restrictions on groundnut imports, maintaining domestic prices at levels higher than international prices. Similarly, price support and quota policies in the USA regulated the quantity of groundnut marketed. Exports from China and the USA fluctuate from year to year and each historically accounted for less than 5 percent of world exports. However, the share of the USA has increased to about 13 percent in recent years. Thus, domestic policies protected producers and kept domestic prices high, but did not significantly influence international groundnut oil prices.

Groundnut oil. Although the major producers have not significantly influenced the international price of groundnut oil, prices have fluctuated widely over time (Fig. 8). Prices reached a peak in 1981, rising above $1000 per ton, and fell to their lowest levels at $ 504 per ton in 1987. The historical trend, however, shows that prices have risen slowly over time, with prices for each year in the period 1994-96 higher than the average for the 10-year period 1987-96. A significant proportion of the extreme variability in international groundnut oil prices is caused by the thin market which results from the concentration of exports in a few countries. Variability in rainfall or other climatic conditions, policy shocks, or structural changes in these countries therefore radiate into world markets and are reflected in variable prices. Much of the price variability in the early 1980s was due to two factors—drought conditions in major exporters such as Senegal and Sudan, and structural shifts away from groundnut into other oilseeds (particularly soybean) in Argentina. Price variability in recent years is due mostly to drought conditions in the small number of major exporters.

Another factor is substitutability—groundnut oil for cooking can be substituted with alternatives such as soybean oil, sunflower seed oil, and rapeseed oil. Thus, the relative prices of alternative oil sources are important. On average, international prices of groundnut oil have been higher than those of other oils, partly because much smaller quantities are traded. But the high degree of substitutability ensures that international prices of all major vegetable

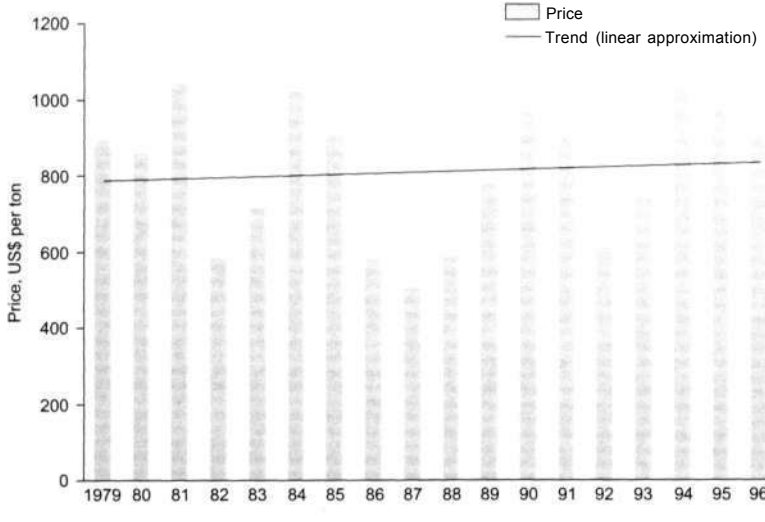

Figure 8. International market prices of groundnut oil, 1979 to 1996.

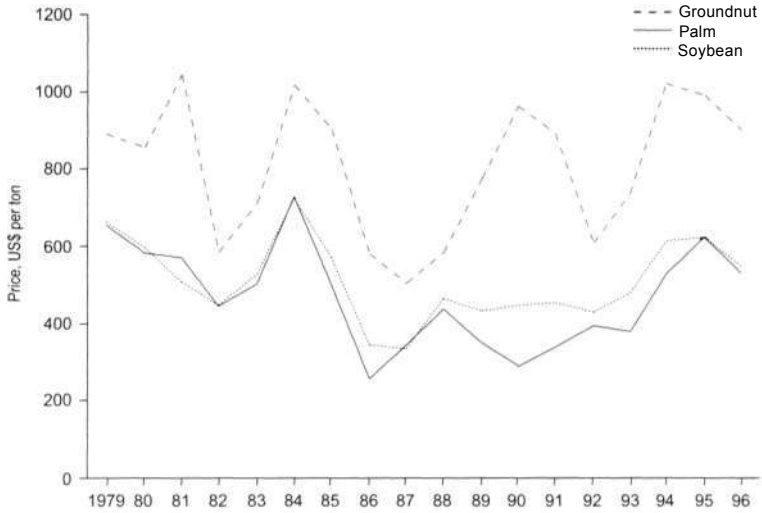

Figure 9. International prices of selected vegetable oils, 1979 to 1996.

oils are closely correlated, despite differences in supply conditions (Fig. 9). Correlation coefficients calculated from annual prices for the period 1990-96 show that price movements are closest among soybean, sunflower, and rapeseed oil, reflecting the degree to which these are substitutable. However, groundnut prices also correlated closely (r = 0.60-0.67) with those of the major substitutes.

Groundnut meal. International prices for groundnut meal have also fluctuated widely, but not as widely as groundnut oil prices (Fig. 10). Prices peaked at $ 240 per ton in 1980 and reached their lowest levels at $ 98 per ton in 1985. The historical trend indicates a long-term decline in prices, reflecting increasing competition from alternative protein sources (both oilseeds and cereals), especially in European markets. All oilseed meals can be used as livestock feeds although the protein contents, and therefore nutritional values, are different. Substitutability is thus even more important in oilseed meals than in vegetable oils, and this is reflected in high correlation coefficients (r = 0.72-0.82) among prices of groundnut, soybean, sunflower, and rapeseed meal during 1990-96 (Fig. 11).

Domestic Pricing and Marketing Policies

A common feature in all major groundnut-producing countries is government intervention through price and marketing policies that directly influence prices, costs, and/or producer income. However, the patterns of intervention are sharply different in developing and developed countries. In general, government price and marketing policies in developing countries discriminated against the groundnut sector by directly suppressing producer prices. In developed countries government policies protected the sector through various price support policies and quantitative restrictions on imports (e.g., quotas) that protect domestic production.

In many African and Asian countries, groundnut pricing and marketing policies were implemented by marketing boards established during the colonial period. In Africa, marketing boards with monopoly powers over procurement, price fixing, and disposal were a ubiquitous feature until the late 1980s and early 1990s, when many governments began liberalizing

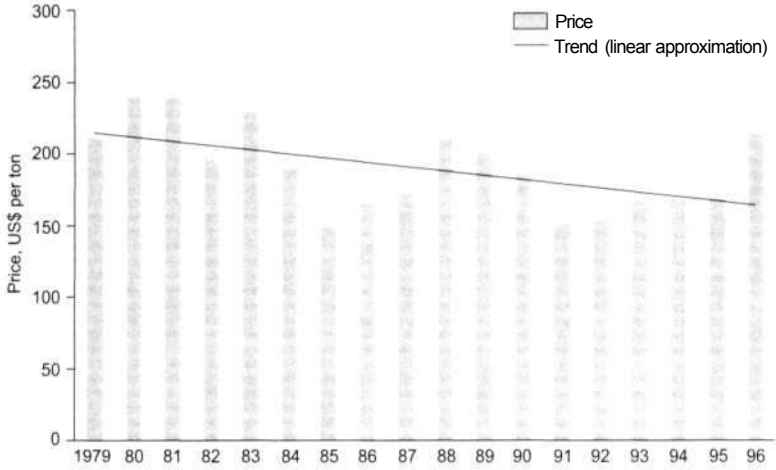

Figure 10. International prices of groundnut meal, 1979 to 1996.

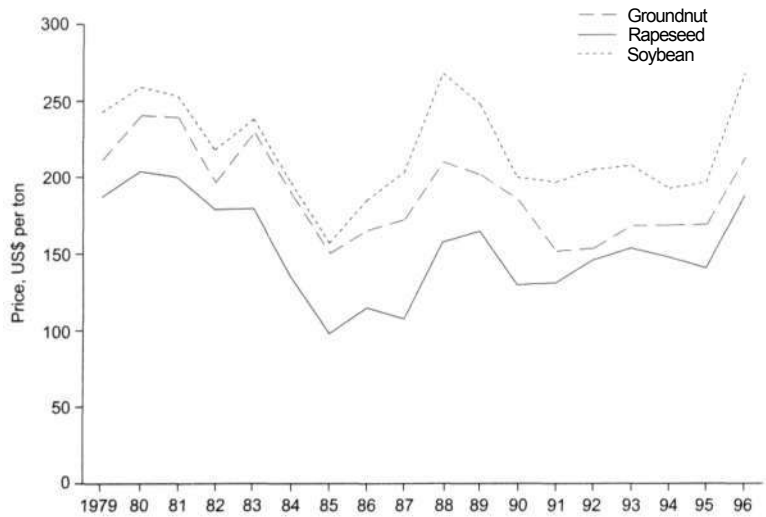

Figure 11. International prices of selected oil meals, 1979 to 1996.

grain policies. Liberalization of groundnut marketing was expected to increase private sector participation, marketing efficiency, and production through increased competition and higher incentives for producers. Despite the entry of the private sector in some countries, state parastatals continued to operate alongside the private sector. In many cases they still dominate groundnut trade through their established marketing network and infrastructure, and because licensing requirements still exist. In Senegal the government parastatal SONACOS, which is responsible for crushing and marketing refined groundnut oil, still operates a form of price fixing through arrangements with licensed private traders who supply it with groundnut. Similarly the Gambian Cooperative Union, a government parastatal, continues to operate alongside an emerging private sector and dominates groundnut marketing.

In Zambia, the National Agricultural Marketing Board continues to enjoy a statutory monopoly, but in practice the bulk of groundnut trade is conducted by private traders in the informal sector. Consequently, market liberalization has had little effect on prices. In Malawi the government parastatal ADMARC exerted strong monopoly power during the 1980s through an extensive network of rural buying points at which producers were paid guaranteed prices. Liberalization has allowed private traders to operate alongside ADMARC, resulting in some competition and somewhat higher prices. However, private sector involvement is still limited, and ADMARC retains a dominant market position which it uses to influence producer prices.

The sluggish response of the private sector in groundnut marketing following liberalization in most African countries is due, in part, to high transaction costs. Transaction costs tend to be high for several reasons, including inadequate rural infrastructure, high marketing costs, lack of trading credit, and the costs of obtaining information on prices and other market conditions. In these situations government parastatals are able to use their established networks and marketing infrastructure to maintain dominant market power even in liberalized markets. In contrast, Sudan has implemented very different pricing and marketing policies. The private sector plays a dominant role in groundnut marketing through a system of rural and urban auction markets. Domestic price and marketing policies—producer price support, exchange rate subsidies, and preferential export taxes—have been used to maintain producer incentives, thus favoring groundnut producers.

In India the government has historically pursued a policy of self sufficiency in vegetable oils and related products by banning imports and imposing other quantitative restrictions on trade. These policies kept domestic groundnut prices higher than international prices and consequently depressed consumption. Starting in 1995 the Indian government began to liberalize imports of vegetable oils. The private sector is now permitted to import all vegetable oils and import duties (applicable to both private and government importers) were reduced from 30 percent to 20 percent in 1995. Trade liberalization led to substantial increases in imports of sunflower oil and palm olein, but groundnut oil imports remain virtually zero. The government provides support prices for many oilseeds, including groundnut, but these have normally been below market prices and have, therefore, not been effective in procuring supplies. Imports of oilmeals are still restricted to the State Trading Corporations, Hindustan Vegetable Oil Company, and a few other government firms. However, duties on oilmeal imports were reduced from 50 percent to 40 percent in 1997 as part of a general reduction in import duties.

In China, participation in imports is highly regulated and currently only six corporations are permitted to import vegetable oil. However, the government is gradually liberalizing international trade in groundnut as part of the policy to promote the livestock sector. Import duties depend on whether the tariff is a Most Favored Nation tariff, an in-quota tariff, an over-quota tariff, or a value added tax. Quotas are also imposed on specific oils at different times during the year. In Argentina various policy incentives are used to encourage domestic groundnut processing. Exports of raw groundnut are taxed at 3.5 percent, while oil exports are not taxed and in addition enjoy a rebate of 1.35 percent on unrefined oil (the main export) and 3.15 percent on refined oil.

In the USA, domestic policies, first initiated in the early 1930s and periodically amended, have been a major factor in influencing production and price trends. The objective of these policies is to restrict or control production and thus support and stabilize farm prices and producers' incomes, and adjust production to match market demand. Until 1978 the policy sought to restrict production, and maintain high producer prices, by restricting acreage. Subsequently the policy changed to one of supply management. Limits were imposed on production rather than area. Farmers were offered a guaranteed price for quantities up to the specified limit.

In 1996, a new farm bill covering the period 1996-2002 further modified the supply management program. Price support and marketing quotas remained, but the quota loan rate for groundnut sold for domestic confectionery use was reduced from $678 to $610 per ton. The loan rate for additional or non-quota groundnuts that are sold for export or crushed for oil and meal was set at a significantly lower level based on the oil market. In addition, the 1996 farm bill enabled wider trading of groundnut within each state, eliminated carryover of undermarketings, and allowed the most efficient production areas to benefit from their competitive advantage.

Technological Issues and Focus of Research

Groundnut research to date has generally been conducted by government or public institutions, apart from some private-sector efforts in the USA. Research priorities (e.g., oil vs confectionery types) vary by country; but in recent years the development of high-quality confectionery varieties for export has become increasingly important in several Asian countries.

The overall trends in global groundnut production over the past two decades can be summarized as follows. Growth in yield has been variable, particularly in developing countries, with widespread technology adoption in some countries (notably Argentina, Brazil, and China) and little or no adoption in others (much of sub-Saharan Africa). Latin America and China have had remarkable success in promoting improved technology—improved varieties, fertilizer, crop rotation, and chemical control of weeds, pests, and diseases. Almost the entire groundnut area in Argentina and Brazil is sown to improved varieties; productivity and crop quality have increased, facilitating increased use of modern inputs and mechanized harvesting. In China, improved varieties cover over 90 percent of the groundnut area and average yields have increased by 80 percent since 1980, when groundnut production began to develop rapidly. But notwithstanding these few successes, on aggregate/groundnut productivity has been stagnant in much of the developing world.

Several factors are involved in the process of technology development, dissemination, and adoption:

- Development of high-yielding varieties with early maturity, resistance or tolerance to pests, diseases, and drought, and adaptation to specific agroecological systems
- Dissemination of improved technologies to farmers through demonstrations and other means; dissemination of methods to maximize yields from new varieties by using improved crop and resource management technologies
- Effective systems for seed multiplication and distribution.

Because adoption of improved varieties remains poor in many developing countries, yields have stagnated and planted area remains highly variable. Poor adoption is due to multiple factors, but one crucial factor is non-availability of seed of these varieties. Significant improvements in seed systems are needed, particularly in Africa, to ensure the diffusion of improved varieties among smallholder farmers. For example, a number of varieties with resistance to rust, late leaf spot, and rosette have been developed, but dissemination has been limited because of inadequate seed multiplication and distribution systems.

Increasing productivity is a key issue in both semi-subsistence and high-input systems. However, in order to reach this objective, research priorities will be different in the two systems. In high-input systems, yields are generally high due to widespread use of fertilizer, micro-nutrients, irrigation, and chemical control of weeds, diseases, and insect pests. Breeders will therefore likely focus on improving yield potentials (as opposed to yield stability) and crop quality, particularly in view of the growing importance of confectionery groundnut. Productivity maintenance research will also be critical in order to avoid yield erosion caused by evolving pest and disease biotypes.

In the semi-subsistence systems found in large parts of the developing world, yields are low and unstable as a result of several factors—drought or erratic rainfall, low soil fertility, and low use of modern inputs. It is increasingly difficult to achieve productivity gains in these environments because of the difficulty of combining drought resistance with high yield potential. The yield advantage of improved varieties in rainfed semi-arid areas is therefore relatively low; other characteristics such as drought tolerance, early maturity, and pest and disease resistance can be more important than genetic yield potential. Breeding strategies must therefore continue to focus on stability of production with a view to increasing the realizable yield under farm conditions rather than maximizing potential yield. Good progress has been made in identifying superior genotypes that perform well under drought conditions,

and can improve food security in drought-prone areas. Breeding programs have focused on early maturity as a means to escape end-of-season drought, which is common in such areas. Early-maturing varieties also provide early supplies of food and cash (during the "hunger period" before the normal harvest, when food and cash shortages are most acute), and allow farmers to efficiently allocate limited labor and draft power resources over the cropping season.

Groundnut pests and diseases cause considerable yield loss on smallholder farms. Chemicals can provide effective protection, but are generally too expensive for smallholders, difficult to manage, and can have negative effects on the environment and human health. Efforts to breed varieties with multiple resistance or tolerance to pests and diseases is an important research focus; such varieties could greatly increase yield stability and contribute to the sustainability of cropping systems through reduced use of pesticides.

Integrated pest management (IPM) is a particularly effective approach to pest control. A combination of genetic resistance, cultural practices such as rotation and crop residue management, biological control methods, and judicious use of insecticides can help ensure that pest populations do not cross economic threshold levels. Effective but labor-intensive measures such as scouting and destruction of insect egg masses are being introduced in parts of Asia. Studies in various countries have shown that farmers can reduce the number of insecticide sprays by up to two-thirds with no loss of effectiveness, provided the sprays are timed to coincide with specific stages of plant growth and the insect's life cycle. This integrated approach can reduce pesticide costs and improve profitability, encourage intensification of groundnut farming without loss of sustainability, and simultaneously reduce environmental damage caused by accumulation of pesticide residues. IPM principles are also being applied to disease management. For example, under experimental conditions, incidence of early leaf spot—the most serious groundnut disease in Eastern and Southern Africa—has been reduced by nearly 50 percent using a combination of early sowing, rotation with non-susceptible crops, and limited but correctly timed spraying.

However, adoption of integrated pest and disease management will depend on several key factors. Researchers need location-specific information on pests, diseases, and damage levels in order to tailor IPM packages to local conditions; and farmers need training on management components of the package. IPM must be a community effort; efforts by a few individual farmers are unlikely to impact significantly on overall insect populations. Most important, governments will need to commit substantial funds and staff resources for training and promotional efforts.

Aflatoxin contamination of groundnut remains an important health risk to both humans and livestock. Importing countries place strict limits on permissible aflatoxin levels, reducing the marketability of export groundnut and lowering foreign exchange earnings by exporting countries. Current control measures for aflatoxin emphasize improved management practices at every stage from sowing and harvesting to processing and storage, but this is difficult to ensure. Genetic resistance or tolerance is available in some genotypes but needs to be complemented with good management. Controlling aflatoxin under smallholder conditions is even more difficult. Several management recommendations have been developed but have not been adopted by farmers due to the high opportunity cost of labor and lack of familiarity with the new technology. However, advances in biotechnology provide some hope for elimination of the aflatoxin problem. Good progress is being made in this area in the USA, but the results from this research are not yet available for practical application in developing countries.

In semi-arid areas in developing countries, improved varieties alone offer only limited productivity gains. However, there are considerable prospects for increasing groundnut productivity through complementary changes in crop management and the management of soil and water resources. Application of organic manure and chemical fertilizer was an important factor in improving groundnut yields in China. In Africa, depletion of soil fertility is a primary cause for the decline of productivity in smallholder cropping systems. Animal manure is widely used, but its contribution to soil fertility is limited by inadequate supply, low quality, and competition among various crops. African smallholders rarely use chemical fertilizer on groundnut because alternative cash crops (coffee, cotton) or cereals (hybrid maize) can offer higher returns to fertilizer investments.

There is abundant evidence that substantial productivity gains can be achieved especially in drier areas through the adoption of improved crop management technologies. For example, crop rotation, sowing at optimum plant populations, and weed management contributed largely to productivity gains in Latin America and China. Considerable research

effort has gone into developing such technologies in Africa but research findings have not had significant impact on farmers' fields. Farmers consistently ignore management recommendations because they are either too costly in terms of investment and knowledge or have high labor requirements. In addition, much of the research on crop management has been conducted on experimental stations on relatively fertile soils and under good management. Greater effort is needed to transfer results from experiment stations to farmers' fields. Researchers need to work together with farmers to identify, from the wide range of available management options, those that are practical, easily implemented, and consistent with farmers' resource constraints, risk perceptions, and cropping priorities.

Groundnut can contribute to the replenishment of soil fertility through biological nitrogen fixation. When management conditions are favorable the crop can meet not only its own nitrogen requirement but also improve nitrogen balance in the entire cropping system. Groundnut residues contain high levels of nitrogen, and if incorporated in the soil, can increase both productivity and sustainabiiity. Yet, there is little or no net contribution from nitrogen fixation by groundnut, for several reasons. One key factor, particularly in large parts of Asia, is that groundnut residues are removed from the field and used as fodder. Correspondingly, research needs to examine in more detail the economics of plant residue incorporation in soils.

Consumption of confectionery groundnut is growing, and demographic and income growth prospects suggest that the fastest growth in consumption will come from confectionery and related products. There are therefore substantial payoffs to research efforts in developing high quality confectionery varieties. Efforts to control aflatoxin need to be intensified in view of the growing importance of confectionery groundnut. Genetic engineering and biotechnology are helping to improve crop quality in some developed countries. Greater efforts are needed to transfer these results to, and encourage similar research in, developing countries despite the large financial and human resources required.

International research programs have helped play a major role in groundnut research in several ways; widening the genetic base available to national research programs, supply of improved breeding lines and other materials, development of improved crop and resource management methods, training courses and sponsorships for graduate or post-graduate education, and support for workshops and other forms of information exchange. Collaborative research by ICRISAT and national research programs has resulted in the release of over 60 improved groundnut varieties worldwide. Varieties resistant to peanut bud necrosis virus are finding their way to farmers' fields in India, and a large impact is expected in India and elsewhere in Asia from new confectionery varieties and cultivars with foliar disease resistance. Similarly, substantial farm-level impact is expected in Africa, where improved short-duration cultivars with resistance to the rosette virus are in the advanced stages of testing. Varieties resistant to rust and late leaf spot have been released in several countries in Asia and Africa. Breeding lines with multiple resistance or tolerance to major diseases have been developed, and are being used by national programs, with considerable impact expected in the future.

Similarly, new crop and resource management technologies are allowing farmers to substantially improve productivity, especially when these technologies are used in combination, as components of a production "package". For example, farmers in parts of China, and in some areas in India, obtain yields of 8-9 t ha^{-1} by using combination of improved varieties, irrigation, plastic mulch, organic and inorganic fertilizer, the broadbed-and-furrow method of cultivation, and other recommended agronomic practices. Multilocational trials in India during 1987-90 demonstrated a 32 percent yield increase from variety adoption alone, and a further 25 percent increase with the use of improved management methods. Integrated pest and disease management technologies are helping to reduce the costs of chemical control. For example, studies have shown that by timing spray applications more effectively, early leaf spot disease in Eastern and Southern Africa can be controlled with 2-3 sprays rather than the 6 or more sprays currently used.

Technologies are available, or likely to become available, to resolve many farm level production constraints in developing countries. But past experience shows that adoption lags are considerable, particularly in smallholder systems in semi-arid areas. It is therefore important to focus on the socioeconomic and policy factors that limit adoption of improved technologies. Farmers need input and marketing support as well as policy incentives to adopt new technologies. In many cases interventions that stabilize prices, particularly during the period following harvest, are also necessary to maintain farmer incentives. Development of efficient seed production and

distribution systems is critical if farmers are to get consistent access at affordable prices to a range of improved varieties, allowing them to choose specific varieties that suit local conditions and priorities. It is important to strengthen markets for other inputs, such as fertilizer and pesticides, so that inputs can be delivered to farmers at the right time, in appropriate packages, and at affordable prices.

Medium-Term Outlook[1]

Production and utilization

This section focuses on factors that are likely to influence developments in the global and regional groundnut economy over the period 1990 to 2010. Trend analysis and assessment of future projections for groundnut (and oilseeds in general) are complicated by a number of production and demand characteristics. One important factor is substitutability between groundnut and other oilseeds. Vegetable oil for cooking oil and protein meal for livestock feed can be obtained from any one of several oilseed crops. In addition, groundnut meal competes with other protein sources such as fishmeal and cereal-based products for use in livestock feed. This high degree of substitutability complicates both supply and demand factors. On the supply side, for example, the area sown to groundnut responds strongly to relative prices for other annual oilseed crops; it may also be affected by the price of maize and other cereals. On the demand side, consumption can switch between different vegetable oils and meals depending on price and availability.

Notwithstanding these complexities, there is evidence that groundnut production is likely to shift increasingly to developing countries in the medium term. Production in developing countries[2] is projected to grow by 3 percent per annum from 16 million tons in 1990 to 30 million tons by 2010. This rapid growth—faster than population growth—will lead to higher per caput consumption in developing countries. However, the projected growth in per caput consumption will differ between countries and particularly between regions (Asia and sub-Saharan Africa) because of differences in the growth of production, population, and incomes.

Population growth, urbanization, and income growth will continue to have profound influences on groundnut supply and demand. World population is expected to increase from 5.3 billion in 1990 to 7.2 billion by 2010. Population is projected to grow at 2 percent per annum in developing countries as a whole, but 2.9 percent in sub-Saharan Africa.

Historically, growth in agricultural import demand has been strongest in the rapidly growing economies of East and Southeast Asia. This suggests that it is per caput income growth, not population growth, that accounts for most of the increase in demand for food, livestock feed, and meat. Demand for groundnut products is influenced by a variety of factors such as relative prices, trade and price policies, consumer preferences, cultural biases, and comparative advantage in production. However, there is often a pattern of demand related to growth in per caput income that transcends national boundaries. In low-income countries with national per caput income less than $500 per year and per caput calorie intake less than 2000 calories per day, food staples typically account for a relatively large share of household expenditure. Vegetable oil, processed groundnut products, and livestock products are considered luxuries, and effective demand is limited. However, as per caput income and urbanization increase consumers seek to add variety to their diet, and preferences shift toward these higher-value commodities. As per caput income rises to levels found in high-income countries, consumption of food staples normally falls, while demand for higher-value foods and livestock products continues to grow at moderate but steady rates. At this stage consumers become satiated with basic food products, and health considerations (e.g., fat and protein content) and food quality influence food preferences and derived demand for inputs such as livestock feed. This stage of demand characterizes all the major developed countries.

Thus groundnut products, as with most oilseeds, have a high income elasticity of demand, particularly in developing countries. In the medium term, therefore, there is considerable scope for growth in consumption in developing countries where economic growth is expected to be faster than during the 1980s. Despite strong economic growth in developing countries in the early and mid 1990s the short-term projection indicates slower growth in East and

1 This section draws heavily from the FAO publication World Agriculture: Towards 2010. Medium term projections cover the period 1988-90 to 2010. Demand projections are based on Engel demand functions and exogenous assumptions of population and GDP growth. Production projections are based on a combination of the FAO World Food Model, provisional production targets, simple rules about self sufficiency and trade levels, and expert judgements.

2 This excludes China, for which no data were available.

Southeast Asia, where the economic crisis of the mid 1990s is causing sharp contractions in domestic demand and agricultural imports. These economies accounted for most of the increase in imports of groundnut oil, meal, and confectionery products over the past 20 years, and therefore the anticipated slowdown in agricultural imports will affect export earnings of many countries, particularly in Africa. However, it is projected that domestic stabilization and policy reform, combined with their strong underlying growth potential, will help these countries recover their earlier rates of economic growth in the. medium term. In sub-Saharan Africa, per caput income gains will be close to zero despite the projected improved economic prospects, because of rapid population growth.

World demand for groundnut (and other oilseeds) oil and meal will continue to grow in the medium term, although at rates lower than those of the 1970s and 1980s. Global utilization patterns will continue to shift away from groundnut oil toward groundnut meal. Consequently, demand for meal will grow faster than for oil. Projected demographic and income growth patterns imply that groundnut oil and meal consumption will continue to shift to developing countries, where most consumers are far from satiation. But there will be important differences between countries in oil and meal utilization patterns.

Reform of vegetable oil import regulations in China and India, the two largest consumers of groundnut oil, is expected to reduce domestic prices and encourage consumption. Projected population and per caput income growth in China will also lead to rapid growth in consumption of groundnut oil. In other developing Asian countries population growth and the expected recovery from the recent economic crisis will lead to strong growth in per caput income, boosting demand for groundnut oil. In Latin America consumption of groundnut oil will continue to fall in Argentina and Brazil (the main producers), as consumers shift to cheaper substitutes such as soybean and sunflower oil. There will be only slow growth in oil consumption in sub-Saharan Africa because the high population growth rate will result in sluggish growth or stagnation in per caput incomes.

In the developed countries, consumer satiation will translate into limited growth in per caput consumption of basic foodstuffs. This will result in lower growth rates in demand for groundnut oil and other basic foodstuffs in the medium term. In addition, changes in relative prices will favor cheaper vegetable oils such as soybean and sunflower, while dietary considerations and health concerns will induce shifts in consumer preference away from groundnut oil towards other vegetable oils, such as sunflower and rapeseed oil, that are perceived to be more healthy. Thus, in the medium term in developed countries, groundnut is expected to lose competitiveness relative to other vegetable oils.

Structural changes in food consumption patterns toward increased consumption of livestock and livestock products in developing countries will increase the demand for groundnut meal. It is projected that about 90 percent of the increase in global demand for meat in the medium term will come from developing countries, two-thirds of this increase from Asia. Correspondingly, growth in demand for livestock products and thus for groundnut meal as livestock feed, will be concentrated in the developing countries of Asia. The Asian economic crisis is expected to dampen livestock consumption and demand for groundnut meal in the short term. However, economic growth rates will recover in the medium term, and in combination with population growth, will lead to a resurgence of growth of the livestock sector, and therefore strong growth in demand for groundnut meal. Consumption of groundnut meal is projected to continue falling in Argentina and Brazil, where good quality pastures are available and relative input prices will continue to favor extensive pasture feeding rather than intensive feeding systems based on protein meal supplements. Similarly in Africa, the predominance of range feeding will be reflected in weak demand for groundnut meal in the medium term.

Among the developed countries, demand for groundnut meal is projected to decline in Western Europe due to sluggish growth of the livestock sector. This trend will be accentuated by ongoing policy reforms that have reduced meal consumption in two ways—use of protein supplements in general is declining, and feed manufacturers are reducing the proportion of oilseed meal in livestock feed. In addition, policy reforms in the cereals sector are expected to increase the competitiveness of cereals as livestock feed compared to oilseeds. Thus, in the medium term demand will shift from oil meals to cheaper cereal-based substitutes such as maize gluten feed. Demand for groundnut meal in the CIS of Eastern Europe is expected to stagnate in the medium term because of slow recovery in per caput consumption after the economic decline of the 1990s.

Income growth and rapid urbanization are expected to increase the demand for confectionery and

other processed groundnut products, particularly in the fast-growing Asian economies, and in middle-income countries in Latin America (Argentina, Brazil), North Africa (Egypt), and the Middle East.

Groundnut production is projected to grow at 3 percent per annum in developing countries excluding China (Table 10). This growth rate reflects both area expansion and yield growth. Groundnut area is expected to recover from its decline in the 1970s and 1980s and grow by 1.2 percent per annum from 17 million ha in the late 1980s to 21 million ha by 2010. Yield is expected to grow by 1.7 percent per annum—almost double the rates of the 1970s and 1980s. Groundnut share in global oilseeds production fell from 27 percent in 1970 to 13 percent in 1990, the lost share being captured by soybean and palm oil. However, this reduced share has remained relatively unchanged in recent years, and groundnut is expected to maintain its current 13 percent share in the medium term. Developing countries as a group will slightly increase their share of world production, but with large differences between regions. Ongoing policy reforms will improve incentives for groundnut production in sub-Saharan Africa, but the region will continue to lose production share to Asia. The share of sub-Saharan Africa in developing-country production will fall from 20 percent in the early 1990s to about 14 percent by 2010, while Asia's share will rise from 77 to 84 percent. Much of the increase in Asian production will come from India, driven by improved seed availability and policy reforms that enhance producer incentives and the competitiveness of groundnut compared to other competing oilseed crops and cereals.

The potential for sustained production growth will depend on the effectiveness of research efforts to develop and disseminate improved varieties that will raise groundnut productivity. In the medium term, production growth will come from productivity improvements arising from technology adoption rather than area expansion. Productivity improvements will in turn depend on the adoption of improved varieties. However, in contrast to Asia's Green Revolution of the 1960s and 1970s, production is likely to grow in small incremental stages as a result of wider adoption, rather than in quantum jumps as a result of breakthroughs in improving yield potentials.

Trade

Global trade in groundnut is projected to slow down from the sharp expansion of the 1980s, due to a fall in demand from traditional importers of groundnut oil and meal in the developed countries. A substantial shift is expected in the medium term, with the bulk of exports and imports shifting to developing countries. Export growth by developing countries will be concentrated in Asia and Latin America; growth in Africa will be small but positive. The USA is currently a major exporter, but this may change depending on changes in American farm policy. The current Asian economic crisis will dampen import demand for groundnut oil and meal severely in the short term and to some extent (despite the expected economic recovery) in the medium term. In India and China, policy reform in vegetable oil imports will contribute to a modest increase in groundnut oil imports. Oil imports in Africa will increase slightly as production fails to keep up with population growth. However, as in the past, groundnut oil will continue to be thinly traded in international markets because the major consumers will rely on domestic production for their requirements.

A number of recent policy changes at international, regional, and national levels are expected to have important implications for groundnut trade. In the European Community, these changes are expected to lower the competitiveness of groundnut meal compared to cereal-based supplements for livestock feed. In developing countries, particularly in Africa, policy reforms will have a positive effect. For example, there is a gradual move away from monopoly marketing parastatals and policies that

Table 10. Groundnut area, production, and yield in developing countries, excluding China.

	Area (million ha)	Production (million t)	Yield (t ha^{-1})
1988-90	17	16	1.0
2010 (projected)	21	30	1.4
Growth rate, 1970-90 (% per year)	-0.4	+0.4	+0.9
Growth rate, 1988-90 to 2010 (% per year)	+ 1.2	+3.0	+ 1.7

directly and indirectly taxed tradable commodities such as groundnut. Liberalization is expected to continue, leading to a more favorable environment for trade and an expanded role for the private sector. This in turn is expected to improve producer incentives, increase the resources allocated to groundnut production, and boost groundnut exports. The recent Agreement on Agriculture under the Uruguay Round of GATT has opened the US market to imported groundnut by reducing import restrictions. In response, Argentine producers have expanded groundnut area in recent years, and are likely to continue expanding in order to service this newly accessible market. However, besides this, the Uruguay Round is not likely to have a major impact on global groundnut trade, although other crops and horticultural products will benefit. To a large extent, future trade patterns will be determined by phytosanitary rules and health regulations on aflatoxin imposed by importing countries.

Outstanding Issues

The trends in groundnut production, utilization, and trade suggest that a number of issues have important implications for the future of the world groundnut economy. In general, improved groundnut technologies have had significant impact in some developing countries but almost no impact in large parts of Asia and Africa. The key issue therefore is how to improve productivity in these areas, most of which lie in the semi-arid tropics, characterized by erratic rainfall, poor soils, and widespread food insecurity. Because of the wide diversity in agroclimatic, socioeconomic, and institutional conditions in these areas, there are likely to be high payoffs to strategies that seek to develop improved varieties in closer collaboration with farmers. Farmer participation in technology development ensures that the end product is relevant, helps set priorities in breeding programs, and is cost-effective because it can speed up testing and adoption of new technologies.

An important issue for breeding strategies for semi-arid cropping systems is the relative emphasis placed on two important but often conflicting objectives—improving yield stability versus maximizing potential yield. It is still not clear whether yield stability alone will lead to significant adoption, but in areas where most households are food-insecure there is good justification for giving priority to improving yield stability and thus ensuring at least moderate yields in most years, rather than breeding for high yield potential.

A closely related issue is the relative emphasis on yield versus other traits. Farmers in semi-arid areas have shown a proclivity to trade yield gains for other traits such as earlier maturity. Thus, it would appear that rather than focusing narrowly on yield, research programs would obtain better results by considering a wide range of seed and plant traits, including disease and pest resistance, to develop varieties suited to different ecological and socioeconomic niches. Yet, most of the improved groundnut varieties released in Africa were selected and developed using narrow, yield-based criteria.

Crop improvement is likely to benefit considerably from advances in biotechnology. The science continues to advance rapidly, providing new opportunities to increase yield and pest/disease resistance, improve specific traits such as seed size or oil composition, characterize viral and other pathogens, and develop transgenic crops. However, biotechnology research has so far been restricted mainly to temperate cash crops. Crops such as groundnut, which are grown in smallholder systems in developing countries, have not benefited greatly. Biotechnology research involves substantial costs for equipment and other facilities, and programs in most developing countries are hampered by lack of facilities and trained staff. Greater efforts and closer cooperation are needed to improve the access of developing countries to advanced technology. The options could include:

- Incentives for private-sector investment in biotechnology research
- Establishment of regional facilities, with costs shared among various governments
- Using international agricultural research institutes to bridge the gap between developing- and developed-country research. International institutes could work with institutes in developed countries and bring in research results, which could then be further tested, adapted, and applied by national programs
- Partnerships or other collaborative arrangements between developing-country national programs and private or public sector research institutes in developed countries.

In addition to developing improved technologies, it is important to ensure that these technologies are targeted more accurately at specific production systems. This targeting could be improved through the use of integrated biophysical and socioeconomic data sets. Geographic Information Systems, GIS,

can provide spatially referenced biophysical information which, together with farm surveys, can be used to characterize production systems. Such interventions can assist in the development of technologies that are better targeted, address farmers' needs more directly, and are therefore more likely to be adopted.

These strategies require a clearer understanding of the dynamics of product markets in domestic, regional, and international economies. They must also be based on a better understanding of farmers' socioeconomic circumstances, their rationale for using (or not using) certain practices, and their resource allocation decisions in risky environments. Improved technologies need to be tested—jointly by researchers and farmers—under the same conditions in which farmers make adoption decisions. This will enable researchers to take account of a range of factors that influence adoption; for example, farmers are more inclined to adopt new technologies in a stepwise manner rather than in complete packages.

Delays between variety release, seed multiplication, and seed marketing and distribution impede adoption and reduce the returns to investments in plant breeding research. Farm-saved seed is the dominant form of seed supply in most developing countries. While farm-saved seed often has acceptable germination rates, progressive loss of seed quality results in poor performance when seed is recycled for several seasons. Private seed companies do not have sufficient incentives to expand operations significantly, and are unlikely, under the present circumstances, to play a major role in improving seed availability. There is a certainly a role for the public sector but this needs to be clearly defined within the context of liberalized markets. The involvement of NGOs in the seed sector has increased considerably in recent years, with mixed results. Some NGO initiatives have been successful, while others have suffered from technical deficiencies and lack of sustainability of seed projects once donor funding ceases. NGOs can play a key role in improving seed systems, particularly through community-level projects, but it is essential that these concerns be addressed at the planning stage of a project.

The inadequacies of the seed industry in Africa pose a major challenge to agricultural development. There are no clear answers to the question of how precisely to resolve seed supply constraints, but efforts will need to exploit the complementary strengths of the public sector, private seed firms, NGOs, community-based organizations, and farmers. The public sector and NGOs, for example, could provide guarantees to private seed companies to purchase excess stocks if the market is saturated after an initial period of seed distribution. Research institutes and development organizations could collaborate to provide technical assistance for local seed entrepreneurs, NGOs, and community-based seed multiplication and distribution projects. Farmers could also benefit from technical assistance on seed selection, treatment, and storage. In the long run the development of a sustainable groundnut seed industry will depend not only on farm-level productivity issues but also on product market incentives for growers. As the demand for groundnut increases and farmers are rewarded for high-quality produce, the derived demand for good quality groundnut seed is likely to increase.

Improved crop management practices offer the best prospects for improving productivity, particularly in semi-arid cropping systems, but adoption of management technologies has been poor. A key objective therefore is to improve adoption of these technologies. This will require researchers, extension staff, and farmers to work together to develop a wide range of practical crop management options for smallholder farmers that are not only profitable but also acceptable, given their resource constraints and investment priorities. Crop simulation models are useful tools in developing such management options. They help speed up experimentation by allowing researchers to test a large number of options across many seasons and soil types, and thus identify a smaller set of best-bet options for participatory testing with farmers. In addition, simulation models enable researchers, using long-term climate data, to understand the effects of climatic conditions and other complex biological processes on crop growth and development. This understanding is particularly important in semi-arid areas characterized by high rainfall variability. On-farm trials are an essential part of technology development, but can be expensive or otherwise difficult to implement. Simulation models can reduce the number and cost of on-farm trials, and when used in conjunction with trials, can help develop, test, and promote adoption of improved crop management practices.

Many countries are liberalizing groundnut marketing and implementing exchange rate reforms, but the pace and impact of reform varies from country to country. In some countries market reforms are still incomplete, and the government

continues to compete with an emerging private sector. In other cases the private sector has taken over most of the functions earlier performed by parastatals. It is difficult to make unambiguous assertions about the impact of grain market reforms on groundnut production and trade. In a few cases the reforms improved producer incentives and encouraged investment in groundnut production; in other cases the withdrawal of state marketing agencies resulted in even lower and more variable prices, leaving producers and consumers worse off after liberalization. Even where reforms have encouraged the private sector, traders are hampered by unavailability of trading credit, storage facilities, and transportation. At the macro level, the transition to a competitive private market has been slowed down by poor infrastructure and communication systems that limit long-distance trading and the flow of price and market information, and reduce overall marketing efficiency.

Lessons can be learnt from cases where reforms have been successful. For market reforms to work, they must be accompanied by sustained and coherent efforts to improve markets, and thus encourage private sector investment in agricultural trade. Particularly in developing countries, governments must continue to invest in physical infrastructure such as access roads (from farm to market) in rural areas, and in price and market information systems. Government interventions can also reduce transaction costs and foster competition by reducing barriers to entry into markets. Essentially, governments must focus on improving the policy environment, with a view to reducing the risks involved in agricultural trade, and providing greater incentives to encourage private sector participation in trade and marketing. This would involve, among other steps, a more effective credit system and better enforcement of contracts. Such an approach will expand and stabilize grain and input markets, while increasing the efficiency of agricultural trade.

Groundnut oil will continue to be thinly traded at the global level, but there will be substantial opportunities for regional trade in Africa, as population growth will increase import demand for vegetable oil. While there is potential for increasing utilization of groundnut meal, especially in Asia, the key factor that will determine utilization of meal is competitiveness in relation to other substitutes. The key to reducing unit production cost and improving the competitiveness of groundnut meal is higher productivity of the primary product, groundnut. Utilization will grow fastest in the confectionery sector. Therefore, development of suitable high-quality varieties that can fetch premium prices should be a priority. Groundnut exports contribute significant revenues to many developing countries, particularly in Africa. Phytosanitary measures and aflatoxin regulations are therefore expected to become even more important as the Agreement on Agriculture in the Uruguay Round of GATT is implemented. The exporting countries most affected generally lack the capacity to deal with these issues, and will need continued assistance on how best to address the health and safety concerns of importing countries while increasing market opportunities and incomes for their own producers.

Appendix: Groundnut Statistics

Eastern and Southern Africa

	Angola	Burundi	Ethiopia	Kenya	Madagascar
General information					
1. Estimated population, 1996 (millions)	11	6	58	27	14
2. Estimated population growth rate, 1994-2010 (% per year)	2.4	na	2.2	3.6	na
3. Per caput GNP (US$), 1996	270	170	100	320	250
4. Per caput oilseed production, 1994-96 (kg)	4.6	2.6	4.7	3.7	9.5
5. Per caput groundnut production, 1994-96 (kg)	2.0	1.8	1.0	0.5	2.1
Groundnut statistics					
6. Groundnut area harvested, 1994-96 average ('000 ha)	34	13	43	23	47
7. Groundnut production, 1994-96 average ('000 t)	22	11	55	14	31
8. Groundnut yield, 1994-96 average (t ha^{-1})	0.6	0.9	1.3	0.6	0.7
9. Groundnut share in total oilseed area, 1994-96 (%)	42.2	72.6	11.0	16.3	42.5
10. Groundnut share in total oilseed production, 1994-96 (%)	43.3	69.6	19.6	14.0	22.2
11. Growth rate of groundnut area, 1977-86 (% per year)	-0.6	4.7	1.3	-2.6	-3.8
12. Growth rate of groundnut area, 1987-96 (% per year)	2.2	-2.4	0.8	5.2	5.3
13. Growth rate of groundnut production, 1977-86 (% per year)	-0.6	6.6	11.0	-1.9	-3.4
14. Growth rate of groundnut production, 1987-96 (% per year)	5.3	-3.5	1.2	5.8	0.1
15. Growth rate of groundnut yield, 1977-86 (% per year)	0.0	1.9	9.7	0.8	0.4
16. Growth rate of groundnut yield, 1987-96 (% per year)	3.1	-1.1	0.3	0.6	-5.2

	Malawi	Mozam-bique	South Africa	Sudan
General information				
1.Estimated population, 1996 (millions)	10	18	38	27
2. Estimated population growth rate, 1994-2010 (% per year)	na	2.2	na	2.8
3. Per caput GNP (US$), 1996	180	80	3520	na
4. Per caput oilseed production, 1994-96 (kg)	11	34.9	21.2	51.5
5. Per caput groundnut production, 1994-96 (kg)	3.5	5.7	3.8	28.3
Groundnut statistics				
6. Groundnut area harvested, 1994-96 average ('000 ha)	65	256	11.8	972
7. Groundnut production, 1994-96 average ('000 t)	34	98	158	756
8. Groundnut yield, 1994-96 average (t ha^{-1})	0.5	0.4	1.3	0.8
9. Groundnut share in total oilseed area, 1994-96 (%)	42.6	54.6	14.6	34.3
10. Groundnut share in total oilseed production, 1994-96 (%)	32.0	16.3	18.0	54.9
11. Growth rate of groundnut area, 1977-86 (% per year)	-7.1	-1.2	1.4	-9.0
12. Growth rate of groundnut area, 1987-96 (% per year)	-12.3	-4.2	-3.6	8.0
13. Growth rate of groundnut production, 1977-86 (% per year)	-4.3	-3.5	-12.1	-13.8
14. Growth rate of groundnut production, 1987-96 (% per year)	-15.8	-1.6	-0.5	10.7
15. Growth rate of groundnut yield, 1977-86 (% per year)	2.8	-2.4	-13.6	-4.8
16. Growth rate of groundnut yield, 1987-96 (% per year)	-3.5	2.5	3.2	2.7

Source: FAO

Eastern and Southern Africa (continued)

	Tanzania	Uganda	Zambia	Zimbabwe
General information				
1. Estimated population, 1996 (millions)	30	20	9	11
2. Estimated population growth rate, 1994-2010 (% per year)	3.1	3.3	3.3	3.2
3. Per caput GNP (US$), 1996	170	300	360	610
4. Per caput oilseed production, 1994-96 (kg)	22.8	16.9	15.0	33.7
5. Per caput groundnut production, 1994-96 (kg)	2.4	7.0	4.4	5.9
Groundnut statistics				
6. Groundnut area harvested, 1994-96 average (000 ha)	113	192	82	148
7. Groundnut production, 1994-96 average ('000 t)	72	137	35	66
8. Groundnut yield, 1994-96 average (t ha^{-1})	0.6	0.7	0.4	0.4
9. Groundnut share in total oilseed area, 1994-96 (%)	11.7	31.7	42.1	26.3
10. Groundnut share in total oilseed production, 1994-96 (%)	10.5	41.1	29.0	17.6
11. Growth rate of groundnut area, 1977-86 (% per year)	2.4	-2.7	-12.9	-2.6
12. Growth rate of groundnut area, 1987-96 (% per year)	1.3	1.8	-0.8	4.5
13. Growth rate of groundnut production, 1977-86 (%per year)	2.8	-4.3	-12.6	-12.7
14. Growth rate of groundnut production, 1987-96 (% per year)	3.3	0.3	-0.2	2.4
15. Growth rate of groundnut yield, 1977-86 (% per year)	0.4	-1.6	0.3	-10.1
16. Growth rate of groundnut yield, 1987-96 (% per year)	2.0	-1.5	0.6	-2.1

North Africa

	Egypt	Libya	Morocco
General information			
1. Estimated population, 1996 (millions)	59	5	27
2. Estimated population growth rate, 1994-2010 (% per year)	2.3	na	na
3. Per caput GNP (US$), 1996	1080	na	1290
4. Per caput oilseed production, 1994-96 (kg)	19.7	12.7	19.4
5. Per caput groundnut production, 1994-96 (kg)	2.0	2.4	0.8
Groundnut statistics			
6. Groundnut area harvested, 1994-96 average ('000 ha)	43	7	17
7. Groundnut production, 1994-96 average ('000 t)	124	13	21
8. Groundnut yield, 1994-96 average (t ha^{-1})	2.9	1.8	1.2
9. Groundnut share in total oilseed area, 1994-96 (%)	9.0	11.7	3.3
10. Groundnut share in total oilseed production, 1994-96 (%)	10.1	18.7	2.9
11. Growth rate of groundnut area, 1977-86 (% per year)	-4.7	0.1	-0.6
12. Growth rate of groundnut area, 1987-96 (% per year)	18.9	-0.5	-7.6
13. Growth rate of groundnut production, 1977-86 (% per year)	-4.3	0.7	7.1
14. Growth rate of groundnut production, 1987-96 (% per year)	22.1	-1.5	-7.7
15. Growth rate of groundnut yield, 1977-86 (% per year)	0.4	0.6	7.7
16. Growth rate of groundnut yield, 1987-96 (% per year)	3.2	-1.0	-0.1

Source: FAO

Western and Central Africa

	Benin	Burkina Faso	Cameroon	Central Afric. Rep.	Chad
General information					
1. Estimated population, 1996 (millions)	6	11	14	3	7
2. Estimated population growth rate, 1994-2010 (% per year)	2.6	2.4	2.7	na	2.1
3. Per caput GNP (US$), 1996	350	230	610	310	160
4. Per caput oilseed production, 1994-96 (kg)	88.0	39.0	25.0	45.4	65.7
5. Per caput groundnut production, 1994-96 (kg)	16.3	20.6	9.4	26.5	36.8
Groundnut statistics					
6. Groundnut area harvested, 1994-96 average ('000 ha)	111	261	363	91	305
7. Groundnut production, 1994-96 average ('000 t)	88	215	124	87	233
8. Groundnut yield, 1994-96 average (t ha^{-1})	0.8	0.8	0.3	1.0	0.8
9. Groundnut share in total oilseed area, 1994-96 (%)	27.2	53.7	65.5	51.2	51.9
10. Groundnut share in total oilseed production, 1994-96 (%)	18.6	52.7	37.5	58.4	56.1
11. Growth rate of groundnut area, 1977-86 (% per year)	-0.2	2.5	-1.7	-2.0	-3.6
12. Growth rate of groundnut area, 1987-96 (% per year)	2.6	2.7	1.9	0.1	11.5
13. Growth rate of groundnut production, 1977-86 (% per year)	-2.0	8.4	-7.6	-3.2	0.5
14. Growth rate of groundnut production, 1987-96 (% per year)	4.7	7.2	4.3	-1.1	10.3
15. Growth rate of groundnut yield, 1977-86 (% per year)	-1.7	5.9	-6.0	-1.2	4.1
16. Growth rate of groundnut yield, 1987-96 (% per year)	2.2	4.6	2.4	-1.0	-1.3

	Congo Dem. Rep.	Congo Rep.	Cote d'Ivoire	Gabon	Gambia
General information					
1. Estimated population, 1996 (millions)	45	3	14	1	1
2. Estimated population growth rate, 1994-2010 (% per year)	na	na	3.9	na	na
3. Per caput GNP (US$), 1996	130	670	660	3950	na
4. Per caput oilseed production, 1994-96 (kg)	14.0	11.0	43.4	15.9	66.2
5. Per caput groundnut production, 1994-96 (kg)	13.1	10.9	10.5	14.3	62.5
Groundnut statistics					
6. Groundnut area harvested, 1994-96 average ('000 ha)	739	23	140	16	73
7. Groundnut production, 1994-96 average ('000 t)	594	28	144	16	67
8. Groundnut yield, 1994-96 average (t ha^{-1})	0.8	1.2	1.2	1.0	0.9
9. Groundnut share in total oilseed area, 1994-96 (%)	86.9	97.5	34.5	90.2	94.3
10. Groundnut share in total oilseed production, 1994-96 (%)	93.3	99.0	24.3	89.6	95.4
11. Growth rate of groundnut area, 1977-86 (% per year)	2.4	-1.3	8.7	7.1	-2.2
12. Growth rate of groundnut area, 1987-96 (% per year)	4.2	-0.6	2.3	1.4	-4.1
13. Growth rate of groundnut production, 1977-86 (% per year)	3.0	5.3	9.9	4.9	0.9
14. Growth rate of groundnut production, 1987-96 (% per year)	4.0	2.0	2.7	2.4	-8.0
15. Growth rate of groundnut yield, 1977-86 (% per year)	0.6	6.6	1.2	-2.2	3.1
16. Growth rate of groundnut yield, 1987-96 (% per year)	-0.2	2.6	0.4	1.0	-3.9

Source: FAO

Western and Central Africa (continued)

	Ghana	Guinea	Guinea Bissau	Mali	Niger
General information					
1. Estimated population, 1996 (millions)	18	7	1	10	9
2. Estimated population growth rate, 1994-2010 (% per year)	2.7	2.5	na	na	3.1
3. Per caput GNP(US$), 1996	360	560	250	240	200
4. Per caput oilseed production, 1994-96 (kg)	28.1	22.2	42.6	48.4	10.5
5. Per caput groundnut production, 1994-96 (kg)	9.2	18.1	16.5	16.6	10.1
Groundnut statistics					
6. Groundnut area harvested, 1994-96 average ('000 ha)	177	145	16	204	230
7. Groundnut production, 1994-96 average ('000 t)	159	132	18	180	93
8. Groundnut yield, 1994-96 average (t ha^{-1})	0.9	0.9	1.1	0.9	0.4
9. Groundnut share in total oilseed area, 1994-96 (%)	62.0	87.8	68.0	39.9	95.0
10. Groundnut-share in total oilseed production, 1994-96 (%)	32.7	81.5	38.8	34.3	96.8
11. Growth rate of groundnut area, 1977-86 (% per year)	7.4	0.5	-4.6	-8.6	-5.0
12. Growth rate of groundnut area, 1987-96 (% per year)	2.5	6.3	-3.7	3.0	10.0
13. Growth rate of groundnut production, 1977-86 (%.per year)	7.3	-1.4	-2.1	-11.1	-8.5
14. Growth rate of groundnut production, 1987-96 (% per year)	-3.4	12.6	0.5	2.2	12.1
15. Growth rate of groundnut yield, 1977-86 (% per year)	-0.1	-1.8	2.5	-2.5	-3.5
16. Growth rate of groundnut yield, 1987-96 (% per year)	-5.7	6.3	4.1	-0.8	2.1

	Nigeria	Senegal	Sierra Leone	Togo
General information				
1. Estimated population, 1996 (millions)	115	9	5	4
2. Estimated population growth rate, 1994-2010 (% per year)	2.8	2.8	na	na
3. Per caput GNP (US$), 1996	240	570	200	300
4. Per caput oilseed production, 1994-96 (kg)	22.8	87.6	10.0	42.4
5. Per caput groundnut production, 1994-96 (kg)	15.8	82.5	8.8	9.8
Groundnut statistics				
6. Groundnut area harvested, 1994-96 average ('000 ha)	1868	863	38	87
7. Groundnut production, 1994-96 average ('000 t)	1770	686	37	40
8. Groundnut yield, 1994-96 average (t ha^{-1})	0.9	0.8	1.0	0.5
9. Groundnut share in total oilseed area, 1994-96 (%)	61.2	94.1	46.5	45.0
10. Groundnut share in total oilseed production, 1994-96 (%)	69.3	94.2	88.3	23.2
11. Growth rate of groundnut area, 1977-86 (% per year)	1.2	-5.1	4.5	8.6
12. Growth rate of groundnut area, 1987-96-(% per year)	10.4	-0.2	7.8	6.0
13. Growth rate of groundnut production, 1977-86 (% per year)	2.2	-0.5	2.9	6.0
14. Growth rate of groundnut production, 1987-96 (% per year)	11.3	-3.3	7.7	5.5
15. Growth rate of groundnut yield, 1977-86 (% per year)	1.0	4.6	-1.5	-2.6
16. Growth rate of groundnut yield, 1987-96 (% per year)	0.9	-3.1	-0.2	-0.6

Source: FAO

East Asia

	China	Japan	South Korea
General information			
1. Estimated population, 1996 (millions)	1215	126	46
2. Estimated population growth rate, 1994-2010 (% per year)	1.8	na	na
3.Per caput GNP(US$), 1996	750	40,940	10,610
4. Per caput oilseed production, 1994-96 (kg)	40.2	1.2	4.6
5. Per caput groundnut production, 1994-96 (kg)	8.3	0.2	0.3
Groundnut statistics			
6. Groundnut area harvested, 1994-96 average ('000 ha)	3770	14	8
7. Groundnut production, 1994-96 average ('000 t)	10,103	30	15
8. Groundnut yield, 1994-96 average (t ha^{-1})	2.7	2.2	1.9
9. Groundnut share in total oilseed area, 1994-96 (%)	14.5	16.2	4.9
10. Groundnut share in total oilseed production, 1994-96 (%)	20.6	19.7	7.3
11. Growth rate of groundnut area, 1977-86 (% per year)	6.4	-3.8	-0.7
12. Growth rate of groundnut area, 1987-96 (% per year)	3.0	-5.9	-12.0
13. Growth rate of groundnut production, 1977-86 (% per year)	12.8	-4.2	2.8
14. Growth rate of groundnut production, 1987-96 (% per year)	7.4	-4.4	-9.7
15. Growth rate of groundnut yield, 1977-86 (% per year)	6.4	-0.4	3.5
16. Growth rate of groundnut yield, 1987-96 (% per year)	4.4	1.5	2.2

West Asia

	Lebanon	Syria	Turkey
General information			
1. Estimated population, 1996 (millions)	4	15	63
2. Estimated population growth rate, 1994-2010 (% per year)	na	na	na
3. Per caput GNP (US$), 1996	2970	1160	2830
4. Per caput oilseed production, 1994-96 (kg)	189.5	48.7	69.0
5. Per caput groundnut production, 1994-96 (kg)	23.0	2.1	1.2
Groundnut statistics			
6. Groundnut area harvested, 1994-96 average ('000 ha)	3	15	31
7. Groundnut production, 1994-96 average ('000 t)	10	30	73
8. Groundnut yield, 1994-96 average (t ha^{-1})	3.7	2.1	2.4
9. Groundnut share in total oilseed area, 1994-96 (%)	87.3	5.8	2.2
10. Groundnut share in total oilseed production, 1994-96 (%)	12.2	4.4	1.7
11. Growth rate of groundnut area, 1977-86 (% per year)	-13.9	-0.2	0.2
12. Growth rate of groundnut area, 1987-96 (% per year)	2.2	3.7	2.9
13. Growth rate of groundnut production, 1977-86 (% per year)	-9.8	1.5	0.3
14. Growth rate of groundnut production, 1987-96 (% per year)	10.6	4.4	1.9
15. Growth rate of groundnut yield, 1977-86 (% per year)	4.1	1.8	0.0
16. Growth rate of groundnut yield, 1987-96 (% per year)	8.4	0.7	-1.0

Source: FAO

South Asia

	Bangladesh	India	Myanmar	Pakistan
General information				
1. Estimated population, 1996 (millions)	122	945	46	134
2. Estimated population growth rate, 1994-2010 (% per year)	na	2.2	2.2	na
3. Per caput GNP (US$), 1996	260	380	na	480
4. Per caput oilseed production, 1994-96 (kg)	2.0	43.3	28.3	39.3
5. Per caput groundnut production, 1994-96 (kg)	0.3	9.0	11.3	0.8
Groundnut statistics				
6. Groundnut area harvested, 1994-96 average ('000 ha)	36	7797	493	101
7. Groundnut production, 1994-96 average ('000 t)	40	8359	508	112
8. Groundnut yield, 1994-96 average (t ha^{-1})	1.1	1.1	1.0	1.1
9. Groundnut share in total oilseed area, 1994-96 (%)	14.5	22.1	24.9	2.9
10. Groundnut share in total oilseed production, 1994-96 (%)	16.9	20.8	39.9	2.1
11. Growth rate of groundnut area, 1977-86 (% per year)	2.5	-0.1	0.6	4.9
12. Growth rate of groundnut area, 1987-96 (% per year)	0.3	-0.1	-0.7	5.0
13. Growth rate of groundnut production, 1977-86 (% per year)	2.2	-0.2	5.0	3.4
14. Growth rate of groundnut production, 1987-96 (% per year)	-0.3	1.7	0.0	7.0
15. Growth rate of groundnut yield, 1977-86 (% per year)	-0.3	-0.2	4.4	-1.5
16. Growth rate of groundnut yield, 1987-96 (% per year)	-0.5	1.8	0.7	2.0

Southeast Asia and the Pacific

	Indonesia	Philippines	Thailand	Vietnam
General information				
1. Estimated population, 1996 (millions)	200	72	60	75
2. Estimated population growth rate, 1994-2010 (% per year)	na	na	2.4	na
3. Per caput GNP (US$), 1996	1080	1160	2960	290
4. Per caput oilseed production, 1994-96 (kg)	81.0	174.4	37.4	21.9
5. Per caput groundnut production, 1994-96 (kg)	5.4	0.5	2.5	4.5
Groundnut statistics				
6. Groundnut area harvested, 1994-96 average ('000 ha)	691	44	100	257
7. Groundnut production, 1994-96 average ('000 t)	1073	36	148	329
8. Groundnut yield, 1994-96 average (t ha^{-1})	1.6	0.8	1.5	1.3
9. Groundnut share in total oilseed area, 1994-96 (%)	14.9	1.4	11.0	40.9
10. Groundnut share in total oilseed production, 1994-96 (%)	6.7	0.3	6.8	20.3
11. Growth rate of groundnut area, 1977-86 (% per year)	0.2	-1.6	3.9	10.7
12. Growth rate of groundnut area, 1987-96 (% per year)	. 2.2	-2.1	-2.7	1.9
13. Growth rate of groundnut production, 1977-86 (% per year)	3.3	-1.4	5.4	11.5
14. Growth rate of groundnut production, 1987-96 (% per year)	0.9	-1.6	-1.6	5.7
15. Growth rate of groundnut yield, 1977-86 (% per year)	3.1	0.1	1.5	0.8
16. Growth rate of groundnut yield, 1987-96 (% per year)	-1.3	0.5	1.1	3.8

Source: FAO

Latin America and the Caribbean

	Argentina	Bolivia	Brazil	Haiti	Mexico	Paraguay
General information						
1. Estimated population, 1996 (millions)	35	8	161	7	93	5
2. Estimated population growth rate, 1994-2010 (% per year)	1.5	na	2.3	1.8	2.7	na
3. Per caput GNP (US$), 1996	8380	830	4400	310	3670	1850
4. Per caput oilseed production, 1994-96 (kg)	545.3	119.6	169.2	8.3	23.6	543.0
5. Per caput groundnut production, 1994-96 (kg)	12.4	1.5	1.0	3.2	0.7	7.1
Groundnut statistics						
6. Groundnut area harvested, 1994-96 average ('000 ha)	176	10	89	28	71	33
7. Groundnut production, 1994-96 average ('000 t)	432	11	162	23	61	35
8. Groundnut yield, 1994-96 average (t ha^{-1})	2.5	1.0	1.8	0.8	0.9	1.1
9. Groundnut share in total oilseed area, 1994-96 (%)	1.6	2.2	0.7	49.2	10.7	2.8
10. Groundnut share in total oilseed production, 1994-96 (%)	2.3	1.2	0.6	38.7	2.8	1.3
11. Growth rate of groundnut area, 1977-86 (% per year)	-13.2	-0.6	-5.8	5.9	6.8	5.7
12. Growth rate of groundnut area, 1987-96 (% per year)	-2.2	-4.5	-2.8	-8.2	2.6	-3.5
13. Growth rate of groundnut production, 1977-86 (% per year)	-5.7	-1.6	-4.9	9.6	4.8	5.3
14. Growth rate of groundnut production, 1987-96 (% per year)	1.4	-5.5	-0.6	-8.2	-7.9	-3.8
15. Growth rate of groundnut yield, 1977-86 (% per year)	7.5	-0.9	0.9	3.7	-1.9	-0.5
16. Growth rate of groundnut yield, 1987-96 (% per year)	3.6	-1.0	2.2	0.0	-10.5	-0.3

Developed countries

	Australia	Bulgaria	South Africa	USA
General information				
1. Estimated population, 1996 (millions)	18	8	38	265
2. Estimated population growth rate, 1994-2010 (% per year)	1.6	na	na	na
3. Per caput GNP (US$), 1996	2090	1190	3520	28,020
4. Per caput oilseed production, 1994-96 (kg)	83.8	78.1	21.2	295.1
5. Per caput groundnut production, 1994-96 (kg)	1.8	1.1	3.8	6.4
Groundnut statistics				
6. Groundnut area harvested, 1994-96 average ('000 ha)	20	11	118	609
7. Groundnut production, 1994-96 average ('000 t)	33	10	158	1719
8. Groundnut yield, 1994-96 average (t ha^{-1})	1.7	0.9	1.3	2.8
9. Groundnut share in total oilseed area, 1994-96 (%)	2.3	1.9	14.6	1.9
10. Groundnut share in total oilseed production, 1994-96 (%)	2.2	1.7	18.0	2.2
11. Growth rate of groundnut area, 1977-86 (% per year)	-0.4	3.6	1.4	-0.2
12. Growth rate of groundnut area, 1987-96 (% per year)	-4.8	3.8	-3.6	-1.2
13. Growth rate of groundnut production, 1977-86 (% per year)	0.4	4.0	-12.1	1.0
14. Growth rate of groundnut production, 1987-96 (% per year)	-1.4	2.3	-0.5	-0.5
15. Growth rate of groundnut yield, 1977-86 (% per year)	0.9	0.3	-13.6	1.2
16. Growth rate of groundnut yield, 1987-96 (% per year)	3.4	-1.5	3.2	0.7

Source: FAO

Regional

	Africa	Asia	Europe	Latin America and the Caribbean	Oceania
General information					
1. Estimated population, 1996 (millions)	739	3488	729	484	29
2. Estimated population growth rate, 1994-2010 (% per year)	3.8	2.1	0.5	2.3	na
3. Per caput GNP (US$), 1996	na	na	na	na	na
4. Per caput oilseed production, 1994-96 (kg)	22.5	42.3	45.2	112.6	118.4
5. Per caput groundnut production, 1994-96 (kg)	8.9	6.1	0.0	1.7	1.3
Groundnut statistics					
6. Groundnut area harvested, 1994-96 average ('000 ha)	7957	13,393	12	463	23
7. Groundnut production, 1994-96 average ('000 t)	6386	20,925	14	808	37
8. Groundnut yield, 1994-96 average (t ha^{-1})	0.8	1.6	1.1	1.7	1.6
9. Groundnut share in total oilseed area, 1994-96 (%)	46.5	16.0	0.1	1.8	1.7
10. Groundnut share in total oilseed production, 1994-96 (%)	39.5	14.4	0.0	1.5	1.1
11. Growth rate of groundnut area, 1977-86 (% per year)	-2.2	1.6	-0.8	-5.5	-0.1
12. Growth rate of groundnut area, 1987-96 (% per year)	3.8	0.8	-0.7	-3.2	-4.5
13. Growth rate of groundnut production, 1977-86 (% per year)	-2.6	4.5	-0.8	-3.6	0.7
14. Growth rate of groundnut production, 1987-96 (% per year)	4.3	4.0	-6.5	-0.8	-1.6
15. Growth rate of groundnut yield, 1977-86 (% per year)	-0.4	2.8	0.1	1.9	0.8
16. Growth rate of groundnut yield, 1987-96 (% per year)	0.5	3.2	-5.9	2.4	2.9

	Developed countries	Developing countries	World
General information			
1. Estimated population, 1996 (millions)	1294	4474	5768
2. Estimated population growth rate, 1994-2010 (% per year)	0.8	2.2	na
3. Per caput GNP (US$), 1996	na	na	na
4. Per caput oilseed production, 1994-96 (kg)	100.8	145.9	135.7
5. Per caput groundnut production, 1994-96 (kg)	1.5	6.3	5.3
Groundnut statistics			
6. Groundnut area harvested, 1994-96 average ('000 ha)	777	21,681	22,458
7. Groundnut production, 1994-96 average ('000 t)	1979	27,907	29,886
8. Groundnut yield, 1994-96 average (t ha^{-1})	2.5	1.3	1.3
9. Groundnut share in total oilseed area, 1994-96 (%)	1.3	20.6	13.6
10. Groundnut share in total oilseed production, 1994-96 (%)	1.5	4.3	3.9
11. Growth rate of groundnut area, 1977-86 (% per year)	0.1	0.1	0.1
12. Growth rate of groundnut area, 1987-96 (% per year)	-1.9	1.8	1.6
13. Growth rate of groundnut production, 1977-86 (% per year)	-0.4	2.3	2.1
14. Growth rate of groundnut production, 1987-96 (% per year)	-0.7	3.9	3.6
15. Growth rate of groundnut yield, 1977-86 (% per year)	-0.5	2.3	2.0
16. Growth rate of groundnut yield, 1987-96 (% per year)	1.2	2.1	1.9

Source: FAO

About ICRISAT

The semi-arid tropics (SAT) encompasses parts of 48 developing countries including most of India, parts of southeast Asia, a swathe across sub-Saharan Africa, much of southern and eastern Africa, and parts of Latin America. Many of these countries are among the poorest in the world. Approximately one-sixth of the world's population lives in the SAT, which is typified by unpredictable weather, limited and erratic rainfall, and nutrient-poor soils.

ICRISAT's mandate crops are sorghum, pearl millet, finger millet, chickpea, pigeonpea, and groundnut; these six crops are vital to life for the ever-increasing populations of the semi-arid tropics. ICRISAT's mission is to conduct research which can lead to enhanced sustainable production of these crops and to improved management of the limited natural resources of the SAT. ICRISAT communicates information on technologies as they are developed through workshops, networks, training, library services, and publishing.

ICRISAT was established in 1972. It is one of 16 nonprofit, research and training centers funded through the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is an informal association of approximately 50 public and private sector donors; it is co-sponsored by the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank.

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The World Groundnut Economy: Facts, Trends, and Outlook reviews the current structure of the world groundnut economy and analyzes the supply and demand situations, both current and projected. Several trends emerging from this analysis are discussed, along with possible implications for research. The book also examines the major constraints to groundnut production, and policy options that could help increase the output and quality of groundnut crops throughout the semi-arid tropics.

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