The World Chickpea and Pigeonpea Economies

Facts, Trends, and Outlook

International Crops Research Institute for the Semi-Arid Tropics

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Abstract

Globally chickpea and pigeonpea are third and fifth most important pulse crops mainly grown in the developing countries by resource-poor farmers in drought prone areas and on degraded soils. Chickpea is traditionally grown in temperate areas while pigeonpea is mainly grown in the tropics. South Asia accounts for bulk of production of both these pulses. During the last 20 years there has been some diversification in area and production as reflected in the internationality index of these crops.

Considerable progress has been achieved in developing improved short- and medium-duration varieties of chickpea and pigeonpea that fit specific niches in the cropping pattern. Fallow areas were brought under chickpea cultivation as the crop could now escape terminal drought. Short- and medium-duration pigeonpea varieties resistant to diseases enabled double cropping leading to an increase in farm income. However, large-scale adoption could not be sustained due to several socioeconomic and technological constraints.

Low productivity growth of chickpea and pigeonpea has resulted in declining or stagnant per caput availability of these pulses in the major producing regions. An important policy question is whether the decline in per caput availability of pulses is a supply or demand constraint. In the short to medium term, supply would be more constrained than demand for both chickpea and pigeonpea. Population and income growth and positive income elasticity of demand would ensure present levels of consumption. In the long run demand would be more constrained due to changes in tastes, preferences, and urbanization.

Chickpea and pigeonpea complement cereals in production and consumption. Their overall benefits extend much beyond generating income to resource-poor farmers. For the long run sustainability of the system improvement in production through improved varieties resistant to pests and diseases and better agronomic management should continue in the future.

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P K Joshi, P Parthasarathy Rao, C L L Gowda, R B Jones, S N Silim, K B Saxena, and Jagdish Kumar

ICRISAT
International Crops Research Institute for the Semi-Arid Tropics
Patancheru 502 324, Andhra Pradesh, India

2001

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Contents

Executive Summary

"Facts and Trends" reports of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) serve as important resource material for scientists in the international agricultural research centers (IARCs) and national agricultural research systems (NARS), extension personnel, and policy makers. These reports provide information on trends in production, trade, and utilization and help establish the current outlook for ICRISAT mandate crops in different regions. This report reviews the trends in chickpea and pigeonpea, the two ICRISAT mandate pulses.

Globally chickpea and pigeonpea are third and fifth most important pulse crops respectively mainly grown in the developing countries by resource-poor farmers in drought prone areas and on degraded soils. Chickpea is traditionally grown in temperate areas while pigeonpea is mainly grown in the tropics. Both the crops are environmentally friendly and they sustain soil productivity. Thus the benefits of these crops extend beyond income to farmers and to the farming system.

Information on area and production of pigeonpea is inadequate since in several countries in Africa, Latin America, and the Caribbean it is grown as a backyard crop and does not enter official statistics. Based on official statistics both chickpea and pigeonpea area witnessed some dynamic changes during the last two decades. South Asia accounts for bulk of production of both these pulses; however, there has been some diversification in area and production during the last 20 years as is reflected in the increase in internationality index of these crops.

During the last 20 years growth in world chickpea production (2% per annum) was mainly due to increase in area with modest increase in yields. Commercial production of chickpea started in early 1980s in Australia mainly targeting the export markets in the Indian subcontinent and Gulf countries. Production grew by 20% in the 1980s and subsequently stabilized around 5%. Production increased in West Asia too, where chickpea area expanded in fallow areas, taking advantage of favorable government policies. The expansion slowed down in the 1990s, as the policies could not be sustained. In recent years chickpea area is further diversifying with new niches in USA and Canada because of the need for crop diversification and to provide farmers with additional income.

In South Asia dramatic shifts in chickpea area occurred during the 20-year period although absolute area remained stagnant. For example, in India with the expansion of irrigation and advent of improved varieties of wheat and later rapeseed and mustard, chickpea area descended to central and western India and subsequently with the availability of improved short- and medium-duration varieties (that mature early and thus escape drought stress) to hot and dry areas of peninsular India. These changes represent a significant shift in the center of production in India. While 70% of chickpea area was concentrated in the five northern states of India in mid-1970s, in the triennium 1996–98 central and southern states accounted for more than 55% of the area.

Pigeonpea production increased on an average by only 1% per annum. Large area expansion under the crop in the 1980s mainly in South Asia (particularly India) was an important contributing factor. Increase in real pigeonpea prices relative to competing crops and availability of improved short- and medium-duration varieties that allow sole cropping of pigeonpea were the main driving forces. Like Australia for chickpeas, Myanmar expanded its pigeonpea area and production to meet the growing demand for pigeonpea in South Asia. The area expansion went hand in hand with the devaluation of Kyat thus ensuring export competitiveness. Area expansion, though less dramatic, occurred in Kenya and Tanzania. As indicated production statistics on pigeonpea are underestimated since the crop grown in home gardens and consumption of green pigeonpea do not enter production statistics.

Low productivity growth of chickpea and pigeonpea has resulted in declining or stagnant per capita availability of these pulses in the major producing regions. Consequently there has been an increase in real prices of chickpea and pigeonpea relative to prices of cereals, milk, and other protein sources. This in turn has induced consumers to shift to cheaper sources of protein. Deficits in production particularly in South Asia are being met through imports.

Several factors contribute to the low overall productivity growth of these crops. In many developing and developed countries government policies play an important role in influencing area planted to pulses. In 1970s and 1980s government policies favored cereals to achieve food security. A combination of policy and technology played a key role in area expansion of chickpea in Australia and Turkey and pigeonpea in Myanmar.

There has been considerable progress in developing improved short- and medium-duration varieties of chickpea and pigeonpea that fit specific niches in the cropping pattern. Fallow areas were brought under chickpea cultivation as the crop could now escape terminal drought. Short- and medium-duration pigeonpea varieties resistant to diseases enabled double cropping leading to an increase in farm income. However, large-scale adoption could not be sustained due to several constraints. Area expansion was generally in the less favorable lands pushing these crops to marginal environments thus increasing the risks of production. Both the crops are also prone to a number of biotic stresses, which further reduce yields. Many times yield increases have not been able to match breakthroughs in productivity of competing crops such as wheat, oilseeds, or companion crops (in pigeonpea intercropping systems).

Among the socioeconomic factors, non-availability of improved seed is one of the key constraints to pigeonpea production in southern and eastern Africa. The fact that farmers can save their own seed is strong disincentive to the involvement of formal seed sector. Without a clear profit incentive the private sector will not invest in the seed sector. Lack of processing technology at the village level is another production constraint for pigeonpea.

Unlike peas and beans where feed grain accounts for a large proportion of the world trade, chickpea and pigeonpea are mainly traded for food use. Chickpea accounts for 10% of total pulse trade. The major countries that export chickpea are Australia for desi types and Turkey, Mexico, and Canada (in recent years) for kabuli types. Trade in pigeonpea is relatively low and official trade statistics (particularly from eastern and southern Africa) grossly underestimate export statistics.

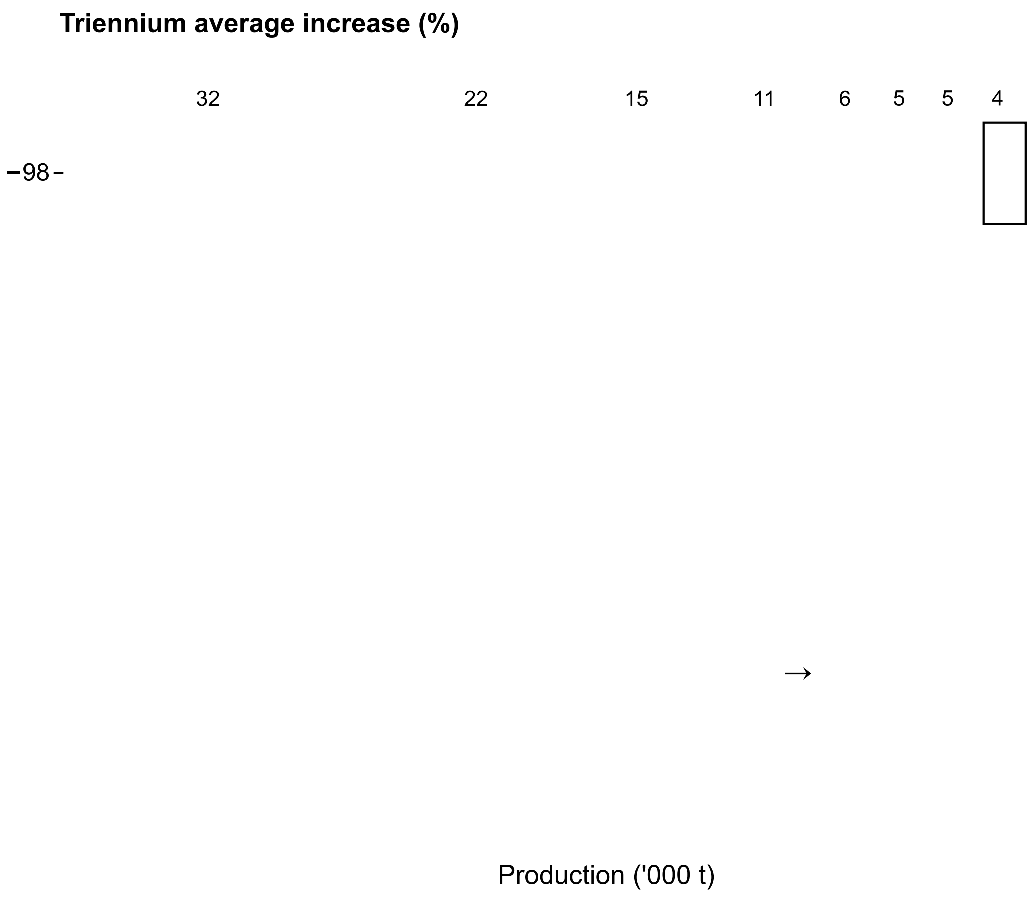
South Asia, mainly India, is the major importer of chickpea and pigeonpea. Although imports to India have expanded during the past 15 years the increase has not been steady over the years. For example, chickpea imports to India peaked in 1987, a drought year (215,000 t) and again in 1997 when more than 300,000 t were imported. In other years it has fluctuated from 14,000 t (1995) to 150,000 t (1993). In recent years Canada has displaced Australia as the leading chickpea exporter to India. There is thus intense competition for the Indian market and this will intensify in future. Recent import data for pigeonpea suggests a decline in imports from 139,000 t in 1996, stabilizing around 50,000–60,000 t. Myanmar is the major exporter although exports from eastern Africa are grossly underestimated.

An important policy question is whether the decline in per caput availability of pulses is a supply or demand constraint. In the short- to medium-term, supply would be more constrained than demand for both chickpea and pigeonpea. Population and income growth and positive income elasticity of demand (though less than 1) would ensure present levels of consumption. However, as the per caput availability of pulses was declining, consumers have shifted to other sources of protein that had become relatively cheaper than pulses due to technological progress. Even in a country like India with a large vegetarian population per caput protein from animal sources is increasing faster than that from pulses. Thus in the long run demand would be more constrained due to changes in tastes, preferences, and urbanization. This trend is likely to intensify as incomes rise, and consumers particularly in the higher income group become more discerning.

In developed countries in contrast proteins from pulses constitute a small proportion of total protein consumption. This is expected to increase marginally since for the small but growing vegetarian population chickpea/pulses would be important in achieving a balanced diet, low in fat and cholesterol but rich in fiber.

As incomes rise the future growth in market will be for improved and value-added quality products and to meet the specific requirements of niche markets (e.g., chickpea as health and snack food in Europe, North America, and Australia; and green pigeonpea in UK and West Indies). Even for the traditional chickpea markets (whole seed and dhal) for low-income consumers, quality standards would have to be improved while keeping the product competitive with other protein sources.

Chickpea and pigeonpea complement cereals in production and consumption. Their overall benefits extend much beyond generating income to resource-poor farmers. For sustainability of the system, improvement in production through improved varieties and better agronomic management should continue in the future.


Triennium average increase (%)
32
22
15
11
6
5
5
4
−98−
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Production ('000 t)

(N) fixation (up to 20–40 kg N ha^{-1} by chickpea and 40 kg N ha^{-1} by pigeonpea), improve soil organic matter through leaf fall and root decomposition, enhance soil physical conditions, and facilitate accessibility of immobilized soil phosphorus. These crops are largely grown in the developing countries by resource-poor farmers in drought prone areas and where soils are degraded.

From the consumers' point of view both crops are a good source of protein and complement diets of resource-poor people, which are high in carbohydrates. In addition to being grown for home consumption they are a source of income and are traded in both domestic and international markets.

Presently the massive application of fertilizers on cereal crops is leading to unsustainable production in several regions, which in turn is leading to environmental imbalance. Consumers are demanding organic farm products. Both chickpea and pigeonpea are environmentally friendly and they sustain the productivity of soils. Thus the benefits of these crops extend beyond income to farmers and to the farming system.

Several issues confront these crops. A few issues mentioned below are addressed in this report.

- Lack of large-scale adoption of improved technologies for chickpea and pigeonpea has been reflected in stagnant overall average yields despite impressive area growth and yield increases in selected pockets. Are stagnant yields a reflection of inappropriate technology, shift of the crops to more marginal areas, or failure of the seed system?
- There has been a decline or near stagnation in per caput availability of chickpea and pigeonpea during the last 10–15 years in the major consuming countries. Are we dealing with supply or demand constraint?
- In the future, will the markets for chickpea and pigeonpea be more for value-added products and superior quality seed attracting price premiums?
- In the past, growth in imports from countries in South Asia due to shortfall in domestic production led to new production niches for both chickpea and pigeonpea. Will the trend of increasing imports continue in the near future? What will be the medium- and long-term implications for production?

This report collates available information on the global status of these two pulse crops, and their utilization pattern, trade, technological development, and medium-term outlook—Part I covers chickpea, and Part II pigeonpea.

Part I: Chickpea

Introduction

By the end of the 20th century, chickpea was the third most important pulse crop in the world after dry bean and dry pea. The crop has an ancient history. The oldest chickpea finds are from excavations at Hacilar near Burdur in Turkey, and estimated by the carbon-dating method to date from about 5450 BC (van Rheenen 1991). There are reports that Hellenes took the crop westwards from Turkey to the Mediterranean region, and eastwards to West Asia and the Indian subcontinent. Singh et al. (1997) reviewed the origin and distribution of chickpea, and concluded that the earliest record of chickpea in India dates from 2000 BC, in Uttar Pradesh, and seed remnants from 300 BC to 100 BC were found near Aurangabad. The review reported that chickpea spread with human movement toward the west to the Mediterranean basin and south towards the Indian subcontinent via Silk Route (Afghanistan). In Ethiopia the earliest finding of chickpea is reported in 1520 BC. The Spanish and Portuguese introduced chickpea to the New World around 1500 AD, and kabuli chickpea (*garbanzo* bean) is of recent origin in India (1500 AD). Commercial cultivation of chickpea in Australia started only two decades ago.

There are two main types of chickpea: desi, which constitutes about 85% and kabuli, which accounts for the remaining 15% of the total grain production (Jambunathan and Singh 1990). Kabuli type has white flowers and relatively large cream seeds with a thin testa. Desi type usually has purple flowers, and relatively small, wrinkled, brown/dark brown seed with thick seed coat (van Rheenen 1991). Desi types are primitive while the kabuli types are of more recent origin (Gowda et al. 1990).

Chickpea is a temperate crop, but is grown more in the subtropical areas of the world. More recently, the cultivation of the crop has moved to tropical areas where it is grown under cool temperatures. Among the cool season grain legumes, chickpea is believed to be the most drought resistant. It is able to produce reasonable yields under low input and marginal environments. Under irrigated condition, the crop yields up to 5 t ha^{-1}. The ability to grow under harsh and low input environments and under available moisture supply allows the crop to be grown by both resource-poor and commercial farmers. Chickpea has many beneficial characteristics. The high protein content of the seed plays a vital role in contributing to a balanced human diet. The symbiotic N-fixation (derives >70% of its N requirement with N-fixation) contributes to the improvement of soil fertility. Nutritionally, chickpea is relatively free from various antinutritional factors, has a high protein digestibility, and is richer in phosphorus and calcium than other pulses (Saxena 1990). Chickpea also holds great promise as a protein and calorie source for animal feed for both ruminants and non-ruminants.

Crop Distribution

About 95% of the total chickpea area is in developing countries (Fig. 2). South and West Asia regions account for about 90% of the world chickpea production (Table 1 and Fig. 3). India, Pakistan, Turkey, Iran, and Syria are major producers in this region. In Africa, the major producers of the crop are Ethiopia, Malawi, Morocco, and Tanzania, accounting for about 80% of total chickpea production in the continent. Latin America accounts for about 3% of total chickpea production with Mexico accounting for 99% of the area under the crop (see Appendix 1 for detailed statistics at country and regional levels).

Production in developed countries was confined to Australia, Spain, and Portugal. Chickpea is also grown in USA (15,000 ha) and more recently its area is expanding in Canada (about 250,000 ha); however, FAO (Food and Agriculture Organization of the United Nations) statistics do not report area under chickpea for these countries. Australia emerged as an important chickpea-growing country. The crop was grown mainly for export and found niches in about 242,000 ha in 1996–98. Most of the chickpea in Turkey, Syria, Mexico, USA, and Canada is kabuli type while in India, Pakistan, Iran, and Australia it is largely desi type.

In the triennium 1996–98 about 92% of chickpea area was concentrated in six countries (excluding Canada): India, Pakistan, Turkey, Iran, Australia, and Mexico (Fig. 4). The Simpson Index of Diversity for chickpea, which measures the internationality, i.e., the extent of diversification of a crop across countries increased from 0.40 in 1970–72 to 0.56 in 1996–98, indicating that chickpea area has spread or diversified to new areas in the last two decades. For example, chickpea was a new crop in Australia, and chickpea area in China and

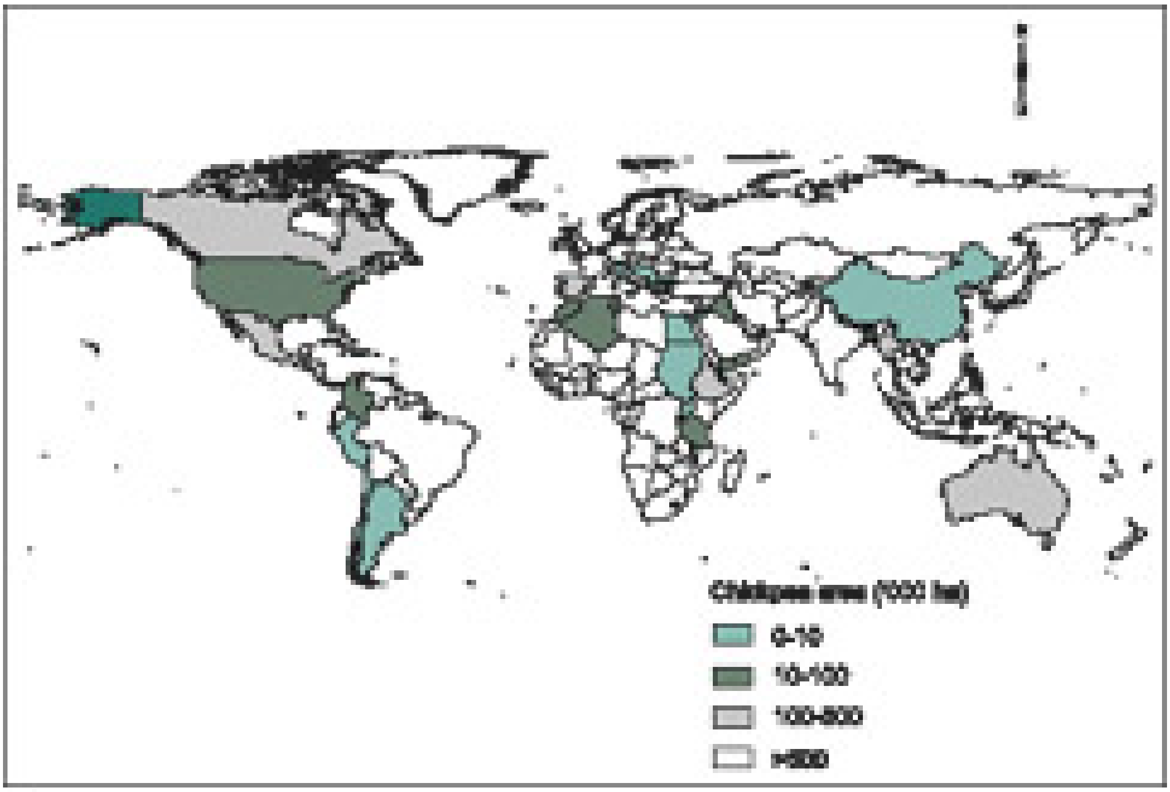


Figure 2. Global distribution of chickpea (Source: FAO, Rome, Italy).

Myanmar was increasing. The share of West Asia has increased from 8% to 13% during the last two decades while the share of South Asia has declined from 81% to 75%. In recent years chickpea area is further diversifying due to area expansion in Canada and USA.

India was a major chickpea producer in 1996–98, accounting for 66% of world production and 88% of production in South Asia. In India, chickpea is grown in winter mainly under residual moisture supply, in the northern and central region of the country. With the introduction of improved varieties of wheat (*Triticum aestivum* L.), and irrigation and high input use technology in the northern region, chickpea area gradually shifted southward towards the central region and in recent years to some non-traditional areas in the southern region, characterized as hot and dry regions.

Production Trends

Area

In 1996–98, worldwide chickpea was grown in about 11.2 million ha. During 1980–98 (some data are of 1981–98), chickpea area expanded by 1.6 million ha (Table 1 and Fig. 5), an annual compound growth rate of 0.9% (Table 2). The dynamics of area changes were, however, different in the two decades. During 1980–90, the overall growth in area was stagnant despite impressive growth in selected regions. In Oceania (Australia) where chickpea production went into commercial production, the area was negligible in the early 1980s and increased to 193,000 ha in the early 1990s. The most important factor contributing to the expansion of chickpea area was the opening up of export markets to the Indian subcontinent in the mid-1980s (Siddique et al. 2000). In West Asia, during 1980–91, about 1 million ha additional area was brought under chickpea cultivation (mainly Iran, Turkey, Syria), an annual increase of 12.1%. It is attributed to the research and extension efforts in the West Asia and North Africa (WANA) region, which aimed at better utilization of fallow areas, and attractive subsidies on exports especially in Turkey (Kusmenoglu and Meyveci 1992). However, the increase in area in Oceania and West Asia did not result in substantial overall increase in area under chickpea because of the decline in area in South Asia, particularly in India, during the same period.

Table 1. Chickpea area, yield, and production[1].

	Area ('000 ha)			Yield (kg ha^{-1})			Production ('000 t)		
Country	1980–82	1990–92	1996–98	1980–82	1990–92	1996–98	1980–82	1990–92	1996–98
Developing countries	9477.4	9950.2	10854.9	579.9	697.0	734.6	5495.5	6935.1	7974.4
Africa	385.2	465.3	475.5	639.1	612.7	612.4	246.2	285.1	291.2
Algeria	39.9	40.0	31.7	350.9	542.5	596.2	14.0	21.7	18.9
Egypt	8.6	5.5	5.6	1558.1	1818.2	1857.1	13.4	10.0	10.4
Ethiopia PDR	152.8	130.5	186.5	808.9	872.0	687.9	123.6	113.8	128.3
Malawi	27.5	101.3	96.0	654.5	388.0	409.4	18.0	39.3	39.3
Morocco	52.7	80.0	57.8	641.4	632.5	731.8	33.8	50.6	42.3
Sudan	0.8	1.6	5.5	1125.0	1000.0	1509.1	0.9	1.6	8.3
Tanzania	28.3	63.0	65.0	293.3	328.6	373.8	8.3	20.7	24.3
Tunisia	70.1	37.0	21.7	452.2	651.4	746.5	31.7	24.1	16.2
Uganda	4.0	6.3	5.6	575.0	507.9	500.0	2.3	3.2	2.8
Southeast Asia	134.7	153.4	142.2	732.7	691.7	733.5	98.7	106.1	104.3
China	NA[2]	NA	1.5	NA	NA	2466.7	NA	NA	3.7
Myanmar	134.7	152.9	140.7	732.7	689.3	715.0	98.7	105.4	100.6
South Asia	8281.7	7689.8	8477.8	547.9	674.3	737.6	4537.6	5185.4	6253.0
Bangladesh	124.0	97.2	84.6	655.6	705.8	722.2	81.3	68.6	61.1
India	7145.7	6523.9	7266.1	575.0	547.9	674.3	4108.8	4564.9	5495.6
Nepal	54.3	27.4	19.0	604.1	655.6	705.8	32.8	16.6	13.7
Pakistan	957.7	1041.3	1108.0	328.6	514.0	616.1	314.7	535.2	682.6
West Asia	486.8	1491.2	1615.1	912.5	784.1	692.1	444.2	1169.3	1117.8
Cyprus	0.6	0.1	0.1	666.7	1000.0	1000.0	0.4	0.1	0.1
Iran	154.5	520.7	745.1	662.8	451.5	401.3	102.4	235.1	299.0
Iraq	18.8	6.6	12.2	648.9	666.7	696.7	12.2	4.4	8.5
Israel	2.5	4.5	5.2	1400.0	1577.8	1538.5	3.5	7.1	8.0
Jordan	2.3	3.8	3.1	695.7	763.2	677.4	1.6	2.9	2.1
Lebanon	2.2	4.4	4.8	1227.3	1863.6	2312.5	2.7	8.2	11.1
Syria	77.6	65.2	103.6	748.7	704.0	646.7	58.1	45.9	67.0
Turkey	228.3	860.0	710.3	1153.3	963.1	963.0	263.3	828.3	684.0
Yemen	NA	26.0	30.7	NA	1434.6	1237.8	NA	37.3	38.0
Latin America and Caribbean	190.5	154.9	149.5	900.8	1267.3	1446.2	171.6	196.3	216.2
Argentina	3.8	2.7	2.4	842.1	888.9	1000.0	3.2	2.4	2.4
Chile	15.6	11.2	7.3	474.4	1000.0	931.5	7.4	11.2	6.8
Colombia	23.0	23.0	NA	478.3	478.3	NA	11.0	11.0	NA
Mexico	144.9	114.6	138.1	1019.3	1473.8	1483.0	147.7	168.9	204.8
Peru	2.4	2.9	1.3	750.0	862.1	1461.5	1.8	2.5	1.9
Developed countries	148.2	289.1	403.0	624.8	934.3	840.7	92.6	270.1	338.8
Europe	145.7	88.7	154.7	610.8	739.6	603.1	89.0	65.6	93.3
Bulgaria	1.0	5.1	4.0	900.0	921.6	1000.0	0.9	4.7	4.0
Greece	12.5	2.3	1.8	1064.0	1695.7	1222.2	13.3	3.9	2.2
Italy	13.2	4.4	3.2	1166.7	1045.5	1156.3	15.4	4.6	3.7
Portugal	33.0	23.3	21.0	324.2	489.3	414.3	10.7	11.4	8.7
Spain	84.2	52.5	124.2	558.2	769.5	599.0	47.0	40.4	74.4
Yugoslav SFR	1.8	1.1	0.5	1000.0	545.5	800.0	1.8	0.6	0.4
Oceania	0.0	192.6	242.0	0.0	1016.6	978.1	0.0	195.8	236.7
Australia	0.0	192.6	242.0	0.0	1016.6	978.1	0.0	195.8	236.7
World	9625.6	10239.3	11257.9	580.5	703.7	738.4	5588.1	7205.2	8313.3

1. Data are 3-year averages.
2. NA = Data not available.

Source: Calculated using FAOSTAT data.

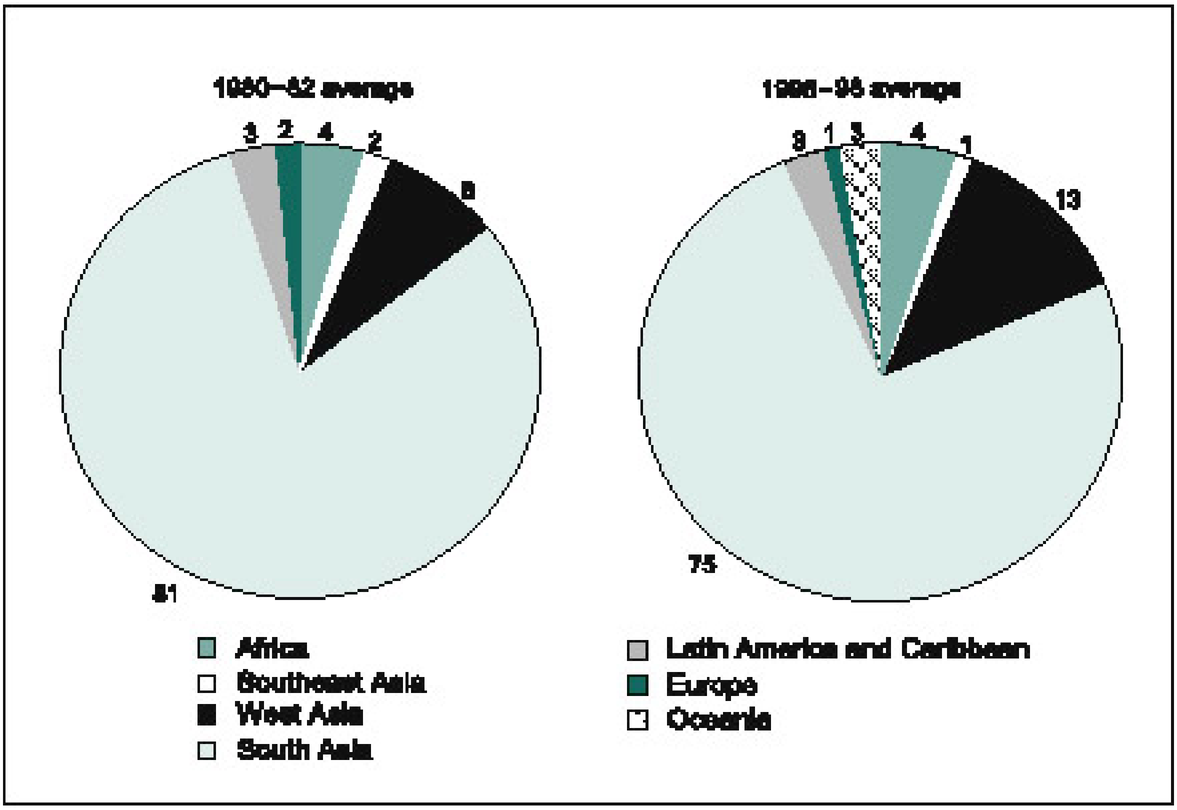


Figure 3. Share (%) of chickpea-producing regions (Source: FAOSTAT).

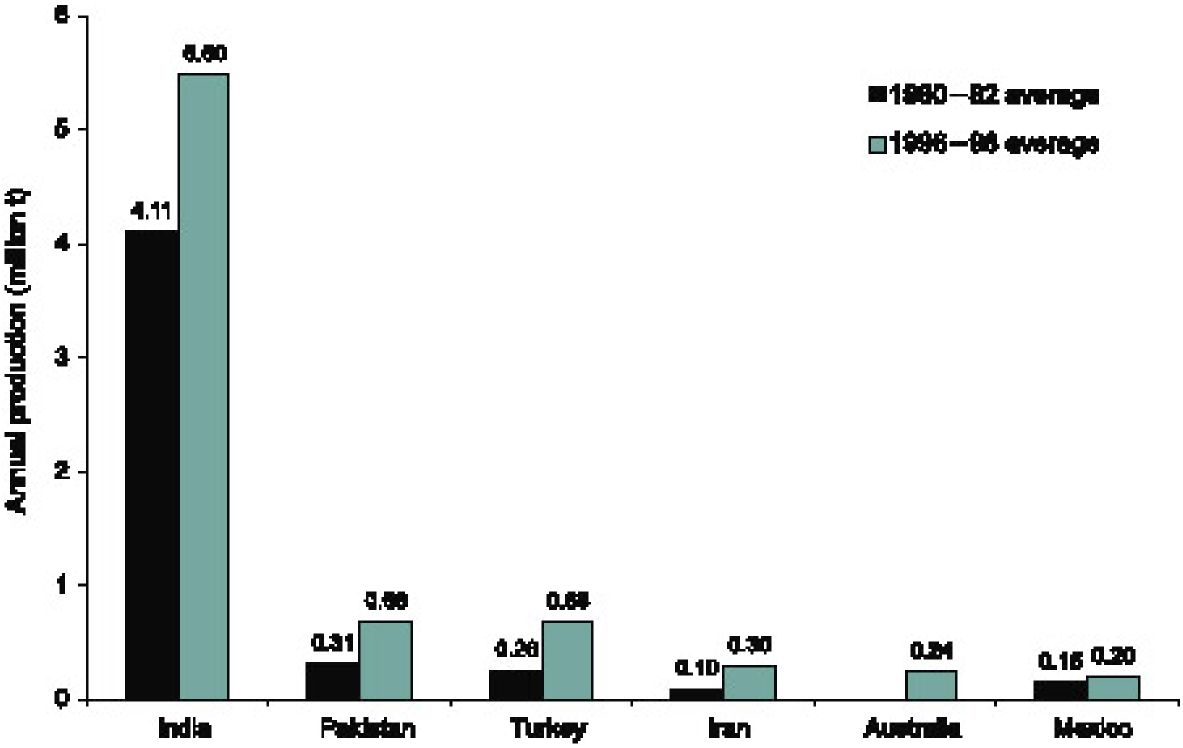


Figure 4. The world's major chickpea producers (Source: FAOSTAT).

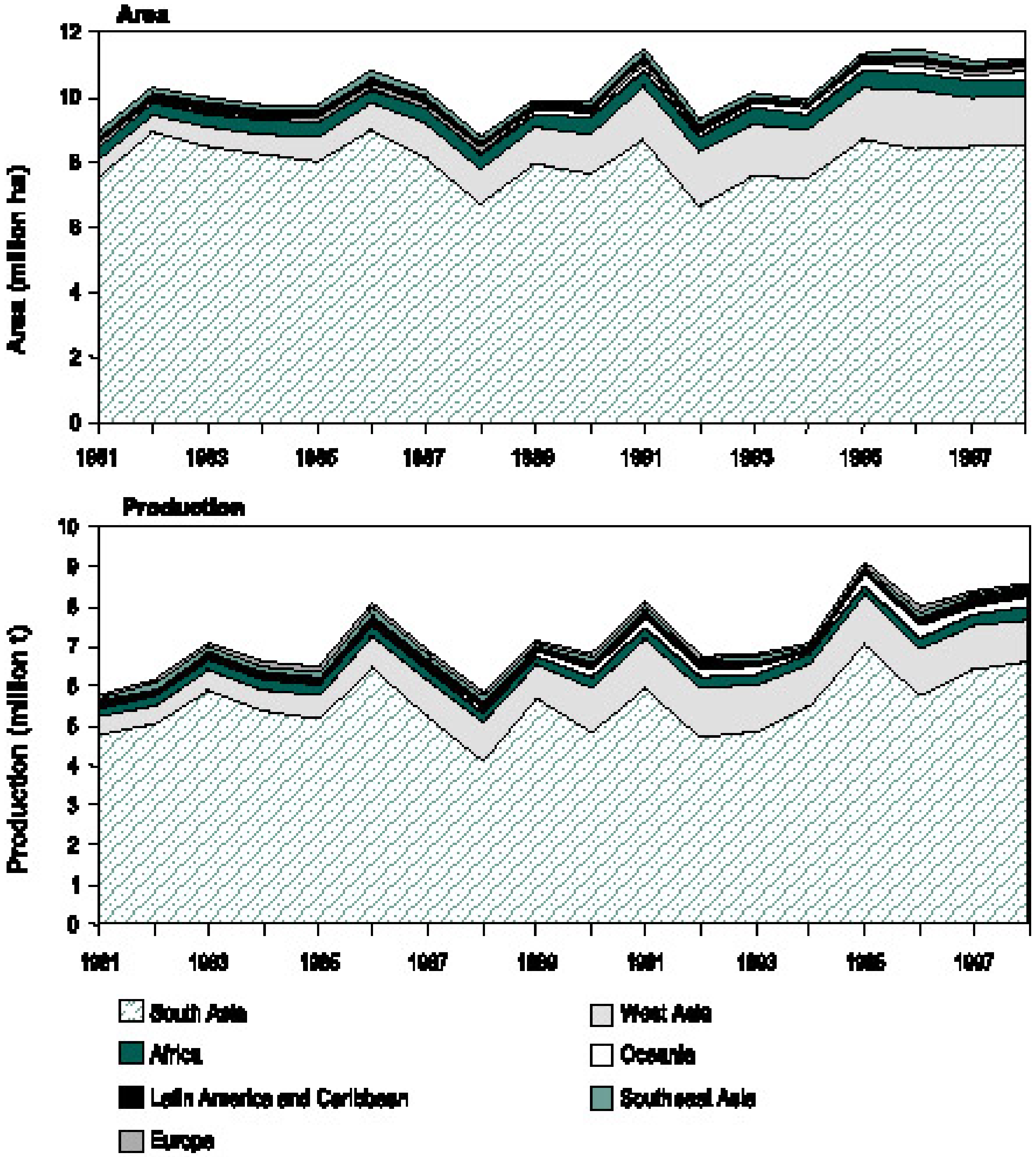


Figure 5. Global trends in chickpea area and production (Source: FAOSTAT).

In India and parts of South Asia rapid technical change in cereal production displaced chickpea from favored areas. These changes are attributed to crop substitution by more profitable postrainy season crops such as wheat, rape (*Brassica napus* L.), and mustard (*Brassica* sp L.) under irrigation and a decline in area under dryland crops due to increase in irrigated area (Kelley and Parthasarathy Rao 1994, 1996). Prior to 1971, five northern states of India with good rainfall and irrigation accounted for 70% chickpea area. However, by 1990, area in the northern states decreased and was the same as that in the more marginal central and southern regions.

The area under chickpea during 1990–98 increased rapidly with additional 1 million ha brought under the crop. However, as in the 1980s increase in area varied from region to region. In West Asia, the increase was only 0.1 million ha, an annual growth of only 0.4% during 1991–98

Table 2. Chickpea annual compound growth rate (%) of area, production, and yield during 1981–98.

	Area			Yield			Production		
Country	1981–90	1991–98	1981–98	1981–90	1991–98	1981–98	1981–90	1991–98	1981–98
Developing countries	0.0	1.3	0.7	0.9	1.3	0.8	0.9	2.6	1.6
Africa	1.7	0.0	1.5	–1.1	0.2	–0.2	0.6	0.1	1.2
Algeria	1.3	–4.9	–1.9	5.1	–0.5	4.6	6.4	–5.3	2.6
Egypt	–3.9	–1.7	–2.7	2.5	0.7	1.2	–1.5	–1.1	–1.5
Ethiopia	–2.3	5.6	1.6	–0.5	–4.0	–0.1	–2.7	1.3	1.4
Malawi	14.5	0.1	9.4	–6.7	1.0	–3.0	6.8	1.0	6.1
Morocco	3.1	–5.3	0.9	1.0	8.7	–0.3	4.1	2.9	0.6
Sudan	11.2	26.1	11.9	–2.3	6.6	3.2	8.6	34.5	15.5
Tanzania	11.1	1.6	3.0	0.9	2.5	0.6	12.0	4.1	3.7
Tunisia	–9.7	–12.1	–6.7	3.5	3.0	1.4	–6.5	–9.5	–5.4
Uganda	3.9	–0.3	1.0	–3.3	–0.3	–1.9	–0.4	–0.6	–0.8
Southeast Asia	–3.1	–3.3	–1.9	0.7	2.5	–1.2	–2.5	–0.9	–3.1
China	NA[1]	–2.0	–2.0	NA	17.6	17.6	NA	15.2	15.2
Myanmar	–2.6	–3.2	–2.0	0.3	1.6	–1.3	–2.3	–1.6	–3.4
South Asia	–1.1	2.9	0.0	0.7	2.0	1.2	–0.4	4.8	1.1
Bangladesh	–2.1	–1.9	–2.4	0.0	0.2	0.2	–2.1	–1.7	–2.2
India	–1.9	3.2	–0.2	1.4	1.5	1.2	–0.5	4.8	1.0
Nepal	–8.8	–6.4	–5.9	–0.4	3.6	0.8	–9.1	–3.0	–5.1
Pakistan	0.8	1.5	1.3	3.7	5.4	1.2	4.6	6.9	2.6
West Asia	12.1	0.4	8.1	–0.6	–1.7	–1.6	11.6	–1.3	6.4
Cyprus	–7.4	2.8	–7.4	5.1	10.4	5.3	–2.7	13.5	–2.5
Iran	5.5	3.5	11.4	–5.4	–2.1	–2.7	–0.1	1.3	8.4
Iraq	–19.0	5.2	–1.4	0.6	1.3	–0.7	–18.4	6.5	–2.1
Israel	11.1	2.4	5.8	0.7	–0.5	1.0	11.8	1.9	6.8
Jordan	–0.1	–6.4	4.5	1.6	–2.2	1.3	1.4	–8.5	5.8
Lebanon	9.6	1.2	6.1	1.6	3.1	5.3	11.3	4.3	11.7
Syria	–2.6	7.5	2.0	–5.2	–2.6	–0.4	–7.7	4.7	1.6
Turkey	17.6	–3.4	7.0	–1.3	0.5	–0.9	16.1	–2.9	6.1
Yemen	16.7	4.5	3.3	1.9	–1.6	–1.9	19.1	2.8	1.3
Latin America and Caribbean	–1.8	1.7	–3.0	1.7	2.2	3.1	0.0	3.5	–0.1
Argentina	10.0	0.0	–3.6	–0.2	1.1	0.7	9.8	1.1	–2.9
Chile	–2.0	–10.5	–3.1	5.1	–4.1	5.7	3.0	–14.1	2.4
Colombia	0.0	–21.7	–2.4	0.0	–0.2	0.0	0.0	–21.8	–2.5
Mexico	–2.3	6.2	–2.3	1.9	–0.2	2.6	–0.5	6.0	0.2
Peru	4.3	–12.8	–2.9	0.8	7.4	3.5	5.1	–6.4	0.5
Developed countries	6.6	6.5	7.2	7.3	–2.1	1.8	14.4	4.2	9.2
Europe	–4.1	11.9	–0.6	2.8	–3.8	–0.5	–1.2	7.7	–1.1
Bulgaria	18.3	2.5	12.1	5.7	0.0	–0.1	25.0	2.5	12.0
Greece	–14.4	–3.9	–10.7	0.7	–5.0	1.7	–13.7	–8.8	–9.2
Italy	–10.7	–4.6	–9.5	–2.6	0.6	–0.2	–13.0	–4.1	–9.6
Portugal	–3.5	–1.1	–2.0	6.3	–1.4	0.9	2.5	–2.5	–1.1
Spain	–3.2	18.7	0.7	4.3	–4.7	0.0	0.9	13.1	0.7
Yugoslav SFR	–5.6	–7.4	–10.0	–2.9	1.6	–2.6	–8.3	–5.8	–12.3
Oceania	69.5	4.4	27.0	0.6	–0.2	–1.5	70.5	4.3	25.0
Australia	69.5	4.4	27.0	0.6	–0.2	–1.5	70.5	4.3	25.0
World	–0.2	2.4	0.9	1.5	1.3	0.9	1.3	3.7	1.8

1. NA = Data not available.

Source: Calculated using FAOSTAT data.

(Table 2). The program on fallow area replacement was not sustainable due to fiscal stringency of 1990s (Byerlee and White 2000). In Oceania area expansion continued in the 1990s but at a slower rate. In contrast, in South Asia, which recorded annual decline of 1.1% during 1980–91, the trend reversed and chickpea area expanded at an annual rate of 2.9% during 1991–98 from 7.7 to 8.5 million ha. India and Pakistan accounted for bulk of the area expansion. Chickpea competitiveness in the central and southern regions of India improved due to higher prices of chickpea more than offsetting smaller yield differences between chickpea and its competing crops (Kelley and Parthasarathy Rao 1994). With the availability of improved varieties the expansion was mainly in the non-traditional chickpea-growing areas. In Bangladesh, the total chickpea area declined in the traditional areas but production shifted to the rice (*Oryza sativa* L.)-fallow areas of the high Barind region due to availability of short-duration varieties of both rice and chickpea.

In Africa chickpea area increased by 23% during 1980–98, from 385,000 ha in 1980–82 to 475,000 ha in 1996–98. Ethiopia, Malawi, and Tanzania led this increase. Chickpea does not compete for land with most other crops in Tanzania as it is grown on postrainy fallow lands (Pundir et al. 1996).

Chickpea area declined in Europe and Latin America. The exception was Spain, where the area increased, particularly in the 1990s after the setting up of a support scheme in 1989. Chickpea area also expanded in USA, largely in the Palouse region and California. The value of legumes in the predominantly cereal-based rotations has been a major factor. In Canada chickpea production has taken off recently. Production in western Canada has increased in recent years because of the need for crop diversification and to provide farmers with additional income. For many years in Canada transport costs to producers were subsidized until it was withdrawn in 1995. Seed producers and companies are now looking for high value and low volume crops like pulses (McVicar et al. 2000, Muehlbauer and Slinkard 2000). Nearly all of the production in USA and Canada is kabuli type, but about 20% of the production in Canada is desi type.

Yield

Compared to cereals and other pulses, globally there has not been a significant increase in chickpea yields. Between 1980 and 1998, increase in average yield was only 158 kg ha^{-1} from 580 to 738 kg ha^{-1}, an annual increase of less than 1%. The poor performance in yield increase was mainly due to slow uptake of improved chickpea technologies on a large scale or shift in areas of production to even more marginal and fragile environments. Besides, most of the chickpea is grown under erratic rainfall, poor soil conditions, and receding soil moisture. For example, in Turkey the previously fallow land where chickpea area expanded is generally of much poorer quality than existing cultivated land. Across countries, chickpea yield ranged from 0.4 t ha^{-1} in Malawi, Tanzania, Iran, and Portugal to 2.4 t ha^{-1} in China during 1996–98. In major chickpea-growing countries, the yields ranged between 0.4 t ha^{-1} in Iran and 1.5 t ha^{-1} in Mexico in 1996–98.

In the last two decades, the general trend was stagnant yields, except in Latin America and Caribbean and to some extent in South Asia, where chickpea yields increased (Fig. 6). In Latin America and Caribbean annual yield increase was 3.1%; yield increased from 0.9 t ha^{-1} in 1980–82 to 1.4 t ha^{-1} in 1996–98. Mexico has the highest yield in the world (among major growing countries) since the crop is grown under irrigated conditions and this is reflected in the yields in Latin America. In South Asia availability of improved varieties and their adoption in selected pockets contributed marginally to overall yield growth.

Production

World chickpea production increased from 5.6 million t in 1980–82 to 8.3 million t in 1996–98, an annual growth rate of about 1.8% during 1981–98 (Tables 1 and 2, and Fig. 5). Both area and yield increase albeit marginal (<1%) contributed to this increase. However, the increase in production was mainly in the 1990s (3.7% per annum) compared to 1.3% in the 1980s. At the global level increase in production during the 1980s was mainly due to yield increase as overall area remained stagnant (area increases in some regions were nullified by declines in other regions). In contrast in the 1990s, about 65% of production increase came from area expansion (particularly in South Asia, Latin America and Caribbean, and Europe) and the remainder from increase in productivity. In South Asia production increased in the 1990s mainly in India and Pakistan. Area expansion was the driving force although yield

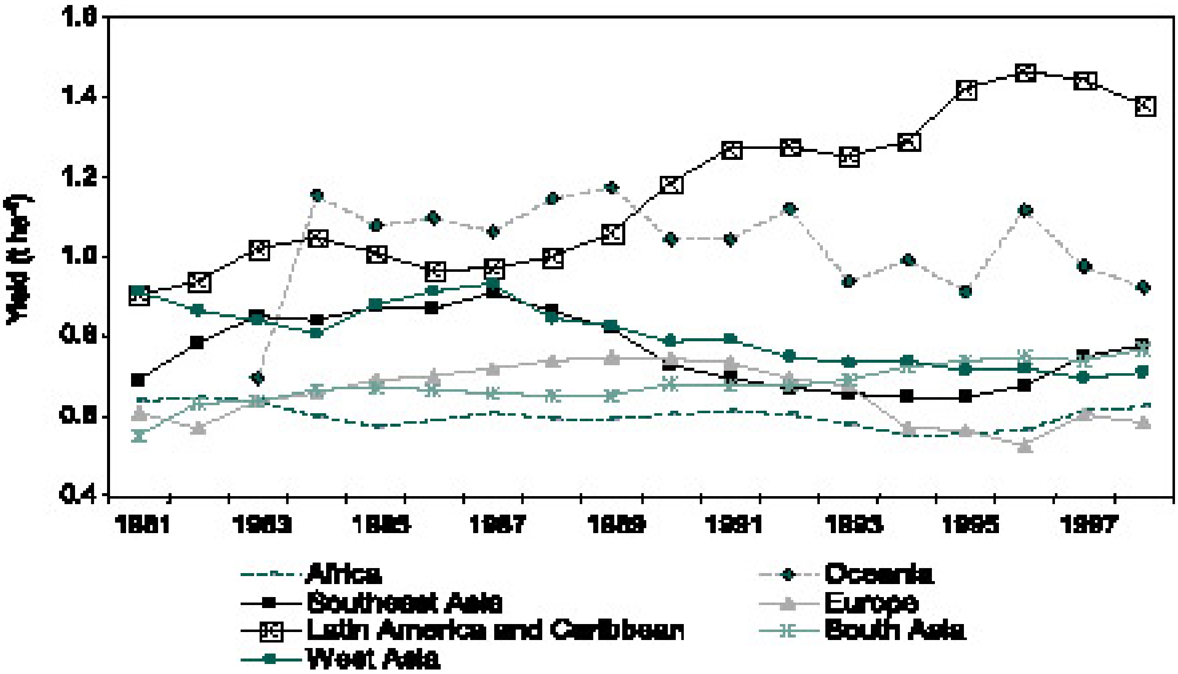


Figure 6. Global trends in chickpea yield, 1981–98 (3-year moving average) (Source: FAOSTAT).

increase also contributed particularly in Pakistan. Short-duration improved chickpea varieties, that overcome heat and moisture stress found niches in the non-traditional areas. Rising prices due to shortfall in the availability of chickpea also contributed to the increasing trend.

Production increased rapidly in Oceania and West Asia mainly due to area expansion. Commercial production of chickpea in Australia is recent but expansion has been rapid (see Box 1). Such dramatic increases in production was mainly due to import demand particularly from South Asia and Gulf countries, and relative profitability of chickpea compared to traditional farming enterprises of wool and wheat (Muehlbauer et al. 1998). About 237,000 t of chickpea was produced in Australia in 1996–98, mainly for export to India, Bangladesh, and Gulf countries. In West Asia, production increased from 0.44 million t in 1980–82 to 1.12 million t in 1996–98, an annual increase of 6.4%. Production mainly increased in Turkey and Iran, the major chickpea producing-countries in West Asia. In Turkey, production increased during 1980s but showed a declining trend in 1990s. The decline in production in Turkey during the 1990s was mainly due to withdrawal of about 50,000 ha area from chickpea production, due to gradual withdrawal and abolition of price subsidy and the guaranteed purchasing program in 1994 (Bayaner et al. 1995).

In Africa, production increased marginally, from 0.25 million t in 1980–82 to 0.29 in 1996–98, an annual increase of 1.2%. Area expansion was the main source of production increase. In Latin America, production increased marginally from 0.17 million t in 1980–82 to 0.21 in 1996–98, mainly due to area expansion in Mexico in the 1990s, which accounts for 95% of the chickpea production in the region. During 1991–98, chickpea production in Mexico increased by 6% annually as the crop was increasingly grown under irrigated conditions. In Europe, chickpea production declined during 1980s but showed an increasing trend in 1990s. Spain, which is the major chickpea producer in Europe, showed an impressive performance during 1990s when production increased annually by 13.1% mainly due to area expansion. It was a result of the European Community (EC) Common Agricultural Policies (CAP) which favored production of pulses, including chickpea, following the CAP reforms in 1993.

Utilization

Food use

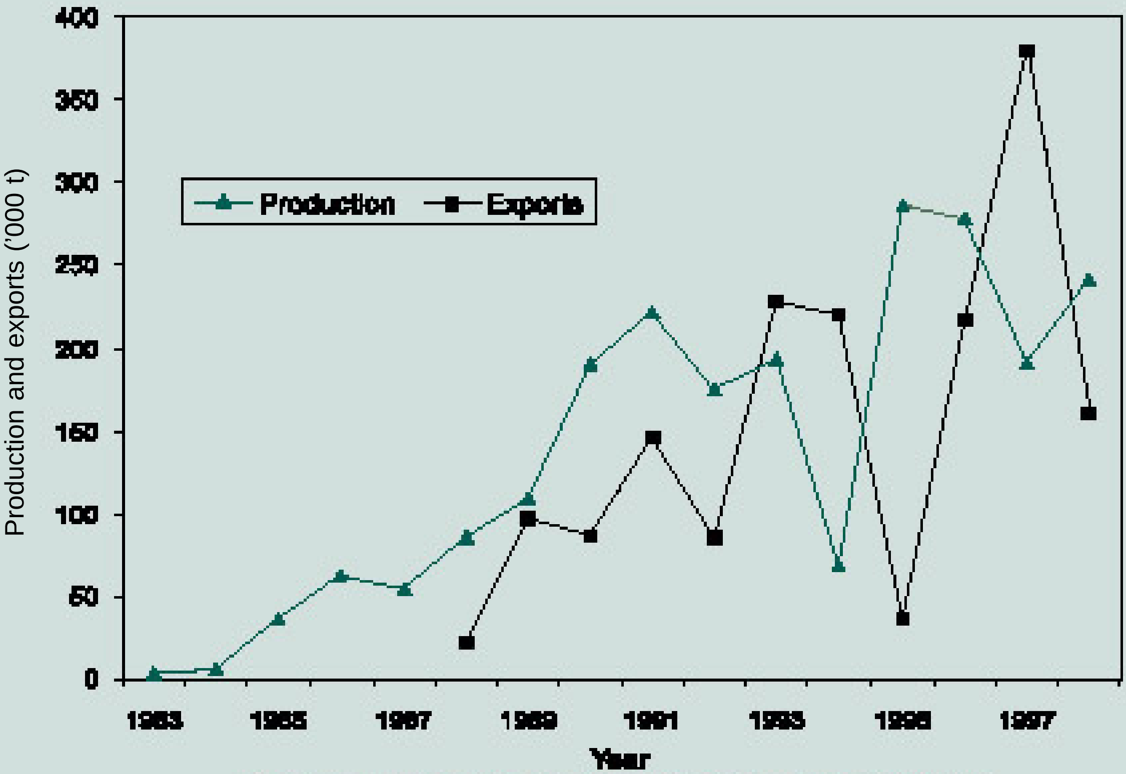
Chickpea forms an important dietary component in those countries in which it is a major crop. As a source of high quality protein, chickpea enriches

Box 1. Chickpea production in Australia

Australia's performance with respect to chickpea production and exports since 1980 has been impressive. Virtually from zero base Australia produces around 250,000 t of chickpea (1996–98) and had emerged as the leading chickpea exporter in the global market. The growing chickpea imports from the countries in South Asia, the largest pulse-consuming region in the world, spurred the Australian Government and the Grain Research and Development Countries (GRDC) to explore the comparative advantage in chickpea for commercial production (Siddique et al. 2000). It soon became evident that Australia has potential for chickpea production, a window of harvest (November to January) coinciding with low pulse supplies in the northern hemisphere and proximity to major pulse markets in South Asia. Investment in pulse research by GRDC increased from a low base to reach US$ 6 million by 1997–98 (Gareaur et al. 2000) (separate figures for chickpea are not available). The research investment was accompanied by the growth of a vibrant pulse crop industry.

In 1978, the Indian desi variety C 235 was released as Tyson in Queensland. A decade later Amethyst the Australian-bred variety was released in New South Wales, followed by several other improved varieties. In 1997 two new varieties Heera and Sona were released. Although seed yields of up to 3 t ha^{-1} were obtained under experimental conditions, average mean yield in farmers' fields was 1 t ha^{-1}. Australia's system of pooling growers' levies from all crops has benefited research activities directed towards a young pulse crop industry. Soon research investments paid off, as Australia emerged as low cost and efficient producer of chickpea able to compete with local market prices in importing countries. Kabuli chickpea too was introduced from former USSR but desi types dominated.

Production increases were largely driven by area increases with yields remaining at around 1 t ha^{-1}. Between 1980 and 1990, area and production increased by about 20% per annum and has since slowed down to around 5.5% per annum. The future of Australian chickpea industry depends to a large extent on sustained growth in demand for chickpea imports in South Asia and Gulf countries. In recent years Australia has been losing its share in world chickpea exports (see figure below). To address the emerging issues the GRDC and Pulse Australia are now focusing on a few core issues that restrict yield, testing of quality standards, and new product development and marketability (Gareaur et al. 2000).



Chickpea production and exports in Australia, 1983–98.

the cereal-based diet of the people and improves their nutritional balance.

Worldwide, approximately 6.2 million t (77%) of chickpea is annually used as food (Table 3). It was about 4.3 million t in early 1980s. Use of chickpea as food has been increasing consistently in Africa, South Asia, and West Asia. It has stagnated in Latin America and Caribbean and Southeast Asia since early 1980s. The per caput availability of chickpea as food has almost remained stagnant globally and declined by nearly 1% in South Asia (and developing countries), due to faster growth in population as compared to growth in production. Worldwide, the per caput availability of chickpea as food was around 1.0 kg yr^{-1}. It was highest (>4 kg yr^{-1}) in India and Turkey. In Iran, Lebanon, and Pakistan, it was around 3.5 kg yr^{-1}. Per caput availability increased significantly only in West Asia from 1.5 kg yr^{-1} in early 1980s to 2.6 kg yr^{-1} in late 1990s (Table 4).

Decline in per caput availability particularly in South Asia led to a sharp increase in prices, inducing consumers to shift to cheaper substitutes like vegetables and animal proteins. Vegetables and livestock products are also replacing chickpea among consumers whose incomes have risen suggesting demand constraint for high-income groups in the long run. Pulses are considered an important source of protein and researchers have postulated shortage of pulse protein in diets in developing countries as indicated by declining or stable per caput consumption (Agostini and Khan 1988).

Among all pulses, chickpea enjoys the status of being consumed in a wide range of products. Jambunathan and Singh (1990) reported that desi chickpea was consumed in the form of whole seed, dhal (decorticated split cotyledons) or as dhal flour (*besan*) in South Asia. Based on a survey, the authors revealed that about 75% of chickpea in India is consumed in the form of dhal or *besan*, and the remaining 25% as whole seed. A similar pattern was noted in other Asian countries, except Afghanistan and Nepal, where

Table 3. Chickpea utilization by type and region.

	Food ('000 t)		Feed ('000 t)		Total utilization[1] ('000 t)	
Region	1980–82	1996–97	1980–82	1996–97	1980–82	1996–97
Developing countries	4271.3	6088.0	442.0	827.2	5335.4	7820.7
Africa	205.5	278.9	17.6	15.0	262.7	353.1
Southeast Asia	87.1	86.4	0.0	1.2	98.7	108.5
South Asia	3657.7	4987.2	382.3	688.9	4545.1	6290.4
West Asia	225.4	637.9	39.2	119.1	318.3	952.7
Latin America and Cribbean	95.9	99.1	2.9	4.4	110.7	116.1
Developed countries	68.5	100.7	39.2	59.6	127.6	190.4
Europe	68.5	100.7	39.2	59.6	127.6	190.4
World	4339.2	6188.7	477.3	886.8	5462.9	8011.1

1. Includes food, feed, and other uses.

Source: Estimated using FAOSTAT data.

Table 4. Per caput food availability of chickpea by region.

	Per caput food availability (g yr^{-1})		Growth rate of per caput food availability in 1981–97 (% yr^{-1})
Region	1980–82	1996–97	
Developing countries	1274.6	1349.8	–0.4
Africa	420.9	372.9	–1.0
Southeast Asia	56.3	45.4	–5.8
South Asia	3993.8	3943.6	–0.9
West Asia	1461.7	2745.8	5.5
Latin America and Caribbean	259.2	201.4	–4.8
Developed countries	58.1	77.7	1.2
Europe	141.2	138.2	–1.5
World	957.6	1065.8	–0.1

Source: Calculated from FAOSTAT data.

besan preparations were uncommon. Most of the chickpea consumed in other countries, including Australia, Ethiopia, Sudan, Tanzania, Turkey, and in Europe and the Americas is in the form of whole seed. Several traditional methods are used to convert chickpea into a consumable form. These processes include soaking, sprouting, fermenting, boiling, steaming, roasting, parching, and frying. Kabuli chickpea is a popular food item in the Mediterranean region.

In South Asia chickpea is prepared as food in a wide variety of ways. Green chickpeas, which are harvested 10–15 days before maturity, are consumed as vegetables with the major meals. Chickpea flour is used for preparation of various snack items and is mixed with wheat flour to make unleavened bread. The preferred quality characteristics of chickpea vary depending on end use (see Box 2).

Most of the chickpea produced in the Mediterranean region is consumed in the form of *homos-biteheneh*, *falafel,* and *tisqieh* (soaked and boiled seeds are used in these preparations). Roasted and sugar-coated chickpeas are also commonly consumed in this region. *Lablebi*, which is prepared by boiling kabuli chickpea in water with salt and pepper is a common food in Tunisia and Turkey. In Ethiopia chickpeas are used in the manufacture of infant and child food *faffa,* and a malted weaning food.

Animal feed

Unlike other pulse commodities [pea, bean, vetch (*Vicia sativa* L.) etc.] only a small fraction (11% in 1996–98) of total chickpea production is used as feed. This consists mainly of broken seeds and residue from dhal production. The high protein content of chickpea haulms is used to enrich dairy animal feeds for higher milk yields. Though chickpea whole seed can be and is to a limited extent used in diets of pigs and poultry it does have high anti-trypsin activity and therefore not recommended in diets of young stock (Rees 1988). In European Union about 5–6% chickpea is used as animal feed compared to 90% dry pea and 65% faba bean (*Vicia faba* L.). On an average 84% of total pulses is used for feed purposes. However, in 1995, proteins from pea and faba bean represented only 5% of the materials rich in protein which are used to balance animal diets compared to 53% from soymeal. A high nutritional value is determined by high digestible energy, high digestible amino acid content, and the absence of anti-nutritional factors. Chickpea has a similar nutritional value as pea and could also be valuable for pigs and poultry with a

Box 2. Chickpea utilization and quality in South Asia

Chickpeas are predominantly used for human consumption in many countries in South Asia. They are consumed in various forms and are subjected to primary processing, i.e., dehulling, splitting, grinding, parching, and roasting. Consumers of chickpea are sensitive to quality characteristics depending on the use. Kabuli chickpeas are mostly consumed as dried whole seed separately or combined with other ingredients. Kabuli chickpeas are differentiated on the basis of seed color (beige or cream) and larger seed size: 7–8 mm; 8–9 mm; and 9 mm and above. Large seed is preferred and fetches higher price. The other preferred qualities are light yellow or cream color, uniform size, and thin seed coat.

Desi chickpeas are consumed in different forms—fresh green seed, dried whole seed, roasted and puffed, roasted and split (*phutana* dhal), dhal, and flour (*besan*). Dhal and flour are the most common forms of consumption (70–75%) followed by whole seed (15–20%). Green immature chickpea is used as vegetable. Large seed, light brown or golden yellow color, thin seed coat, and good water absorption capacity are the preferred qualities. In a recent study in India chemical quality characteristics were found to be unimportant in determining market price of chickpea. Dehulling chickpea seed to prepare dhal involves pre-treatment to loosen the seed coat from the cotyledons, splitting, and dehusking. Millers prefer seeds with high recovery rates of dhal. The dhal is subsequently graded into different sizes; bigger size dhal fetch premium of Rs 2–3 kg^{-1} (1 US$ ≈ Rs 43 in 1998) in the market. The dhal millers strike a balance between higher recovery rate and dhal size. In some regions in India chickpea seed is roasted prior to splitting (roasted split dhal). Only select varieties of chickpea are used for this purpose.

Chickpea flour is a major ingredient in snacks and sweets in India and Pakistan. It is also blended with wheat or maize (*Zea mays* L.) flour for preparing *roti* (bread). Flour millers buy whole seed or dhal for making flour. Seed size is not important, although color is. Golden yellow color is generally preferred. Consumers prefer to buy dhal and process in local flour mills to ensure unadulterated flour.

very different composition. For a given nutritional value, a competitive price and guaranteed supply are minimum requirements for the feed industry (Carrouée et al. 2000).

International Trade

Exports and imports

Global trade in pulses continues to increase, but at a slower rate in the early 1990s than in the 1980s. The world market volume in 1996–98 stood at 7.3 million t representing 13.3% of production. Dry pea was the most important pulse crop traded by volume (2.9 million t or 40%) followed by dry bean (2.35 million t or 32%). Lentil (*Lens culinaris* Medic.) was the most widely traded pulse crop relative to its production (29%). In contrast chickpea share in total pulse trade is low at about 10%; it was 7% in 1980–82.

Global trade in chickpea was negligible in early 1970s, and was around 1% of the total production. However, trade has rapidly expanded since then as new countries are entering the market to meet increasing demand from both developed and developing countries. In 1996–98 about 0.7 million t were exported compared to 0.2 million t in early 1980s. Thus since 1980 the market volume expanded by a factor of three. Trade in chickpea is largely to meet the food requirements in the consuming countries.

India is the largest chickpea importer (Table 5). In 1996–98 India imported about 204,000 t of chickpea, which accounted for about 35% of the world imports, and 3.3% of the domestic production. After the severe drought in 1987, chickpea import for both kabuli and desi types increased to meet the domestic demand and check the rising prices. All pulses including chickpea imports were put on open general license and import duties were substantially reduced from 35% to 10% in 1989 to 5% since 1995. More recently in 1998 the Government eliminated all tariffs on pulse imports. Import data from Government of India statistics, however, indicate large fluctuations in annual imports ranging from 5% to <1% of domestic production. According to the Government of India statistics in 1996–97, Australia accounted for 79% of imports to India followed by Turkey (14%), Myanmar (3%), and Iran (2%). In contrast in 1998–99 Canada accounted for 46% of imports followed by Australia (25%), Iran (11%), Turkey (4%), and Myanmar (3%). Thus in 1998–99 Canada emerged as a leading importer to India displacing Australia and Turkey. There is thus an intense competition among exporters for the Indian market. Although chickpea import to India has grown since early 1980s it has peaked in some years as in 1988 when 200,000 t were imported; and 1997 when more than 300,000 t were imported. As already indicated there is considerable year-to-year fluctuation in exports depending on domestic production and availability in the world market at competitive prices. The competition for a share of chickpea imports to India would intensify in future.

Europe imports significant amount of chickpea, which represents about 18% of total chickpea import. Spain, Italy, Greece, and Portugal are the major chickpea importing countries. Chickpea import in Spain has more than doubled from 26,000 t in early 1970s to 55,000 t in 1996–98 to meet the growing domestic demand particularly for kabuli chickpeas.

Major chickpea exporting regions are Oceania (Australia), West Asia, and Latin America and Caribbean (Table 6). About 37% of the world export in 1996–98 was from Oceania. Australia started commercial production of chickpea recently, essentially as an export crop targeting markets in India, Pakistan, Bangladesh, and Gulf countries. It exported about 0.25 million t of chickpea in 1996–98 and about a third of these exports was to India.

In West Asia, Turkey is the major exporter, accounting for nearly 30% of the world chickpea exports in 1996–98 and 30% of domestic chickpea produced in the country. It is largely of kabuli type. Chickpea export from Turkey has increased substantially from 17,000 t in early 1970s and reached a peak of 304,000 t in early 1990s, largely due to the attractive export subsidy the Turkish government has on chickpea (Oram and Agcaoili 1994). As the subsidies on production and exports were withdrawn exports came down to 205,000 t in 1996–98 due to decline in area under chickpea. Trade in chickpea by Turkey is also being strongly influenced at present by barter trade to Iraq in exchange for oil on the “food for oil scheme” (Rees et al. 2000).

Mexico is another big exporter of kabuli chickpea and accounts for about 17% of total export and targets mainly USA. Myanmar is also exporting desi chickpea. Myanmar’s export expansion went hand in hand with a devaluation of the Kyat (Kyi et al. 1997). Eastern Africa has the potential of becoming a major exporter of the

Table 5. World chickpea imports ('000 t).

Country	1980–82	1990–92	1996-98
Developing countries	81.6	301.9	433.3
Africa	24.3	39.1	72.4
Algeria	20.9	33.2	36.9
Egypt	0.1	1.3	4.7
Ethiopia PDR	0.0	1.5	3.8
Malawi	0.0	0.0	0.0
Morocco	0.0	0.1	7.8
Sudan	0.0	0.0	0.0
Tanzania	0.0	0.0	0.1
Tunisia	0.0	1.8	17.4
Uganda	0.0	0.0	0.0
Southeast Asia	0.4	1.4	1.5
China	0.0	0.0	0.1
Myanmar	0.0	0.0	0.0
South Asia	8.1	188.8	271.3
Bangladesh	0.0	27.5	16.4
India	4.4	112.0	204.4
Nepal	0.0	0.0	0.0
Pakistan	3.7	37.4	39.0
West Asia	26.7	47.6	65.0
Cyprus	0.1	0.5	0.2
Iran	0.0	0.0	0.0
Iraq	8.7	15.7	8.0
Israel	0.0	11.3	8.0
Jordan	6.6	14.0	13.4
Lebanon	11.3	6.1	7.2
Syria	0.0	0.0	0.0
Turkey	0.0	0.0	7.6
Yemen	0.0	0.0	0.0
Latin America and Caribbean	9.5	16.4	21.1
Argentina	0.0	0.2	0.7
Chile	0.0	0.0	0.6
Colombia	3.7	4.0	8.4
Mexico	0.0	0.2	0.1
Peru	0.0	2.0	0.8
Developed countries	52.5	144.7	155.1
Europe	40.8	115.4	128.6
Bulgaria	0.0	0.1	0.0
Greece	1.1	9.3	5.8
Italy	0.0	26.7	21.5
Portugal	1.4	8.2	8.6
Spain	38.3	42.6	55.3
Yugoslav SFR	0.0	0.5	0.3
Oceania	0.0	0.2	0.2
Australia	0.0	0.2	0.1
World	134.1	446.7	588.3

Soruce: FAOSTAT.

crop. In recent years Canada is emerging as an important exporter of chickpea.

Future trade prospects of chickpea will be influenced by a number of key economic, political, social, and technological factors. These include: income growth rate and associated expenditure elasticities of demand in consuming countries; relative prices of chickpea and close substitutes in consuming countries; growth rate in chickpea production in major consuming countries; trade policies of major potential importers; growth rate in production in exporting

Table 6. World chickpea exports ('000 t).

Country	1980–82	1990–92	1996–98
Developing countries	222.9	364.4	403.8
Africa	4.2	6.0	10.9
Egypt	0.1	0.1	0.0
Ethiopia PDR	0.2	0.1	0.0
Malawi	0.0	0.9	1.9
Morocco	3.0	4.6	8.2
Tunisia	0.9	0.3	0.0
Southeast Asia	0.0	0.2	0.4
China	0.0	0.1	0.4
Myanmar	0.0	0.2	0.0
South Asia	0.6	4.2	0.9
Bangladesh	0.1	0.0	0.0
India	0.4	4.2	0.1
Pakistan	0.2	0.0	0.8
West Asia	152.6	304.6	275.1
Israel	0.0	0.0	0.2
Jordan	0.1	0.2	4.7
Lebanon	0.0	0.4	0.4
Syria	13.5	0.1	7.7
Turkey	139.0	303.9	204.6
Latin America and Caribbean	64.0	48.5	116.1
Argentina	0.9	0.1	0.2
Chile	2.5	2.5	0.8
Colombia	0.0	0.0	0.0
Mexico	60.6	44.1	115.0
Peru	0.0	0.7	0.0
Developed countries	2.3	123.1	282.2
Europe	2.3	9.9	15.0
Bulgaria	0.0	3.4	2.1
Greece	0.7	0.0	0.2
Italy	0.0	0.2	0.2
Portugal	0.3	0.4	0.6
Spain	1.3	0.9	5.4
Oceania	0.0	106.5	253.7
Australia	0.0	106.5	253.7
World	225.1	487.5	686.0

Source: FAOSTAT.

countries; and growth in demand for specialty products.

International prices

International prices are dictated largely by Australia and Myanmar for desi type, and by Turkey, Mexico, and Syria for kabuli type. Australia produces desi chickpea largely for export while Turkey exports a large proportion of kabuli chickpea. Kabuli chickpea fetches a higher price, at least twice that of desi type, and often even more. To that extent these two types can be considered as separate commodities. Spain and to some extent Syria and Turkey are exporting the highest value (best quality) kabuli chickpea. There is a high demand and price premium given for larger size (>9.5 mm) and creamy white chickpea in the European market (Kelley 1999). Turkey produces two types of kabuli chickpea: 'Ispaniola' and 'Velvet', the former having superior quality traits as reflected in a price premium of 5–7% (Knights and Siddique 1998). India being the largest producer and importer of chickpea, production fluctuation in the country influences both the demand and international prices particularly of desi chickpea.

Domestic Pricing and Marketing Policies

In the past, pulses have been neglected relative to cereals since food security was one of the primary goals of most developing countries. Since mid-1980s policy makers in many Asian countries have become aware of the negative welfare implications of high pulse prices to poor consumers and have started implementing programs to boost pulse productivity.

In Pakistan a systematic approach to improvement of pulse production has brought together activities at national and provincial level, with focus on rainfed areas. In Bangladesh under the crop diversification program of the Government of Bangladesh, the Pulses Research Center (PRC) was set up for cultivar development, improved management practices and postharvest technologies. In both these countries, the government can control market prices and the supply of pulses to some extent through procurement and storage (Bashir and Malik 1995, Sarwar 1995).

In India minimum support prices and subsidies (nitrogenous fertilizers, irrigation, etc.) were targeted towards cereal crops. India is the major producer and consumer of chickpea. Due to shortfall in the production chickpea prices in the domestic market rose rapidly in early 1990s. However, the producers did not share the gains of rising prices. Due to high marketing and processing margins, retail prices were substantially high. Most crops in India, including chickpea are subjected to restrictions on domestic trade regulated under the Essential Commodities Act of 1955. Some of these restrictions include compulsory levies on millers, stocking limits for private traders, processing reserved for small-scale industries, occasional restrictions on interstate movements, and prohibition on futures trading (ICRISAT/ICAR 1999). External trade (exports) is also regulated. The problem is also compounded by small size of processing units since millers are reluctant to invest due to high year-to-year variation in production. For example, during the development of India's soybean (*Glycine max* (L.) Merr.) industry, increases in production went hand in hand with processing capacity (Parthasarathy Rao and von Oppen 1987).

To protect the interest of producers and increase pulses and oilseeds production, the Government of India initiated the 'Oilseed and Pulse Mission' with major focus on increasing production of edible oilseeds and pulses. This program helped producers to adopt improved oilseeds and pulses technologies. Seeds of improved varieties were distributed at subsidized prices. Minimum support prices were announced before sowing the crop to assure the farmers that the government would buy the produce in the event of falling prices as a result of increased production. Although the success of the policy is questionable, particularly for pulses since minimum support price were always lower than market prices, the declining trend in chickpea area reversed. Availability of improved varieties, agroeconomic management factors, and competitive prices in non-traditional areas have resulted in chickpea finding new niches. Reducing the import duty on pulses also encouraged import, and checked the rising chickpea prices.

In Australia, industry coordination played a critical role in the development of pulse production. The formation of Pulse Australia in 1995 is seen as a major step in this direction. Its goals include: improved industry coordination, leadership and planning, developing new markets, and expanding market share in existing domestic and international markets (Hamblin et al. 2000). There is no price support system for Australian pulses.

Technological Issues and Research Focus

Available technologies and their adoption

There are several constraints mainly biotic, abiotic, and socioeconomic that adversely affect chickpea productivity and production. However, the prevalence of, and the magnitude of damage caused by various constraints vary depending on location, environmental conditions, and cropping systems in which chickpeas are grown (Saxena et al. 1996). The research focus to alleviate constraints and increase productivity was based on priority needs of each region. During the last three decades, several national agricultural research systems (NARSs) and international agricultural research centers (IARCs) have been actively engaged in developing improved chickpea production technologies to alleviate major production constraints. Among IARCs, the main centers include the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Center for Agricultural Research in the Dry Areas (ICARDA).

Major breakthrough in chickpea technologies

Asia. The major abiotic constraints in Asia include drought/heat stress, and cold tolerance. Pod borer (*Helicoverpa armigera*), ascochyta blight, fusarium wilt, root rot, stunt, and botrytis gray mold are the major biotic constraints. Economic losses due to abiotic constraints are generally larger than those from biotic constraints (Ryan 1995). Chickpea is traditionally grown in areas where temperatures are cool. This had restricted the cultivation of the medium- and long-duration varieties to high latitude areas. These varieties matured far too late when planted in the tropics and succumbed to heat, drought, and disease pressure. The development of short-duration varieties that escape the above constraints has enabled expansion of chickpea cultivation to lower latitudes where chickpea was not traditionally grown. In these areas, the new varieties have proved profitable leading to expansion of cultivated area, e.g., Andhra Pradesh in southern India (see Box 3). Success stories of short-duration tropical chickpea are also available from a number of other semi-arid states of India.

Improved varieties have found niches in the high Barind region of Bangladesh, greening the drylands of Barind, which were earlier left fallow (see Box 4). Following hundreds of field demonstrations, adoption increased from 200 ha in 1984 to 10,000 ha by 1998 (Musa et al. 1998).

In Myanmar the local chickpea cultivars and land races suffered heavy losses in production due to fusarium wilt, drought, and heat stress. The introduction and release of fusarium resistant and early-maturing cultivars have changed the situation (ICRISAT 2000). In northern latitudes, e.g., northern India and Pakistan, varieties with resistance to ascochyta blight have been developed and this has led to increased productivity of the crop.

Eastern Africa. The major constraints in eastern Africa include drought, *Helicoverpa*, fusarium wilt, root rot, low yield potential, and stunt. Chickpea is usually grown under residual soil moisture. Development of extra-short and short-duration varieties has also enabled chickpea crop to avoid terminal drought and give high yields. Ethiopia and Sudan have released some of these varieties. Ethiopia has in addition released varieties with resistance to fusarium wilt.

West Asia and North Africa. Drought is one of the major constraints to chickpea productivity mainly because chickpea is grown in rainfed areas under receding residual soil moisture. In Turkey, area under chickpea expanded into the wheat fallow rotations due to the availability of improved varieties and management practices and supportive government policies (Acikgoz et al. 1994). In other countries in WANA region chickpea is a spring-grown crop. In WANA rainfall is in winter; due to susceptibility to low temperatures and ascochyta blight, chickpea is planted in spring and the crop grows under receding residual soil moisture, and as a result low yields are obtained. Advancing sowing from spring to winter ensures that most of the vegetative and reproductive growth would occur under moisture assured conditions and would thus result in high yields. Blending of genetic improvement (incorporation of cold and ascochyta blight resistance) and appropriate agronomic practices allowed the crop to be grown in late autumn or early winter, thus escaping terminal stress. This has substantially increased the yields (Saxena et al. 1996).

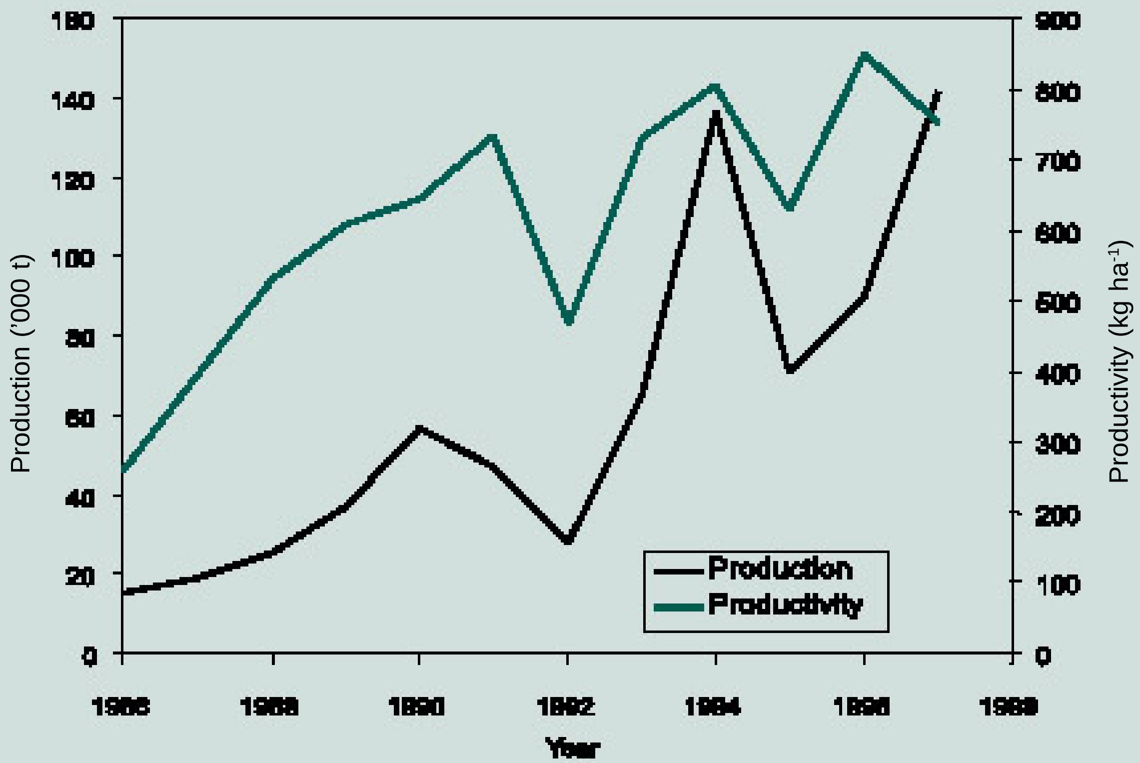
Other regions. Spillover benefits to USA and Canada have also been significant. In early 1990s, Washington State University, USA released the early maturing, ascochyta blight resistant desi variety 'Myles' which has expanded dramatically in Canada during 1998 and 1999 accounting for 10,000 ha in western Canada (ICRISAT 2000).

Integrated pest management

Integrated pest management (IPM) practices have been developed to reduce the reliance on chemical pesticides to manage *Helicoverpa armigera*. Due to development of insecticidal resistance farmers in northern India used 5–6 sprays of insecticide to control *Helicoverpa*; yet crop losses were about 50% (Wightman et al. 1995). This prompted scientists to seek IPM options for chickpea. These now include tolerant varieties, monitoring pest population (using

Box 3. Production and productivity of chickpea in Andhra Pradesh, India

Chickpea as a winter pulse crop had gained considerable importance in the past few years in peninsular India. The "silent" pulse revolution in Andhra Pradesh was attributed to the introduction of improved short-duration, fusarium wilt resistant varieties which did well with limited available moisture. The short-duration desi variety Kranthi (ICCC 37) ideally suited the short winter in Andhra Pradesh. It matured in 90–100 days and found a ready market. Farmers were now able to grow two crops where only one crop was grown earlier. Swetha (ICCC 2), a white-seeded extra-short-duration kabuli line with fusarium wilt resistance was another improved variety tried by farmers which matured in 85 days and fetched a premium price in the market. Much of the seed spread from farmer to farmer encouraged by the local agricultural university scientists. ICRISAT economists found that the production under improved chickpea varieties has rapidly increased in the hot and dry climatic regions since 1991 (see figure below). A large part of the area expansion is coming from the area of either rabi (postrainy) sorghum (*Sorghum bicolor* (L.) Moench) or rabi fallow or both (Joshi et al. 1998, 1999). In some areas soybean-chickpea and sesame (*Sesamum indicum* L.)-chickpea replaced cotton (*Gossypium* sp)/chili (*Capsicum annuum* L.) cultivation that were plagued by heavy pest damage. The new cultivars are popular because they are high yielding, resistant to diseases particularly fusarium wilt that is a common problem in hot and dry areas and they escape drought because of their short growing season. Adopting chickpea also helped farmers reduce costs of purchased inputs such as fertilizer, pesticides, and labor. Availability of improved seeds and favorable prices has witnessed a silent chickpea revolution in the non-traditional regions. This must be sustained by ensuring availability of good quality improved seeds.



Production and productivity of chickpea in Andhra Pradesh, India (Source: Crop Statistics of Andhra Pradesh).

Box 4. Chickpea in Barind region of Bangladesh

Barind area is a north-south tract of land stretching from the Ganges in the south through the Indian state of West Bengal in the north, and is different from the floodplains. The hard-pan soils in this area are deficient in soil moisture and organic matter, and have a low pH. The Barind region of Bangladesh, which comprises approximately 0.8 million ha, is also the home of the poorest farmers. Barind area is largely rice-fallow system. During winter, most of the Barind area is fallow except for pockets where deep tube wells are utilized to grow *boro* (winter) rice. But for the vast majority of Barind farmers, however, this is not a viable option as the watertable recedes to an extremely low level.

Virtually all cultivated land in the Barind region is sown to rice in the rainy season. After harvest and with cessation of rains the moisture in the fields quickly disappears. Very little time is available to sow another crop in the fallows. Through experimentation, scientists of the Bangladesh Agricultural Research Institute and ICRISAT, and from Canada found that if chickpeas were sown during this brief window of 4–10 days, a good crop could be obtained.

Chickpea is able to establish itself and grow to full maturity despite conditions that would prove fatal for most crops. Farmers started growing chickpea without almost any monetary input after rice. Besides providing food for their families, farmers can feed chickpea pod walls and seed coats to their animals. Top twig of chickpea, locally know as *shak*, is consumed as a green vegetable.

Chickpea in Barind, which was introduced in 1984, has increased gradually to 985 ha in 1992. Since then there has been a significant increase up to 2550 ha in 1994, 8000 ha in 1995, and reached 10,000 ha in 1997–98. Farmer to farmer exchange of seed played an important role. The available estimates suggest that farmers in Barind are now producing about 8500 t of chickpea, which is expected to save Bangladesh huge foreign exchange each year. There are estimates that if only 10% of the Barind area is sown to chickpea (presently about 1%), total production in Bangladesh would be doubled.

(Source: ICRISAT 1996)

pheromone traps and larval counts), application of bio-pesticides [need-based spray of neem (*Azadirachta indica* A. Juss.)-based products and nuclear polyhedrosis virus (NPV)], and enhancing activity of natural enemies. Farmer acceptance is just beginning to show in some countries in South Asia.

Constraints to large-scale adoption

Despite a few success stories, adoption of improved chickpea varieties on a large scale has been variable. We can only speculate on the factors constraining their adoption. The success stories are restricted to specific niches in the cropping pattern. In marginal areas early maturity is essential for the crop to escape drought or heat stress. But several other factors such as seed quality and resistance to diseases play a role in farmers' adoption decisions. Farmers may not have been fully involved in technology generation, evaluation, and exchange. However, there are evidences where the technology has been widely adopted as it has benefited farmers and varieties involved have met the end user needs. For example, ICCV 2, an extra-short duration variety developed for warm and dry environment, has spread in the non-traditional chickpea areas of India and Myanmar where farmers were extensively involved in on-farm verification. Lack of seed of improved varieties constrains wide-scale adoption. The seed industry in general is not keen to be involved in production of seed of open-pollinated crops. Relatively high quantity of seed and low profit are the major constraints preventing seed companies, particularly the private sector, in chickpea seed business. Due to non-availability of good quality seed, farmers do not replace their seed stocks often enough (Brouwer et al. 2000). Hence there is a need to improve the seed production and distribution system, preferably through strengthening rural, farmer-based seed production, storage, and distribution. Availability of seed should be complemented by better management to increase adoption and production of improved varieties.

Ascochyta blight caused by the fungus *Ascochyta rabiei* is the most devastating disease and has been reported in 35 countries. Research focus has been on developing varieties with resistance to the disease. A number of varieties with resistance/tolerance to the disease have been developed. Frequent breakdown of resistance, however, poses serious problems in the development of durable resistance.

Fusarium wilt caused by the fungus *Fusarium oxysporum* f. sp *ciceris* is the most important soilborne disease of chickpea. The disease has been reported in most of the countries where chickpea is grown. A number of varieties with resistance/tolerance to the disease have been developed. As in *A. rabiei*, there is pathogenic variation in the wilt pathogen. Although stable sources of resistance have been identified, none of the lines have resistance across all chickpea-growing countries.

Weeds are also major yield constraints, particularly in the early-sown or winter-sown crop. In the Mediterranean region advancing sowing from spring to winter has resulted in doubling of yields, but this is accompanied by high infestation by weeds. To overcome the weed problem in the Mediterranean region, sowing in early spring is being encouraged.

Among the storage pests of chickpea, bruchids (*Callosobruchus* spp) cause extensive damage, especially under poor storage. Good storage practices (e.g., proper drying, clean storage areas, and storing in sealed containers) can reduce the postharvest losses.

Socioeconomic constraints

Among the socioeconomic constraints, a few common problems afflicting all pulses including chickpea are: high price and production risk; thin and fragmented markets leading to low farm harvest prices; sharp fluctuation in prices during the year; inability of small farmers to store the produce to realize better prices; postharvest losses during storage and processing; widening gap between farm gate price and retail price to consumers due to high middlemen and processing margins.

Additionally pulses generally received low priority in government policy and research due to emphasis on cereals (Brouwer et al. 2000). In India almost all the subsidies on water, electricity, and fertilizers are targeted towards cereals. A frequent change in government policies with respect to subsidies and procurement of pulses has also adversely affected area and production. For example, in Turkey, the abolition of guaranteed purchasing program for chickpea in 1994 stopped expansion in chickpea area. In the past few years government policies are increasingly being targeted towards pulses to make up for earlier lapses.

Pulses need to compete with other crops to be attractive to producers. Profitability of chickpea was significantly low compared to competing crops, which adversely affect its profitability in relative terms. In India chickpea area in the traditional areas was replaced by wheat, rape, and mustard. Dramatic increases in wheat yields and a combination of yield and high prices for rape and mustard made these crops more attractive (Kelley and Parthasarathy Rao 1996; Gulati and Kelley 1999). High production cost and lack of appropriate machinery are the most often cited reasons in some countries of West Asia (Abbas et al. 1996, El-Ahmed et al. 1996, Masadeh et al. 1996). In certain areas of Tunisia and Morocco chickpea is competing with sunflower (*Helianthus annuus* L.) for a place in the cereal-based rotation system (Halila et al. 2000). Lack of availability of and information on improved cultivars in areas where chickpeas are grown on fallow lands constrains chickpea production in southern and eastern Africa, and non-traditional growing areas in South Asia.

On the consumption side vegetables and livestock products are replacing chickpea among consumers, whose incomes have risen, suggesting a demand constraint for high-income groups in the long run.

Outlook

Medium term

Several factors influence the demand and supply of chickpea. The demand is largely governed by the prices of chickpea relative to alternative protein sources, growth rate in population, growth rate in income, and expenditure elasticities of demand. On the other hand the supply is influenced by domestic and international policy environment, availability of improved technologies, and relative profitability vis-à-vis competing crops. A good example is the movement of chickpea in India from the traditional growing areas, where it is no longer competitive (replaced by wheat, rape, mustard, etc.), to the warmer areas. Chickpea demand and supply are also interlinked via prices. The price the consumer is willing to pay and the price elasticity of demand would influence both supply and demand. As chickpea prices rise, due to high price elasticity of demand there is likelihood of substitution of chickpea with other protein sources. This will have a negative impact on both the demand and supply.

Demand for chickpea in 2010 is estimated on the basis of growth rates in population and income, and expenditure elasticity of demand (keeping all other factors constant). The chickpea demand in 2010 is estimated at 11.1 million t up from 8.0 million t in 1996–98, an increase of 38% (Table 7). Approximately 85% of the additional demand is coming from India alone.

There are two possible options to meet the additional demand for chickpea. Chickpea yields should be increased from the existing level of 0.7 t ha^{-1} to 1 t ha^{-1} in the next 12 years, implying annual yield increase of 25 kg ha^{-1}. Even to maintain the existing level of per capita consumption of chickpea in the year 2010, average yields will have to increase from the present level of 0.7 t ha^{-1} to 0.85 t ha^{-1}, assuming area to remain constant. During the past decade, the average global yields have stagnated at 0.65–0.75 t ha^{-1} despite availability of improved technology. If past trends continue this is not an easy target. Improved technologies for chickpea certainly helped in area expansion, in selected pockets but could not raise the overall average yields significantly. The movement to marginal areas has increased the risk of production. Chickpea yields in India were more variable than wheat yields (Kelley and Parthasarathy Rao 1994). While development of improved varieties is the key to a technical breakthrough in yields these should be targeted to specific niches in cropping patterns especially lines with early maturity to escape drought and heat stress, and resistance to major pests and diseases. An important priority is to characterize existing and potential cropping patterns in terms of both agroclimatic and socioeconomic factors (Byerlee and White 2000). A combination of yield and area expansion would be a possible option in meeting projected demand in 2010. Chickpea area could be expanded in the northeastern plains of India in rice-fallows, in lower Myanmar if cultivars were available with tolerance to high temperature and acid soils, and in Bangladesh in the high Barind tract where large areas remain fallow in winter. Adoption of available technology should be increased through improved seed multiplication system, improved crop management practices, resistance to biotic and abiotic stresses, and more importantly wide demonstration to farmers and policy makers on the advantage of incorporating legumes in the farming system.

Finally high-yielding varieties should also target the traditional chickpea-growing areas to allow substitution of cereals by legumes. For example, in India an option would be to enable chickpea to shift to their traditional growing areas in favored environment to sustain the cereal-based systems, which are presently facing severe soil and environmental constraints.

Long term

In the short- to medium-term chickpea production would be more constrained by supply. Population and income growth particularly for low-income consumers will ensure increase in consumption from current levels. To meet the growing demand adoption and availability of improved seeds in the major growing countries would be critical. In the long run, however, demand would be more constrained due to changes in taste, preferences, growing urbanization, and income growth. Data from Pakistan shows that with changing prices, there is a significant substitution of pulses with livestock products and vegetables (Ali and Ullah 1996). Even in a country like India with a large vegetarian population, per caput protein from animal source (milk and poultry meat) is now higher than from pulses (Kelley et al. 2000). Fruits and vegetables too have a higher income elasticity of demand compared to pulses. For the developing countries as a group during the last 25 years (1970–95) per caput protein consumption increased from 45 g to 56 g and 80% of this increase was from livestock sources while proteins from pulses actually declined by more than 25%. Consumers particularly in the higher income groups would become more discerning. Thus decline in availability of pulses has not reduced protein availability since technological progress has made other protein sources (milk, meat, chicken, eggs, fish, and prawns) relatively cheaper than pulses (Kelley et al. 2000).

In developed countries in contrast proteins from pulses constitute a small proportion of total protein consumption. This is expected to increase marginally since for the small but growing vegetarian population chickpea/pulses would be important in achieving a balanced diet, low in fat and cholestrol but rich in fiber.

Table 7. Chickpea demand projection in 2010[1].

Country	Present consumption ('000 t)	Population growth rate (% yr^{-1})	Income growth rate (% yr^{-1})	Income elasticity	Demand growth rate (% yr^{-1})	Projected demand in 2010 ('000 t)
Africa	353.1	-	-	-	-	465.7
Algeria	62.2	1.7	–2.4	0.5	0.5	66.4
Egypt	14.2	1.6	1.1	0.4	2.0	18.4
Ethiopia PDR	132.8	2.8	–0.3	0.2	2.7	188.6
Malawi	39.0	2.4	–0.7	0.4	2.1	51.2
Morocco	41.5	1.6	0.9	0.3	1.9	52.8
Sudan	8.0	2.2	1.0	0.1	2.3	10.8
Tanzania	25.5	2.6	1.0	0.4	3.0	37.4
Tunisia	27.3	1.5	1.9	0.3	2.1	35.7
Uganda	2.8	2.6	2.7	0.4	3.7	4.4
Southeast Asia	108.5	-	-	-	-	141.9
China	2.8	0.8	8.3	0.4	4.3	4.8
Myanmar	105.7	1.6	1.0	0.4	2.0	137.1
South Asia	6290.4	-	-	-	-	8872.5
Bangladesh	103.7	1.5	2.1	0.4	2.4	140.9
India	5488.5	1.3	3.2	0.4	2.6	7705.3
Nepal	13.8	2.2	2.4	0.4	3.2	20.9
Pakistan	684.3	2.5	1.2	0.4	3.0	1005.4
West Asia	952.7	-	-	-	-	1249.3
Cyprus	0.3	2.0	1.0	0.4	2.4	0.5
Iran	308.6	2.4	1.0	0.1	2.5	425.3
Iraq	15.3	3.0	1.0	0.6	3.6	24.2
Israel	15.8	1.4	2.5	0.2	1.9	20.2
Jordan	13.6	2.4	–4.5	0.2	1.5	16.5
Lebanon	13.3	1.3	1.0	0.2	1.5	16.1
Syria	51.0	2.7	0.9	0.4	3.1	75.5
Turkey	498.9	1.4	2.2	0.1	1.6	614.8
Yemen	36.0	3.3	1.0	0.2	3.5	56.2
Latin America and Caribbean	116.1	-	-	-	-	141.1
Argentina	3.2	1.0	1.8	0.1	1.2	3.8
Chile	8.0	1.1	6.1	0.1	1.7	10.0
Colombia	7.5	1.3	2.6	0.1	1.6	9.1
Mexico	95.0	1.5	0.1	0.1	1.5	115.4
Peru	2.3	1.6	–1.6	0.1	1.4	2.8
Europe	190.4	-	-	-	-	196.6
Bulgaria	2.2	–0.3	–2.6	0.1	–0.6	2.0
Greece	8.3	0.2	1.3	0.1	0.3	8.6
Italy	25.9	–0.1	1.8	0.1	0.1	26.2
Portugal	16.3	0.1	3.6	0.1	0.5	17.3
Spain	137.0	0.0	2.6	0.1	0.3	141.7
Yugoslav SFR	0.7	0.8	1.0	0.1	0.9	0.8
World	8011.1	-	-	-	-	11067.1

1. To predict future demand, projections of population and income growth (weighted by income elasticity of demand) have been used according to the following equations:

$$D_t = D_0 (1+d)^t$$

and $d = p + i*n$

where D_t is chickpea demand at future time t, D_0 is chickpea consumption at the 1996–98 level, d is the compound growth rate, p is the population growth rate, i is the income growth rate, and n is the income elasticity of demand.

An increasing share of the food dollar in non-traditional pulse markets is being spent on food consumed outside the home; this has implication for product development (Lovett and Gent 2000). Even in developing countries with growing urbanization the demand for quick and easy to prepare chickpeas would increase. Thus in the long run, the growth in market demand for chickpea will be for improved quality products, pre-cooked preparations, products requiring less preparation time, snack foods, and refrigerated products (Rees et al. 2000). Exporters must start to discriminate within the bulk commodity market for chickpeas and would have to gear up to invest in value-added products suitable for supermarket shelves.

It is likely that different markets will evolve for the middle to high income class in South Asia, who are prepared to pay for high quality in terms of grain appearance, cooking time, and taste. Packaged products are also gaining acceptance (Brouwer et al. 2000, Lovett and Gent 2000). Australia has been exporting small-seeded desi cultivars for the low value bulk market, but is increasingly emphasizing seed color and size in new cultivars targeting high value niche in markets (Siddique et al. 2000). The focus on quality will thus become increasingly important in the long run. This is generally more difficult to achieve than yield gains. Even for the traditional chickpea markets (whole grains, split dhal), for low income consumers quality standards would have to be improved while keeping the product competitive with other substitute protein sources.

Part II: Pigeonpea

Introduction

Pigeonpea is an important pulse crop of the tropics and subtropics, grown between latitudes 30° S and 30° N and at elevations ranging from sea level to 2000 m. It is a major crop in India, and is widely grown in eastern and southern Africa. The center of origin of the crop is India. It moved to Africa from India more than 4,000 years ago and a secondary center of diversity developed later in eastern Africa (van der Maesen 1980). Pigeonpea accounts for less than 5% of total world pulse production. The traditional varieties, mainly medium- and long-duration types are grown in the developing countries, in areas prone to drought on degraded soils by resource-poor farmers. It is the preferred pulse crop in dryland areas where it is intercropped or grown in mixed cropping systems with cereals or other short-duration annuals. The traditional medium- and long-duration types take between 150 days and 280 days to reach maturity. The crop provides yield stability, particularly in drought prone environments where the less drought tolerant cereals often fail. Its deep root system allows for optimum moisture and nutrient utilization. Pigeonpea offers multiple benefits—protein rich seed (approximately 21% protein), fuel, fodder, and fencing material, improved soil fertility, and erosion control (Nene and Sheila 1990).

Crop Distribution

Pigeonpea area and production statistics are often underestimated because a large proportion of pigeonpea is cultivated around homesteads, in backyards, and as a hedge crop. Reported statistics suggest that the crop is mainly grown in the developing countries (Fig. 7), covering an area of 4.3 million ha. In the early 1980s, more than 90% of pigeonpea production of 2.2 million t was produced in South Asia, but it has since come down to 84% indicating that pigeonpea cultivation is spreading to other regions (Fig. 8). Within South Asia, India dominates the scene accounting for 99% production in 1996–98 (Fig. 9). In India, the important pigeonpea-growing states are Uttar Pradesh in the north, Maharashtra, Madhya Pradesh, Karnataka, and Andhra Pradesh in south and central India, and Gujarat in the west. Pigeonpea is also grown in

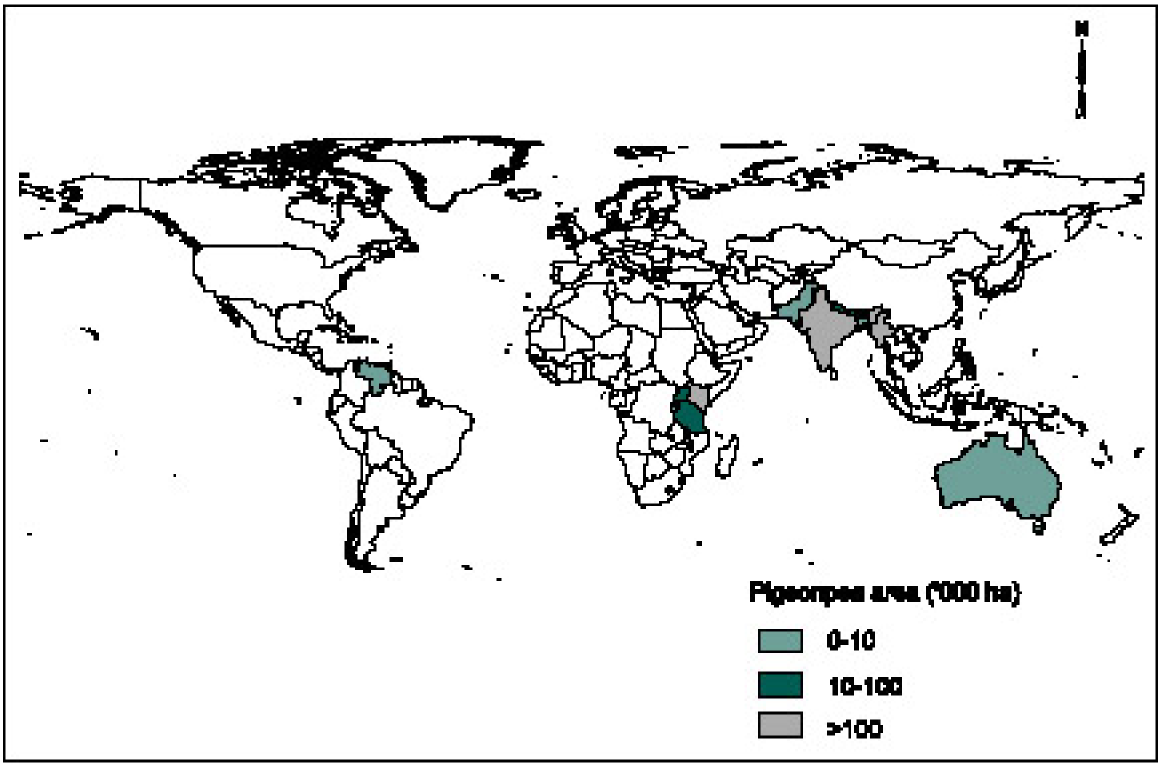


Figure 7. Global distribution of pigeonpea (Source: FAO, Rome, Italy).

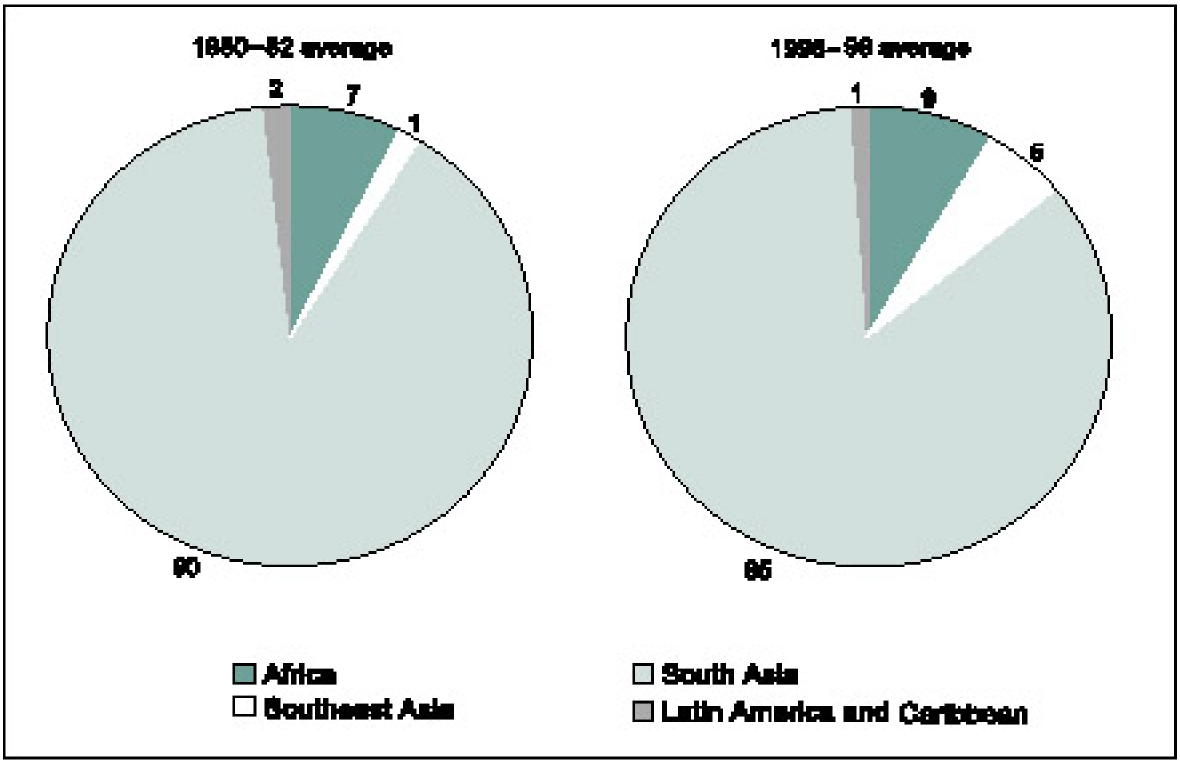


Figure 8. Share (%) of major pigeonpea-producing regions (Source: FAOSTAT).

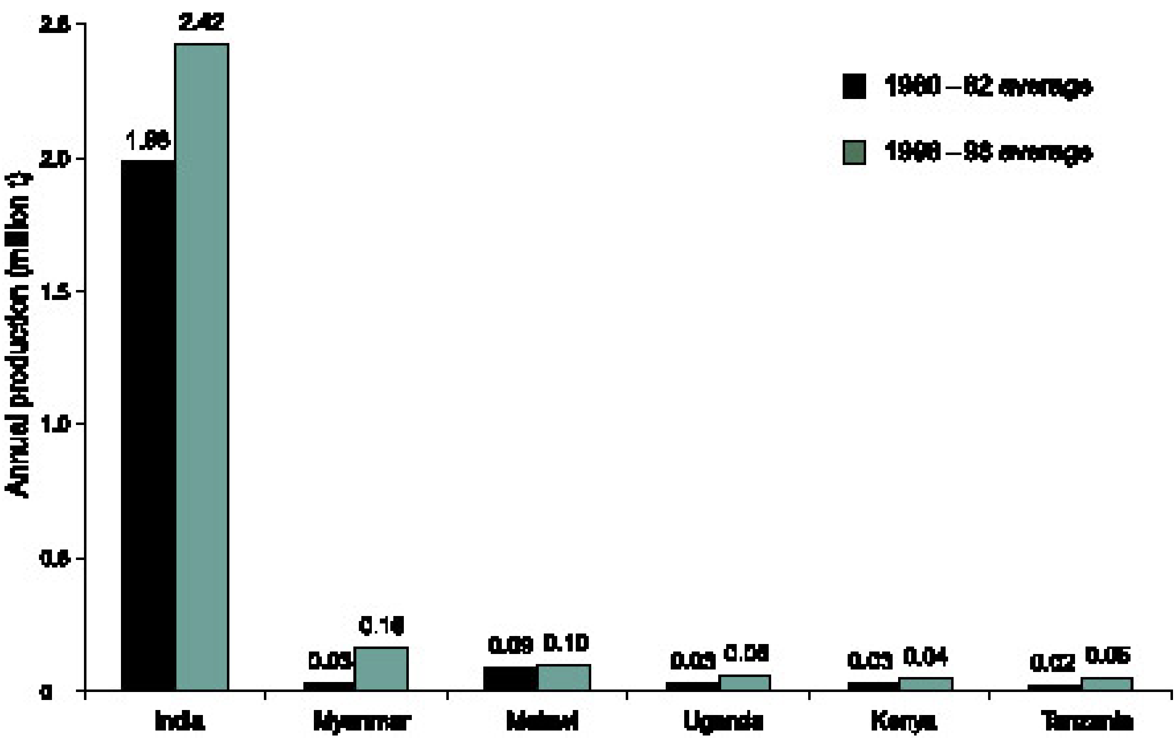


Figure 9. The world's major pigeonpea producers (Source: FAOSTAT).

several other South Asian countries notably Nepal and Bangladesh. In Nepal the crop is grown in the Terai region (the foothill plains). Southeast Asia has emerged as an important producer of pigeonpea and its share in global production has increased from 1% in 1980–82 to 6% in 1996–98 mainly due to area expansion in Myanmar. Pigeonpea production in Myanmar is concentrated in the central dry areas of Mandalay, Sagaing, and Magwe Divisions. Generally the long-duration tall varieties are grown, either mixed or as an intercrop with sesame or groundnut (*Arachis hypogaea* L.).

Only limited information is available on pigeonpea in other regions of the world. According to available statistics, in Africa, the crop covers about 10% of the area under pigeonpea. Major pigeonpea-producing countries are Kenya (34% area; 18% production), Malawi (33% area; 39% production), Uganda (17% area; 23% production), and Tanzania (16% area; 19% production). Although the area planted to pigeonpea in Mozambique is not known the general perception is that it is higher than that in Malawi. The other parts of the world account for only 1% of pigeonpea area and production, concentrated mainly in some countries in Latin America and Caribbean (see Appendix 1 for detailed statistics at country and regional levels).

Although India has the largest area and is the biggest producer of pigeonpea, in some countries pigeonpea is the most important pulse crop. It accounts for about 90% of the total pulse production in Puerto Rico, 86% in Trinidad, and 36% in Malawi. In the Dominican Republic, Jamaica, Panama, and Uganda, it is the second most important pulse crop. In India, pigeonpea is the third most important pulse crop, after chickpea and dry beans.

The Simpson Index of Diversity shows that the crop has relatively low internationality, i.e., production is concentrated in few countries. The index was around 0.20 in 1980–81. But during the last two decades the crop has gained importance in many countries and consequently the index was marginally higher at 0.26 in 1996–98.

Production Trends

Area

Pigeonpea plants have been spotted in many countries but in only a few countries it is grown as a field crop, and still fewer countries report statistics of pigeonpea area and production. In Africa the crop is extensively grown in village compounds, kitchen gardens, and field bunds but is not reported in statistics. Based on the available statistics worldwide, pigeonpea was grown on about 4.4 million ha in 1996–98 according to FAO statistics (Table 8). During the last two decades, its area increased by about 32% which translates into an annual growth rate of 1.6% (Table 9). Area increased in all regions, but at a differential rate in different countries (Table 9 and Fig. 10). The highest annual growth rate of 10.6% was recorded in Myanmar in 1980–82 and 1996–98, from 54,000 ha in early 1980s to about 250,000 ha in late 1990s. Most of the increase in area came in 1990s, when the annual growth rate was 17% (Table 9). The crop is largely produced as a cash crop for export to India. Devaluation of Kyat (local currency) made export prices competitive.

India accounts for about three-quarters of the increase in pigeonpea area during the last two decades. Most of the increase in area occurred during 1980s. High pigeonpea prices and availability of wilt resistant and medium-duration varieties led to an increase in pigeonpea area in central and peninsular India. With the availability of early-maturing pigeonpea, double cropping with wheat was increasingly being adopted in northern India and parts of central India where irrigation facilities exist. Traditionally pigeonpea is mainly intercropped with cereals or legumes or cotton. The relative profitability of the intercrops determines the number of rows planted to pigeonpea. In the 1990s area expansion slowed down due to decline in relative profitability of pigeonpea compared to cotton, sunflower, and soybean and increase in disease and pest infestation problems in the improved varieties. Government policy encouraged oilseed production by raising the tariff barriers on the import of edible oils, and at the same time extending improved technologies to farmers under the Technology Mission on Oilseeds. Coarse cereals and pulses were further relegated to marginal areas.

In Africa pigeonpea is mainly produced in eastern and southern Africa. The major pigeonpea-producing countries are Kenya, Malawi, Tanzania, and Uganda. Although Mozambique is an important pigeonpea-growing country, area figures are not available. Here

Table 8. Pigeonpea area, yield, and production[1].

	Area ('000 t)			Yield (kg ha^{-1})			Production ('000 t)		
Country	1980-82	1990-92	1996-98	1980-82	1990-92	1996-98	1980-82	1990-92	1996-98
Developing countries	3275.3	4109.5	4392.9	681.9	682.7	657.2	2233.3	2805.4	2887.0
Africa	287.7	340.1	432.2	574.6	748.3	580.5	165.3	254.5	250.9
Burundi	2.4	2.3	2.3	1041.7	1043.5	1000.0	2.5	2.4	2.3
Kenya	66.3	78.1	147.5	434.4	850.2	304.4	28.8	66.4	44.9
Malawi	127.3	142.3	143.0	667.7	683.8	687.4	85.0	97.3	98.3
Tanzania	36.7	56.0	68.0	618.5	673.2	691.2	22.7	37.7	47.0
Uganda	55.0	61.3	71.3	478.2	827.1	817.7	26.3	50.7	58.3
Southeast Asia	54.3	76.6	247.8	537.8	620.1	640.4	29.2	47.5	158.7
Myanmar	54.3	76.6	247.8	537.8	620.1	640.4	29.2	47.5	158.7
South Asia	2888.4	3630.3	3667.0	693.5	674.2	666.2	2003.1	2447.4	2443.1
Bangladesh	9.4	5.5	6.0	755.3	545.5	500.0	7.1	3.0	3.0
India	2859.1	3606.6	3635.7	693.8	674.3	665.8	1983.6	2432.1	2420.7
Nepal	17.1	18.1	25.3	631.6	674.0	766.8	10.8	12.2	19.4
Pakistan	2.8	0.3	NA[2]	535.7	666.7	NA	1.5	0.2	NA
Latin America and Caribbean	44.9	62.5	46.0	795.1	896.0	745.7	35.7	56.0	34.3
Dominican Republic	16.5	33.5	23.7	854.5	1152.2	827.0	14.1	38.6	19.6
Haiti	8.5	8.0	7.5	482.4	450.0	400.0	4.1	3.6	3.0
Jamaica	2.5	1.8	1.6	960.0	944.4	1187.5	2.4	1.7	1.9
Panama	2.4	4.0	4.5	875.0	450.0	488.9	2.1	1.8	2.2
Puerto Rico	5.6	3.2	0.8	857.1	562.5	625.0	4.8	1.8	0.5
Trinidad	1.8	1.1	1.1	1888.9	1545.5	2909.1	3.4	1.7	3.2
Venezuela	6.8	10.2	6.1	514.7	558.8	541.0	3.5	5.7	3.3
World	3275.3	4109.5	4392.9	681.9	682.7	657.2	2233.3	2805.4	2887.0

1. Data are 3-year averages.
2. NA = Data not available.

Source: Calculated using FAOSTAT data.

pigeonpea is grown both as sole crop and as intercrop or mixed crop. In Uganda pigeonpea/ millet intercropping is popular. In many African countries pigeonpea is also alley cropped (Ali 1990). During the last two decades, pigeonpea area in Africa has increased by about 40% from 287,000 ha in 1980–82 to 432,000 ha in 1996–98. Kenya and Tanzania in eastern Africa were the main contributors to this growth, where area under pigeonpea nearly doubled. Increase in area can be attributed to increase in effective cost of fertilizer as subsidies were being removed/cut. Farmers were seeking additional cropping options that require less fertilizer and also improve soil fertility. Responding to these forces pigeonpea area expanded.

In Latin America and Caribbean, the overall area under pigeonpea was stagnant. Both long-duration and short-duration types are grown, usually intercropped with maize. Pigeonpea area increased in Dominican Republic and Panama and declined in other countries in the region.

Yield

Globally average pigeonpea grain yields (field crop only) have remained stagnant at about 0.7 t ha^{-1} (Table 8 and Fig. 11). Global yields largely reflect the situation in India where pigeonpea yields stagnated around 0.7 t ha^{-1}. Stagnant growth in pigeonpea yields in India may be related to the crop's relatively low status in the cropping system. It is often relegated to marginal soils and is usually intercropped with coarse cereals and cotton. The medium-duration varieties are adapted to central and peninsular India where soils are relatively shallow and winters are milder than in the north. The onset of terminal drought stress is more rapid than on the heavy soils (Troedson et al. 1990). As a crop of secondary importance in many of these systems it receives little or no purchased inputs, nor does it attract much of farmer's crop management attention (Müller et al. 1990). The average yields in Latin America and Caribbean are relatively higher with

Table 9. Pigeonpea annual compound growth rate (%) of area, production, and yield during 1981–98.

	Area			Yield			Production		
Country	1981–90	1991–98	1981–98	1981–90	1991–98	1981–98	1981–90	1991–98	1981–98
Developing countries	2.2	1.8	1.6	0.7	0.4	–0.6	2.9	1.2	1.0
Africa	2.1	1.4	0.9	1.6	0.1	1.4	3.7	1.5	2.2
Burundi	–0.2	0.5	0.2	–0.4	–1.1	–0.4	–0.5	–0.6	–0.1
Malawi	1.4	0.2	0.5	0.4	0.2	0.1	1.8	0.4	0.6
Tanzania	5.7	4.2	1.8	0.3	–0.1	0.8	6.0	4.1	2.6
Uganda	1.0	2.6	0.9	6.2	–0.2	5.1	7.2	2.4	6.1
Southeast Asia	0.0	16.7	10.6	2.2	0.5	0.8	2.5	17.2	11.5
Myanmar	–0.3	17.1	10.6	2.4	0.4	0.8	2.1	17.6	11.5
South Asia	2.2	0.2	1.3	0.5	0.6	–0.8	2.7	0.8	0.6
Bangladesh	–6.3	1.0	–2.1	–2.8	–0.7	–3.3	–9.0	0.3	–5.4
India	2.3	0.1	1.4	0.5	0.5	–0.8	2.8	0.7	0.5
Nepal	0.3	5.6	2.6	0.5	2.3	0.9	0.7	8.1	3.6
Pakistan	–20.3	NA[1]	–20.3	2.4	NA	2.2	–18.6	NA	–18.6
Latin America and Caribbean	5.2	–5.6	0.5	1.3	0.2	0.2	6.1	–6.0	0.6
Dominican Republic	8.8	–8.6	2.8	4.1	–0.1	1.0	13.2	–8.7	3.8
Haiti	–0.1	–0.5	–1.0	–0.7	–0.9	–1.7	–0.8	–1.4	–2.7
Jamaica	–5.7	–1.5	–3.1	–0.3	3.2	1.7	–6.0	1.6	–1.5
Panama	3.7	2.9	3.9	–4.5	0.2	–4.5	–0.7	3.1	–0.8
Puerto Rico	–5.8	–21.2	–11.3	–5.3	0.8	–2.7	–10.8	–20.8	–13.7
Trinidad	–5.2	1.0	–2.2	–1.3	12.6	3.2	–6.4	13.7	0.9
Venezuela	4.6	–9.4	–0.4	1.1	–0.3	0.1	5.7	–9.6	–0.3
World	2.2	0.8	1.6	0.7	0.4	–0.6	2.9	1.2	1.0

1. NA = Data not available.

Source: Calculated using FAOSTAT data.

the average productivity in Jamaica and Trinidad being more than 1 t ha^{-1}.

Production

Pigeonpea production has marginally increased during the past two decades (Table 8 and Fig. 10). It increased from 2.2 million t in 1980–82 to 2.9 million t in 1996–98, an increase of about 28%. The increase has almost exclusively come from area expansion. The increased production was led by India, which contributed about 68% to the change. Although India was the main contributor to increase in production, the highest annual growth rate of 11.5% was from Myanmar. The production increased from about 29,200 t in early 1980s to about 158,700 t in 1996–98. As in other countries, the increase was mainly due to more area being planted to the crop. During this period an additional area of 193,500 ha was brought under pigeonpea cultivation.

In Africa, increase in production was due to increase in both area and productivity. Pigeonpea production doubled in Uganda and Tanzania. The annual production increase in these countries was 6.1% and 2.6%, respectively. While growth in yield of pigeonpea was the major source of production increase in Uganda, in Tanzania it was largely due to area expansion.

The pace of increase in pigeonpea production was quite dismal. Major factors include biotic and abiotic constraints, lack of market information particularly of improved varieties, and narrow utilization base. Improvement in pigeonpea production is particularly important since the crop is grown by resource-poor farmers in drought prone environment.

Production Constraints

Abiotic and biotic constraints

There are a number of constraints that adversely affect pigeonpea productivity. Joint assessment by IARCs and NARS indicate that in pigeonpea economic losses from abiotic constraints exceed those from biotic constraints (Ryan 1995). The major abiotic constraint that limits pigeonpea production is drought. Waterlogging, salinity, and

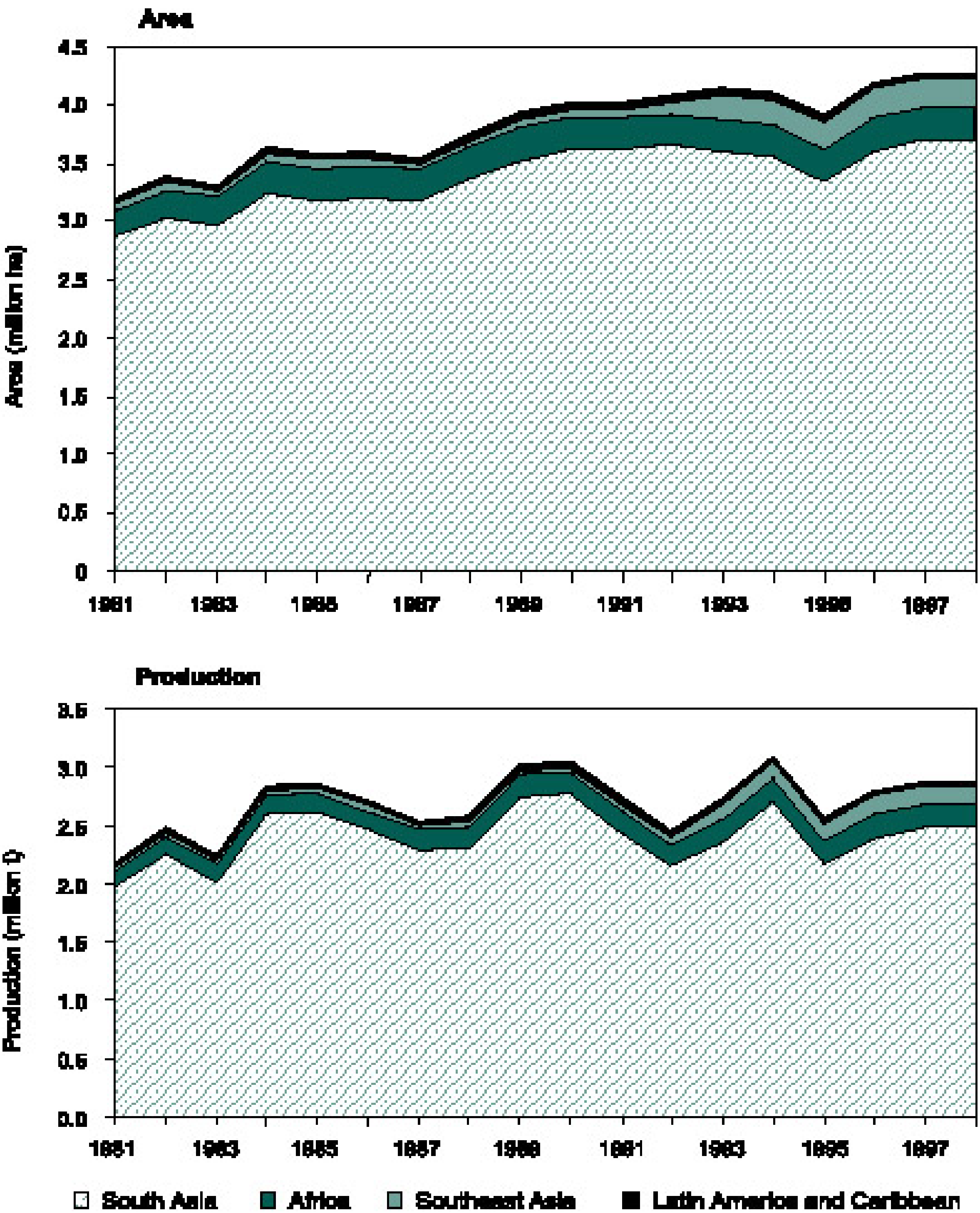


Figure 10. Global trends in pigeonpea area and production.

narrow adaptation base are other constraints that affect the crop. Droughts in low rainfall areas and waterlogging in heavy rainfall regions in the semi-arid tropics adversely affect production of pigeonpea. Yield reduction due to waterlogging is particularly high in the short-duration varieties.

The major biotic factors of pigeonpea are diseases and insect pests. The pigeonpea diseases of major importance are sterility mosaic, fusarium wilt, and phythophthora blight in the Indian subcontinent; wilt and cercospora leaf spot in eastern Africa; and witches' broom in the

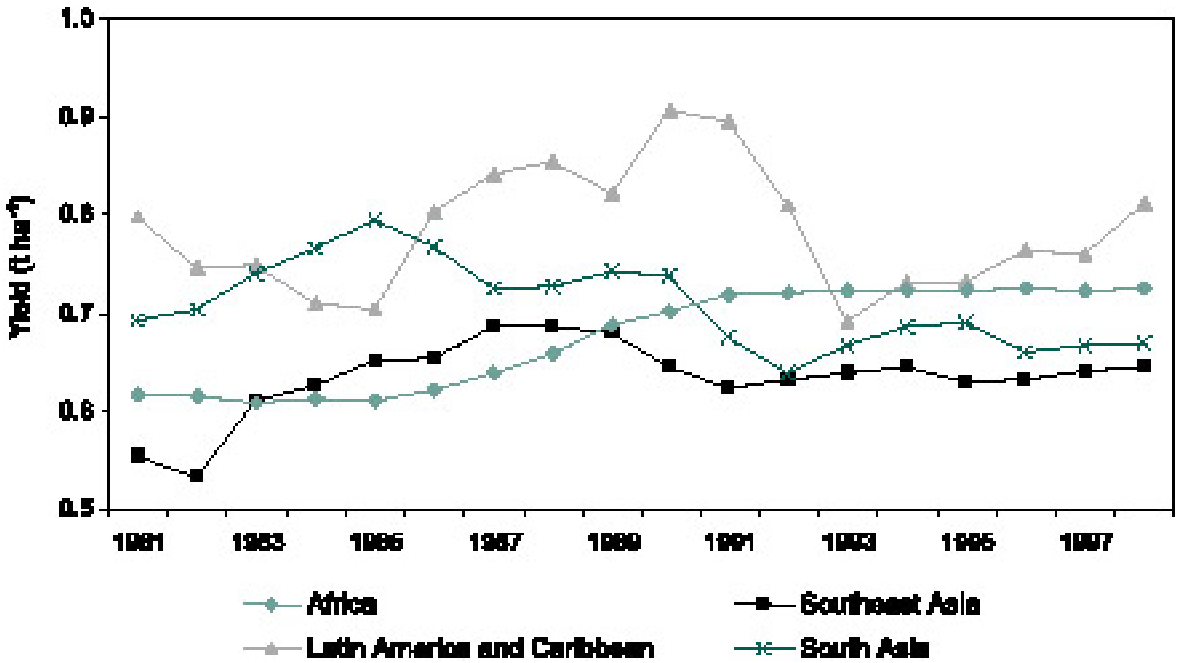


Figure 11. Global trends in pigeonpea yield,1980–98 (3-year moving average) (Source: FAOSTAT).

Caribbean and Central America (Reddy et al. 1990). The major insect pests of pigeonpea are pod fly (*Melanagromyza* sp), pod borers (*Helicoverpa armigera* and *Maruca vitrata*), and pod sucker (*Clavigralla* sp).

Pigeonpea is generally intercropped and thus has to compete with the associated crop for water and other resources. Sorghum, cotton, maize, and groundnut are some of the popular intercrops with pigeonpea in Asia, Africa, and the Caribbean. A better understanding of the complementarity of associated crops, moisture needs, nutrient needs, and pest management in intercropping systems would help in achieving higher and stable productivity (Ali 1990).

Socioeconomic constraints

Among the socioeconomic factors, low profitability relative to competing crops or companion crops in the intercropping system, high inter- and intra-year variation in prices, and lack of information on quality standards affect pigeonpea production at the farm level. Most pigeonpea is grown on small farms by semi-subsistence farmers who lack resources for adopting improved varieties and management practices.

High processing margins reduce producer's share in consumer's rupee. Lack of small-scale processing and postharvest practices in Africa are major bottlenecks for increased commercialization of the crop. Kenya and Malawi, however, have large dhal mills for dehulling pigeonpea for export and for local consumption by people of Asian origin. Another important factor is the subsidiary status of food pulses for both farmers and governments in all regions where it is grown. In 1980s governments have given their attention to cereal crops in terms of price policies, investment in infrastructure, research, extension, and development (McWilliam and Dillon 1987). Farmers too tend to allocate pulse crops to more marginal areas since pulses can adapt to deficient resource base.

Research efforts are in progress in different countries in developing resistance through genetic improvement and through crop and resource management technologies to overcome major production constraints of pigeonpea. But these should be accompanied by extension, inputs pricing policies, and marketing opportunities.

Utilization

Pigeonpea is used in diverse ways. Besides its use in food preparations as dhal (decorticated, split cotyledons) and as whole grain, its tender green seeds are used as vegetable, crushed dry seeds or pigeonpea haulms as animal feed, green leaves as fodder, and stems as fuel wood. The plants are also used to culture the lac-producing insects (Nene and Sheila 1990).

Food use

The most important usage of pigeonpea still remains as human food. Globally pigeonpea utilization has increased by about 28% during the last two decades (Table 10). The annual growth in pigeonpea utilization was 1% during 1980–97. Consumption of pigeonpea as dhal is most popular in South Asia. Dhal is made by dehulling and splitting the pigeonpea seed by using different processes. Dehulling greatly reduces cooking time and improves the appearance, texture, palatability, digestibility, and nutritional quality (Faris and Singh 1990). In eastern Africa, the West Indies, and Indonesia, whole dry seed is boiled and consumed. In parts of Tanzania and Uganda, seed is split by grinding and then cooked as dhal. In Myanmar pigeonpea is consumed locally and is the pulse preferred by people of Indian and Nepalese origin.

Green (immature) seed of pigeonpea is also used as a vegetable. In many countries in the Caribbean region, in eastern and southern Africa, and in parts of India (e.g., Gujarat), green fresh pigeonpea is an important vegetable. A viable pigeonpea industry is reported from the Dominican Republic. The industry is driven by export demand for canned pigeonpea from Latin American emigrants to USA. In parts of Java and India, very young pods are harvested before the seeds are formed, and cooked like beans (french beans) in curries.

Although absolute food use of pigeonpea has increased the per caput availability has declined at the global level marginally from 0.394 to 0.388 kg (–0.6% yr^{-1}). The decline is mainly due to a decline in per caput availability in India from 2.3 kg yr^{-1} in early 1980s to 2 kg yr^{-1} in late 1990s, reflecting a decline of 1.3% yr^{-1} in South Asia (Table 11). The implications of decline in per caput availability will be discussed in later sections.

Feed use

Pigeonpea plants and seed are also used as animal feed in South Asia and Africa, and to lesser extent

Table 10. Pigeonpea utilization by type and region.

	Food ('000 t)		Feed ('000 t)		Total utilization[1] ('000 t)	
Region	1980–82	1996–97	1980–82	1996–97	1980–82	1996–97
Developing countries	1783.3	2251.9	170.1	269.7	2206.5	2824.2
Africa	88.5	142.1	2.1	2.3	129.7	200.9
Southeast Asia	25.7	17.1	0.0	0.0	29.2	20.8
South Asia	1639.0	2006.6	168.0	267.3	2010.2	2497.9
Latin America and Caribbean	30.2	31.2	0.0	0.0	32.6	33.4
World	1783.3	2251.9	170.1	269.7	2206.5	2824.2

1. Includes food, feed, and other uses.

Source: Estimated using FAOSTAT data.

Table 11. Per caput food availability for pigeonpea by region.

	Per caput food availability (g yr^{-1})		Growth rate of per caput food availability (% yr^{-1})
Region	1980–82	1996–97	1981–97
Developing countries	532.5	499.1	–0.9
Africa	180.8	189.9	0.3
Southeast Asia	16.7	9.0	–10.7
South Asia	1790.2	1587.6	–1.3
Latin America and Caribbean	81.8	63.6	0.3
World	393.7	387.7	–0.6

Source: Estimated and calculated using FAOSTAT data.

in Caribbean countries. The by-product of seed coats, broken bits, and powder from dhal mills, forms a valuable protein source for dairy animals. Cracked and shriveled seeds are also used as animal feed. Pigeonpea seed has been found useful in the rations of pig and poultry and can be substituted for soybean to some extent (Nene and Sheila 1990). Plants left in the field after harvest are a good source of browse for animals. Dry pigeonpea leaves are a valuable source of fodder, particularly in the dry season when green fodder is not available. Globally about 9% of available by-products from the seed is consumed as animal and poultry feed.

Other uses

One of the potential uses of pigeonpea plant is to produce silk and lac. In China and Myanmar, the crop is also grown for lac production. The branches of the plant are used as fuel for cooking by the population living in abject poverty. Dry stems of pigeonpea are an important source of fuel in rural India. Considering the wide uses of pigeonpea, more postharvest research may be initiated to increase focus on processing aspects.

International Trade

Global world trade for pigeonpea is insignificant and trade statistics are incomplete. From available statistics in 1996–98, pigeonpea accounted for only 2% of the total pulse trade, which is still an increase over the early 1980s when it represented only 0.5% of the total pulse trade. In early 1980s the volume of total annual imports was only 10,720 t but increased to 140,800 t in late 1990s. The driving force was the rising import demand from India due to shortfalls in domestic production (Table 12). Pigeonpea imports to India accounted for less than 0.5% of domestic production in 1980s but in mid- and late 1990s it accounted for 3–5% of domestic production. India has thus emerged as the largest importer of whole grain pigeonpea, with imports increasing during the last two decades.

What are the future prospects of pigeonpea imports to India? More recent data available from Government of India statistics reveal that in 1998 and 1999 pigeonpea imports to India have tapered off and now account for about 40,000 to 50,000 t per annum. Thus although pigeonpea imports to India have increased during the last 20 years the increase has been in spurts with large increases in some years followed by decreases in other years. Import demand is influenced by domestic production of pigeonpea and other substitute pulses, and world market prices in relation to prices in India. In 1997 all pulses including pigeonpea were put on open general license and imports were allowed duty free. Despite this there is no surge of imports indicating that consumers are adjusting to the lower per caput availability of pigeonpea by substituting other protein sources in their diets. In contrast imports of other pulses [mung bean (*Vigna radiata* (L.) Wilczek), black gram (*Vigna*

Table 12. World pigeonpea imports[1] ('000 t).

Country	1980–82	1990–92	1996–97
Developing countries	10.7	47.6	140.8
Africa	0.0	1.2	1.4
Malawi	0.0	0.0	0.0
Tanzania	0.0	0.0	0.0
Southeast Asia	0.0	0.0	0.0
Myanmar	0.0	0.0	0.0
South Asia	7.1	45.2	138.6
India	7.1	45.1	138.5
Nepal	0.0	0.1	0.0
Latin America and Caribbean	3.7	1.1	0.9
Dominican Republic	0.0	0.0	0.0
Jamaica	0.0	0.0	0.0
Trinidad	0.5	0.7	0.7
Venezuela	3.1	0.4	0.0
World	10.7	47.6	140.8

Source: FAOSTAT.

mungo (L.) Hepper), lentil, etc.] have been more stable averaging around 300,000 to 500,000 t per annum and account for 7–8% of domestic production.

Myanmar is the major exporting country of pigeonpea. In 1996–97, Myanmar exported 130,200 t of pigeonpea, of which 90% was exported to India and the remaining to Malawi, Singapore, and Dominican Republic (Table 13). Kenya and Tanzania are other important exporters during the last 10–15 years. Proximity to Indian market and the devaluation of the Kyat helped Myanmar to gain a competitive edge over other exporters.

International trade in pigeonpea from eastern and southern Africa is grossly underestimated. For example during 1998, Kenya exported over 40,000 t, Malawi over 20,000 t, and Tanzania over 8,000 t of pigeonpea. Both Kenya and Malawi exported whole seed to India and dhal to South Africa, Europe, and North America. A significant portion of the pigeonpea crop attributed to Malawi is actually grown in Mozambique, and crosses the border through informal trade. In the Dominican Republic trade is the driving force for pigeonpea production; exports of canned pigeonpea account for a significant portion of the national crop (Müller et al. 1990). In South Asia there is a large unofficial cross-border trade of pigeonpea, which does not enter formal trade statistics (pigeonpea imports to India from Nepal).

Technological Issues and Research Focus

Concerted research efforts to alleviate constraints that would lead to improvement in pigeonpea productivity is recent. In India, the major producer of pigeonpea, efforts to alleviate production constraints started earnestly in the late 1960s and intensification of research efforts in collaboration with ICRISAT in the 1970s. In Africa, research started in Uganda and Kenya about the same time, but at low levels of funding and only in the 1990s did concerted efforts take place targeting Kenya, Malawi, Mozambique, Sudan, Tanzania, and Uganda. In India and Myanmar, technological breakthrough has reached a wider population, but other countries have yet to benefit from investments made.

Available technologies

Varieties with resistance to wilt

Fusarium wilt caused by *Fusarium udum* is a major disease of pigeonpea in both Asia and Africa. The disease, which is soilborne, can be overcome through genetic improvement and better agronomic management. Research efforts in alleviating this problem have resulted in the development of a number of varieties resistant to wilt and a few were released and are grown in the wilt affected areas by the farmers (see Box 5).

Table 13. World pigeonpea exports[1] ('000 t).

Country	1980–82	1990–92	1996–97
Developing countries	9.7	39.6	140.8
Africa	6.8	4.4	6.0
Malawi	6.8	3.6	6.0
Tanzania	0.0	0.8	0.0
Southeast Asia	1.2	34.3	134.2
Myanmar	1.2	34.3	130.2
Singapore	0.0	0.0	4.0
South Asia	1.1	0.4	0.0
India	0.0	0.4	0.0
Nepal	1.1	0.0	0.0
Latin America and Caribbean	0.6	0.4	0.6
Dominican Republic	0.6	0.4	0.6
Jamaica	0.0	0.0	0.0
Trinidad	0.0	0.0	0.0
Venezuela	0.0	0.0	0.0
World	9.7	39.6	140.8

Source: FAOSTAT.

Box 5. Wilt resistance in pigeonpea in northern Karnataka, India

Fusarium wilt is a widespread disease in almost all pigeonpea-growing areas in Asia, Africa, and the Americas. Joint assessments by ICRISAT and NARS indicate that in the 1980s economic losses in pigeonpea due to wilt were 470,000 t in India and 30,000 t in Africa (Ryan 1995).

Research to overcome this production constraint was aimed primarily at identifying resistant lines, conducting multilocational screening for resistance, and developing resistant cultivars. A combination of genetic resistance and cultural practices was expected to offer farmers a cost-effective method of controlling the disease. The work conducted by ICRISAT in collaboration with NARS partners in different countries has led to the release of four wilt-resistant cultivars in different regions. Here we report the success story in northern Karnataka, India.

Wilt-related losses were particularly severe in northern Karnataka. Demand of farmers from this region for wilt resistant cultivars catalyzed the fast track development and release of wilt resistant medium-duration cultivar ICP 8863 as Maruti in 1986. Adoption of ICP 8863 in its target domain steadily increased from 5% in 1987 to 60% in 1993. Farmers perceived higher yields due to wilt resistance, shorter duration than other medium-duration varieties, suitability for either sole or intercropping, and efficiency in input use, i.e., good response to irrigation. Subsequent survey data revealed that ICP 8863 provided 57% yield gain over the next best cultivar. The yield gain has expanded production as yield gains translate to lower per unit production costs and improved profitability levels. Although northern Karnataka was the target zone of adoption the zones of diffusion included the districts neighboring northern Karnataka in the states of Andhra Pradesh, Maharashtra, and Madhya Pradesh. Limited availability of breeder and certified seed in eastern Maharashtra has constrained adoption [since the variety was released in Karnataka and the priority clientele of the Karnataka State Seeds Corporation (KSSC) was in Karnataka]. However, farmer to farmer exchange of seeds played an important role.

The total net present value of benefits from the collaborative fusarium wilt research was approximately US$ 62 million, representing an internal rate of return of 65%. The success story can be attributed to a favorable production environment, largely because the state seed agency ensures relatively good seed availability. It is also serviced by a good extension network operated by the state department of agriculture that helped popularize ICP 8863 through minikit trials and a training and visit system. Once ICP 8863 was released in Karnataka seed production was taken up immediately by KSSC.

(Source: Bantilan and Joshi 1996)

Integrated pest management

Insect pests are the most important constraint to improved productivity. The major field pests of pigeonpea are pod fly (*Melanagromyza* sp), pod borers (*Helicoverpa armigera* and *Maruca vitrata*), and pod suckers (*Clavigralla* sp) while the major storage pests are bruchids (*Callosobruchus* sp). Currently, farmers in Asia are using chemicals to control field pests. Indiscriminate use of pesticides has resulted in insects developing resistance to chemicals. Research efforts are now being focused on the development of IPM strategies, with special emphasis on use of tolerant varieties, cultural practices, natural enemies, and judicious use of pesticides. Non-availability of good quality IPM components such as plant-based products, NPV, pheromones, and seed of high-yielding tolerant varieties were identified as major constraints. The success story of IPM in Astha village in central Maharashtra, India is encouraging. In 1999 farmers in Astha village did not use even a single spray of chemical insecticide and today the entire village practices IPM. Under an ICRISAT-ICAR project funded by the International Fund for Agricultural Development (IFAD) farmers were encouraged to collect neem fruits from their backyards for extraction of insecticide. Also, village-based *Helicoverpa* nuclear polyhedrosis virus (HNPV) production units that yielded satisfactory results for adoption of IPM options were established. The traditional practice of shaking the plant was also part of the package. Astha farmers in 1999 harvested 25–50% higher yields of pigeonpea compared to nearby non-IPM villages (ICRISAT 2001).

Options for improving pigeonpea productivity and production

The areas where pigeonpea is grown are characterized by erratic and poor rainfall distribution and variation in temperature and photoperiod. Similarly, the availability of resources varies among farmers who grow pigeonpea. Varieties developed should therefore target end user needs and agroecological region so as to reach their yield potential.

Extra-short- and short-duration varieties. Traditional pigeonpea varieties are medium- and long-duration types. These varieties are suited for intercropping and often have low yield potential. However, these varieties often suffer from intermittent or terminal drought stress. As a sole crop long-duration pigeonpea has limited scope in low rainfall areas. Research efforts were concentrated on developing extra-short- and short-duration types that would mature within 90–120 days and would, therefore, grow and produce yields under a more assured moisture supply in irrigated/assured rainfall areas. The varieties are adapted to warm conditions and are less sensitive to photoperiod. They have high yield potential and are grown as sole crops. In areas where the growing season is long or where there is irrigation, two to three crops can be grown in a year. The traditional configuration of diversity in space (intercropping) appears to be now supplemented by diversity in time (multiple cropping). This would enhance overall returns from a given piece of land. A number of varieties have been released to meet different end user needs. ICPL 87 released in 1986 as Pragati is now widely grown in the assured rainfall regions of Maharashtra and Karnataka in India. The bottom line benefit to the overall enterprise was a 30% increase in net farmer income (Bantilan and Parthasarathy 1999). Farmers also perceived and valued benefits to soil fertility and erosion control by including pigeonpea in crop rotation. Double cropping systems involving extra-short-duration varieties were being widely practiced in north and central irrigated region. Varieties such as ICPL 151, Manak, AL 15, and UPAS 120 were adopted in pigeonpea-wheat rotation in India (Singh 1991). Intercropping pigeonpea with complementary pulse crops further increased the monetary returns. The short-duration group tends to be more susceptible to pests and is therefore targeted to farmers with resources, as a commercial crop. Another possibility is rice-pigeonpea sequential cropping in the rice-fallows of eastern coastal India. In Africa, Kenya, Sudan, Tanzania, and Uganda have released short-duration varieties for growing as sole crop for grain and vegetable. ICPL 87091 is now being exported from Kenya to Europe as vegetable pigeonpea. In parts of Eastern Province of Kenya adoption of a new pigeonpea variety NPP 670 was due to early maturity that enabled farmers to get their crop to market earlier, and get a better price (Tripp 2000).

Medium-duration varieties. The medium-duration varieties are adapted to warm conditions and are sensitive to daylength where long days prevent them from flowering. They are therefore well adapted to elevations <1,200 m and in areas between 20° N and 20° S. This group is suited for intercropping. A number of improved varieties have been released in peninsular India and Myanmar. In Kenya, northern Tanzania, and Uganda a number of varieties are in on-farm trials where in some areas, farmers are already growing them in their fields. The varieties identified in eastern Africa satisfy two major conditions: (1) they allow farmers to intercrop with cereals and short-duration legumes; and (2) they give two crops a year through ratooning.

Long-duration varieties. The long-duration varieties are adapted to cool conditions and are sensitive to daylength where long days delay flowering. They are therefore well adapted to elevations >1,000 m and in areas away from the equator. The duration group is suited for intercropping. A number of improved varieties have been released for growing in northern India and in eastern and southern Africa. Their high degree of tolerance to drought make them suitable for growing in drought prone areas.

Hybrid pigeonpea. To break the yield barrier in pigeonpea, the pigeonpea research program was directed towards developing genetic male sterility. Its discovery in 1974 offered exciting new potential for plant breeders. Concerted research efforts resulted in developing the world's first pigeonpea hybrid in 1991 (see Box 6). Pigeonpea hybrids are yet to become popular among the farmers.

Box 6. Hybrid pigeonpea

To break the pigeonpea yield barrier, an initiative was taken to develop hybrid pigeonpea. The process was complex because cross-pollination systems are usually difficult to develop in all leguminous species, which tend to exhibit very limited natural outcrossing, and seed multiplication rates are low, resulting in uneconomic costs of hybrid seed production. It took 15 years of concerted research efforts to produce the world's first pigeonpea hybrid, ICPH 8, which reached farmers' fields in 1991. This has opened a new vista to make pigeonpea more competitive in both fragile and favorable environments. The hybrid technology was shared by ICRISAT with the NARS and seed sector in India. In 1989, the Indian Council of Agricultural Research (ICAR) launched a comprehensive hybrid pigeonpea development program by involving nine research centers. In a short span of time leading Indian agricultural universities and the ICAR developed two additional hybrids, PPH 4 and CoH1. The hybrids demonstrated a grain yield advantage of 25–35% over non-hybrids of similar plant traits. With the success of developing hybrid pigeonpea, a new wave of hybrid research has been launched. The consortiums of interested research organizations are now focusing to develop cytoplasmic male sterility (CMS) system. It will bypass many of the operational difficulties of the nuclear male sterility approach, particularly the high labor requirement for rouging. Although adoption levels are low it is expected that soon the ongoing research efforts will benefit the pigeonpea-growing farmers.

(Source: ICRISAT 1998)

Seed systems

Pigeonpea is a crop with a relatively high seed multiplication rate (>100) comparable to small cereal grains such as sorghum, and much higher than groundnut (<10). Although the floral biology of pigeonpea favors self-pollination, natural outcrossing to the extent of 1–70% has been reported (Gupta et al. 1991). In Africa, the multiplication and dissemination of pigeonpea seed through the formal seed sector has started very recently. As with most small grains, informal seed diffusion mechanisms have been responsible for meeting farmer seed needs of this crop in virtually all the countries where the crop is presently being cultivated. Earlier efforts in Africa were for a limited number of seasons, and with little attention paid to ensure that seed multiplication was carried out according to accepted seed production standards. The significant increase in pigeonpea cultivated area recorded in some countries testifies to the efficiency of informal seed diffusion systems, but there has been some decline in quality. In Malawi, there is evidence that the fusarium wilt resistant variety ICP 9145 is less resistant to this disease than when it was first released. In Kenya, the medium-duration determinate variety NPP 670 is considered to be later maturing than when it was first released, probably due to outcrossing with local landraces. As long as the primary pigeonpea market has been for whole pigeonpeas to meet production shortfalls in India, the production of mixed pigeonpea grades as a result of the underdeveloped seed sector was not a problem. However, recent research has identified several high-value niche markets with very specific seed quality requirements. To access these markets, there is a need to ensure that pigeonpea seed, with necessary quality traits and resistance to diseases, is available to farmers. The high pigeonpea seed multiplication rate, the lack of clearly differentiated quality standards for pigeonpea seed, and the fact that farmers can save their own seed are strong disincentives to the involvement of the formal seed sector in pigeonpea seed production and marketing. Pigeonpea is not unique, as similar problems exist for most food crops except hybrid maize, where there is a strong incentive for farmers to purchase fresh seed every season because of the yield advantage to be gained. To overcome these constraints, a number of initiatives are underway to increase the level of vertical coordination between seed supply and marketing. Two examples are provided: dry seed; and fresh green pigeonpeas.

The emergence of large-scale dhal mills in India has resulted in a year-round demand for pigeonpea seed to feed these mills. In India, there is a shortage of pigeonpea seed from June to November after the crop has been harvested, and before the new crop is ready. Dhal millers are interested to source seed from elsewhere provided that seed quality is similar to the Indian product, and the strict delivery schedule can be met. This requires that farmers have access to seed of improved short-duration varieties that have the necessary seed quality traits to fit into the existing processing facilities. The identified market demand for pigeonpea seed with specific quality traits is stimulating investment by the formal seed sector in pigeonpea seed multiplication. The whole process is driven by profit incentives, but requires a strong degree of coordination between research, seed producers, traders, and processors.

The second example describes the demand for fresh pigeonpeas in UK. For a long time there has been a seasonal export of green pigeonpeas to UK from Kenya. The export was seasonal because the local landraces grown by farmers were all indeterminate long-duration cultivars that are harvested from May to October. The development of determinate, short-duration pigeonpea varieties provided the opportunity for year-round harvesting of green pigeonpeas. Fresh pigeonpea samples of several short-duration varieties were sent to buyers in UK to determine consumer requirements. Consumers exhibited a strong preference for green pigeonpeas over speckled and purple types. The existing handling and storage facilities used to get the pigeonpeas from farm to market necessitated a variety with good shelf life. The improved short-duration variety ICPL 87091 met these requirements, and seed of this variety is now being multiplied by the formal seed sector in Kenya.

The two examples illustrate the type of vertical coordination that is considered necessary to stimulate investment in seed production. Without a clear profit incentive, the private sector will not invest in seed production. The poor history of government seed intervention and the unsustainability of seed initiatives undertaken by development programs is unlikely to replace private sector investment in seed production for such crops as pigeonpea.

Outlook

Medium term

Pigeonpea production in the past increased at a very slow rate. In the next decade, we expect a faster increase in production growth rate due to availability of better technologies. In the past, production increased as a result of more area brought under the crop. It is expected that in future pigeonpea production will increase due to increase in productivity gains, a result of improved pigeonpea technologies and area expansion. Most of the area increase is expected in India, Nepal, Myanmar, Kenya, Mozambique, Sudan, Tanzania, and Uganda, and to a lesser extent in the Dominican Republic.

Due to growth in population and income, and moderately responsive income elasticities of demand it is expected that pigeonpea demand will continue to grow at least in the short to medium term. The demand projections indicate that pigeonpea demand in 2010 is expected to be about 3.47 million t, an increase of about 30% from 2.68 million t in 1996–98 (Table 14). In all the regions the consumption would go up, with substantial increase in South Asia and Africa. In India, which is a major producer and consumer of pigeonpea, the consumption may be about 22% higher in 2010 than in 1996–98. The demand for pigeonpea in India is projected at 3.09 million t in 2010.

To meet the entire pigeonpea demand, the pigeonpea average yields at the global level have to be increased from 650–700 kg ha^{-1} in 1996–98 to about 800–825 kg ha^{-1} in 2010 assuming area to remain constant. This is not a difficult task if pigeonpea was grown in the favorable and better resource endowed environments where availability of improved seed was ensured. Alternatively area under pigeonpea could be increased if varietal improvement of medium- and short-duration types is focused on varieties resistant to diseases and pests particularly sterility mosaic, wilt, and pod borer complex. The conventional intercropping is oriented toward subsistence and multiple crop production rather than to high productivity. But unless yield increases are forthcoming pigeonpea will not be able to compete for area with competing crops.

The above projections are at constant prices. Due to lack of technological breakthrough relative to competing crops, real prices for pigeonpea rose in India since supply could not keep pace with demand. The increase in real pigeonpea prices (adjusted for inflation) was faster than that for cereals like wheat and rice, and also other protein sources like milk and eggs which had experienced remarkable technological breakthroughs in their production (Kelley et al. 2000). Since demand for pigeonpea is more price elastic, as prices increased consumers tended to shift to other cheaper sources of protein, such as milk, meat, vegetables, and other pulses. Higher pigeonpea prices did not lead to large area

Table 14. Pigeonpea demand projections for 2010[1].

Country	Present consumption ('000 t)	Population growth rate (% yr^{-1})	Income growth rate (% yr^{-1})	Income elasticity	Demand growth rate (% yr^{-1})	Projected demand in 2010 ('000 t)
Africa	200.9	-	-	-	-	285.1
Burundi	2.4	2.5	–1.3	0.3	2.1	3.1
Malawi	92.0	2.4	–0.7	0.3	2.2	121.9
Tanzania	48.0	2.6	1.0	0.3	2.9	69.6
Uganda	58.5	2.6	2.7	0.3	3.4	90.5
Southeast Asia	20.8	-	-	-	-	26.6
Myanmar	20.8	1.6	1.0	0.3	1.9	26.6
South Asia	2428.8	-	-	-	-	3122.7
Bangladesh	3.0	1.5	2.1	0.4	2.4	4.1
India	2406.0	1.3	3.2	0.2	1.9	3088.7
Nepal	19.6	2.2	2.4	0.4	3.2	29.6
Pakistan	0.2	2.5	1.2	0.2	2.7	0.3
Latin America and Caribbean	33.9	-	-	-	-	40.4
Dominican Republic	19.2	1.3	2.1	0.1	1.5	23.3
Haiti	3.0	1.3	–5.2	0.1	0.8	3.3
Jamaica	1.9	1.0	3.6	0.1	1.4	2.3
Panama	2.2	1.3	–0.4	0.1	1.3	2.6
Puerto Rico	0.5	0.8	1.5	0.1	1.0	0.5
Trinidad	3.9	1.0	–1.7	0.1	0.8	4.3
Venezuela	3.2	1.7	0.5	0.1	1.8	4.0
World	2684.4	-	-	-	-	3475.1

1. To predict future demand, projections of population and income growth (weighted by income elasticity of demand) have been used according to the following equations:

$$D_t = D_0 (1+d)^t$$

and $d = p + i*n$

where D_t is pigeonpea demand at future time t, D_0 is pigeonpea consumption at the 1996–98 level, d is the compound growth rate, p is the population growth rate, i is the income growth rate, and n is the income elasticity of demand.

expansion since the relative profitability of competing crops were more attractive. Thus unless pigeonpeas are available at competitive prices per caput consumption will continue to decline. However, population and income growth in India and other pigeonpea-growing areas in the world will ensure growth in absolute demand. Thus technological breakthrough should lead to decline in unit cost of production to enable pigeonpea to compete with other crops and also ensure consumer demand.

Long term

In the short- to medium-term pigeonpea production would be more constrained by supply. Population and income growth particularly for low-income consumers will lead to increase in consumption from current levels. To meet the growing demand adoption and availability of improved seeds in the major growing countries would be critical. In the long run, however, demand would be more constrained due to changes in taste and preferences due to growing urbanization and income growth. Even in a country such as India with a large vegetarian population, per caput protein from animal source is now higher than from pulses (milk and poultry meat contribute to this change). This trend is likely to intensify in the future. Fruits and vegetables too have a higher income elasticity of demand compared to pulses. Consumers particularly in the higher income groups would become more discerning.

Pigeonpea is an attractive crop for resource-poor smallholder farmers, but if the crop is to remain important in the foreseeable future, a number of issues will need to be addressed. Outside India, pigeonpea consumption, apart from subsistence use, is low. Nowhere is pigeonpea dhal consumed as a staple food in the same way as in India. This narrow consumption base makes the crop particularly vulnerable to changing consumption patterns in the single major market. Preliminary research in Africa suggests that consumption of the crop could be increased if there was a concerted effort to popularize improved processing and utilization technologies at various levels.

Whole unprocessed pigeonpea takes a long time to cook, and has a bitter taste imparted by the seedcoat. They are therefore consumed as a food of last resort when other legumes such as beans and cowpea (*Vigna unguiculata* (L.) Walp.) are in short supply. Once the seed coat is removed, cooking time is reduced by more than half, the bitter taste disappears, and the product is much less susceptible to attack from bruchids in storage. The technology to dehull pigeonpea is not complicated, but in many countries of sub-Saharan Africa, women are moving away from household-level processing of staple foods towards village-level processing. There needs to be a concerted effort to introduce and test such technologies to popularize food products that can be prepared from pigeonpea so as to increase the consumption base.

The consumption of fresh, green pigeonpea has always been popular among communities growing pigeonpea in sub-Saharan Africa. Green pigeonpea is harvested during the dry season when other green vegetables are in short supply. It is an important source of income for people in peri-urban areas where there is an accessible market. Small quantities of green pigeonpeas are exported to UK from Kenya. In the Caribbean, there is an established canning industry as green pigeonpea is a popular dish amongst people of Caribbean and Hispanic descent. There is a need to look at the potential of applying more modern food processing techniques to green pigeonpea, to make this product both more accessible and palatable. The development of determinate varieties allows for year-round production of green pigeonpeas, whereas in the past, production was only possible on a seasonal basis.

Even for traditional pigeonpea markets countries that invest in improving product quality standards required by the markets will be able to increase their market shares and benefit from relatively higher prices. Therefore, Kenya, Malawi, Mozambique, and Tanzania identified a high-yielding, drought and wilt resistant variety, with large, cream seed for cultivation. In eastern and southern Africa, other measures that contribute to reducing costs of marketing such as linking producers, traders, transporters, and markets are being tested. Increasing productivity, providing quality product, and reducing marketing costs all contribute to increase in competitiveness of pigeonpea in local, regional, and international markets.

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Appendix 1: Chickpea and Pigeonpea Statistics

Africa

Description	Algeria	Burundi	Egypt	Ethiopia PDR	Malawi
General information					
1. Estimated population, 1997 (million)	29.47	6.40	64.47	63.56	10.09
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	1.70	2.50	1.60	2.80	2.40
3. GNP average annual growth rate (1985–95) (% yr^{-1})	–2.40	–1.30	1.10	–0.30	–0.70
4. Per caput pulses production, 1996–97 (kg yr^{-1})	1.65	50.53	8.19	18.73	27.87
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.70		0.16	2.05	3.91
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})		0.37			9.84
Chickpea statistics					
7. Chickpea area harvested, 1996–98 average ('000 ha)	31.68		5.64	186.50	96.00
8. Chickpea production, 1996–98 average ('000 t)	18.88		10.38	128.33	39.33
9. Chickpea yield, 1996–98 average (t ha^{-1})	0.60		1.84	0.69	0.41
10. Chickpea share in total pulses area, 1996–98 average (%)	38.09		3.13	13.89	20.20
11. Chickpea share in total pulses production, 1996–98 average (%)	46.05		1.90	10.90	14.06
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	1.45		0.23	2.77	1.67
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	1.84		0.13	1.93	2.45
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	1.94		0.17	1.84	2.23
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	1.30		–3.90	–2.30	14.50
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	–4.85		–1.75	5.55	0.06
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	6.40		–1.50	–2.70	6.80
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	–5.29		–1.07	1.27	1.02
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	5.10		2.50	–0.50	–6.70
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	–0.46		0.69	–4.02	0.96
Pigeonpea statistics					
21. Pigeonpea area harvested, 1996–98 average ('000 ha)		2.33			143.00
22. Pigeonpea production, 1996–98 average ('000 t)		2.33			98.33
23. Pigeonpea yield, 1996–98 average (t ha^{-1})		1.00			0.69
24. Pigeonpea share in total pulses area, 1996–98 average (%)		0.70			30.08
25. Pigeonpea share in total pulses production, 1996–98 average(%)		0.74			35.16
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})		0.53			7.24
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})		0.38			5.99
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})		0.33			5.26
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})		–0.20			1.40
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})		0.50			0.20
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})		–0.50			1.80
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})		–0.60			0.40
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})		–0.40			0.40
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})		–1.10			0.20

continued

Africa *(continued)*

Description	Morocco	Sudan	Tanzania	Tunisia	Uganda
General information					
1. Estimated population, 1997 (million)	27.52	27.90	31.51	9.33	20.79
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	1.60	2.20	2.60	1.50	2.60
3. GNP average annual growth rate (1985–95) (% yr^{-1})	0.90		1.00	1.90	2.70
4. Per caput pulses production, 1996–97 (kg yr^{-1})	9.52	6.00	13.66	8.61	17.29
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	1.27	0.29	0.82	1.11	0.13
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})			1.54		2.85
Chickpea statistics					
7. Chickpea area harvested, 1996–98 average ('000 ha)	57.77	5.50	65.00	21.67	5.60
8. Chickpea production, 1996–98 average ('000 t)	42.34	8.33	24.33	16.19	2.77
9. Chickpea yield, 1996–98 average (t ha^{-1})	0.73	1.52	0.37	0.75	0.49
10. Chickpea share in total pulses area, 1996–98 average (%)	15.76	4.13	8.34	21.02	0.71
11. Chickpea share in total pulses production, 1996–98 average (%)	17.06	4.95	5.78	19.34	0.79
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.97	0.00	0.36	2.91	0.14
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	1.47	0.00	0.68	2.37	0.15
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	1.10	0.00	0.72	2.15	0.10
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	3.10	11.20	11.10	–9.70	3.90
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	–5.32	26.09	1.59	–12.07	–0.29
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	4.10	8.60	12.00	–6.50	–0.40
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	2.94	34.47	4.12	–9.47	–0.60
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	1.00	–2.30	0.90	3.50	–3.30
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	8.73	6.64	2.50	2.95	–0.29
Pigeonpea statistics					
21. Pigeonpea area harvested, 1996–98 average ('000 ha)			68.00		71.33
22. Pigeonpea production, 1996–98 average ('000 t)			47.00		58.33
23. Pigeonpea yield, 1996–98 average (t ha^{-1})			0.69		0.82
24. Pigeonpea share in total pulses area, 1996–98 average (%)			8.73		9.05
25. Pigeonpea share in total pulses production, 1996–98 average(%)			11.17		16.58
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})			0.97		1.60
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})			1.41		2.44
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})			1.36		2.21
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})			5.70		1.00
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})			4.20		2.60
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})			6.00		7.20
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})			4.10		2.40
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})			0.30		6.20
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})			–0.10		–0.20

South Asia

Description	Bangladesh	India	Nepal	Pakistan
General information				
1. Estimated population, 1997 (million)	122.01	960.18	22.59	143.83
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	1.50	1.30	2.20	2.50
3. GNP average annual growth rate (1985–95) (% yr^{-1})	2.10	3.20	2.40	1.20
4. Per caput pulses production, 1996–97 (kg yr^{-1})	4.32	14.28	9.38	7.48
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.51	5.63	0.62	4.49
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})	0.02	2.53	0.88	0.00
Chickpea statistics				
7. Chickpea area harvested, 1996–98 average ('000 ha)	84.62	7266.13	19.04	1108.03
8. Chickpea production, 1996–98 average ('000 t)	61.13	5495.60	13.73	682.57
9. Chickpea yield, 1996–98 average (t ha^{-1})	0.72	0.76	0.72	0.62
10. Chickpea share in total pulses area, 1996–98 average (%)	12.40	30.00	6.53	63.42
11. Chickpea share in total pulses production, 1996–98 average (%)	11.81	39.78	6.65	61.63
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.83	4.75	1.98	2.30
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	0.80	4.48	0.78	3.00
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	0.79	4.62	0.56	3.36
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	–2.10	–1.90	–8.80	0.80
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	–1.93	3.18	–6.38	1.49
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	–2.10	–0.50	–9.10	4.60
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	–1.71	4.76	–3.03	6.94
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	0.00	1.40	–0.40	3.70
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	0.22	1.53	3.58	5.38
Pigeonpea statistics				
21. Pigeonpea area harvested, 1996–98 average ('000 ha)	6.00	3635.67	25.33	
22. Pigeonpea production, 1996–98 average ('000 t)	3.00	2420.67	19.40	
23. Pigeonpea yield, 1996–98 average (t ha^{-1})	0.50	0.67	0.77	
24. Pigeonpea share in total pulses area, 1996–98 average (%)	0.88	15.01	8.68	
25. Pigeonpea share in total pulses production, 1996–98 average (%)	0.58	17.52	9.39	
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})	0.07	2.30	0.65	0.01
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})	0.03	2.36	0.57	0.00
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})	0.02	2.09	0.79	0.00
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})	–6.30	2.30	0.30	–20.30
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})	1.00	0.10	5.60	
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})	–9.00	2.80	0.70	–18.60
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})	0.30	0.70	8.10	
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})	–2.80	0.50	0.50	2.40
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})	–0.70	0.50	2.30	

Southeast Asia

Description	China	Myanmar
General information		
1. Estimated population, 1997 (million)	1244.20	46.77
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	0.80	1.60
3. GNP average annual growth rate (1985–95) (% yr^{-1})	8.30	
4. Per caput pulses production, 1996–97 (kg yr^{-1})	3.59	26.74
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.00	2.28
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})		3.38
Chickpea statistics		
7. Chickpea area harvested, 1996–98 average ('000 ha)	1.50	140.67
8. Chickpea production, 1996–98 average ('000 t)	3.67	100.58
9. Chickpea yield, 1996–98 average (t ha^{-1})	2.44	0.72
10. Chickpea share in total pulses area, 1996–98 average (%)	0.05	7.86
11. Chickpea share in total pulses production, 1996–98 average (%)	0.08	7.74
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.00	2.50
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	0.00	1.94
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	0.00	1.84
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	0.00	–2.60
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	–2.03	–3.16
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	0.00	–2.30
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	15.21	–1.57
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	0.00	0.30
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	17.61	1.65
Pigeonpea statistics		
21. Pigeonpea area harvested, 1996–98 average ('000 ha)		247.77
22. Pigeonpea production, 1996–98 average ('000 t)		158.66
23. Pigeonpea yield, 1996–98 average (t ha^{-1})		0.64
24. Pigeonpea share in total pulses area, 1996–98 average (%)		13.85
25. Pigeonpea share in total pulses production, 1996–98 average (%)		12.20
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})		0.74
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})		0.29
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})		0.37
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})		–0.30
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})		17.10
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})		2.10
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})		17.60
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})		2.40
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})		0.40

West Asia

Description	Cyprus	Iran	Iraq	Israel
General information				
1. Estimated population, 1997 (million)	0.76	71.52	21.18	5.78
2. Estimated population growth rate, 1995–2010 (% yr^{-1})		24.00	3.00	1.40
3. GNP average annual growth rate (1985–95) (% yr^{-1})				2.50
4. Per caput pulses production, 1996–97 (kg yr^{-1})	1.88	8.85	1.77	1.74
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.20	4.37	0.39	1.44
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})				
Chickpea statistics				
7. Chickpea area harvested, 1996–98 average (’000 ha)	0.06	745.13	12.17	5.20
8. Chickpea production, 1996–98 average (’000 t)	0.14	299.04	8.50	7.98
9. Chickpea yield, 1996–98 average (t ha^{-1})	2.30	0.40	0.70	1.53
10. Chickpea share in total pulses area, 1996–98 average (%)	5.67	63.93	37.32	65.84
11. Chickpea share in total pulses production, 1996–98 average (%)	10.78	49.59	22.56	82.56
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.46	2.13	1.45	0.79
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	0.81	3.06	1.03	3.56
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	0.39	3.56	0.67	2.59
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	–7.40	5.50	–19.00	11.10
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	2.78	3.50	5.17	2.40
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	–2.70	–0.10	–18.40	0.70
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	13.48	1.31	6.48	1.87
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	5.10	–5.40	0.60	11.80
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	10.41	–2.11	1.26	–0.53

continued

West Asia *(continued)*

Description	Jordan	Lebanon	Syria	Turkey	Yemen
General information					
1. Estimated population, 1997 (million)	4.52	3.14	14.95	62.77	16.29
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	2.40	1.30	2.70	1.40	3.30
3. GNP average annual growth rate (1985–95) (% yr^{-1})	–4.50	0.00	0.90	2.20	0.00
4. Per caput pulses production, 1996–97 (kg yr^{-1})	1.29	13.19	14.12	28.29	4.18
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.50	3.55	3.54	11.66	2.25
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})					
Chickpea statistics					
7. Chickpea area harvested, 1996–98 average (’000 ha)	3.09	4.79	103.64	710.33	30.70
8. Chickpea production, 1996–98 average (’000 t)	2.13	11.05	66.96	684.00	37.96
9. Chickpea yield, 1996–98 average (t ha^{-1})	0.69	2.31	0.65	0.96	1.24
10. Chickpea share in total pulses area, 1996–98 average (%)	38.58	24.05	36.87	40.38	53.20
11. Chickpea share in total pulses production, 1996–98 average (%)	38.05	26.92	28.46	39.67	54.88
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	2.78	4.50	2.76	1.55	0.00
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	4.07	4.19	2.31	5.19	1.99
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	2.67	3.49	2.11	4.52	1.46
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	–0.10	9.60	–2.60	16.70	16.70
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	–6.45	1.17	7.50	–3.38	4.47
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	1.40	11.30	–7.70	19.10	19.10
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	–8.46	4.28	4.74	–2.94	2.77
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	1.60	1.60	–5.20	1.90	1.90
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	–2.15	3.06	–2.57	0.45	–1.59

Latin America and Caribbean

Description	Argentina	Chile	Colombia	Dominican Republic
General information				
1. Estimated population, 1997 (million)	35.67	14.63	37.07	8.10
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	1.00	1.10	1.30	1.30
3. GNP average annual growth rate (1985–95) (% yr^{-1})	1.80	6.10	2.60	2.10
4. Per caput pulses production, 1996–97 (kg yr^{-1})	8.63	7.00	4.10	8.07
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.07	0.57	0.00	
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})				2.39
Chickpea statistics				
7. Chickpea area harvested, 1996–98 average ('000 ha)	2.37	7.25		
8. Chickpea production, 1996–98 average ('000 t)	2.37	6.79		
9. Chickpea yield, 1996–98 average (t ha^{-1})	1.00	0.94		
10. Chickpea share in total pulses area, 1996–98 average (%)	0.82	9.61		
11. Chickpea share in total pulses production, 1996–98 average (%)	0.74	6.86		
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.05	0.29	0.50	
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	0.04	0.39	0.42	
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	0.06	0.32	0.19	
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	10.00	–2.00	0.00	
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	–0.03	–10.46	–21.68	
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	9.80	3.00	0.00	
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	1.06	–14.10	–21.81	
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	–0.20	5.10	0.00	
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	1.10	–4.07	–0.17	
Pigeonpea statistics				
21. Pigeonpea area harvested, 1996–98 average ('000 ha)				23.69
22. Pigeonpea production, 1996–98 average ('000 t)				19.60
23. Pigeonpea yield, 1996–98 average (t ha^{-1})				0.83
24. Pigeonpea share in total pulses area, 1996–98 average (%)				33.06
25. Pigeonpea share in total pulses production, 1996–98 average (%)				31.64
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})				2.14
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})				4.90
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})				2.23
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})				8.80
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})				–8.60
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})				13.20
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})				–8.70
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})				4.10
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})				–0.10

continued

Latin America and Caribbean *(continued)*

Description	Haiti	Jamaica	Mexico	Panama
General information				
1. Estimated population, 1997 (million)	7.40	2.52	94.28	2.72
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	1.30	1.00	1.50	1.30
3. GNP average annual growth rate (1985–95) (% yr^{-1})	–5.20	3.60	0.10	–0.40
4. Per caput pulses production, 1996–97 (kg yr^{-1})	11.82	2.26	15.08	4.26
5. Per caput chickpea production, 1996–97 (kg yr^{-1})			2.27	
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})	0.41	0.78	0.82	
Chickpea statistics				
7. Chickpea area harvested, 1996–98 average ('000 ha)			138.10	
8. Chickpea production, 1996–98 average ('000 t)			204.83	
9. Chickpea yield, 1996–98 average (t ha^{-1})			1.48	
10. Chickpea share in total pulses area, 1996–98 average (%)			6.70	
11. Chickpea share in total pulses production, 1996–98 average (%)			13.60	
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})			1.10	
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})			1.30	
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})			0.89	
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})			–2.30	
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})			6.17	
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})			–0.50	
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})			5.97	
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})			1.90	
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})			–0.19	
Pigeonpea statistics				
21. Pigeonpea area harvested, 1996–98 average ('000 ha)	7.50	1.63		4.50
22. Pigeonpea production, 1996–98 average ('000 t)	3.00	1.94		2.18
23. Pigeonpea yield, 1996–98 average (t ha^{-1})	0.40	1.19		0.48
24. Pigeonpea share in total pulses area, 1996–98 average (%)	6.13	32.59		19.89
25. Pigeonpea share in total pulses production, 1996–98 average (%)	3.63	35.35		19.25
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})	0.65	0.96		0.93
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})	0.48	0.64		0.68
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})	0.36	0.70		0.76
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})	–0.10	–5.70		3.70
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})	–0.50	–1.50		2.90
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})	–0.80	–6.00		–0.70
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})	–1.40	1.60		3.10
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})	–0.70	–0.30		–4.50
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})	–0.90	3.20		0.20

continued

Latin America and Caribbean *(continued)*

Description	Peru	Puerto Rico	Trinidad & Tobago	Venezuela
General information				
1. Estimated population, 1997 (million)	24.37	3.77	1.31	22.78
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	1.60	0.80	1.00	1.70
3. GNP average annual growth rate (1985–95) (% yr^{-1})	–1.60		–1.70	0.50
4. Per caput pulses production, 1996–97 (kg yr^{-1})	5.60	0.12	2.82	1.54
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.06			
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})		0.12	2.44	0.14
Chickpea statistics				
7. Chickpea area harvested, 1996–98 average ('000 ha)	1.32			
8. Chickpea production, 1996–98 average ('000 t)	1.90			
9. Chickpea yield, 1996–98 average (t ha^{-1})	1.44			
10. Chickpea share in total pulses area, 1996–98 average (%)	0.88			
11. Chickpea share in total pulses production, 1996–98 average (%)	1.35			
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.09			
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	0.14			
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	0.09			
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	4.30			
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	–12.79			
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	5.10			
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	–6.37			
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	0.80			
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	7.39			
Pigeonpea statistics				
21. Pigeonpea area harvested, 1996–98 average ('000 ha)		0.75	1.10	6.09
22. Pigeonpea production, 1996–98 average ('000 t)		0.45	3.18	3.25
23. Pigeonpea yield, 1996–98 average (t ha^{-1})		0.61	2.89	0.53
24. Pigeonpea share in total pulses area, 1996–98 average (%)		93.13	78.57	12.63
25. Pigeonpea share in total pulses production, 1996–98 average (%)		90.80	85.97	9.30
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})		0.00	3.45	0.42
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})		0.00	1.89	0.28
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})		0.00	2.89	0.14
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})		–5.80	–5.20	4.60
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})		–21.20	1.00	–9.40
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})		–10.80	–6.40	5.70
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})		–20.80	13.70	–9.60
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})		–5.30	–1.30	1.10
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})		0.80	12.60	–0.30

Europe and Oceania

Description	Bulgaria	Greece	Italy	Portugal
General information				
1. Estimated population, 1997 (million)	8.43	10.52	57.24	9.80
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	–0.30	0.20	–0.10	0.10
3. GNP average annual growth rate (1985–95) (% yr^{-1})	–2.60	1.30	1.80	3.60
4. Per caput pulses production, 1996–97 (kg yr^{-1})	4.71	4.14	2.15	3.88
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.47	0.21	0.06	0.87
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})				
Chickpea statistics				
7. Chickpea area harvested, 1996–98 average ('000 ha)	4.00	1.78	3.18	21.00
8. Chickpea production, 1996–98 average ('000 t)	4.00	2.19	3.66	8.67
9. Chickpea yield, 1996–98 average (t ha^{-1})	1.00	1.23	1.15	0.41
10. Chickpea share in total pulses area, 1996–98 average (%)	7.36	6.84	4.17	10.65
11. Chickpea share in total pulses production, 1996–98 average (%)	9.79	5.08	3.02	23.17
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.06	0.86	0.13	0.71
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	0.09	0.78	0.26	1.13
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	0.15	0.48	0.22	0.97
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	18.30	–14.40	–10.70	–3.50
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	2.54	-3.94	–4.63	–1.14
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	25.00	–13.70	–13.00	2.50
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	2.50	–8.80	–4.08	–2.54
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	5.70	0.70	–2.60	6.30
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	–0.04	–5.02	0.59	–1.41

continued

Europe and Oceania *(continued)*

Description	Spain	Yugoslav SFR	Australia
General information			
1. Estimated population, 1997 (million)	39.72	22.61	18.25
2. Estimated population growth rate, 1995–2010 (% yr^{-1})	0.00	0.20	0.80
3. GNP average annual growth rate (1985–95) (% yr^{-1})	2.60		1.40
4. Per caput pulses production, 1996–97 (kg yr^{-1})	11.03	9.54	127.69
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	1.98	0.02	12.93
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})			
Chickpea statistics			
7. Chickpea area harvested, 1996–98 average ('000 ha)	124.23	0.50	242.00
8. Chickpea production, 1996–98 average ('000 t)	74.43	0.35	236.67
9. Chickpea yield, 1996–98 average (t ha^{-1})	0.60	0.70	0.98
10. Chickpea share in total pulses area, 1996–98 average (%)	20.04	0.37	11.72
11. Chickpea share in total pulses production, 1996–98 average (%)	17.74	0.16	10.35
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	1.17	0.06	0.00
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	1.09	0.03	0.83
14. Per caput chickpea consumption, 1996–98 average (kg yr^{-1})	1.81	0.02	–0.35
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	–3.20	–5.60	69.50
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	18.66	–7.44	4.45
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	0.90	–8.30	70.50
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	13.06	–5.76	4.29
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	4.30	–2.90	0.60
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	–4.72	1.62	–0.15

Regional aggregates

Description	World	Developed countries	Developing countries
General information			
1. Estimated population, 1997 (million)	5848.73	166.57	3286.15
2. Estimated population growth rate, 1995–2010 (% yr^{-1})			
3. GNP average annual growth rate (1985–95) (% yr^{-1})			
4. Per caput pulses production, 1996–97 (kg yr^{-1})	9.42	12.30	8.59
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	1.41	0.26	1.74
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})	0.49		0.63
Chickpea statistics			
7. Chickpea area harvested, 1996–98 average ('000 ha)	11257.90	403.00	10854.90
8. Chickpea production, 1996–98 average ('000 t)	8313.30	338.80	7974.40
9. Chickpea yield, 1996–98 average (t ha^{-1})	0.70	0.80	0.70
10. Chickpea share in total pulses area, 1996–98 average (%)	16.40	4.27	18.33
11. Chickpea share in total pulses production, 1996–98 average (%)	14.99	2.07	20.41
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.96	0.06	1.27
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	1.03	0.06	1.32
14. Per caput chickpea consumption, 1996–97 average (kg yr^{-1})	1.07	0.08	1.35
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	–0.10	6.20	0.00
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	2.40	6.47	1.28
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	1.30	14.40	0.90
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	3.70	4.23	2.62
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	1.50	7.30	0.90
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	1.29	–2.10	1.32
Pigeonpea statistics			
21. Pigeonpea area harvested, 1996–98 average ('000 ha)	4392.90		4392.90
22. Pigeonpea production, 1996–98 average ('000 t)	2887.00		2887.00
23. Pigeonpea yield, 1996–98 average (t ha^{-1})	0.70		0.70
24. Pigeonpea share in total pulses area, 1996–98 average (%)	6.18		7.17
25. Pigeonpea share in total pulses production, 1996–98 average (%)	5.12		7.27
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})	0.39		0.53
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})	0.42		0.55
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})	0.39		0.50
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})	2.20		2.20
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})	0.80		1.80
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})	2.90		2.90
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})	1.20		1.20
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})	0.70		0.70
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})	0.40		0.40

continued

Regional aggregates *(continued)*

Description	South Asia	Southeast Asia	West Asia
General Information			
1. Estimated population, 1997 (million)	1248.61	1290.97	200.91
2. Estimated population growth rate, 1995–2010 (% yr^{-1})			
3. GNP average annual growth rate (1985–95) (% yr^{-1})			
4. Per caput pulses production, 1996–97 (kg yr^{-1})	12.21	4.00	12.05
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	4.81	0.06	4.95
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})	1.92	0.08	
Chickpea statistics			
7. Chickpea area harvested, 1996–98 average ('000 ha)	8477.80	142.20	1615.10
8. Chickpea production, 1996–98 average ('000 t)	6253.00	104.30	1117.80
9. Chickpea yield, 1996–98 average (t ha^{-1})	0.70	0.70	0.70
10. Chickpea share in total pulses area, 1996–98 average (%)	31.41	2.14	47.76
11. Chickpea share in total pulses production, 1996–98 average (%)	39.88	1.34	40.25
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	3.99	0.06	1.46
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	3.82	0.05	2.96
14. Per caput chickpea consumption, 1996–97 average (kg yr^{-1})	3.94	0.05	2.75
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	–1.10	–3.10	12.10
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	2.85	–3.32	0.36
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	–0.40	–2.50	11.60
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	4.85	–0.87	–1.25
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	0.70	0.70	–0.60
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	1.99	2.54	–1.68
Pigeonpea statistics			
21. Pigeonpea area harvested, 1996–98 average ('000 ha)	3667.00	247.80	
22. Pigeonpea production, 1996–98 average ('000 t)	2443.10	158.70	
23. Pigeonpea yield, 1996–98 average (t ha^{-1})	0.70	0.60	
24. Pigeonpea share in total pulses area, 1996–98 average (%)	13.59	3.73	
25. Pigeonpea share in total pulses production, 1996–98 average (%)	15.58	2.04	
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})	1.79	0.02	
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})	1.81	0.01	
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})	1.59	0.01	
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})	2.20	0.00	
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})	0.20	16.70	
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})	2.70	2.50	
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})	0.80	17.20	
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})	0.50	2.20	
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})	0.60	0.50	

continued

Regional aggregates *(continued)*

Description	Africa	Latin America and Caribbean	Oceania	Europe
General information				
1. Estimated population, 1997 (million)	291.04	254.62	18.25	148.32
2. Estimated population growth rate, 1995–2010 (% yr^{-1})				
3. GNP average annual growth rate (1985–95) (% yr^{-1})				
4. Per caput pulses production, 1996–97 (kg yr^{-1})	9.87	11.69	81.59	8.61
5. Per caput chickpea production, 1996–97 (kg yr^{-1})	0.37	0.46	8.07	0.13
6. Per caput pigeonpea production, 1996–97 (kg yr^{-1})	0.28	0.07		
Chickpea statistics				
7. Chickpea area harvested, 1996–98 average ('000 ha)	475.50	149.50	242.00	154.70
8. Chickpea production, 1996–98 average ('000 t)	291.20	216.20	236.70	93.30
9. Chickpea yield, 1996–98 average (t ha^{-1})	0.60	1.50	1.00	0.60
10. Chickpea share in total pulses area, 1996–98 average (%)	3.35	1.83	11.58	5.79
11. Chickpea share in total pulses production, 1996–98 average (%)	3.92	3.85	10.09	1.42
12. Per caput chickpea consumption, 1980–82 average (kg yr^{-1})	0.42	0.26	0.00	0.14
13. Per caput chickpea consumption, 1990–92 average (kg yr^{-1})	0.39	0.30	0.53	0.14
14. Per caput chickpea consumption, 1996–97 average (kg yr^{-1})	0.37	0.20	–0.22	0.14
15. Growth rate of chickpea area, 1981–90 (% yr^{-1})	1.70	–1.80	69.50	–4.10
16. Growth rate of chickpea area, 1991–98 (% yr^{-1})	–0.05	1.67	4.45	11.93
17. Growth rate of chickpea production, 1981–90 (% yr^{-1})	0.60	0.00	70.50	–1.20
18. Growth rate of chickpea production, 1991–98 (% yr^{-1})	0.13	3.48	4.29	7.69
19. Growth rate of chickpea yield, 1981–90 (% yr^{-1})	–1.10	1.70	0.60	2.80
20. Growth rate of chickpea yield, 1991–98 (% yr^{-1})	0.18	2.21	–0.15	–3.79
Pigeonpea statistics				
21. Pigeonpea area harvested, 1996–98 average ('000 ha)	432.20	46.00		
22. Pigeonpea production, 1996–98 average ('000 t)	250.90	34.30		
23. Pigeonpea yield, 1996–98 average (t ha^{-1})	0.70	0.80		
24. Pigeonpea share in total pulses area, 1996–98 average (%)	2.01	0.56		
25. Pigeonpea share in total pulses production, 1996–98 average (%)	2.77	0.61		
26. Per caput pigeonpea consumption, 1980–82 average (kg yr^{-1})	0.18	0.08		
27. Per caput pigeonpea consumption, 1990–92 average (kg yr^{-1})	0.21	0.11		
28. Per caput pigeonpea consumption, 1996–98 average (kg yr^{-1})	0.19	0.06		
29. Growth rate of pigeonpea area, 1981–90 (% yr^{-1})	2.10	5.20		
30. Growth rate of pigeonpea area, 1991–98 (% yr^{-1})	1.40	–5.60		
31. Growth rate of pigeonpea production, 1981–90 (% yr^{-1})	3.70	6.10		
32. Growth rate of pigeonpea production, 1991–98 (% yr^{-1})	1.50	–6.00		
33. Growth rate of pigeonpea yield, 1981–90 (% yr^{-1})	1.60	1.30		
34. Growth rate of pigeonpea yield, 1991–98 (% yr^{-1})	0.10	0.20		

Source: Calculated using FAOSTAT data.

About ICRISAT

The semi-arid tropics (SAT) encompass 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 SAT. 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.

“Facts and Trends” reports serve as important resource material for IARC and NARS scientists, extension personnel, and policy makers. These reports provide information on trends in production, trade, and utilization and help establish the current outlook for ICRISAT mandate crops in different regions. The World Chickpea and Pigeonpea Economies: Facts, Trends, and Outlook reviews the trends in chickpea and pigeonpea, the two ICRISAT mandate pulses.

Science with a Human Face

ICRISAT
International Crops Research Institute for the Semi-Arid Tropics
Patancheru 502 324, Andhra Pradesh, India
www.icrisat.org

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