Peanut Production and Utilization in the People's Republic of China

Gang Yao

Peanut in Local and Global Food Systems Series Report No. 4
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Department of Anthropology
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Summary

Peanut is an important oilseed crop in Chinese agricultural system. Over the decades, peanut has remained top ranked oilseed crop. Its cultivation history in the country can be traced to ancient times. However, the large increase in peanut production has been recorded since 1980s. Currently, China is the largest peanut producing country in the world accounting for about two-fifths of the world production. In terms of area it ranks second only to India accounting for one-fifth of the total world acreage. Although peanut is grown in different parts of the country, Shandong is the major peanut producing area accounting for about 23 percent of area and 35 % of production of the entire nation.

The tremendous increase in peanut production was made possible by adoption of technologies that combined development of improved varieties and improved packages of cultivation practices. Among other improved cultivation practices, polythene mulching has greatly contributed towards boosting peanut production. Chinese government's policy of encouraging individual farmers through a program called 'Household Responsibility System' provided incentives to the farmers leading to increased production. This report presents a brief overview of production history and distribution, agro-ecological zones, utilization and marketing aspects of peanut in China.

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1. Introduction

1. 1 Peanut in China

Peanut is an important industrial and oilseed crop in China. It is grown both for domestic market and for exports. While peanut is grown mainly for oil production and export in high-income provinces it is grown primarily as food crop in other provinces. Popular not only as a source of protein and vegetable oil, peanut is also valued for the food and medicine industry. Over 5 million ha area is under peanut cultivation in China which accounts for about 19% of the world's area under peanut (FAO 2003). In the year 2003 total peanut production in China has reached to 15 million tons, that constitutes 42% of the total world production.

China has a long history of peanut cultivation. Peanut has become one of the most important oilseed crops and its production has consistently increased since 1980s. This report on China's peanut food system offers a general overview of many aspects of this important crop. As a contribution to the "Peanut in Food Systems" series of the World Geography of the Peanut Project, this report examines the history of introduction, agroecological zones and production trends, production practices and technologies, marketing, utilization, and production constraints. This report also discusses the regional distribution of peanut production and constraints that limit the peanut production.

1.2 History

Peanut, which has a long cultivation history in China, was apparently introduced into the country in different places at different times. Early accounts record the cultivation of peanut in China since 1368 (Shuren et al 1995). *Chanshu County Magazine* (1503) reports "peanut planted in March, as not a long branched, not underground, boiled and delicious." Another document reports that the Virginia type (var. *vulgaris*) was introduced by American missionaries in the middle of the 19th century via Shanghai to Shandong peninsula. The Virginia type then gradually spread to several other provinces of the country.

Recent archeological works in China provide evidences of the presence of peanut seeds during the Neolithic period sites in Zhejiang and Jiangxi (around 4000 b.p.). Based on these evidences, some scholars argue that the peanut is indigenous to China and, therefore, not all varieties were introduced from overseas. Other experts argue that that these evidences are not

conclusive enough to suggest that the peanut was domesticated in China. Unfortunately, no written documents predating the Ming Dynasty (15th century, A.D.) mentioning peanut cultivation in China have been discovered. The modern peanut is known to be of South American origin, having spread around the world after Columbus' discovery of the Americas. Debate regarding the Chinese origin of the peanut continues.

In the Chinese language over a dozen local names are used for peanut. Some examples are *Changshengguo* (long-life nut), *Luohuasheng* (falling flower-born nut), *Didou* (underground nut), *Xiangdou* (fragrant nut), *Wuhuaguo* (flowerless nut), and *Qianshuizi* (thousand-year-old-fruit).

1.3 Peanut production in China in an international context

China is the world's largest peanut producer accounting for 42 % of the total world production in the year 2003. Country's share of total peanut production has been increasing every year. China is second only to India in land area devoted to the crop. China with one-fifth of the world area under peanut produces more than two-fifths of the total world peanut production. Since early 1960s, the total peanut production has increased by almost 12 folds. Figures 1 and 2 show China's share in total world peanut production and area under cultivation. Overall, peanut is an essential economic product earning significant income for China.

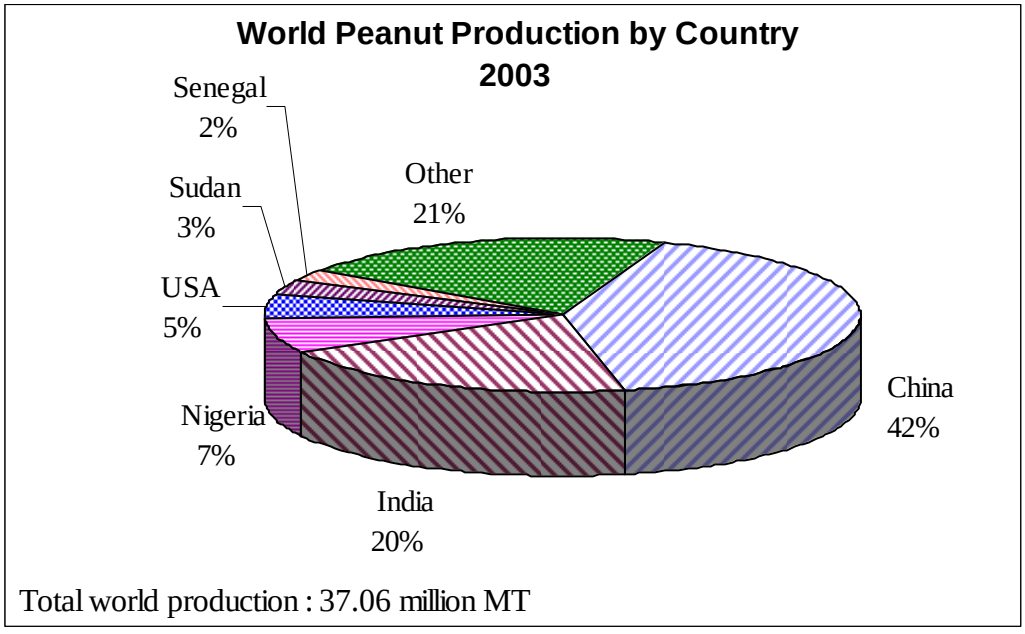


Figure 1. World peanut production in 2003 (Source FAO)

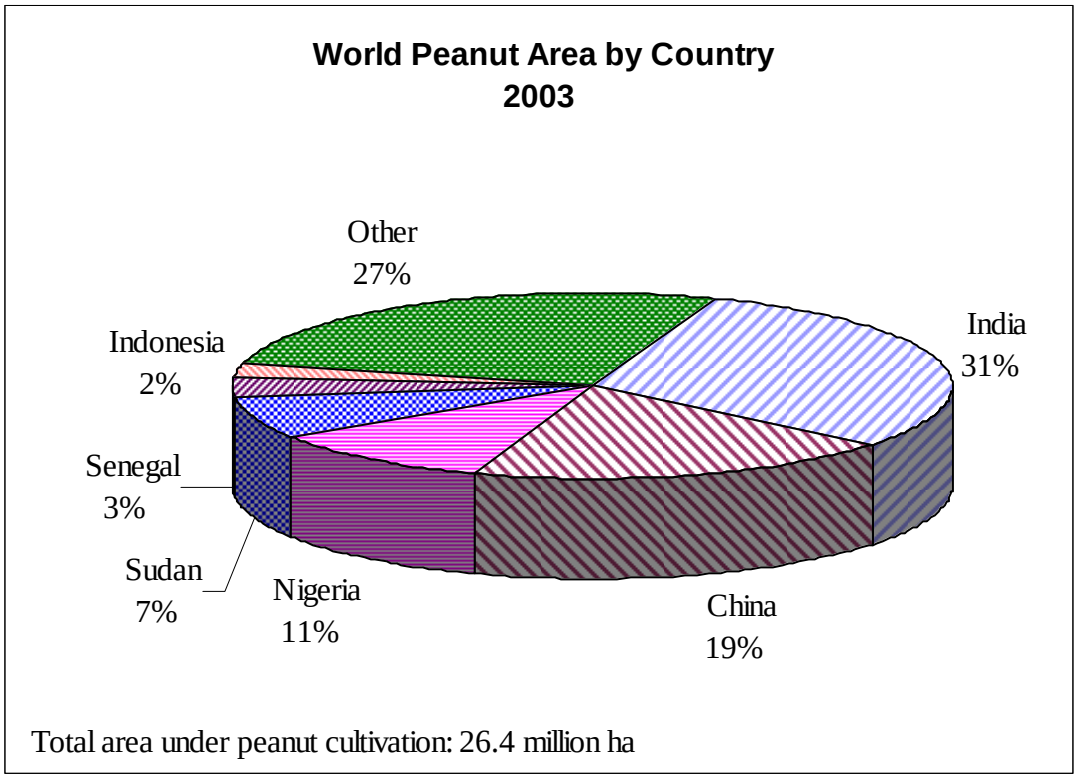


Figure 2. World peanut cultivation area (Source FAO 2003)

2. Agro-ecological Zones

Peanut is widely cultivated in China from the frigid north (50°N) to the humid south (18°N), from east (132°E) to west (76°W). Average temperatures across the peanut producing areas range from -5° to 25°C. The major peanut agriculture zones are: I – North Large Peanut (Virginia Type) Region; II – South Spring and Autumn Peanut Region; III – Yangtze Spring and Summer Peanut Region; IV – Loess Peanut Region; and VII – Northwest Inland Peanut Region. These zones are shown on Map 1. Each agro-ecological zone is briefly described below.

Map 1: Agroecological zones of peanut production in China

Adapted from Peanut Breeding and Cultivation by Feng Haishen

2.1 Region I: North large peanut (Virginia type) region

Region I includes the south of Liadong Peninsula, Hebei and Shandong Provinces, the north and the east of Henna, the south of Shanxi, and the north of Jiangsu and Anhui Provinces. This is the largest peanut production region having the most centralized production system.

Shandong is the largest peanut producing province. The major types of soil are arenaceous soil eroded from granite or shale and alluvial sands in the Yellow River watershed. In this region, the average elevation ranges from 50 to 200 msl. With the exception of a few hilly areas in Shandong and Liadong Peninsulas, the region is largely alluvial plain. The mean daily temperature ranges between 11 to 14 ^{o}C; the frost-free period lasts 180 to 230 days per year. Annual rainfall is about 450 – 900 mm, most of which falls in the northeast part and occurs during July and August.

Generally one crop per year or three crops per two years are grown in the region. Peanut is usually intercropped with corn, bean, and sweet potato. Mostly large seeded varieties of Virginia type are grown in this region, which are used for oil extraction and export. Depending on elevation, soil, and cropping systems, this region can be divided into three sub-regions: Yellow River alluvial plain, Liadong and Shandong Peninsula, and Huaibei plain. The differences between the sub-regions are shown in Table 1.

Table 1: Sub-regions of north large peanut region.

Features	**Yellow river alluvial plain**	**Liaodong and Shandong peninsula**	**Huaibei plain**
Elevation (m)	100	100-200	20
Frost-free days	200	180-200	200-230
Mean temperature (^{o}C)	14	12	15
Sunlight coefficient (%)	55-60	60	55
Precipitation (mm)	400-800	600-900	700-1000
Major cropping system	One crop per year	Three crops per two years	
Major peanut varieties	Spanish type	Virginia type	Nongshen type

Source: *Peanut Breeding and Cultivation* (Haishen Feng 1993).

2.2 Region II: South spring and autumn peanut region

This most southerly peanut region includes Guangdong, Guangxi, the southeastern part of Fujian, the southern Hunan, and Hainan. The region accounts for 31.2% of the total peanut production area in China. Peanut cultivation can be found in areas that are about 50 meters above sea level and which are mostly coastal hilly areas or river alluvial regions, such as Leizhou Peninsula and Zhujiang Delta in Guangdong Province. The soil in this alluvial region is alluvial sands, while in the hilly areas soil is relatively less fertile. The region is located on sub-tropical and tropical climatic zones, where more than half of a year is summer with abundant rainfall (1500 to 2000 mm per year). The average temperature ranges between 20 to 25 ^{o}C;

almost the whole year is frost-free, and the sunlight coefficient is about 40 to 50%. Peanut can be planted year round in the South. Generally, two crops per year are grown in this region. However, there are also instances of growing three crops per year or five crops every two years. Peanut is often rotated with rice and other crops. The period of rotation and selection of the crops in rotation are decided based on soil characteristics and the availability of suitable crop varieties. Generally, small seeded varieties, which are mostly used as food and for oil extraction, are grown in the region.

2.3 Region III: Yangtze spring and summer peanut region

Lying between 26^{o} and 34^{o}N, this region includes Hubei and Zhejiang provinces, southern Jiangsu, Anhui, and Henan and Jiangxi, and Sichuan Basin. Peanut cultivation is concentrated in hills in Hubei, Hunan, and Jiangxi, and in river alluvial plains. The elevation of the peanut production area in this region is at least 300 msl. The major soil types where peanut is grown are red soil, brown soil, and sandy soils with pH ranging between 6 and 7. The average temperature ranges between 15^{o} to 19^{o} C and the frost-free period is long. The annual precipitation ranges between 800 to 1800 mm, principally occurring in spring and summer. Generally, one crop is grown per year, which may also change to three crops every two years. Peanut is usually rotated with sweet potato, wheat, bean, and occasionally with rice. This region can be divided into three sub-regions: the Yangtze River north plain sub-region, the Yangtze River south plain sub-region, and the Sichuan basin.

2.4 Region IV: Yungui plateau peanut region

This region includes Yunan and Guizhou provinces, southwestern Sichuan and northwestern Guangxi. Peanut production is centered in the Nanpan River watershed. Topography in this region is complex and elevation exceeds 500 msl. Peanut cultivation is spread in hilly or terraced areas below 1500 msl. Soils are typically red and brown or sandy. The high topographic relief is accompanied by both semi-tropical and temperate climate. The mean temperature ranges between 15 and 20^{o}C, but some areas experience temperature below 12^{o}C. The sunlight coefficient is 30 to 40%, but due to varying terrain it can reach up to 50% in some areas. Annual precipitation varies from 900 to 2000 mm. The western region has more variation in precipitation than the eastern region. In the past, peanut was cultivated once per year.

However, now three crops are grown every two years, and in some areas two crops are grown each year. Peanut is rotated with corn, tobacco, and sugar cane. Pearl peanuts, multi-nuts, and some other small and medium size peanuts are typical in this area.

2.5 Region V: Northeast early peanut region

This region is located between 40^{o} and 50^{o}N, and includes North Liaoning, Jilin, South Heilongjiang and a small part of Inner Mongolia. Peanut is mostly spread in hilly region where the soil is sandy and in plains where soil is black. The mean annual temperature ranges between 2^{o} to 7^{o}C, and the annual frost-free period is 130 to 160 days. This peanut region is the coldest and has the longest frost period. The annual rainfall is around 450 to 700 mm, and the sunlight coefficient is 60%. Only one crop can be grown each year. Mostly small seeded varieties are grown in this region.

2.6 Region VI: Loess peanut region

This region includes Ningxia, North and Center of Shanxi, North and West of Shanxi, and some parts of Gansu and Qinghai. The peanut cultivation in this region is mostly spread around Wei River and Fen River watersheds, which are as high as 1000 to 2000 msl. The region is arid, and the most common soil type is eroded loose sandy soils. The mean annual temperature is around 7 to 10^{o}C and the frost-free period is 150 to 200 days. The annual rainfall is only about 300 to 550 mm. Only one crop is grown each year.

2.7 Region VII: Northwest inland peanut region

This region spreads towards China's far northwest border and includes Xinjiang and Gansu. Climate is characterized by hot and dry summers and cold winters; yearly and daily variation in temperature is also large. Mean annual temperature ranges between 5 to 10^{o}C. The annual rainfall ranges between 50 to 100 mm and the sunlight coefficient is over 60%. Only one crop is grown each year. The following tables summarizes the geographical and agronomic features of these seven regions.

Table 2: Geography and climate of peanut production regions

Region	Latitude	Longitude	Altitude (msl)	Mean temp (^{o}C)	Frost-free period (days)	Precipitation (mm)	Sunlight coefficient (%)
North large peanut	32-42 ^{o}N	east of 107^{o}E	50-200	11-14	180-230	450-900	55-60
South spring and autumn peanut	18-26^{o}N	107-122^{o}E	50	20-25	310	1500-2000	40-50
Yangtze spring and summer peanut	26-34^{o}N	East to 120^{o}E	50-300	15-19	240-330	800-1800	30-45
Yungui plateau peanut	29^{o}N	East to 109.5^{o}E	500-2000	15-20	230-330	900-1400	30-40
Northeast early peanut	40-50^{o}N	East to 117^{0}E	100-200	2-7	130-160	450-700	50
Loess peanut	32-42^{o}N	100-113^{o}E	1000-2000	7-10	150-200	300-550	60
Northwest inland peanut	North to 36^{o}N	West to 100^{o}E	1000-2500	3.5-14	170-240	50-280	60-70

Table 3: Cropping systems in peanut regions

Region	Planting time	Cropping intensity	Crops rotated with peanut	Varieties
North large peanut	Late April to early May	One crop per year/three crops per two years	Sweetpotato, wheat, corn, barley, bean	Large-seeded
South spring and autumn peanut	Spring: Feb-March, fall: July-Aug	Two crops per year, five crops per two years	Sweetpotato, bean vegetable, rice, sugarcane	Small-seeded
Yangtze spring and summer peanut	Spring: April-May summer: May-June	Three crops every two years	Sweetpotato, barley, wheat, bean, rape	Small-seeded
Yungui plateau peanut	March-April	One crop per year, three crops per two years	Corn, sweetpotato, bean	Small-seeded
Northeast early peanut	May	One crop per year	Sweetpotato, millet, sorghum	Small-seeded
Loess peanut	April-May	One crop per year	Millet, wheat	Small-seeded
Northwest inland peanut	May	One crop per year	Wheat, corn	Small-seeded

3. Growth of Peanut Cultivation in China

3.1 Growth in national production

Although peanut has been cultivated since ancient times in China, peanut production has taken a significant stride after economic reforms of 1970s. Table 4 gives a trend of growth in peanut production, acreage, and yield since early 1960s. Several factors have contributed to rapid increase in peanut production in China. Among them, the 'Household Responsibility System' carried out in 1980s enhanced the farmers' enthusiasm and efficiency. The 'Household Responsibility System' devised in the early 1980s was characterized by partial privatization, increased price incentives, and increased use of specialized production and marketing. Introduction of a market economy which has provided price incentives. In spite of marginal increase in the area under peanut cultivation, a large increase in total production has been recorded mainly due to increase in productivity.

Research in two areas, namely, on i) varietal technology, and ii) improved packages of cultivation practices, in particular since the 1980s have been instrumental for this increase in production. Several peanut varieties with high yield, good quality, and stress resistance have been promoted. The improved package of cultivation practices include deep tillage, balanced fertilizer, close planting, chemical control, and polythene mulching. All these factors have contributed to increase the peanut production in China. As a result, with one fifth area under peanut cultivation China today shares two fifths of the world peanut production.

Table 4: Trend of peanut production in China

Year	Harvested Area (Ha)	Yield (Kg/Ha)	Production (Mt)
1961	1,297,350	889	1,153,644
1962	1,396,250	856	1,195,496
1963	1,552,542	976	1,515,438
1964	1,900,775	981	1,864,727
1965	1,949,321	1,054	2,053,817
1966	2,013,026	1,207	2,429,995
1967	2,027,906	1,147	2,325,999
1968	1,834,317	1,103	2,023,489
1969	1,825,385	1,059	1,932,764
1970	1,795,477	1,264	2,270,198
1971	1,871,400	1,244	2,327,579
1972	1,952,250	1,120	2,186,032
1973	1,832,079	1,217	2,229,932

1974	1,889,414	1,279	2,416,939
1975	1,939,100	1,218	2,361,470
1976	1,897,807	1,034	1,961,864
1977	1,738,413	1,182	2,055,056
1978	1,823,673	1,354	2,469,184
1979	2,126,520	1,367	2,907,881
1980	2,389,974	1,542	3,686,127
1981	2,520,853	1,550	3,907,713
1982	2,464,645	1,623	3,998,832
1983	2,244,668	1,788	4,013,196
1984	2,470,705	1,984	4,901,993
1985	3,370,935	2,003	6,752,662
1986	3,302,164	1,805	5,959,150
1987	3,086,489	2,036	6,282,700
1988	3,022,638	1,911	5,776,119
1989	2,980,270	1,821	5,426,510
1990	2,941,453	2,187	6,433,465
1991	2,919,892	2,187	6,386,816
1992	3,012,861	2,001	6,028,579
1993	3,411,035	2,491	8,496,462
1994	3,810,900	2,562	9,762,783
1995	3,848,164	2,684	10,327,225
1996	3,649,504	2,800	10,218,944
1997	3,755,300	2,592	9,732,185
1998	4,069,900	2,937	11,954,325
1999	4,294,500	2,959	12,706,157
2000	4,884,910	2,972	14,515,755
2001	5,016,421	2,885	14,471,835
2002	5,025,171	2,986	15,006,087
2003	5,125,400	2,981	15,277,455

Source : FAO

Peanut has remained an important oilseed crop in China. Importance of peanut in Chinese oil production sector can be inferred by comparing peanut production with other oilseed crops. Table 5 shows that in all the decades peanut ranked the first followed by rape, sunflower, and sesame.

Table 5: Major oilseed crops production in China in three decades

Crop	1970-1979		1980-1989		1990-1995	
	Production (K ton)	% of oilseeds	Production (K ton)	% of oilseeds	Production (K ton)	% of oilseeds
Peanut	2225	49.7	4988	40.2	7827	42.9
Rape	1464	32.7	4917	39.6	7709	42.3
Sunflower	310	6.9	1333	10.7	1359	7.6
Sesame	274	6.1	451	3.6	519	2.8

Source: SPRI material at Oil Crops Institute Conference in 1995

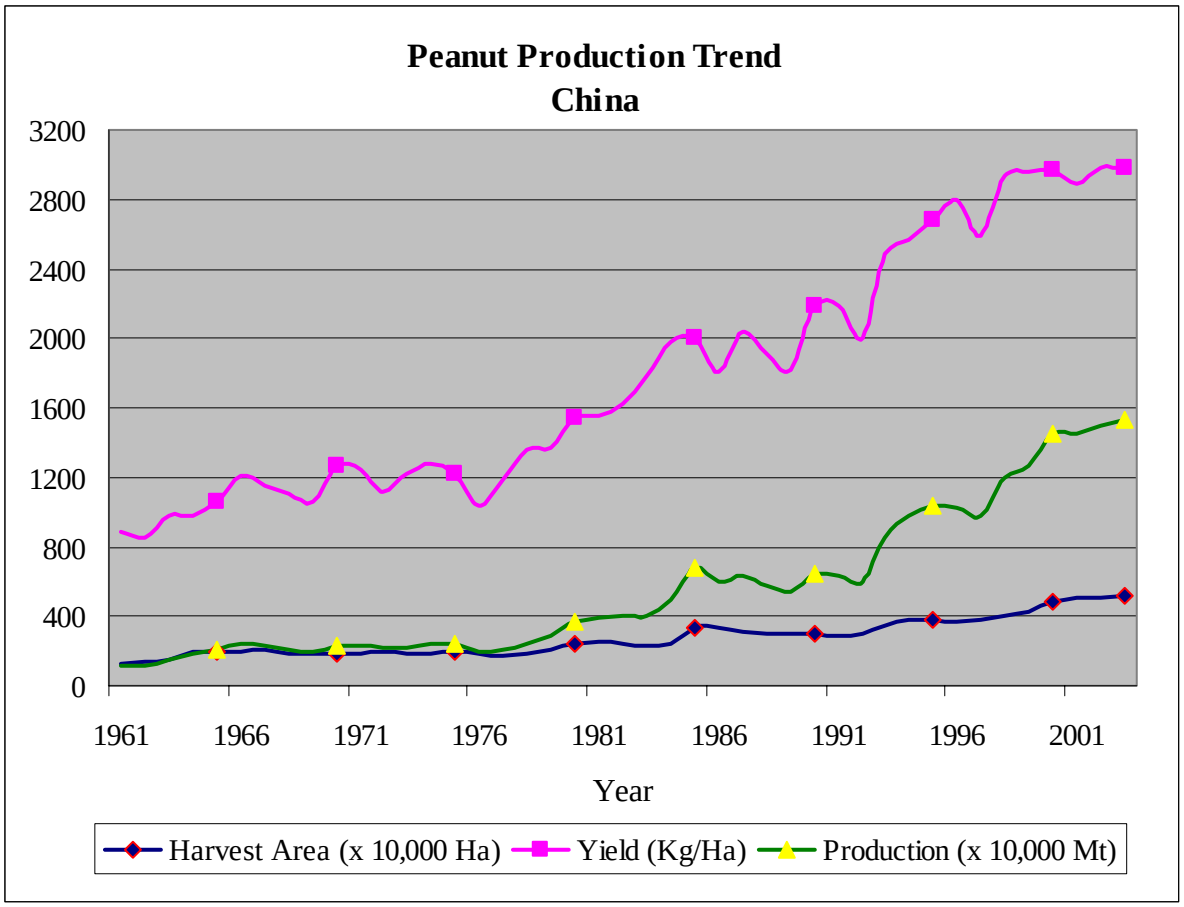


Figure 3: Trend of growth in peanut production

3.2 Production distribution

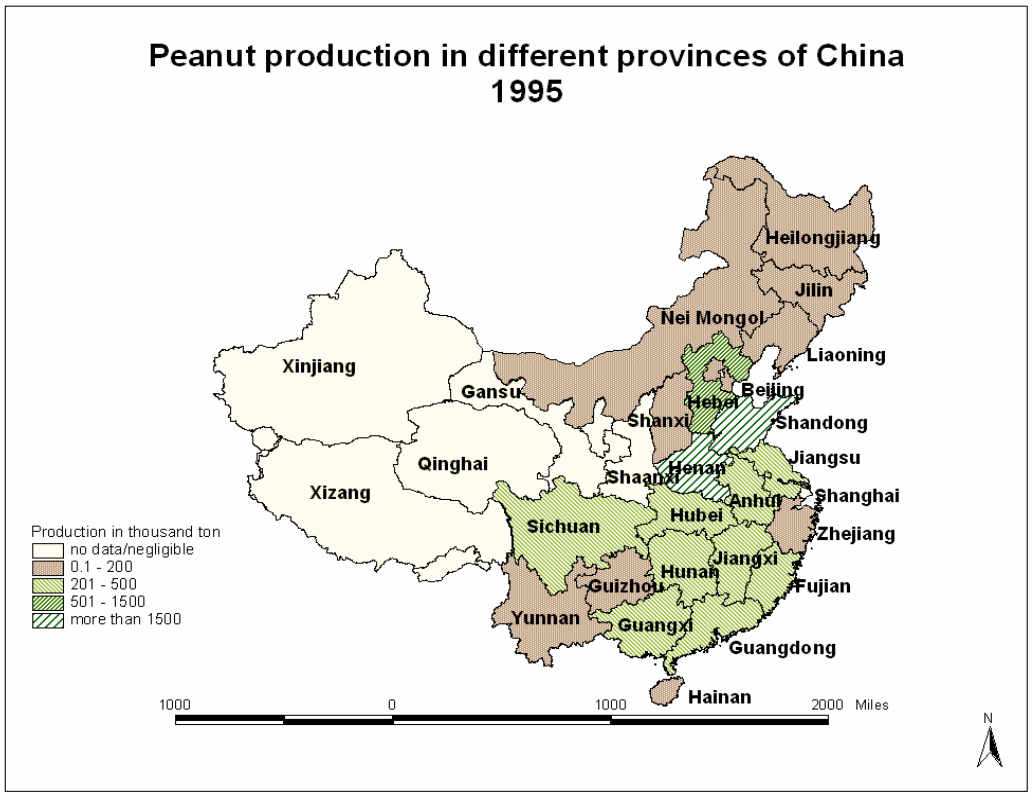
Although peanut is grown in different regions, its production is concentrated in relatively few provinces. More than 70% of production takes place in five provinces – Shandong, Henan, Hebei, Guangdong, and Jiangsu. Shandong is the leading peanut producer, with the largest area under peanut cultivation and highest yield. Peanut is the most important export crop in Shandong province. Shandong alone accounts for 23 percent of area and 34 percent of production of the entire nation. The average yield of peanut in Shandong is 34 percent higher than national average. Provinces in the far west like Tibet and Quinghai have very little peanut production. Table 6 presents the peanut production distribution in China.

Table 6: Peanut area and production in different provinces of China in 1995

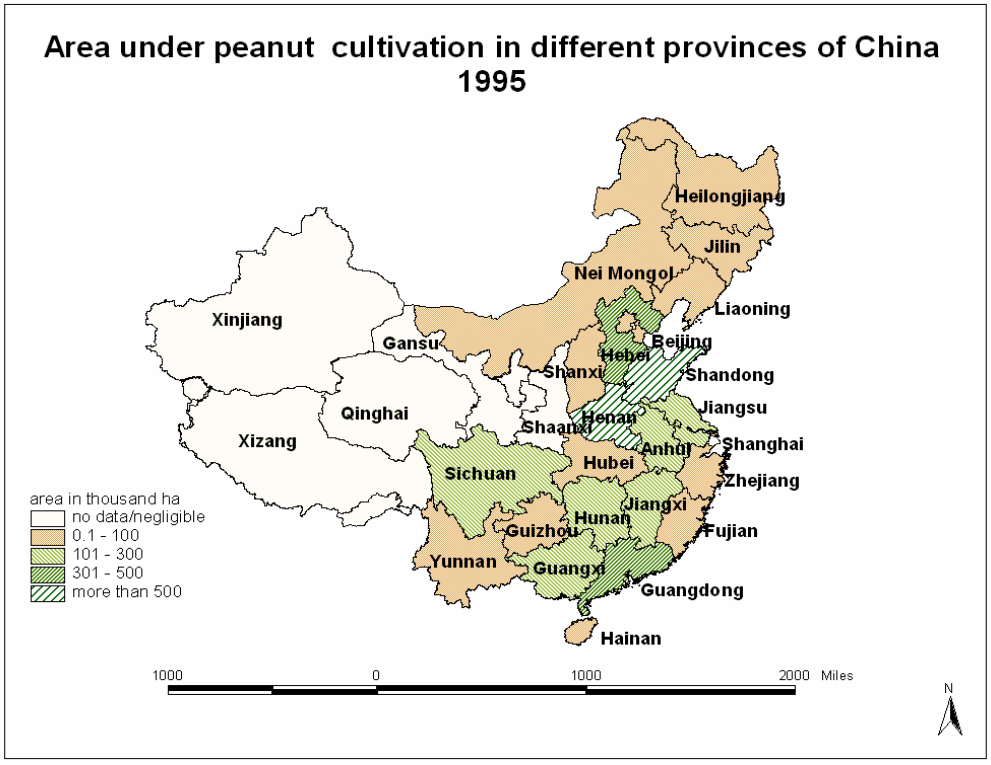
Province	Area under peanut (x 1000 ha)	Yield (kg/ha)	Total production (ton)
Beijing	11.17	2,883	32,200
Tianjin	7.86	2,539	19,954
Hebei	371.70	254	946,841
Shanxi	26.20	1,855	48,611
Inner Mongolia	0.30	1,987	596
Liaoning	94.49	1,723	162,764
Jilin	21.4	2,164	46,319
Heilongjiang	2.35	1,431	3,363
Shanghai	1.00	2,780	2,780
Jiangsu	148.70	3,257	484,275
Zhejiang	10.20	2,306	23,517
Anhui	181.50	2,356	427,600
Fujian	97.70	2,185	243,449
Jiangxi	130.30	2,322	302,510
Shandong	849.90	3,635	3,089,500
Henan	767.30	3,045	2,336,502
Hubei	91.90	2,969	272,809
Hunan	120.91	1,662	200,941
Guangdong	333.07	2,101	399,781
Guangxi	208.40	1,880	391,733
Hainan	45.60	1,593	72,623
Sichuan	183.40	1,629	298,695
Guizhou	33.70	1,500	50,552
Yunnan	36.30	1,193	43,307
Tibet			29

Source: Peanut Technology, SPRI 1997

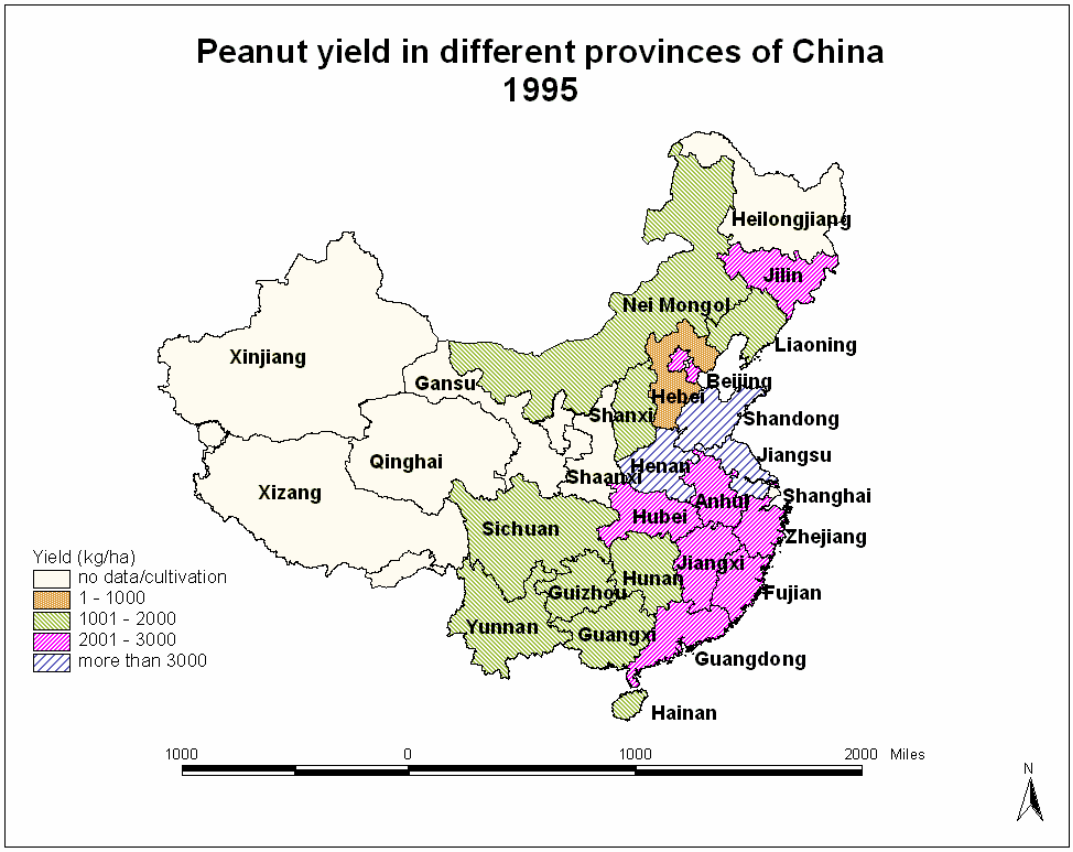
Maps 2,3, and 4 show the pattern of total production, acreage, and yield in different provinces. It is clear from these maps that Shandong and Henan provinces are the leading peanut producing provinces in China. Different provinces have witnessed a differing trend of peanut production. Provinces, with the long history of peanut cultivation, have added little area to peanut cultivation. However, in some regions there is increase in the area under peanut cultivation. Although there is a fluctuation in peanut production in a particular region from year to year, mostly due to climatic factors, there is an overall trend of increase in peanut production.



Map 2: Peanut production in different provinces of China (source: Peanut Technology 1997)



Map 3: Area under peanut cultivation in different provinces (Source: Peanut Technology 1997)



Map 4: Peanut yield in different provinces of China

4. Production Technology

Research in two areas, namely on i) varietal technology, and ii) improved packages of cultivation practices have been instrumental for tremendous increase in peanut production. The improved production technology includes deep tillage, balanced fertilizer, close planting, and polythene mulching etc. This section presents the production technology adopted for peanut cultivation in China.

4.1 Crop rotation

Peanut is grown in rotation with other crops for several reasons. Some of them are: 1) to rationally utilize the land with more intensive agriculture; 2) to control pest and weed damage more effectively; and 3) to improve soil fertility and make full use of existing soil resources. Although peanut is a major income crop in some areas, in other places it is viewed as a supplemental cash crop. Crop rotation, to some extent, is dependent on the importance of peanut in the respective regions. Duration and sequence of crop rotation varies widely in different regions of China. Crop rotation involving peanut varies widely in China. The examples below illustrate the diversity of the rotation and cropping systems involving peanut.

1. Two-crops-per-year rotation: usually with winter wheat and summer peanut. This rotation pattern is followed mostly in Shandong province.
2. One-crop-per-year: spring peanut or spring sweet potato. This pattern is adopted in hilly semi-arid areas suitable for both peanut and sweet potato.
3. Three/four-crops-per-two-years rotation:

· spring peanut--winter wheat—summer sweet potato, summer corn or other crops

· winter wheat—summer peanut—spring sweet potato, summer corn or other crops

· winter wheat—summer peanut—winter wheat—summer sweet potato, summer corn or other crops

4. Five-crops-per-three-years rotation

· winter wheat-summer corn-winter wheat-summer corn or summer sweet potato-spring peanut

· winter wheat-summer corn-winter wheat-corn-spring peanut

· winter wheat-summer corn-winter wheat-summer tobacco or vegetable-spring peanut

4.2 Cultivation

Different regions, characterized by different agricultural situations, adopt different cultivation strategies. For instance, crop rotation in the North involves growing peanut with wheat, whereas in the South peanut is rotated with rice. Intensity of land use, soil management, pest and disease control all vary from region to region. In hilly areas, people build terraces, follow deep plowing to minimize or prevent soil erosion and improve land quality. In sandy and windy areas, farmers use wooded areas as windbreaks. These steps help solidify sand, protect soil, and increase peanut production. Although intensive land use has been historically an important aspect of Chinese agriculture, achieving optimal crop densities and the selection of appropriate techniques has remained a problem.

4.3 Polythene mulching

Polythene mulching, introduced in China from Japan in 1978, has been attributed as one of the major improved cultivation practices for enhanced productivity. Because of its contribution in increasing groundnut production, polythene mulching is called as the "White Revolution." Polythene mulching has been found to be effective not only in increasing the yield but also in increasing seed oil content, protein content, and the level of eight essential amino acids. It was found to increase yield between 18 to 49% depending on soil fertility conditions.

When grown under polythene mulch system, groundnut is sown approximately 10 days earlier and it matures about 10 days earlier than under non-mulched condition. The polythene mulch makes it possible to extend the production areas to the cooler northern parts of the country also. Polythene mulching creates a suitable condition for plant growth by influencing soil temperature, moisture, texture, and microbial activities. Polythene mulch also prevents late set pegs from penetrating the soil thus saving nutrients for earlier set pods. Polythene mulching has been found effective in controlling weeds.

There are also some disadvantages of using polythene mulching. All the polythene film used in mulching cannot be retrieved, thereby causing environmental pollution. Residual film in the soil may interfere with the root development of the next crop. Sowing with polythene mulch takes much more time, labor, and the cost of cultivation. It has also been found that seeds produced under polythene mulch condition are less viable.

Although polythene film of 0.004 to 0.014 mm thickness can be used, a thickness of 0.007 mm is optimum and more economical.. The thinner (less than 0.005 mm) film does not well maintain the soil temperature and moisture and does not stop late set pegs from penetrating the soil. A film of light transmittance of more than 70 percent is optimum.

5. Utilization and Marketing

5.1 Peanut uses

Peanut has broad utilization possibilities in China. Many products can be made out of peanut for human consumption. Some of the major peanut products made in the country are vegetable oil, peanut butter. It is eaten fresh and dried as a popular snack in many parts of the country. Roasted, boiled, and candied peanuts have become popular food items. Special peanut cuisine may vary from region to region for example, candy cooked with peanuts is a popular peanut food in the South. There are many anecdotes about peanut cuisine in China's history. According to a biography of Jing Shengtan, a scholar during the Qing Dynasty, his favorite recipe was peanut with a special kind of firm tofu. One popular peanut recipe in China is "boiled peanut with spice." It is made by boiling peanuts with salt and spices for over an hour. After draining the water and drying for few minutes this dish is served warm as an appetizer or snack food. In some regions, peanut with sunflower seeds and jujube (the Chinese date, *Ziziphus jujube*) are indispensable at weddings because together they sound like "bear babies earlier" in the Chinese language.

It is also processed for producing many industrial products. Different peanut parts and products like stalks, leaves, nuts and industrial by-products are fed to animals. Since peanut leaves and stalks contain protein (13%), fat (1.9%), and carbohydrate (44%), they can be used as animal feed and also as good source of green manuring to improve the soil fertility. Peanut shells were mostly ignored in the past. However, peanut shells are now being used as animal feed and as a compost material. Chinese farmers traditionally use peanut shells mostly for fuel.

Peanut has different roles in different regions. In some areas it is grown as an economic product but in other it is grown primarily for food consumption. Regional differences in overall income influence the use of peanut. High-income provinces tend to reserve a high percentage of the yield for processed products, whereas low-income provinces use peanut mostly for household consumption as a food item. Provinces with high peanut production produce peanut mostly for extraction of oil and selling in national or international markets. For many provinces with little production, peanut is grown primarily as snack food.

5.2 Peanut processing

Simple processing of peanut by farmers includes shelling and drying after harvest. The shelled nuts fetch a better price than the un-shelled ones. Fresh nut is used for both food processing and industrial applications. Industrial processing, such as compression, detachment, and saturation turn peanut into different products (e.g. peanut butter, peanut oil, or composite protein product). A range of high quality products with export potential are produced. A soy sauce made from peanut has been developed which is indistinguishable from the soy-based product.

Approximately half of the peanut produced is used for extracting oil. The technologies used for extracting oil include compression, saturation, and hydrolyzation. These various methods have both advantages and disadvantages, for example, compression can process a large amount of peanut at a time, but significant sediment is left which cannot be used as food. Peanut jam (also known as peanut butter America) is one of the major peanut products produced mostly in Shandong province. Peanut candy (a kind of peanut brittle), a popular product in China, is made by stirring cooked peanut and syrup together and then cooling the mixture. Many rural families in China make peanut candy on holidays as a special snack.

5.3 International and provincial trade

The actual extent of trade is unknown, but regional and international trade of peanut has existed for a long time and is growing. The way for intra-and inter-provincial trade has been opened substantially by the easing the strict local self-sufficiency requirements since 1978. Chinese government encourages production of any product that earns hard currency. Peanut is competitive in the international market for vegetable oil, snack foods markets, and to some extent for animal feed.

Before the 1960s, China exported peanut substantially to the Soviet Union. However, since 1970s most of the peanut export goes to Western Europe, Japan, and Southeast Asia. The quantity of peanut export has been increasing over the years.

5.4 Marketing of peanut since reform

Marketing and utilization patterns of peanut have undergone drastic changes since the introduction of economic reforms in 1978. The nature of demand has changed as incomes have

increased. Over the years, use of peanut as food has declined and its use as industrial products and for export has increased. Utilization is now directed toward higher value uses, such as industrial processing, animal feed, and processed food products in more developed regions of the country, rather than simple consumption. The marketing structure has changed as a result of government withdrawal from former procurement and marketing functions. Many enterprises and traders have been competing with government agencies which earlier enjoyed the monopoly in procuring farm products. These new marketing channels allow multiple entries into the market.

In the case of suburban production, where the peanuts are sold for fresh consumption, farmers may market peanut themselves, individually, or collectively, if they have access to transportation, such as a bicycle, tricycle, or small tractor-drawn cart. They may also sell their products to traders who have these or more sophisticated transportation means. The retail prices farmers charge for fresh nuts is usually about 20% less than that charged by traders, and the wholesale cost to traders is usually about 20% less than the retail price charged by farmers. Besides the growth in peanut export, there is also change in the proportion of the product being exported. Earlier, peanut oil used to be the second most important export goods after raw peanut, but now processed products are becoming the major export items.

Table 7: Peanut products export growth in China

Period	Total export quantity (ton)	Peanut oil		Peanut without shell		Peanut with shell		Processed peanut products	
		quantity (ton)	%	quantity (ton)	%	quantity (ton)	%	quantity (ton)	%
1970s	42.7	16.1	37.7	26.6	62.3				
1980s	277.4	55.7	20.1	171.1	61.7	20.2	7.3	30.4	10.9
1990s	509.4	43.5	8.5	338.9	66.5	39.5	7.8	87.5	17.2

Source: SPRI material at National Oil Plant Institute Conference 1995

6. Major Constraints for Production and Use

4.1 Constraints for production

China has many favorable factors for peanut production, such as suitable climate, wide cultivation regions, and a healthy planting tradition. Through the rapid growth of peanut production in the recent decades, China has developed several new improved varieties, for example, *luhua* 14, *luhua* 15, *yuhua* 6, *tianfu* 9, and many others. Despite advances in promotion of improved varieties and cultivation technology, there are still some constraints that limit the peanut production in China. Followings are the major constraints.

Fluctuating yield and uneven growth: Although there is a general trend of increase in peanut production, there is a fluctuation in production in individual years. During the forty year period between 1950-1990, 29 years experienced an increase in total production over the preceding year. However, there was decline in total production compared to preceding years for 12 years. There is also an annual fluctuation in yield. Uneven development among different provinces is another problem. Even within provinces there is regional variation in production. While different geographic and climatic conditions in different regions must contribute to this variation, uneven adoption of improved technology must have contributed towards this.

Technology development: Since 1949, China has continued to develop new technologies for peanut production and utilization. However, the adoption of new technology by farmers is still slow. Many laboratory or experimental technologies have not been successfully applied in the field. There is still a wide gap between yields from experimental station and farmers' fields. This gap between experiment station yields and farmers' abilities to achieve the same rates needs to be investigated further. Other constraints on peanut yield in China include quality of cultivars, pests and diseases, cultural practices, access to inputs, and shifts in cropping systems.

One of the major challenges for increasing production is pest and disease management. Several diseases such as white leaf disease, root-knot nematode disease (*Meloidogyne hapla*), peanut stripe virus (PStV) seriously impair the peanut production. Development of varieties resistant to pests and diseases has become one important research focus. Besides these diseases, storage diseases such as aflatoxin, a product of *Aspergillus flavus* is also a major disease drawing research focus.

6.2 Constraints for utilization and trade

Peanut utilization in China is moving from predominantly oil production to various processed food items. New peanut products are frequently introduced to the markets and are being accepted by more and more consumers. Unfortunately, little attention has been paid to research on food processing in China. Processing equipment and technologies are antiquated. Many by-products from processing are often not properly utilized.

In recent decades, China's peanut trade abroad has dramatically increased and the products have changed from raw materials to processed products. However, several problems continue to plague the management of peanut export. The government limits the amount of peanut export by regulating the permit for peanut exports. However, because of insufficient monitoring, the actual export quantity often surpasses the permit levels. For example, in 1994 the export permit for peanut was 0.4 million tons, but the actual export reached 0.48 million tons. In addition, such lax controls can allow inferior product to be exported, which may result in returned shipments. In the period 1993-1994, one food exporter in Shandong lost 30 million yuan RMB as a result of returning goods. Another limitation to export trade is that China's processed peanut products are not as competitive as the same products from other technologically advanced countries.

6.3 Possible means to overcome the constraints

In order to maintain the consistency of growth of peanut production in China, following measures are suggested.

Stabilization of area under cultivation: Cultivation in already peanut dominated area has to be maintained whereas it can also be extended in newer dispersed areas. There is a general tendency to convert land under peanut to industrial purposes. This tendency has to be discouraged.

Adoption of improved varieties and technologies: The current level of production has been achieved mostly by promotion of improved varieties and adoption of improved packages of cultivation practices. Widespread adoption of existing but underutilized technologies would greatly increase peanut utilization and export trade. Although the importance of mechanization and commercialization is consistently emphasized in agricultural development, the increased

mechanization has created new serious environmental problems drawing the attention of Chinese agricultural policy makers.

Improved marketing: Improvement in peanut processing and marketing would help boost the peanut production in the country.

To sum up, despite these constraints China has been consistently making progress in peanut production.

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