TROPICAL LEGUMES II

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Tropical Grain Legumes in Africa and South Asia

Knowledge and Opportunities



Tsedeke Abate • Arega D. Alene • David Bergvinson
Bekele Shiferaw • Said Silim • Alastair Orr • Solomon Asfaw

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Centro Internacional de Agricultura Tropical
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Abbreviations and acronyms

AgGDP	Agricultural Gross Domestic Product
AR4D	Agricultural Research for Development
ASTI	Agricultural Science and Technology Indicators (of IFPRI)
AVRDC	Asian Vegetable Research and Development Center
B&MGF	Bill & Melinda Gates Foundation
BCMV	Bean Common Mosaic Virus
CAR	Central Africa Republic
CIAT	International Center for Tropical Agriculture
CPMV	Cowpea Mosaic Virus
CSA	Central Statistical Agency (Ethiopia)
DRC	Democratic Republic of Congo
DTMA	Drought Tolerant Maize for Africa (CIMMYT project)
ECX	Ethiopian Commodity Exchange
ESA	Eastern and Southern Africa
GCARD	Global Conference on Agricultural Research for Development
GRV	Groundnut Rosette Virus
HH	Household(s)
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
MT	Metric Ton(s)
N2Africa	Making Nitrogen Fixation to Work for Africa
NSO	National Statistical Office (Malawi)
PASS	Program for Africa's Seed Systems
PICS	Purdue Improved Cowpea Storage
ROG	Rate of Growth (annual)
SA	South Asia (including Bangladesh, Bhutan, India, Myanmar, Nepal, Pakistan and Sri Lanka)
SIMLESA	Sustainable Intensification of Maize and Legumes for Eastern and Southern Africa
SSA	Sub-Saharan Africa
TL I	Tropical Legumes I
TL II	Tropical Legumes II
UBOS	Uganda Bureau of Statistics
WCA	Western and Central Africa

1.0 Extended Summary

1.1 General background

1. In this report we attempt to bring together the information required to develop an effective research and development strategy for tropical legumes. More specifically, we analyze the impact on productivity of investment in agricultural research and development; review past trends in productivity and trade, and projections through 2020; and identify constraints on production, and opportunities for improving productivity.

2. More than 30 species of grain legumes are grown across the tropics for food security, income, improved nutrition and helping to maintain soil fertility. The major grain legumes for Sub-Saharan Africa (SSA) and South Asia (SA) include chickpea (*Cicer arietinum*), common bean (*Phaseolus vulgaris*), cowpea (*Vigna unguiculata*), groundnut (*Arachis hypogaea*), pigeonpea (*Cajanus cajan*), and soybean (*Glycine max*).

3. Annual area planted to these crops stands at about 27 million ha in SSA and 40 million ha in SA; the annual production is estimated at approximately 19 million metric tons (MT) and 43 million MT for SSA and SA, respectively. Average yields are less than 1 MT per ha. Yields of less than 69% and just over 90% of the world average are obtained in the two regions, respectively.

4. An estimated 141 million households (more than 101 million in the SSA and 39 million in the SA regions) or a total of more than 724 million smallholders grow one or more of the six tropical grain legumes – valued at more than US$ 31 billion each year.

5. Production of tropical legumes, particularly in Africa, is characterized by smallholder farmers whose average age of a household head is 48 years; average schooling is less than 4 years; average area of land under grain legumes is less than 0.2 ha; and landholdings are largely fragmented.

6. The SSA and SA regions represent approximately 16% and 24% of the world total area of the six tropical grain legumes, respectively, but their contribution to the world total production is just over 6% and 10%, respectively. The average annual rate of growth (ROG) of area under these legumes during the period from 1985-87 to 2005-07 was 3.3% in SSA and 1.1% in SA. However, productivity increased by 1.4% in SSA and 1.1% in SA. This meant that the small increments obtained in production ROG came mainly from area expansion rather than increases in yield per unit area.

7. World trade for the six major crops is estimated at more than US$ 21.8 billion in export, with soybean accounting for 83.8% of the total, followed by common bean (8.8%), groundnut (4.9%), and chickpea (2.4%). Earnings from exports for SSA and SA are estimated at 0.4% and 2%, respectively, of the world total.

1. 2 Impact of agricultural technologies on grain legumes production

8. In general, the bulk of changes in total production were due to area expansion in both regions and globally. Area alone explained 57-98%, 40-99%, and 5-99% of changes in total production for SSA, SA, and the world, respectively. The effects of yield have been very minimal for the most part; the only exception is that of pigeonpea in the SSA region where changes in area and yield explained 64% and 68%, respectively, and about 96% when the two are considered together).

9. However, it should be noted that there have been examples of successes at country or local levels where increases in yield have made significant contributions to changes in total production. For example, experience from Ethiopia shows that, nationally, 53-59% of the output growth for tropical grain legumes, viz. chickpea, common bean and lentil, is attributed to yield growth due to technological change.

1. 3 Crop highlights

1. 3.1 Chickpea

10. World production of chickpea has not shown dramatic changes over the 20 years; the ROGs for area, yield, and production during this period were 0.4%, 0.0%, and 1.2%, respectively. India supplies about 65% of the world's total production, followed by Pakistan, Turkey, Iran, Myanmar, Ethiopia, Australia, Canada, Mexico, and Iraq. Significant production in Australia and Canada started in the 1980s and 1990s, respectively. Canada, followed by Iraq and Australia, has shown the fastest annual rate of growth, with Ethiopia showing the highest growth rate in yield. Area, yield and/or production have declined in some traditional chickpea producing countries, such as Turkey, Morocco, and Spain over the last 20 years.

11. The SSA region accounts for about 3.5% (398,000 ha) of the world's total area whereas more than 76% (8.3 million ha) is attributed to SA. Ethiopia, followed by Malawi and Tanzania, is accountable for 52% of total area and

76% of total production in SSA. More than 1.8 million households (11.4 million people) are estimated to grow chickpea in this region.

12. Chickpea production in SSA is projected to grow at 7.1% per annum – i.e. from 548,000 MT in 2010 to 1,082,000 MT in 2020. Ethiopia, Malawi, Sudan and Tanzania are projected to be the largest producers in the region. In a similar fashion, the demand for chickpea in SSA will grow at the rate of 2.8% per annum.

13. The ROG for production and demand in SA is projected at 3.8% and 4.2%, respectively. India's demand for chickpea by 2020 is expected to reach close to 11 million MT; Pakistan, Myanmar, and Bangladesh also have substantial demands.

14. Chickpea export has shown sustained growth over the last two decades, with more than 882,000 MT worth approximately US$ 525 million each year. Ethiopia's share of export is estimated at nearly 100,000 MT (76% of the total for SSA). Tanzania, with about 21% of the regional share, is the second largest exporter in SSA.

15. Projections suggest that SSA will continue to be net exporter of chickpea through 2020 (582,000 MT of net export). A total of 36 countries are known to import chickpea in SSA, with Sudan accounting for 71%, followed by South Africa. By contrast, the SA region will continue to be net importer of chickpea through 2020. The major importing countries in this region are Pakistan, India, Bangladesh, and Myanmar.

1. 3.2 Common bean

16. Common bean is grown in 128 countries and territories on more than 27 million ha across the world, with total production of nearly 20 million MT. The FAO data suggest that India has the largest area under this crop in the world; however, these figures appear to refer to other beans (such as mung bean and urd bean) even though FAOSTAT reports them as common bean. Brazil, Myanmar, China, USA, Mexico, Tanzania, Kenya, Uganda and Indonesia are the leading producers. The world average yield is just over 720 kg per ha. Myanmar, Ethiopia, Canada, Cameroon and Nicaragua have registered the highest ROGs in area planted as well as production over the 20 years. Highest ROGs for yield were registered in Iran (4.4%) and Brazil (3.4%). Overall, common bean has not seen sustained growth in productivity over the years; the bulk of increases in production are accounted for by area expansion.

17. SSA and SA account for about 16% and 30% of the total world common bean production. It is grown in 27 of the SSA countries on more than 5 million ha, producing over 3 million MT each year; average yields are estimated at about 600 kg per ha. Tanzania, Kenya, and Uganda, followed by Rwanda, Burundi, Cameroon, Ethiopia, the Democratic Republic of Congo (DRC), Malawi and Benin are the top ten common bean-producing countries in SSA. Fastest growth rates in area and production were registered in Ethiopia, Cameroon, Chad, Angola and Sudan; yields in this region declined by 0.9% per annum. Close to 35 million households (benefiting more than 188 million people) are estimated to grow common bean in SSA.

18. World common bean trade involves 186 countries and territories with more than 2.75 million MT worth well over US$ 1.77 billion. India, USA, Cuba, the UK, Japan, Italy, Mexico, Brazil, Pakistan, and South Africa are the major importers. Major world exporters include China, Myanmar, USA, and Canada. Trade in SSA involves some US$ 128 million in imports among 45 countries and US$ 37 million in exports among 34 countries. The bulk of common bean trade in Africa is among African countries themselves. South Africa, Kenya and Angola are the major importers whereas major exporters include Ethiopia, Uganda, and Tanzania.

19. Projections suggest that national demand for common bean in SSA will grow at the rate of approximately 2.8% per annum whereas production will grow at the rate of 6.9% (average for Burundi, Cameroon, Ethiopia, Kenya, Malawi, Rwanda, Tanzania and Uganda only). This would mean that the region will be net exporter by 2020. Highest annual growths of production are projected for Cameroon, Ethiopia, and Burundi. The highest rate of growth per annum in yield is projected for Ethiopia, Rwanda and Malawi.

20. Fluctuations in producer price are the major drawback for common bean trade in SSA. There is no grading and standards. Prices are usually set by buyers who collect all grades and pay the same price; they clean and sell for a premium price. Farmers have no intention to clean grain as there is no incentive by way of price differentials. Post-harvest handling (including harvesting, transportation, threshing and storing) is very poorly organized.

1. 3.3 Cowpea

21. Cowpea is grown in 45 countries across the world. An estimated 14.5 million ha of land is planted to cowpea each year worldwide. The SSA region accounts for about 84% of area as well as production. The world average yield is estimated at about 450 kg per ha, the lowest for all tropical grain legumes discussed here. Just as in chickpea and common bean

discussed above, cowpea productivity has not seen sustained growth over the last two decades. Total area, yield, and production in SSA grew at the rate of about 4.3%, 1.5%, and 5.8%, respectively. An estimated 38 million households (194 million people) grow cowpea in SSA.

22. Nigeria and Niger each cultivate well over 4 million ha and account for more than 45% and nearly 15% of the world's total production, respectively. Other major producers include Burkina Faso, Cameroon, Mali, Uganda, Kenya, Senegal, Tanzania, and DRC. Cowpea is a minor crop in the SA region. Myanmar and Sri Lanka are the only two countries that produce substantial amounts of this crop in the region. Production in Myanmar has shown sustained growth whereas Sri Lanka's production has declined over the years.

23. Cowpea production in SSA is projected to grow at the rate of 2.6% per annum – i.e. from about 6.2 million MT in 2010 to nearly 8.4 million MT by 2020. Fastest rates of growth are expected to come from Senegal, Mali and Niger. Nigeria, Niger, Ghana, Cameroon, Burkina Faso, and Mali will continue to dominate cowpea production on the continent. The overall demand for cowpea grain in SSA is projected to grow at the rate of 2.7% per year. Nigeria, Ghana, Tanzania, Mali, and Niger are expected to perform well.

24. Little information is available for cowpea trade, perhaps because it is not traded internationally. Niger's export is reported to have increased from less than 5,000 MT in 1970-72 to nearly 25,000 in 1980-82 and well over 34,000 MT in 1990-92 but has dwindled since. Myanmar exported an average of 75 MT in 1970-72 compared to 17,000 MT in 1991 alone, but there have been no records of export since.

25. Producer price fluctuation is a major drawback for cowpea development. For example, prices in Nigeria fell from US$ 2,065 per MT in 1996 to US$ 451 in 2000. Similarly, prices in Malawi were around US$ 783 per MT in 1996 compared to US$ 151 in 1999. In general, least producer prices were received in Niger.

1. 3.4 Groundnut

26. Groundnut is the most widely grown major legume worldwide – cultivated in 118 countries and occupies more than 22.6 million ha that produce about 36.4 million MT, with average yield of about 1600 kg per ha. World groundnut production has shown a steady pace over the years whereas the area expansion grew at a slower rate and somewhat leveled off since

the 1990s. Average ROGs for area, yield and production are estimated at 1%, 1%, and 2.9%, respectively. India has the largest area but China is the highest producer because of better yields per unit area.

27. An estimated 18.3 million households (86.6 million people) grow groundnut in SSA on more than 9 million ha (40% of world total) with average yield of about 1000 kg per ha. Top ten producing countries out of the 44 in SSA are Nigeria, Sudan, Senegal, Ghana, Chad, DRC, Tanzania, Guinea, Mali and Burkina Faso. The average productivity grew by about 1.3% whereas faster growth rates have been registered in Cameroon (5.6%) and Guinea (4.8%). Sierra Leone, Tanzania, Ghana, and Nigeria registered growth rates in area ranging between 9.8% and 6.6% whereas annual increases in production of 9.7% to 8.3% have been registered in Niger, Tanzania, Sierra Leone, Nigeria and Guinea.

28. The SA region occupies more than 7 million ha (31% of world total); nearly 83% of this is in India. The average area in SA declined by about 1.1% per annum whereas yield and production increased by about 1% and 0.2%, respectively. The fastest growth in yield (2.2%) has been registered for Myanmar. About 6.7 million households (26.6 million people) grow groundnut in SA.

29. It has been projected that production in SSA will jump from about 10.4 million MT in 2010 to nearly 13 million MT in 2020, with Nigeria, Sudan and Senegal as largest producers. In a similar fashion, there would be demand for nearly 12 million MT in 2020, compared with about 10 million MT in 2010. Estimated production and demand for SA in 2020 are about 9.8 million MT and 11 million MT, respectively.

30. Annual groundnut import trade values for SSA and SA are estimated at about US$ 54 million and US$ 5 million, respectively. By contrast, SSA export stands at US$ 42 million whereas that for SA is nearly US$ 184 million. Projections show that SSA would have net surplus trade of nearly 957,000 MT by 2020. Senegal, followed by South Africa, Sudan, Cameroon, Ghana, Gambia, Nigeria and Ivory Coast would be by far the largest exporters. By contrast, all SA countries would continue to have net deficit trade of about 951,000 MT by 2020.

1. 3.5 Pigeonpea

31. Pigeonpea is the least widely grown (about 4.7 million ha) major tropical legume worldwide – including South Asia, Sub-Saharan Africa and the Caribbean. India and Myanmar account for about 72% and 16%,

respectively, of world production. Malawi, Kenya, Uganda, Tanzania, Dominican Republic, Nepal, DRC and Haiti are among the top-ten producers. SSA share of cultivated area is approximately 499,000 ha (less than 11% of world total). Average yields are approximately 730 and 840 kg per ha for SSA and SA, respectively, compared to 885 kg per ha world average. World ROGs for area, yield and production were 1.1%, 0.5%, and 1.1% respectively.

32. An estimated 1.6 million households (7.8 million people) and 5.2 million households (30 million people) grow pigeonpea in SSA and SA, respectively. The ROGs for area, yield and production in SSA were 3.1%, 1.7%, and 4.3%, respectively, compared to 1%, -1.1%, and 0.9, respectively for SA. All countries in SSA, except Burundi, have shown positive ROGs in area whereas all countries but DRC and Burundi had also positive ROGs for yield, with Uganda and Kenya registering ROGs of 3.4% and 2.3%, respectively. ROGs for SA were 1%, -0.1%, and 0.9% for area, yield, and production, respectively. The fastest ROGs 12.7%, 2.4%, and 15.4% for area, yield, and production, respectively, were registered for Myanmar; by contrast, area, yield, and production in Bangladesh declined by 4.7%, 0.6%, and 5.3%, respectively.

33. It has been projected that production in SSA would grow at about 7.5% per annum (841,000 MT in 2020 compared to 482,000 in 2010) whereas the demand is estimated at 352,000 MT in 2020 compared to 264,000 MT in 2010 (3.3% growth per annum). Figures for SA are nearly 4.6 million MT in 2020 compared to 3.6 million MT in 2010 (2.7% growth) for production and nearly 5 million MT in 2020 to nearly 3.7 million MT in 2010 (3.5% growth) in demand.

34. Net trade in SSA is expected to grow at 17.4% per annum (427,000 MT in 2020 compared to 156,000 MT in 2010). Kenya, Uganda, Malawi, and Tanzania would continue to be the major surplus producing countries. The net trade for SA (India, Nepal, Bangladesh and Bhutan) would be -476,000 MT; only Myanmar would continue to be a surplus producer of pigeonpea in this region.

35. Information on pigeonpea trade is scanty. Available data show an average decline in imports of about 2.7% per annum (from 4,600 MT in 1985-87 to just over 2,100 MT in 2005-07), with annual value of US$ 1.6 million. World export dropped from well over 29,000 MT in the mid 1980s to a mere 330 MT in 2005-07 (average decline of more than 4.9% per annum). Malawi used to be the largest exporter of pigeonpea in the world but its share has hit its lowest ebb in recent years.

36. Heavy fluctuations in producer price are a major concern for pigeonpea producers in Africa. For example, in Malawi, the price jumped from US$ 65 per MT in 1995 to US$ 727 per MT in 1996. The price for Burundi fluctuated from US$ 2136 per MT in 1991 to US$ 1284 per MT in 2003 and US$ 2460 in 2008. Prices for Kenya have not fluctuated very much over the 1991-2008 period, with the most recent prices hovering around US$ 500 per MT.

1. 3.6 Soybean

37. Soybean is grown in more than 100 countries and territories around the globe, with an estimated total area of more than 92.5 million ha and 217.6 million MT of production each year (with the average yield of 2346 kg per ha). This is the one major tropical grain legume that has shown sustained growth in productivity and production over the last two decades. The ROGs for area, yield and production were 3%, 1.4%, and 4.4%, respectively. The USA, Brazil, and Argentina combined produce nearly 81% of the world's production. China, India, Paraguay, Canada, Bolivia, Ukraine, and Indonesia are among the top world producers.

38. Soybean area in SSA jumped from about 380,000 ha in 1985-87 to about 1.23 million ha in 2005-07, an average ROG of 3.8%, with ROGs of 3.5% and 7.3% for yield and production, respectively. Nigeria, South Africa and Uganda are the major producers in SSA. This region accounts only for about 1.3% of the world total area. The SA region occupies nearly 8.5 million ha of soybean cultivation (about 9.2% of the world total). Area, yield, and production in this region grew by 8.4%, 1.6%, and 10% per annum, respectively. More than 6.3 million households (nearly28.6 million people) and 9.1 million households (48.3 million people) are estimated to grow soybean in SSA and SA, respectively.

39. It has been projected that SSA production would grow at the rate of about 2.3% per annum (from about 1.5 million MT in 2010 to over 1.9 million MT in 2020); by the same token, demand would grow at 3.1 % per annum (from 1.6 million MT in 2010 to nearly 2 million MT in 2020). SA's production is projected to grow by about 3% (nearly 15 million MT in 2020 from about 11 million MT in 2010); by contrast, demand would grow at 3.2% per annum (about 15.8 million MT in 2020, from 11.6million MT in 2010).

40. Soybean is the largest traded commodity among the major tropical grain legumes in the world (ca. 69 million MT valued at US$ 19 billion each year). More than 170 countries and territories import soybean, with China

accounting for 45% of the total. Other major importing countries include the Netherlands, Japan, and Germany. USA, Brazil, and Argentina are the major exporters. Major importers of soybean in SSA include South Africa, Nigeria and Kenya whereas Nigeria, Malawi and Kenya are among the major exporters.

41. Nigeria and South Africa are slated to be major net exporters whereas Tanzania, Somalia, Kenya would be major net importers; SSA is projected to have surplus net trade by 2015 (10,000 MT) and 2020 (nearly 32,000 MT). By contrast, all SA countries are expected to be net deficit traders in 2010 (-845,000 MT), 2015 (-1.16 million MT) and 2020 (-1.44 million MT).

42. Some countries in the SSA region experienced volatile producer prices for soybean during the period from 1991 to 2008. For example, producer prices in Nigeria varied from US$ 305 per MT in 1992 to US$ 1,501 in 1998. Similarly, the producer price in Rwanda was US$ 258 per MT in 1992, compared to US$ 1,307 in 1996. Furthermore, the price in Burundi fell from US$ 1,062 per MT in 1996 to US$ 546 per MT in 2003. Fluctuations in the SA region have not been so dramatic.

1. 4 Major constraints

43. Major constraints to the development of major tropical grain legumes can be grouped into two main categories – technical and institutional. Technical constraints are attributed to abiotic and biotic factors as well as to issues related to crop management in general. Institutional constraints, on the other hand, include government policies and regulations, and partnerships.

44. Drought (or low moisture stress) is perhaps the most important abiotic constraint that limits the production of tropical grain legumes, as it does most other crops in the semi-arid tropics. Available data indicate that annual losses attributed to drought are estimated at 3.2 million MT for chickpea; 300,000 MT for common bean; and US$ 520 million for groundnut.

45. Drought is not necessarily a lack of moisture but rather it is the result of erratic distribution of rainfall in many situations. Different crops have different critical periods in their demand for adequate rainfall. Some crops like pigeonpea are particularly sensitive to low moisture stress especially near maturity stage. In many circumstances (e.g. common bean), the impact of drought is exacerbated by low soil fertility and soil pathogens.

46. Extreme heat is another abiotic factor that threatens the development of tropical legumes. At present chickpea and cowpea are the most affected

crops. The importance of heat is anticipated to worsen with the impact of climate change.

47. Soil degradation is a common phenomenon in most of the countries that grow tropical legumes in SSA and SA. This is caused by continuous cropping of the land without adequate soil conservation methods. Furthermore, grain legumes are traditionally grown in marginal lands, with the more fertile areas being allocated to crops that are perceived to be more important. This is partly because of the lack of commercialization for grain legumes.

48. A large number of diseases, insects and parasitic weeds cause varying levels of damage to tropical grain legumes at different stages of growth – from seedling to storage. Examples of major diseases for the six crops include: chickpea (*Fusarium* wilt, root rots, *Ascochyta* blight); common bean (bacterial blight, anthracnose, common mosaic virus); cowpea (viruses); groundnut (rosette, leaf spots, rust); pigeonpea (*Fusarium* wilt); and soybean (rust, frog eye).

49. Major insect problems include pod borer on chickpea and pigeonpea; bean stem maggots on common bean; bruchids (storage pest) in cowpea and common bean; Maruca pod borer (cowpea); and aphids as virus vectors (common bean, cowpea and groundnut). The parasitic weeds Alectra vogelli and Striga gesnirioides are major problems in cowpea, especially in WCA.

50. However, all of the biotic factors mentioned above (perhaps with the exception of rust in soybean) have been researched upon over the last two decades or more and ample knowledge has been accumulated. While research needs to continue for tackling those and emerging constraints, adaptation and application of available technologies can go a long way in increasing tropical grain legumes productivity and production.

51. Institutional constraints include mainly government policies and regulations – such as lengthy variety release process, lack of grading and standards for tropical legume grains, lack of incentive for private investment in seed production, decline in investment in agricultural research and development, and many others.

52. Tropical grain legumes involve about 30 leguminous species, a huge number of national programs, regional institutions and five international centers. Currently there are many initiatives aimed at sustainable development of these crops. Effective partnerships need to be strengthened and new ones established for creating synergy for accelerating development in SSA and SA.

53. The TL II project has tried to address many of these and related issues during the first phase and has learned important lessons. Perhaps the most important achievement of the first phase has been creating excitement about tropical legumes technologies, and the possibilities of bringing about change in the lives and livelihoods of smallholder farmers in target countries.

1.5 Introduction

There are about 30 species of economically important legumes grown in the tropics (Baldev et al. 1988; Raemaekers 2001; Gowda et al 2007). Among the major ones are chickpea (*Cicer arietinum*), common bean (*Phaseolus vulgaris*), cowpea (*Vigna unguiculata*), groundnut (*Arachis hypogaea*), pigeonpea (*Cajanus cajan*), and soybean (*Glycine max*). Others that are important in one or other regions of the tropics include faba bean (*Vicia faba*), lentil (*Lens culinaris*), field pea (*Pisum sativum*), Bambara groundnut (*Vigna subterranea*), hyacinth bean (*Lablab purpurea* – also known as *Dolichos lablab*), Kerting's groundnut (*Macrotyloma geocarpum*), lima bean (*Phaseolus lunatus*), yam bean (*Sphenostylis stenocarpa*), mung bean or green gram (*Vigna radiata*), black gram or black bean (*Vigna mungo*), moth bean (*Vigna aconitifolia*), rice bean (*Vigna umbellata*), and horse gram (*Macrotyloma uniflorum*).

More than 101 million households (HH) in Sub-Saharan Africa (SSA) and 39 million HH in South Asia (SA) grow one or more of the major tropical legumes for food security, income generation, improved nutrition, and maintaining soil fertility. An estimated 27 million ha in SSA and 40 million ha in SA are planted to these crops each year; annual production is estimated at about 19 million metric tons (MT) in SSA and 30 million MT in SA, valued at about US$ 9.3 billion and US$ 15.1 billion, respectively. Despite their importance, investment in tropical legumes research and development has been low. However, this situation has been changing for the better in recent years. The Tropical Legumes II project (TL II), funded by the Bill & Melinda Gates Foundation, aims to improve the livelihood of smallholder farmers in SSA and SA through improved productivity and production of the six major grain legumes mentioned above. Improved systems and partnership approaches between national programs and CG centers have shown positive changes in some countries (Abate et al 2011) that could serve as examples of good practice.

1.5.1 Objectives

The objective of this report is to review the information required to develop an effective research and development strategy for tropical legumes. The four specific objectives are to:

1. Bring together information for all six major tropical legumes;
2. Analyze the impact on productivity of investment in research and development;
3. Review past trends in productivity and trade, and projections through 2020;
4. Identify constraints on production, and opportunities for improving productivity.

Previous reviews dealing with tropical legumes have focused on individual crops, in accordance with the mandates of the CG centers (e.g. Freeman et al 1999; Joshi et al 2001) or have been mostly of general nature (e.g. Akibonde and Maredia 2011). This report takes a wider view by reviewing experience with six major legume crops and focuses on the information required to develop an effective research and development strategy.

1.5.2 Data

The major source of our data for production and trade was the FAOSTAT, accessed from July 2008 and frequently updated through 2010. Data from national statistics are employed where no FAOSTAT data were available. Projections on the production and demand for chickpea, groundnut, pigeonpea and soybean were obtained from Shiferaw et al (2008b), and cowpea projections were obtained from IITA database. Projections on the production and demand for common bean were calculated from data provided by CIAT, Uganda.

1.5.3 Methods

To estimate the ROG, we employed the logarithmic estimation method: ROG (%) =100*LOGEST (Y_1:Y_n)-1) on Excel spreadsheet, where Y_1 and Y_n are the first and last year for each variable considered.

To estimate the contribution of changes in area and productivity (yield per unit area) on the change in production, we used an Ordinary Least Square regression procedure. The change in total production is used as a dependent variable and is

measured as average production in 2005-07 minus average production in 1985-87. The explanatory variables used in the model are area (i.e. average area in 2005-07 minus average area in 1985-87) and yield (average yield in 2005-07 minus average yield in 1985-87).

Thus, $\Delta Q = \beta + \alpha \Delta A + \chi \Delta Y + \mu$

Where:
ΔQ is change in total production
ΔA is change in area
ΔY is change in yield
μ is error term, and β, α, and χ are the parameters to be estimated. Parameters for each crop are separately estimated using this equation.

1.6 General background

The SSA and SA regions are characterized by high levels of undernourishment and poverty. Currently there are more undernourished people in both of the two regions than there were 20 years ago (Figure 1-1). In the SA region, the number of undernourished people in 2004-06 was 337 million, compared to 286 million in 1990-92. Similarly, there were 212 million undernourished people in the SSA region in 2004-06 as opposed to 169 million in 1990-92. The total number of undernourished people in the two regions combined accounts for approximately 63% of the world total (Figure 1-2) - 24% in SSA and 39% in SA.

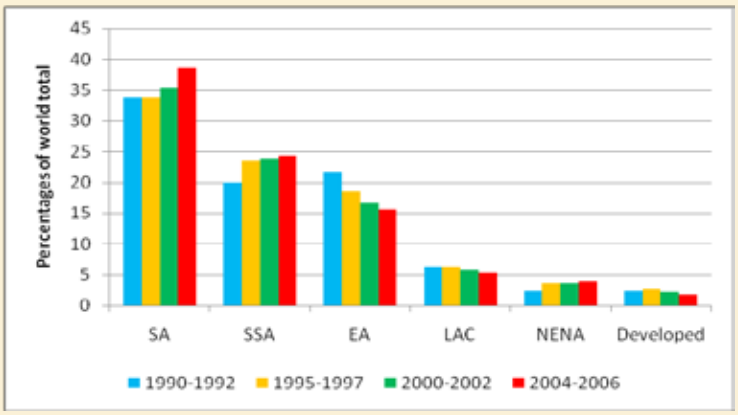

Figure 1-1: Undernourished population in selected regions of the world (SA=S. Asia, SSA=sub-Saharan Africa, EA=E. Asia, LAC=Latin America & Caribbean; NENA=Near East & N. Africa; Developed=Developed countries; calculated from FAOSTAT, 2010)

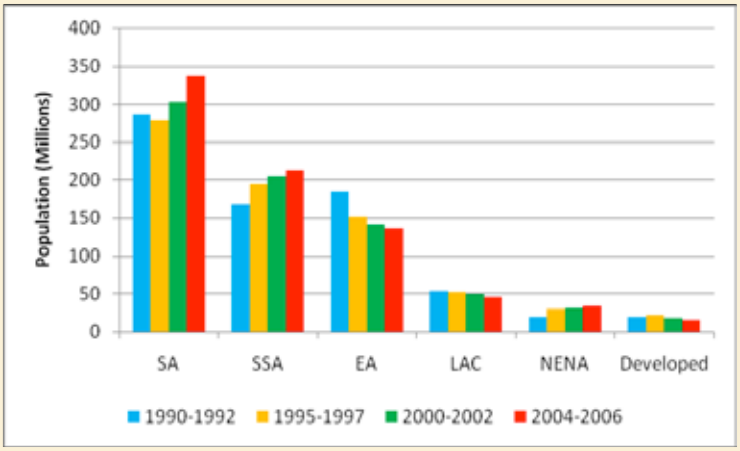

Figure 1-2: Percentages of world total undernourished population in selected regions of the world (calculated from FAOSTAT, 2010)

Worldwide, the six major tropical legumes mentioned above are grown on nearly 173 million ha of land, with average grain production of more than 292 million MT (Table 1-1) valued at more than US$ 146 billion each year. Of this, approximately 16% (nearly 27 million ha) and nearly 24% (close to 40 million ha) were in SSA and SA, respectively. However, it can be seen that SSA and SA contribute to just over 6% and about 10%, respectively, of the total world production, indicating the low level of productivity of these crops in the two regions (Table 1-1).The world average yield is estimated at more than 1,100 kg per ha. Soybean occupies the largest proportion of area (54%) followed by common bean (16%), groundnut (13%), cowpea (8%), chickpea (6%), and pigeonpea (<3%).

Cowpea occupies the largest proportion of land planted to tropical legumes (ca. 43%) in SSA, followed by groundnut (34%), common bean (19%), soybean (<5%), pigeonpea (<2%), and chickpea (<2%). In SA, beans occupy the largest proportion of area (29%), followed by soybean (21%), chickpea (21%), groundnut (18%), pigeonpea (10%), and cowpea (<1%).

The ROG in area of the six legumes is estimated at 1.7%, 3.3%, and 2.3% for the world, SSA and SA, respectively. By contrast, yields grew by 0.9%, 1.4%, and 1.1%, respectively. The ROG for production in the world, SSA, and SA is estimated at 2.8%, 4.7%, and 3.2%, respectively (Table 1-1).

Estimates from various sources suggest that more than 101 million rural households in SSA (*ca* 516 million people) and more than 39 million households in SA (*ca* 208 million people) grow one or more of the major six crops (Table 1-2) for their use as sources of improved nutrition in the form of dry seed or vegetable, for income generation, animal feed, and for maintaining soil fertility (mostly intercropped or

grown in rotation with cereals such as maize and sorghum). This translates into a total of more than 724 million people. Woody tropical legumes such as pigeonpea are also important source of energy as fuel wood and for construction purposes. Average plot sizes range from about 0.20 ha in SSA to 0.86 ha in SA. The average per capita production is estimated at a little over 186 kg per HH for SSA and nearly 770 kg per HH for SA.

Table 1-1: Trends of TL II crops in the world, Sub-Saharan Africa, and South Asia

Crop	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
World									
Chickpea	10,294	10,914	0.4	692	818	0.0	7,136	8,929	1.2
Common Bean	26,185	27,232	0.1	582	723	0.0	15,230	19,705	1.2
Cowpea	5,466	14,500	4.5	341	454	1.4	1,718	6,155	5.9
Groundnut	18,784	22,633	1.0	1,137	1,607	1.0	21,363	36,379	2.9
Pigeonpea	3,549	4,655	1.1	845	885	0.5	2,679	3,463	1.1
Soybean	52,503	92,622	3.0	1,877	2,348	1.4	98,569	217,397	4.4
Total	**116,781**	**172,556**	**1.7**	**895**	**1,116**	**0.9**	**146,695**	**292,028**	**2.8**
Sub-Saharan Africa									
Chickpea	250	398	2.4	587	769	1.4	132	315	4.4
Common bean	3,045	5,190	2.9	684	596	-0.9	2,070	3,045	2.0
Cowpea	4,629	11,440	4.3	333	450	1.5	1,427	5,145	5.8
Groundnut	5,507	9,057	3.0	782	1,007	1.3	4,277	8,942	4.3
Pigeonpea	249	499	3.1	593	729	1.7	148	363	4.3
Soybean	380	1,228	3.8	928	1,060	3.5	257	1,279	7.3
Total	**13,627**	**26,864**	**3.3**	**648**	**767**	**1.4**	**8,186**	**18,557**	**4.7**
South Asia									
Chickpea	8,585	8,334	-0.1	693	855	1.3	5,747	6,792	4.4
Common bean	9,959	11,532	0.3	602	985	1.8	3,714	5,908	2.9
Cowpea	50	159	5.4	655	975	1.0	33	154	4.4
Groundnut	7,647	7,038	-1.1	930	1,122	1.0	6,310	8,457	0.2
Pigeonpea	3,255	4,118	1.0	710	840	-1.1	2,495	3,068	0.9
Soybean	1,526	8,490	8.4	701	1,275	1.6	979	5,735	10.0
Total	**31,022**	**39,671**	**2.3**	**715**	**1,009**	**1.1**	**19,278**	**30,114**	**3.2**

Source: Calculated from FAOSTAT (2010); cowpea data for SSA are both from FAOSTAT and other sources, including national statistics.

Even though there have been examples of successes at country and local levels for some crops, in general, only limited gains have been made in the yield levels of tropical legumes in SSA and SA over the last four decades (Figure 1-3); yields have generally remained below the 1 MT per ha levels and consistently remained below the world averages. The lack of sustained yield gains is indicative of the fact that production of most tropical legumes is dominated by small-scale farming, characterized by the lack of access to modern technologies – improved varieties and the accompanying crop and pest management practices, inputs such as fertilizers (both mineral and biofertilizers), seeds of improved varieties, and poor input and output market access.

Table 1-2: Estimates of number of households growing TL II crops, number of people, and per capita production of major tropical legumes in Sub-Saharan Africa and South Asia

Crop	Parameter		
	No. Households ('000)	No. People ('000)	Production per HH (Kg)
Sub-Saharan Africa			
Chickpea	1,812	11,445	161
Common bean	34,955	188,066	109
Cowpea	38,000	194,000	135
Groundnut	18,292	86,581	450
Pigeonpea	1,642	7,772	238
Soybean	6,630	28,583	200
Sub-total/avg.	101,331	516,447	183
South Asia			
Chickpea	6,631	40,504	929
Common bean	11,573	61,420	584
Cowpea	159	842	101
Groundnut	6,655	26,621	1,234
Pigeonpea	5,169	30,047	644
Soybean	9,096	48,275	1,113
Sub-total/avg.	39,283	207,709	768
Grand total/avg.	140,614	724,156	346

Source: calculated by authors from various sources

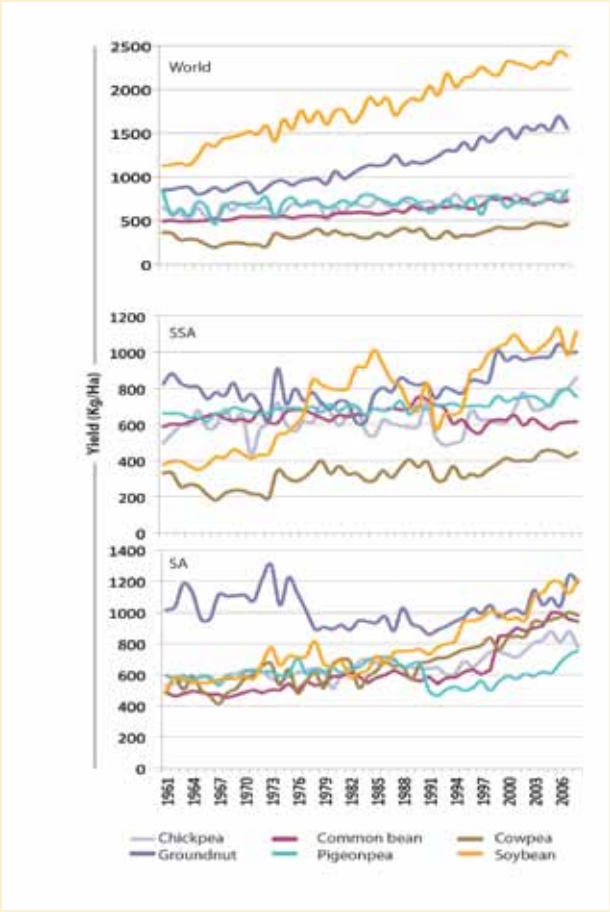

Figure 1-3: Grain yields of major tropical legumes in the world, Sub-Saharan Africa and South Asia, 1961-2008 (calculated from FAOSTAT, 2010)

Changes in the area planted, productivity, and hence production, in the 20 years between 1985-87 and 2005-07 varied according to the crop and region (Table 1-1). While cowpea and soybean registered the highest ROGs in area in SSA of 4.3% and 3.8%, respectively, chickpea and common bean recorded the lowest of 2.4% and 2.9%, respectively. The overall area for all the crops in the SSA region jumped from nearly 14 million ha to about 27million ha, a more than 97% increase, or an ROG of 3.3%. By contrast, the ROG for yields in this region was a mere 1.4%. Common bean yield showed an ROG of a 0.9% decline whereas soybean, pigeonpea, cowpea, chickpea and groundnut yields grew by about 3.5%, 1.7%, 1.5%, 1.4%, and 1.3%, respectively, per annum. Production in 1985-87 was just over 8 million MT, compared to nearly 19 million MT in 2005-07, average growth of 4.7% per annum (Table 1-1). In general, the growth in production has been attributed mainly to expansion in area rather than gains in productivity – i.e. the crops that showed

the highest ROG in area also showed the highest ROG in production (see section on impacts of agricultural technologies below). Cowpea (nearly 11 million ha) and groundnut (approximately 9 million ha) occupy the largest area of the six crops in the SSA region whereas chickpea (about 400,000 ha) and pigeonpea (*ca* 500,000 ha) have the lowest acreage. More than 1.2 million ha are planted to soybean.

The ROG in the area planted in the SA region grew at a rate of 2.3 % whereas increases in productivity stood at 1.1% per annum. Both area (8.4%) and productivity (1.6%) for soybean grew faster than all the other crops, with the resulting ROG in production of 10% (Table 1-1). Soybean recorded a massive ROG of 8.4% while groundnut and chickpea area ROG declined by 1.1% and 0.1%, respectively. This region saw the total area of all the crops to jump from just over 31 million ha to about 40 million ha, average yields from 715 kg per ha to 1,009 kg per ha, and production from about 19 million MT to over 30 million MT (an ROG of 3.2%). It is important to note that the region, which is the most important producer globally, reported pigeonpea yield ROG decline of 1.1% over the 20 years period (Table 1-1). Table 1-1 also indicates that beans occupy the largest area (close to 12 million ha) in this region, but it is suspected that the FAOSTAT for "beans" might be inclusive of not only just the common bean (dry bean) but also other beans such as mung bean, urd bean and others. Soybean, chickpea and groundnut occupy more than 7 million ha each, with pigeonpea occupying more than 4 million ha. Cowpea has the lowest acreage (*ca* 159,000 ha). The production of all legumes other than cowpea in the region is dominated by India.

Worldwide, common bean and chickpea showed the slowest growth rates in area planted of 0.2% and 0.4%, respectively, whereas cowpea and soybean registered the highest growth rates of 4.5% and 3%, respectively. Highest ROGs in productivity were reported for soybean and cowpea at 1.4% each while chickpea recorded a stagnant productivity ROG (Table 1-1). Global production of these TL II crops is pushed more by area expansion than productivity growth just as it was observed in the two regions under review here. For example, from Table 1-1, it is clear that soybean and cowpea that registered the highest area ROGs also reported the highest production ROG. In general, soybean is the fastest expanding crop both globally and in both regions.

The importance of each region in global production of the six legumes is as presented in Table 1-3. The SSA region accounts for about 16% of the world total area but contributes only 6.4% of the production (Table 1-3). The low production contribution vis-à-vis area share is because yields in this region are lower than the world average by more than 31%. In a similar fashion, the SA region accounts for 22% and contributes about 10% of production. The average yields here also are lower than the world average by nearly 10% (Table 1-3).

Table 1-3: Percent share of the world totals of TL II crops in Sub-Saharan Africa and South Asia (2005-07 averages)

Crop	Area	Yield	Production
Sub-Saharan Africa			
Chickpea	3.6	94.1	3.5
Common Bean	19.1	82.4	15.5
Cowpea	84.0	97.0	83.4
Groundnut	40.0	62.7	24.6
Pigeonpea	10.7	98.0	10.5
Soybean	1.3	45.1	0.6
Total	**16.0**	**68.7**	**6.4**
South Asia			
Chickpea	76.4	104.5	76.1
Common Bean	42.3	136.1	30.0
Cowpea	1.5	214.6	3.2
Groundnut	31.1	69.9	23.2
Pigeonpea	88.5	113.0	88.6
Soybean	9.2	54.3	2.6
Total	**23.6**	**90.4**	**10.4**

Source: Calculated from FAOSTAT (2010)

World trade for the six major crops is estimated at nearly US$ 25 billion for imports and US$ 22 billion for exports, respectively (Table 1-4)[4]. Soybean accounts for about 84.5% of the world grain legumes trade, followed by common bean (8%), groundnut (5.1%), and chickpea (2.3%). SSA and SA contribute 0.4% and 2%, respectively, to the world grain legumes export.

3. Data from FAOSTAT for cowpea and pigeonpea trade are either not available or incomplete.

Table 1-4: Tropical grain legumes trade in the world, Sub-Saharan Africa and South Asia

Commodity	Import		Export	
	1000 MT	US$ Millions	1000 MT	US$ Millions
World				
Chickpea	826	543.2	878	524.0
Common bean	2,765	1,791.5	3,297	1,925.7
Cowpea	2	0.7	2	1.2
Groundnut	1,672	1,325.3	1,342	1,076.1
Pigeonpea	2	1.6	3	2.1
Soybean	69,183	21,057.5	69,245	18,288.3
Total	**74,451**	**24,719.7**	**74,767**	**21,817.4**
Sub-Saharan Africa				
Chickpea	16	6.8	99	38.4
Common bean	243	129.6	82	36.6
Cowpea	NA*	NA	NA	NA
Groundnut	53	28.3	70	36.0
Pigeonpea	2	1.6	3	1.9
Soybean	110	32.9	36	14.4
Sub-total	**424**	**199.2**	**290**	**127.3**
South Asia				
Chickpea	375	191.3	175	107.8
Common bean	574	332.5	1,074	560.2
Cowpea	NA	NA	NA	NA
Groundnut	12	5.1	240	183.6
Pigeonpea	NA	NA	NA	0.2
Soybean	147	41.4	9	4.1
Sub-total	**1,107**	**570.3**	**1,498**	**855.9**

* NA=not available.

With the exception of chickpea, the bulk of production in SSA is consumed locally. Here, nearly 32% of the 315,000 MT of chickpea produced in 2005-07 was exported while the remaining 68% was used locally. About 2% of soybean and 1% of groundnut were exported during this period. Similarly, exports for common bean, groundnut, chickpea, and soybean in the SA region amounted to 9%, 2.8%, 2.6%, and 0.5%, respectively.

1.7 Impacts of agricultural technologies on tropical legumes

Table 1-5 shows the contribution of area expansion and changes in yield to the total production of the various crops. For the SSA region, neither the expansion in area nor changes in yield had any significant effect on the production of chickpea, common bean and soybean, though the bulk of the difference in production of the two crops was explained by area expansion (R^2 of 57%, 70%, and 98%, respectively). By contrast, area expansion had a significant effect on pigeonpea and highly significant effects on the rest of the crops (Table 1-5). Yield effects were significant for groundnut and pigeonpea. Here, area and yield accounted for 64% and 68%, respectively, for changes in pigeonpea production whereas 93% of the change in the production of groundnut was explained by area expansion, as opposed to 0.03% for change in yield (Table 1-5).

For South Asia, area expansion had a positive and significant effect on production of beans and soybean at the 1% level of significance. On the other hand, area expansion had a negative and significant effect on production of chickpea and groundnut at the 5% and 10% levels of significance, respectively. Similarly, changes in yield had a significant effect on production of chickpea and beans. While yield changes affected production of chickpea positively and significantly at the 10% level of significance, changes in yield affected production of common bean negatively and significantly at the 5% level of significance. Yield effects were statistically non-significant for groundnut, pigeonpea and soybean.

Globally, changes in area significantly affected production of chickpea, common bean, cowpea, and soybean at the 1% level of significance. However, while production of common bean, cowpea and soybean were affected positively by area expansion, the effect on chickpea was negative. Similarly, area expansion affected groundnut production negatively and this was significant at 10%. The area expansion accounted for approximately 67%, 88%, 75%, 5%, 33%, and 99% of the changes in total production of chickpea, common bean, cowpea, groundnut, pigeonpea, and soybean, respectively.

In general, the bulk of changes in total production were due to area expansion in both regions and globally. Area alone explained 57-98%, 40-99%, and 5-99% of changes in total production for SSA, SA, and the world, respectively. The effects of yield have been very minimal for the most part; the only exception is that of pigeonpea in the SSA region where changes in area and yield explained 64% and 68%, respectively, and about 96% when the two are considered together (Table 1-5).

Table 1-5: Relative contribution of area expansion and yield to tropical legumes production (based on 20 years' data for the period 1985/87-2005/07)

Crop	Coefficients		Coefficient of determination (R2)		
	Area	Yield	Area	Yield	Area + Yield
Sub-Saharan Africa					
Chickpea	1.590 (0.649)	0.057 (0.055)	0.57	0.15	0.58
Common Bean	1.590 (0.649)	0.032 (0.021)	0.70	0.02	0.72
Cowpea	0.512 (0.090)***	0.738 (0.79)	0.75	0.12	0.75
Groundnut	17.436 (0.710)***	0.104 (0.047)**	0.93	0.03	0.93
Pigeonpea	0.837 (0.180)**	0.058 (0.012)**	0.64	0.68	0.96
Soybean	1.37 (0.040)***	0.002 (0.006)	0.98	0.06	0.98
South Asia					
Chickpea	-4.193 (0.767)**	2.455 (0.980)*	0.65	0.00	0.85
Common Bean	1.065 (0.052)***	-2.916 (0.711)**	0.94	0.03	0.98
Cowpea	NA	NA	NA	NA	NA
Groundnut	-1.773 (0.460)*	0.590 (0.650)	0.83	0.23	0.82
Pigeonpea	5.353 (4.940)	0.226 (0.300)	0.40	0.26	0.30
Soybean	0.691 (0.004)***	0.027 (0.040)	0.99	0.02	0.99
World					
Chickpea	-3.153 (0.670)***	0.238 (0.298)	0.67	0.00	0.66
Common Bean	0.949 (0.060)***	0.056 (0.068)	0.88	0.01	0.88
Cowpea	0.539 (0.080)***	0.227 (0.410)	0.75	0.02	0.74
Groundnut	-1.074 (0.600)*	0.357 (0.190)*	0.05	0.06	0.10
Pigeonpea	4.435 (0.110)	0.110 (0.160)	0.33	0.14	0.29
Soybean	0.688 (0.010)***	0.019 (0.020)	0.99	0.02	0.99

*, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; values in parentheses are standard errors.

2.0 Crop Highlights

2.1 Chickpea

2.1.1 Production trends

World chickpea area and production have not shown dramatic increases. The area, yield, and production grew at annual rates of 0.4%, 0.0%, and 1.2%, respectively, during the period from 1985-87 to 2005-07. The 2005-07 average world area planted to chickpea stands at nearly 11 million ha with the corresponding production of close to 9 million MT; average yields are just over 800 kg per ha (Table 1-1). This crop is grown in nearly 60 countries around the world. India supplies about 65% of the world's total production. Pakistan is a distant second with about 8%. Other countries that grow chickpea on more than 100,000 ha are Turkey, Iran, Ethiopia, Myanmar, Australia, Canada, Mexico and Iraq (Annex Table 2-1). Myanmar, Ethiopia, Australia, Canada and Iraq have shown the fastest growth in chickpea production over the two decades. By contrast, area, yield and production have declined in some traditionally major producing countries such as Turkey (Annex Figure 2-1) over the last two decades. The long-term world production trends for chickpea are presented in Figure 2-1.

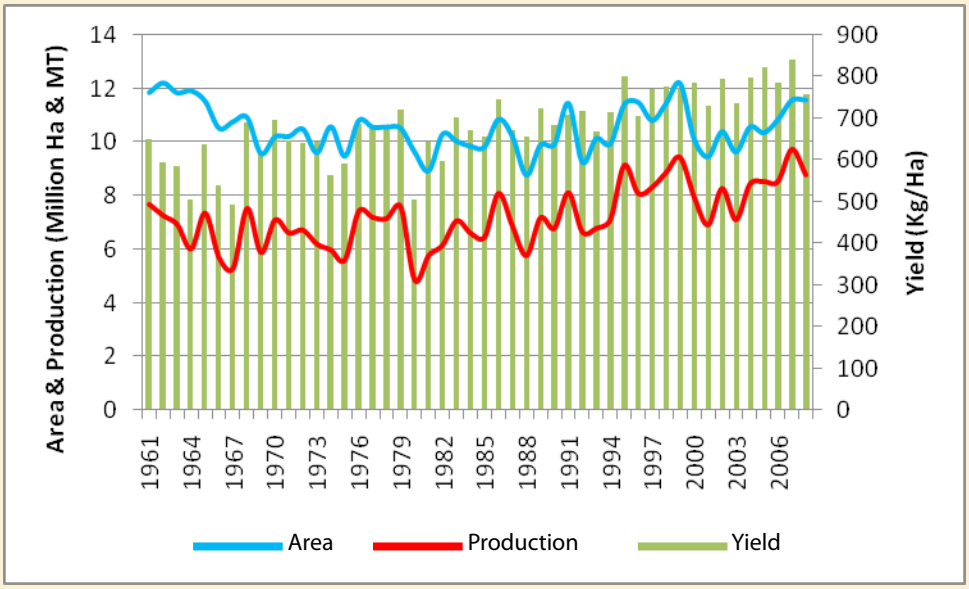

Figure 2-1: Chickpea world trends (calculated from FAOSTAT, 2010)

SSA's contribution to total area (and production) is approximately 398,000 ha (315,000 MT) whereas that of SA is more than 8.3 million ha (6.8 million MT), which is more than 76% of the world total (Table 1-3). Ethiopia, followed by Malawi and Tanzania, is the major producer of chickpea in SSA (Table 2-1), accounting for nearly 52% of the total area and 73% of production. The annual area planted to chickpea in Ethiopia is estimated at about 204,000 ha with a production total of 227,000 MT. Sudan, Eritrea, and Uganda have more than 1,000 ha; Zimbabwe, Niger, and Kenya plant less than 500 ha each year (Table 2-1). More than 1.8 million rural households (more than 11.4 million people) grow chickpea in the SSA region (Table 1-2).

The average yield for SSA is about 769 kg per ha; only Ethiopia and Sudan get yields over 1 MT per ha. The average area for the region grew by about 2.4% per year whereas the ROG for yield was 1.4% (Table 2-1). By contrast, Ethiopia registered ROGs of 2.3% in yield, 2.5% in area, and 4.8% in production. This improvement in chickpea yield is brought about by a value chain approach introduced over the last few years (Abate et al. 2011). Annex Figure 2-2 presents the long-term production trends of chickpea in Ethiopia.

Table 2-1: Chickpea trends in Sub-Saharan Africa and South Asia

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
Sub-Saharan Africa									
Ethiopia	137	204	2.5	640	1,114	2.3	84	227	4.8
Malawi	44	92	2.9	478	406	-0.3	20	37	2.6
Tanzania	62	70	0.4	344	447	1.6	21	31	2.0
Sudan	1	7	11.7	1,067	1,786	4.2	1	12	16.4
Eritrea*	NA	19	20.2	NA	190	-10.6	NA	4	7.4
Uganda	6	6	0.2	583	524	-0.1	4	3	0.1
Zimbabwe*	0	0	0.5	0	714	1.9	0	0	2.3
Niger*	0	0	3.7	0	548	-0.1	0	0	3.5
Kenya*	0	0	-48.2	0	361	-1.5	0	0	-49.0
Total/avg.	250	398	2.4	587	769	1.4	132	315	4.4
South Asia									
India	7,231	7,035	-0.1	684	823	1.0	4,960	5,793	1.0
Pakistan	1,043	1,058	0.0	513	685	1.4	534	729	1.5
Myanmar	177	218	1.3	869	1,157	1.5	154	252	2.8
Bangladesh	105	13	-11.6	761	767	0.3	80	10	-11.3
Nepal	29	11	-5.7	639	842	2.0	18	9	-3.7
Total/avg.	8,585	8,334	-0.1	693	855	1.3	5,747	6,792	1.0

The SA region produces close to 6.8 million MT of chickpea grains each year. More than 85% of this is accounted for by India, with Pakistan contributing nearly 11%. The average yield for India is just over 820 kg per ha. India's chickpea area declined by approximately 0.1% per annum whereas the yield and production grew by about 1% each (Table 2-1). The area for Bangladesh and Nepal declined by 11.6% and 5.7% per year, respectively. Production in these two countries also declined at a rate of 11.3% and 3.7%, respectively. More than 6.4 million rural households (*ca* 23.7 million people) grow chickpea in the SA region each year.

2.1.2 Projections

Chickpea production in SSA is projected to grow at the rate of 10.5% per annum (Shiferaw et al. 2008b). That is, from 548 thousand MT in 2010 to 1.125 million MT in 2020, as depicted in Table 2-2. Ethiopia, followed by Malawi, Sudan, and Tanzania, is expected to continue to be the lead producer. Similarly, the projected demand will grow at 3.3% per annum over the same period, with the highest demands coming from Ethiopia, Malawi, Sudan, Somalia, Tanzania, Eritrea and 17 other countries (Table 2-2). See Annex Tables 2-11a, 2-11b and 2-11c for projection data on area, yield, and production, respectively, of all the crops.

The ROG in the SA region is projected at 3.3% and 4.2% for production and demand, respectively. India's demand for chickpea by 2020 will reach close to 11 million MT; Pakistan, Myanmar and Bangladesh also have significant amounts of demand for chickpea grain (Table 2-2).

The global ROG for production and demand is estimated at 3.8% and 4.2%, respectively. The higher ROG for production in SSA and for national demand in SA provides a window of opportunities for export to SA countries like India and Pakistan from SSA countries such as Ethiopia.

2.1.3 Trade

The world chickpea export has shown continued growth over the years (Figure 2-1). For example, according to the 2005-07 FAO data, the average world annual export stands at more than 882,000 MT, with the corresponding value of approximately US$ 510 million (Annex Table 2-2). This is a more than 154% increase in volume over the 20 years period or an average annual growth rate of about 7.7%. The corresponding change in value was 283% over the 20 years, or an average of nearly 14.2% per year. See Annex Table 2-2 for details of chickpea importing and exporting countries.

Table 2-2: Production and national demand projections for chickpea in Sub-Saharan Africa and South Asia

Country	Production (1000 MT)			National Demand (1000 MT)		
	2010	2015	2020	2010	2015	2020
Sub-Saharan Africa						
Ethiopia	350	517	734	226	258	302
Malawi	62	86	116	45	50	57
Sudan	32	39	43	32	36	42
Somalia	0	0	0	30	34	41
Tanzania	48	66	87	25	28	32
Eritrea	9	12	15	9	11	13
Uganda	6	9	12	4	5	6
Gambia	0	0	0	3	3	4
South Africa	0	0	0	1	1	1
Mauritania	0	0	0	0	0	1
Others (13)	42	95	118	1	1	1
Sub-total	**548**	**823**	**1,125**	**377**	**429**	**500**
ROG (%)	7.4			2.8		
South Asia						
India	7,333	8,649	9,898	7,887	9,456	10,811
Pakistan	601	632	658	986	1,308	1,703
Myanmar	108	122	136	135	189	239
Bangladesh	18	20	22	90	119	155
Sri Lanka	0	0	0	20	24	27
Nepal	14	16	17	11	14	16
Bhutan	0	0	0	1	1	1
Sub-total	**8,074**	**9,439**	**10,732**	**9,129**	**11,110**	**12,953**
Grand total	8,622	10,262	11,857	9,506	11,539	13,453
ROG (%)	3.2			3.8		

Source: Calculated from Shiferaw et al (2008b)

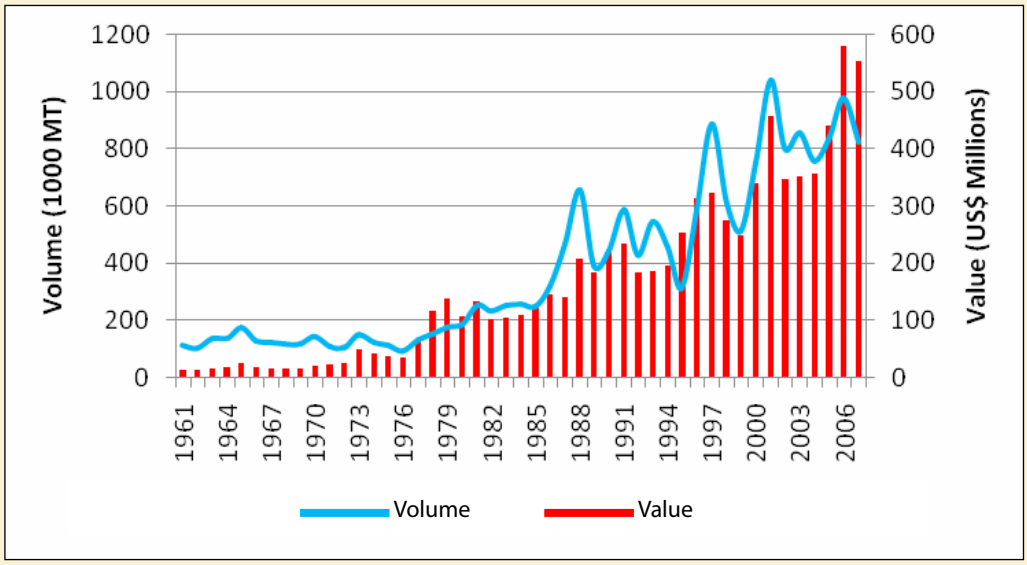

Figure 2-2: Chickpea world export, 1961-2007 (calculated from FAOSTAT, 2010)

SSA's share of export is estimated at nearly 100,000 MT, with the corresponding value of close to US$ 39 million. It imports nearly 16,000 MT worth over US$ 6 million. This puts Africa as the net exporter. Ethiopia accounts for nearly 76% and 78% of the total volume and value, respectively, of chickpea export in Africa (Table 2-3). Tanzania, with approximately 21% and 18% of the volume and value, respectively, is the second largest exporter of chickpea in Africa, followed by Malawi. Mali, South Africa, Zambia, Burkina Faso, Botswana, Kenya, Uganda and 11 other countries account for less than 1% each (Table 2-3).

A total of 36 countries in SSA are known to import chickpea. Sudan, accounting for nearly 71% volume and 56% value, is the largest importer, followed by South Africa. Other important countries importing chickpea in this region are Mauritius, Malawi, Zambia, Zimbabwe, Niger, Madagascar, and Swaziland (Table 2-3). Heavy fluctuations in producer prices are experienced over the years in some countries in the SSA region (Figure 2-3a). According to FAOSTAT, the producer price for chickpeas in Malawi showed sharp increases in the mid 1990s but sharply fell in the late 1990s; similar (though less dramatic) situations have been observed in Ethiopia, Sudan, and elsewhere (Shiferaw et al. 2008c; Akibonde and Maredia 2011).

Table 2-3: Chickpea trade in Sub-Saharan Africa and South Asia (2005-07 averages)

Import			Export		
Country	Volume (MT)	Value (US$ 1000)	Country	Volume (MT)	Value (US$ 1000)
Sub-Saharan Africa			Sub-Saharan Africa		
Sudan	11,247	3,705	Ethiopia	75,521	30,005
South Africa	1,467	1,043	Tanzania	20,570	7,012
Mauritius	577	391	Malawi	1,961	856
Malawi	460	195	Mali	645	96
Zambia	344	183	South Africa	370	234
Ethiopia	280	166	Zambia	243	92
Zimbabwe	270	109	Burkina Faso	221	92
Niger	260	110	Botswana	138	36
Madagascar	247	155	Kenya	110	51
Swaziland	167	133	Uganda	46	20
Others (26)	598	474	Others (11)	51	13
Total	**15,917**	**6,189**	**Total**	**99,876**	**38,508**
South Asia			South Asia		
India	184,893	93,965	India	89,045	69,303
Pakistan	108,993	55,532	Myanmar	53,885	26,890
Bangladesh	66,548	32,770	Pakistan	31,978	11,553
Sri Lanka	12,856	8,170	Sri Lanka	59	25
Nepal	1,838	891	Bangladesh	1	1
Myanmar	Negligible	Negligible	Nepal	Negligible	73
Total	**375,128**	**191,328**	**Total**	**174,969**	**107,845**

Source: Calculated from FAOSTAT (2010)

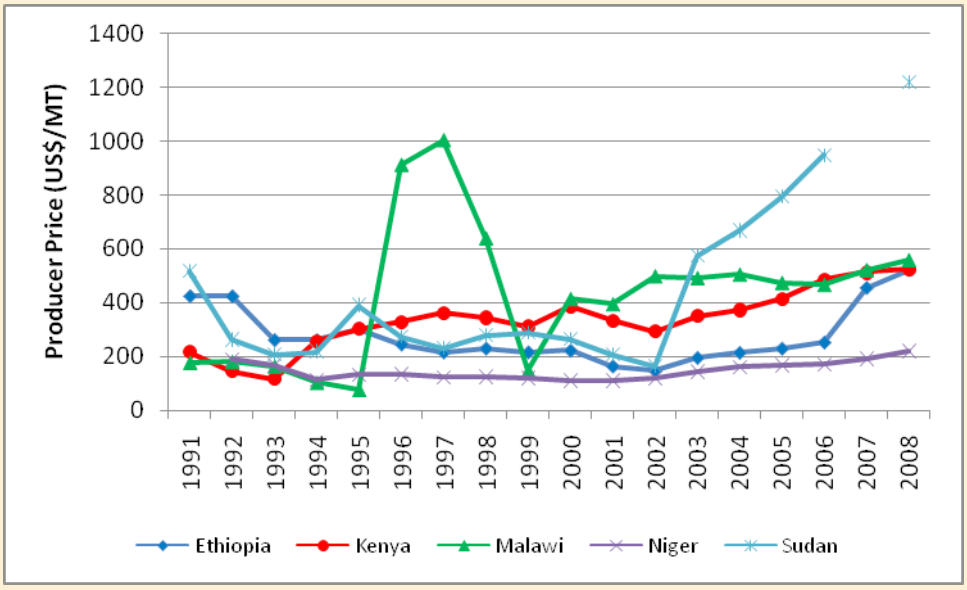

Figure 2-3a: Producer prices of chickpea in Sub-Saharan Africa (source: calculated from FAOSTAT, 2010)

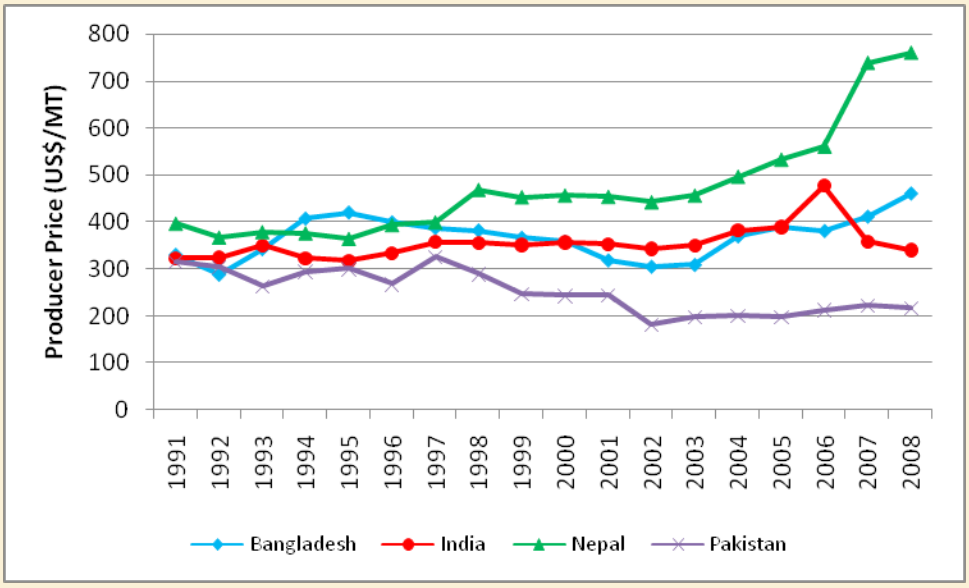

Figure 2-3b: Producer prices of chickpea in South Asia (calculated from FAOSTAT, 2010)

South Asia's share of import (and export) is estimated at about 375 (175) thousand MT amounting to US$ 191 (and US$108) million annually (Table 2-3). India, followed by Myanmar and Pakistan is the major exporter of chickpea in SA. India, followed by Pakistan, Bangladesh, Sri Lanka and Nepal, is also the major importer (Table 2-3). All of these countries are net importers of chickpea. India is projected to continue to be a net importer of chickpea in the next 20 years even if a 25% increase in production is achieved. The producer price for chickpea in Pakistan declined from more than US$ 300 per MT in the early to late 1990s to about US$ 200 per MT in recent years. The prices for India have shown a small but steady increases over most of this period, but fell from about US$ 478 per MT in 2006 to US$ 341 per MT in 2008 (Figure 2-3b).

It has been projected that the SSA region will continue to be net exporter of chickpea through 2020, amounting to more than 582,000 MT. Ethiopia would account for more than 74% of the total export, followed by Malawi, Tanzania, and Kenya (Table 2-4). On the other hand, some 22 countries, including Somalia and Gambia are projected to be net importers of chickpea in SSA.

Table 2-4: Net-trade projections (1000 MT) for chickpea in selected countries of Sub-Saharan Africa and South Asia

Country	2010	2015	2020
Sub-Saharan Africa			
Ethiopia	123.31	258.49	431.44
Malawi	17.11	36.29	58.93
Tanzania	22.25	37.48	54.45
Kenya	20.55	36.46	54.03
Uganda	2.17	3.85	5.45
Others (20)	-2.14	0.98	1.87
Gambia	-2.84	-3.44	-4.2
Somalia	-8.65	-13.14	-19.5
Sub-total	**171.75**	**356.96**	**582.46**
South Asia			
Pakistan	-388.39	-680.26	-1,048.66
India	-546.9	-799.57	-905.65
Bangladesh	-73.4	-99.75	-134.02
Myanmar	-27.56	-66.69	-102.41
Sri Lanka	-20.18	-24.41	-27.45
Nepal	-1.52	-3.07	-4.74
Bhutan	-0.3	-0.55	-0.79
Sub-total	**-1,058.25**	**-1,674.30**	**-2.223.7**

All countries in the SA region are projected to be net importers of chickpea by 2020, with the major ones being Pakistan, India, Bangladesh and Myanmar (Table 2-4).

2.2 Common bean

2.2.1 Production trends

Common bean is grown in 128 countries on more than 27 million ha of land across the world (cf. Table 1-1); nearly 20 million MT of this crop (also known as haricot bean) is produced annually. The world average yield is 723 kg per ha. World area, yield, and production grew by about 0.1%, 0.8%, and 1.2%, respectively (Table 1-1). Figure 2-4 shows the world common bean production trends. The gap between production and area has narrowed starting in the late 1990s as a result of increases in productivity.

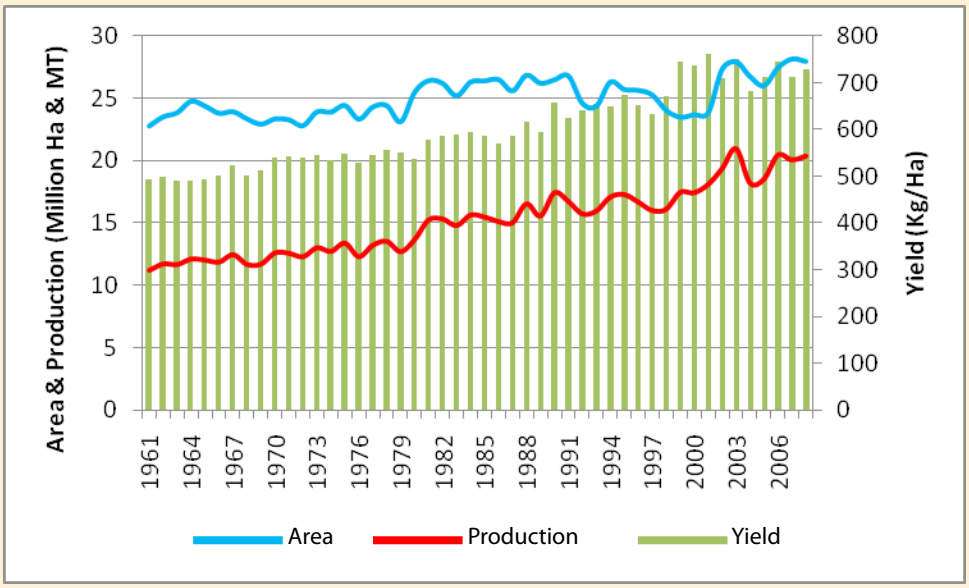

Figure 2-4: Common bean world trends (calculated from FAOSTAT, 2010)

The highest area (*ca* 8.9 million ha) and production (*ca* 3.3 million MT) in the world have been reported for India. However, what is reported as dry beans for India (and perhaps for South Asia, in general) is likely to be all kinds of beans, including mung bean (*Vigna radiata*), *urad* or *urd* bean (*Vigna mungo*), moth bean (*Vigna aconitifolia*), and *kulthi* or black gram (*Macrotyloma unfiflorum*); common ban (*Phaseolus vulgaris*) is not featured on the Government of India official statistical data (http://www. agricoop.nic.in/Agristatistics.htm). Other largest producers in the world include Brazil, Myanmar, China, USA, Mexico, Tanzania, Kenya, Uganda, Indonesia and Canada (Annex Table 2-3). Area in eight of the

top 20 common bean-producing countries has declined at annual rates ranging from 2% (Indonesia) to 0.4% (China). By contrast, Myanmar, Ethiopia, Canada, Cameroon and Nicaragua have shown positive growth rates in area ranging from 10.5% to 6.2%. Growth rates for yield have also declined in six of the top 20 producing countries at annual rates ranging from 2.5% (Indonesia) to 0.2% (Korea, DPR). Highest annual rates of growth of yield were observed in Iran (4.4%) and Brazil (3.4%).

SSA accounts for about 16% and 6.4% of the total world area and production, respectively (cf. Table 1-3). Common bean is grown by 27 of the 48 SSA countries. Nearly 35 million households (more than 188 million people) grow common bean in this region. The national average area under common bean in SSA region is estimated at about less than 0.12 ha per rural household. Annual area and production are estimated at more than 5 million ha and 3 million MT, respectively (Table 2-5). Tanzania, Kenya, and Uganda are the largest producers, followed by Rwanda, Burundi, Cameroon, Ethiopia, DRC, Malawi, and Angola. Kenya has the largest area but Tanzania produces more because of its better yield (662 kg per ha as opposed to 471 kg per ha for Kenya). The ROGs for yield in nine of the top 20 SSA countries have declined at rates ranging from 2.4% (Kenya) to 0.4% (DRC and Cote d'Ivoire). Only Sudan, Togo, Mauritius and Benin registered annual growth rates exceeding 2%. Overall, growths in yield declined by 0.9% per annum for SSA. Ethiopia and Sudan registered the highest rates of growth of greater than 10% in production (Table 2-5). Annex Figure 2-3a shows production trends of common bean in SSA.

In the SA region India accounts for nearly 94% of the area and 87% of production of beans (Table 2-5). The balance is covered by Myanmar, Pakistan, Bangladesh, Nepal, Sri Lanka, and Bhutan. The area planted to these crops declined in Sri Lanka (7.8%), Bangladesh (5%) and India (0.8%) over the 20 years during 1985-87 to 2005-07 whereas it increased in Myanmar (10.5%), Nepal (3.1%), and Pakistan (2%). ROGs increased for yield in all countries, ranging from 0.2% for India to 1.6% in Nepal (Table 2-5). The overall average yield increase for the region was 2.9%. The ROGs for yields grew much faster starting in the late 1990s. Annex Figure 2-3b shows the production trends of beans in SA.

Table 2-5: Common bean trends in Sub-Saharan Africa and South Asia

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
Sub-Saharan Africa									
Tanzania	386	720	3.6	670	662	0.2	257	477	3.8
Kenya	520	959	3.0	621	471	-2.4	323	448	0.5
Uganda	368	849	4.0	757	526	-1.8	278	446	2.1
Rwanda	329	343	1.3	861	737	-1.0	283	254	0.3
Burundi	310	245	-1.2	1,005	897	-0.8	312	220	-1.9
Cameroon	78	231	6.2	673	876	1.3	53	202	7.6
Ethiopia	49	209	7.9	572	836	0.7	28	174	12.8
DRC	203	206	-0.2	573	541	-0.4	117	111	-0.6
Malawi	142	246	2.7	535	448	-1.4	76	111	1.3
Benin	82	131	2.3	485	810	2.4	40	105	4.8
Angola	147	367	4.8	277	285	0.6	41	104	5.4
Madagascar	57	81	2.0	791	1,049	0.9	45	85	2.9
Chad	51	143	8.9	401	514	0.2	20	74	9.1
Togo	117	180	2.5	246	341	2.5	29	61	5.0
South Africa	78	52	-2.3	1,215	1,140	0.1	95	59	-2.2
Zimbabwe	64	57	-0.4	729	483	-0.8	47	27	-1.2
Côte d'Ivoire	0	29	3.9	0	873	-0.4	0	25	3.5
Somalia	41	66	2.8	425	277	-1.4	17	18	1.4
Sudan	2	7	9.2	1,201	2,272	3.0	2	16	12.6
Mauritania	0	10	5.5	0	1,000	2.5	0	10	8.1
Others (6)	18	40	-	617	391	-	8	10	-
Total/avg.	**3,045**	**5,190**	**2.9**	**684**	**596**	**-0.9**	**2,070**	**3,045**	**2.0**
South Asia									
India	9,181	8,865	-0.8	344	367	0.2	3,150	3,277	-0.6
Myanmar	408	2,309	10.5	869	1,035	1.1	354	2,392	11.7
Pakistan	185	257	2.0	487	617	1.4	90	160	3.5
Bangladesh	127	47	-5.0	644	792	0.9	82	37	-4.1
Nepal	24	42	3.1	542	703	1.6	13	29	4.7
Sri Lanka	35	9	-7.8	730	922	1.4	25	9	-6.4
Bhutan	0	1	NA	0	2,456	NA	0	4	NA
Total/avg.	**9,959**	**11,532**	**0.3**	**602**	**985**	**2.9**	**3,714**	**5,908**	**1.8**

*Base data start from 1999 (source: calculated from FAOSTAT, 2010)

2.2.2 Projections

Area, yield, production and national demand projections for common bean have been calculated from Enid Katungi (pers. com.) only for eight countries in Africa – Burundi, Cameroon, Ethiopia, Kenya, Malawi, Rwanda, Tanzania, and Uganda. The ROG for area expansion is projected to range from 0.2% for Burundi to 6.3% for Cameroon (overall average: 2.4%). The highest rate of growth for yield (8.3%) is projected for Ethiopia and the lowest (1.2%) for Cameroon (average: 3.2%). The average production is expected to grow at 9.1% per year, with Cameroon, Ethiopia and Burundi registering the highest growth rates of 25.1%, 13.4%, and 10.3%, respectively (Table 2.6).

Production is expected to outstrip national demand in all SSA countries but Kenya and Burundi by 2020. Cameroon, Ethiopia, Rwanda, and Tanzania are projected to be surplus producers (net exporters) whereas Kenya would continue to experience more demand than it can produce throughout the 2010 to 2020 period (Table 2-6), with its imports estimated at more than 100,000 MT by 2020.

Table 2-6: Common bean projections for selected countries of Sub-Saharan Africa

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)			National Demand (1000 MT)		
	2010	2020	ROG (%)	2010	2020	ROG (%)	2010	2020	ROG (%)	2010	2020	ROG (%)
Burundi	253	259	0.2	906	1,136	2.5	145	294	10.3	222	298	3.4
Cameroon	254	413	6.3	875	979	1.2	222	779	25.1	207	259	2.6
Ethiopia	316	403	2.8	981	1,799	8.3	310	726	13.4	180	232	2.9
Kenya	954	1,062	1.1	420	516	2.3	400	548	3.7	505	649	2.9
Malawi	261	335	2.8	423	554	3.1	127	185	4.6	133	175	3.2
Rwanda	435	516	1.9	727	957	3.2	316	494	5.6	300	396	3.2
Tanzania	815	1,086	3.3	688	851	2.4	561	924	6.5	501	666	3.3
Uganda	903	980	0.9	532	675	2.7	480	662	3.8	464	641	3.8
Total/avg.	4,190	5,053	2.4	694	933	3.2	2,561	4,611	9.1	2,511	3,318	3.2

Source: Calculated from Enid Katungi (pers. comm.)

Burundi would be net importer between 2010 and 2014, and then in 2020. Likewise, Malawi would be net importer between 2010 and 2015 but net exporter starting in 2016. Uganda would be net importer between 2011 and 2014 but would be net exporter starting in 2015. Overall, the eight countries combined are projected to be net exporters of common bean grain amounting to nearly 1.3 million MT by 2020. The overall average ROGs for production and demand are estimated at 9.1% and 3.2%, respectively (Table 2-6).

2.2.3 Trade

The world trade in common bean involves 186 countries and territories, with well over US$ 1.77 billion worth of imports and 155 countries and territories with US$ 1.64 billion export values; the corresponding volumes of imports and exports amount to more than 2.76 and 2.75 million MT, respectively (Annex Table 2-4). India is the world's largest importer of beans with the average value of nearly US$ 288 million and volume of more than 470,000 MT. This is about 16% and 17% of the world's total value and volume, respectively. Other major importers include the USA, Cuba, the UK, Japan, Italy, Mexico, Brazil, Pakistan, and South Africa. China, followed by Myanmar, the USA, and Canada, accounts for more than 28% of the world's common bean export volumes. Other major exporting countries include Argentina, the UK, Kyrgyzstan, Thailand, Australia, and Nicaragua (Annex Table 2-4).

Common bean trade in SSA involves over US$ 128 million in imports among 45 countries and nearly US$ 37 million in export among 34 countries. This region is a net importer of common bean. In other words, there is a huge gap to be filled in the area of common bean import substitute. The bulk of common bean trade in Africa is among African countries themselves. South Africa, Kenya, and Angola combined account for nearly 61% of all common bean imports here; other major importers are Zimbabwe, Sudan, Burundi, Zambia, Congo, Tanzania and Swaziland, accounting for approximately 20% of the total import volume among them (Table 2-7). The balance is covered by 35 other countries. Ethiopia, Uganda, and Tanzania account for about 39%, 23%, and 11%, respectively, of the total common bean export in SSA. Other major exporting countries are Djibouti, South Africa, Kenya, Niger, Madagascar, Cameroon and Malawi (Table 2-7).

Producer price for common bean in SSA suffered substantial fluctuations through the 1990s (Figure 2-5a). For example, in Ethiopia, it showed a steady decline throughout the 1990s and early 2000s; slight upward trends were observed starting in 2004 but the 2008 price (US$ 303 per MT) is still less than what it was in 1991 (US$ 372 per MT). Prices in Rwanda also have been falling sharply since the mid 1990s; the prices for Cameroon and Burundi also heavily fluctuated until the early 2000s but have shown steady increases since, with the 2008 prices of around US$ 900 per MT.

Table 2-7: Common bean trade in Sub-Saharan Africa and South Asia (2005-07 averages)

Import			Export		
Country	Volume (MT)	Value (US$ 1000)	Country	Volume (MT)	Value (US$ 1000)
Sub-Saharan Africa			Sub-Saharan Africa		
S. Africa	69,635	36,611	Ethiopia	32,014	16,080
Kenya	39,693	8,463	Uganda	18,727	5,586
Angola	36,746	25,527	Tanzania	9,130	4,687
Zimbabwe	12,859	13,287	Djibouti	4,007	1,508
Sudan	8,761	4,191	S. Africa	3,270	1,882
Burundi	8,750	4,300	Kenya	2,899	1,454
Zambia	6,998	1,900	Niger	2,672	859
Congo	6,567	3,654	Madagascar	2,091	1,233
Tanzania	5,184	2,117	Cameroon	1,792	684
Swaziland	4,036	2,800	Malawi	1,628	832
Others (35)	41,776	25,411	Others (24)	4,389	1,828
Total	**241,004**	**128,261**	**Total**	**82,620**	**36,634**
South Asia			South Asia		
India	470,266	287,751	Myanmar	510,677	268,310
Pakistan	77,312	34,111	Pakistan	17,221	7,328
Sri Lanka	12,807	6,528	India	6,268	4,419
Bangladesh	12,755	3,742	Nepal	169	50
Myanmar	44	32	Sri Lanka	140	77
Nepal	643	297	Bhutan	112	39
Bhutan	590	577	Bangladesh	1	1
Total	**574,417**	**333,038**	**Total**	**534,588**	**280,224**

Source: Calculated from FAOSTAT (2010)

The major drawback for producer price is the lack of grading and standards. Prices are usually set by buyers who collect all grades (including varietal mixtures and high levels of foreign material) and pay the same price for all. They do the cleaning and get premium prices. Farmers have no incentive to bring to the market purified grain as there is no premium for quality. In Ethiopia, for example, impurities of up to 20% in common bean grains are not uncommon. Impurities emanate from poor post-harvest handling of the crop at the farm level. Farmers use human labor or domestic animals to transport and thresh the harvest; the harvesting ground is not plastered and no canvas is used in most instances. The grain thus collects so much dust and dirt, and at times gets mixed up with animal waste like dung and urine.

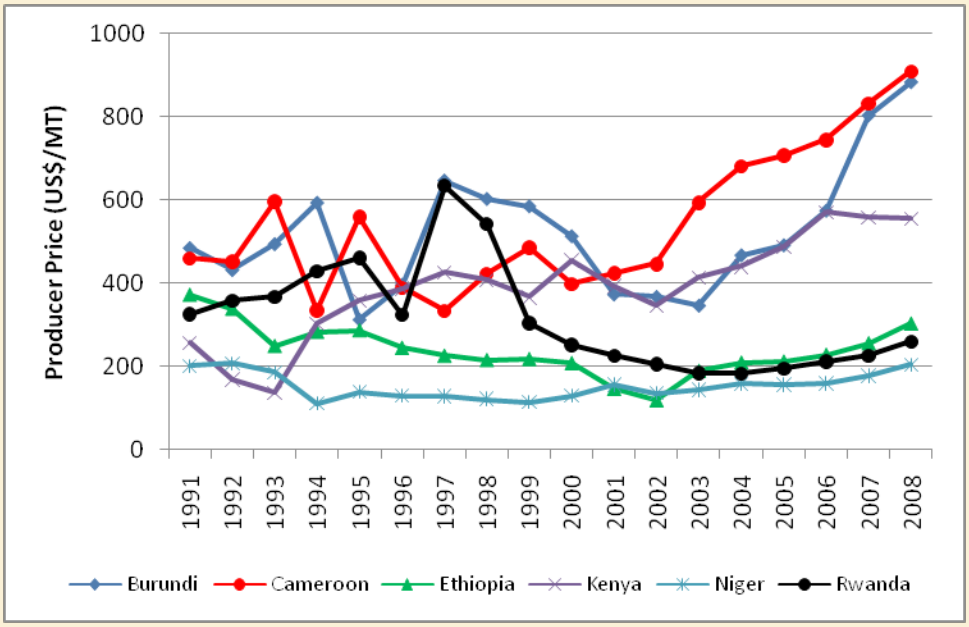

Fig. 2-5a: Producer prices of common bean in selected Sub-Saharan Africa (source: calculated from FAOSTAT, 2010)

The government of Ethiopia is introducing grades and standards for common bean. Collectors will be licensed and export is to be channeled through ECX (the Ethiopian Commodity Exchange); daily prices for the various grades will be announced through the media (mostly radio). This has worked successfully for coffee in the past and is expected to improve common bean marketing.

Beans trade in SA involves more than US$ 333 million in import and more than US$ 280 million in export each year (Table 2-7). SA is a net importing region for beans. India and Pakistan account for nearly 82% and 14%, respectively, of the total common bean import volumes, followed by Sri Lanka, Bangladesh, Myanmar, Nepal, and Bhutan (Table 2-7). With an annual volume of nearly 511,000 MT, Myanmar is the largest exporter of beans in SA, followed by Pakistan and India. Nepal, Sri Lanka, Bhutan and Bangladesh also export small amounts. Myanmar is a net exporter whereas all the other SA countries, including India, are net importers.

Producer prices here varied from country to country and fluctuated over the 18 years period (1991-2008) but were more stable than in the SSA region (Figure 2-5b). These were US$ 203, US$ 259, US$ 494, US$ 429, and US$ 632 per MT for Pakistan, Sri Lanka, Bangladesh, India and Nepal, respectively, in 2008 in comparison to US$ 294, US$ 199, US$ 374, US$ 263, and US4 247, respectively, for the same countries in 1991, as illustrated in Figure 2-5b below.

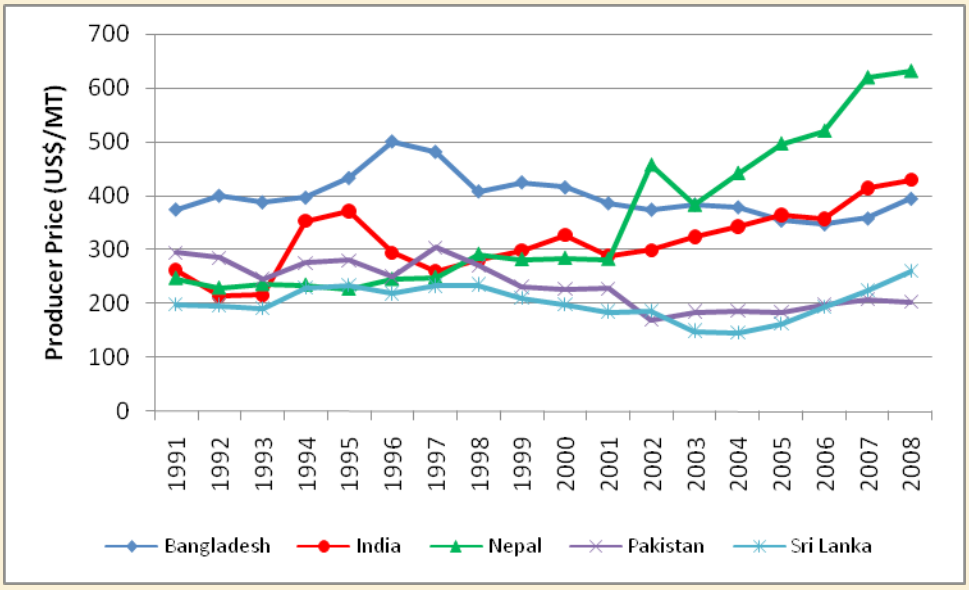

Fig. 2-5b: Producer prices of beans in South Asia (calculated from FAOSTAT, 2010)

2.3 Cowpea

2.3.1 Production trends

Cowpea is grown in 45 countries across the world. An estimated 14.5 million ha of land is planted to cowpea each year worldwide; total annual production is approximately 6.2 million MT (cf. Table 1-1). The current average yield is estimated at about 454 kg per ha. This is the lowest among the six tropical legumes; this crop is mainly grown under subsistence conditions where the environment is harsh because of frequent droughts and excessive heat, and the soils are marginal. World cowpea area, yield and production grew at an annual rate of 4.5%, 1.4% and 5.9%, respectively (Table 1-1). Figure 2-6 shows long-term trends for cowpea world production. It can be observed from the figure that generally, the gap between area and production has been widening, particularly since the late 1980s.

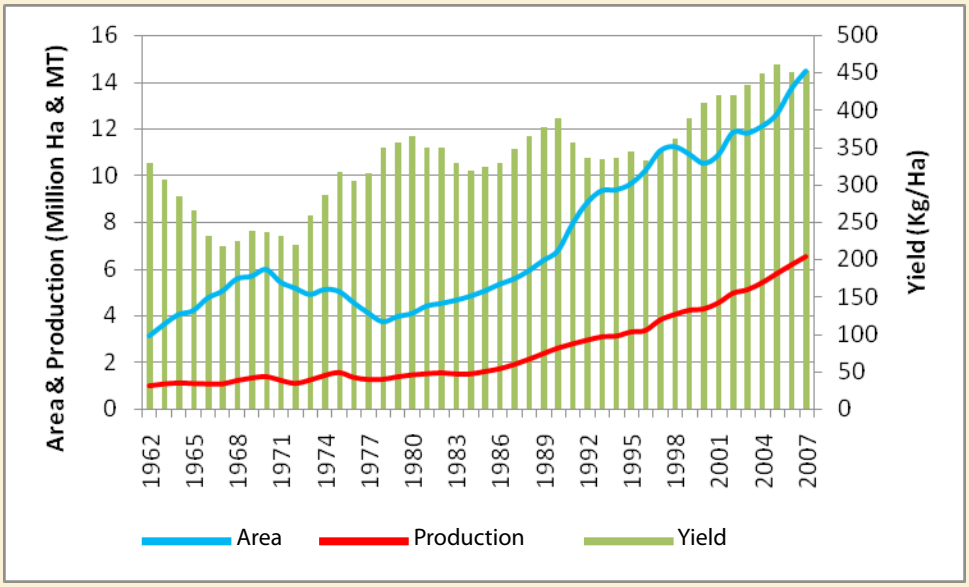

Figure 2-6: Cowpea world p trends (calculated from FAOSTAT 2010)

Cowpea is primarily an African crop. Nine of the top ten cowpea-producing countries are found in SSA (Annex Table 2-5). Approximately 38 million households (*ca* 194 million people) grow cowpea in this region (cf. Table 1-2). SSA accounts for about 84% and 83.4% of the world's area and production, respectively (cf. Table 1-3). Yields are comparable to the world average of 454 kg per ha. Cultivated area grew at a much faster pace than productivity, especially starting in the mid 1980s (Annex Figure 2-4a). The ROG for total area was 4.4% whereas the yield and production grew at the rate of 1.5% and 5.9%, respectively (Table 2-8). It can be observed from Annex Figure 2-4a that yields have shown little difference between the early 1970s and the current decade.

Nigeria and Niger each cultivate well over 4 million ha and account for more than 45% and nearly 15%, respectively, of the total world production. Burkina Faso stands a distant third, with 6.1% of the world's total production (Table 2-8). Other important producers in SSA include Cameroon, Ghana, Benin, Mali, Uganda, Kenya, Senegal, Tanzania, and DRC. Malawi, Sudan, Mauritania, South Africa, Madagascar, Swaziland, Guinea-Bissau and Zimbabwe also grow cowpea.

The average area under cowpea in the SSA region is estimated at a little more than 0.27 ha per rural household. More than 38 million households (194 million people) grow cowpea each year in the SSA region (cf. Table 1-2).

Table 2-8: Cowpea trends in Sub-Saharan Africa and South Asia

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
Sub-Saharan Africa									
Nigeria	1,435	4,346	10.1	451	664	2.4	647	2,885	17.3
Niger	1,649	4,132	7.5	123	183	2.5	202	764	13.9
Burkina Faso	435	804	4.2	400	470	0.9	174	378	5.9
Cameroon	24	206	38.9	673	1,201	3.9	16	247	72.6
Ghana	159	156	-0.1	101	904	39.6	16	143	39.8
Benin	84	118	2.0	512	844	3.2	43	98	6.5
Mali	160	261	3.2	173	288	3.3	27	75	8.8
Uganda	45	71	2.9	819	1,014	1.2	37	72	4.8
Kenya*	NA	122	-	NA	560	-	NA	69	-
Senegal	103	195	4.4	471	349	-1.3	50	69	1.9
Others (12)	534	1,029	4.6	444	589	1.8	215	345	3.0
Total	4,629	11,440	4.4	333	454	1.5	1,427	5,145	5.9
South Asia									
Myanmar	24	148	12.0	492	966	3.9	12	143	15.9
Sri Lanka	26	11	-5.0	821	985	1.0	21	11	-4.0
Total	**50**	**159**	**7.0**	**655**	**976**	**2.1**	**33**	**154**	**9.2**

*Base data for Kenya start from 1989
Source: Calculated from FAOSTAT (2010) and other sources, including national statistics.

The total area planted to cowpea in SA is about 159,000 ha, with annual production of 154,000 MT (Table 2-8). Myanmar and Sri Lanka are the only two countries that produce significant amounts of cowpea in the SA region. Cowpea area and production in Sri Lanka have declined at the rate of approximately 5% and 4.4%, respectively. By contrast, Myanmar has registered annual growth rates of more than 12% in area and nearly 15.9% in production over the 20 years between 1985-87 and 2005-07. The ROG for yield in this country for the same period was 3.9% while Sri Lanka registered only 1% ROG (Table 2-8). The total area and production of cowpea in Myanmar are not very large but the growth patterns (especially starting in the early 1990s) show an ideal situation whereby increases in production are obtained more from the increases in productivity rather than area expansion, as shown in Annex Figure 2-4b. Cowpea yields in this country showed consistent and significant increases starting in the early 1990s. The current average yield for Myanmar is over 966 kg per ha.

2.3.2 Projections

Cowpea production in SSA is projected to grow at nearly 3% per annum – that is, from 6 million MT in 2010 to 8 million MT in 2020 (Table 2-9). Nigeria, Niger, Cameroon, Burkina Faso, Ghana, Mali, and Senegal are predicted to continue to dominate cowpea production in SSA. High ROGs of 5.9%, 4.5%, and 4.2% were projected for Mali, Senegal, and Niger, respectively, for cowpea production; other countries with relatively high ROGs include Ghana (3%) and Cameroon (2.7%).

Table 2-9: Projected production and demand for cowpea in Sub-Saharan Africa

Country	Production (1000 MT)			National Demand (1000 MT)		
	2010	2015	2020	2010	2015	2020
Nigeria	3,051	3,367	3,654	4,922	5,618	6,411
Niger	1,489	2,057	2,570	25	29	35
Cameroon	297	358	413	31	35	39
Ghana	201	249	293	236	272	313
Senegal	142	203	258	21	24	28
Mali	142	189	253	21	24	27
Burkina Faso	279	241	206	26	31	38
Benin	102	109	116	40	47	55
Uganda	84	95	105	86	108	136
Mozambique	62	63	64	73	88	106
Malawi	55	56	57	60	69	80
Congo DR	55	56	57	58	63	68
Kenya	50	44	40	79	90	102
Tanzania	46	36	28	63	76	91
Mauritania	8	8	8	5	6	7
S. Africa	7	7	7	7	7	8
Madagascar	4	4	4	4	5	5
Others	182	255	343	146	136	198
Total	**6,194**	**7,336**	**8,410**	**5,830**	**6,639**	**7,639**
ROG (%)		5.0			5.0	

Source: IITA database

Both the overall demand and supply for cowpea grain in SSA are projected to grow at about 5% per year. High ROGs in demand are predicted for Uganda (4.4%), Mozambique (3.6%), Burkina Faso (3.5%), Tanzania (3.4%), Niger (3.4%), and Benin (3.1%). Both demand and supply are projected to decline in South Africa and Kenya.

2.3.3 Trade

Information on cowpea trade is very scanty. The FAOSTAT indicates that Niger was the major exporting country between the mid 1970s and early 1990s. This country's export increased from less than 5,000 MT in 1970-72 to nearly 25,000 MT in 1980-82 and well over 34,000 MT in 1990-92, but has dwindled since (Figure 2-7). Similarly, Myanmar exported an average of 75 MT in 1970-72 and nearly 17,000 MT in 1991 alone but there have been no records of export since. There was at least 10,000 MT of cowpea world export for the most part of the mid 1970s and early 1990s but this has almost vanished since the mid 1990s.

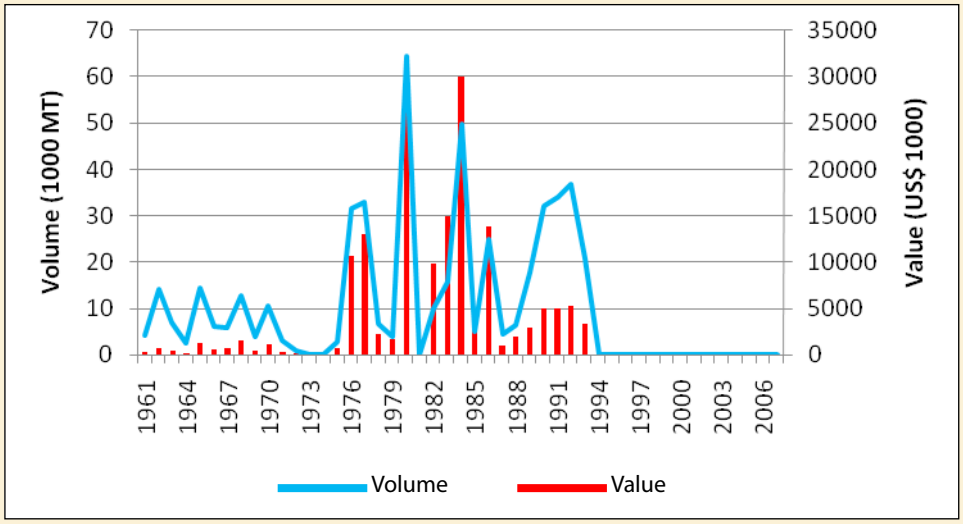

Figure 2-7: Cowpea export in Niger (calculated from FAOSTAT, 2010)

The paucity of information on cowpea trade may be due to (at least partly) the fact that transactions are effected among neighboring countries in Western and Central Africa. Perhaps there is little overseas trade of cowpea as such. Most of the trade takes place within the WCA region.

Producer prices were variable from country to country (Figure 2-8). The highest fluctuations were observed in Nigeria, and to some extent, Malawi. For example, the price fell from US$ 2065 per MT in 1996 to US$ 451 per MT in 2000; it was US$ 697 per MT in 2008. In Malawi the price increased sharply in 1996 (US$ 783 per MT) but fell dramatically in 1999 (US$ 151 per MT). It remained somewhat stable

around US$ 500 per MT from 2001 to 2006 and was US$ 637 per MT in 2008. The prices for Burkina Faso, Mali and Niger were relatively stable throughout the 18 years between 1991 and 2008. Least producer prices were received in Niger.

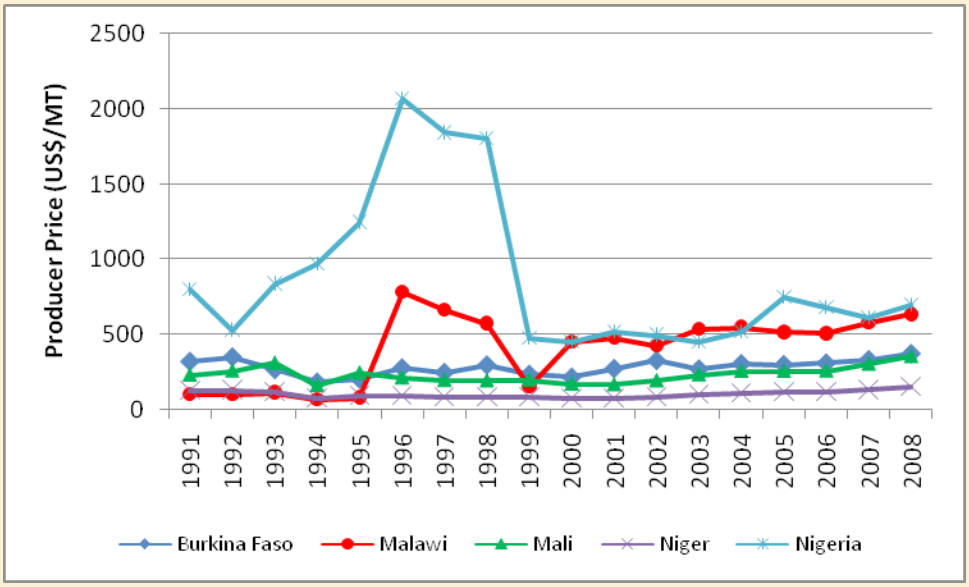

Figure 2-8: Producer prices of cowpea in selected Sub-Saharan Africa countries (source: calculated from FAOSTAT, 2010)

2.4 Groundnut

2.4.1 Production trends

Groundnut is one of the most widely grown tropical legumes in the world. The 2005-07 averages of FAOSTAT show that this crop is grown in 118 countries and occupies more than 22.6 million ha of land (cf. Table 1-1). The average annual production is estimated at about 36.4 million MT, with the average yield of about 1610 kg per ha. Figure 2-9 depicts the long-term world groundnut production trends. It can be seen that production has increased at a steady pace because of accompanying growth in yield, whereas the area expanded at a slower rate and somewhat has been leveling off since the early 1990s. For example, the 20-year average ROGs for area, yield, and production were about 1%, 1%, and 2.9%, respectively (cf. Table 1-1). Production started to outstrip the area in the early 1980s and the gap between production and area has been widening since, in favor of the former (Figure 2-9).

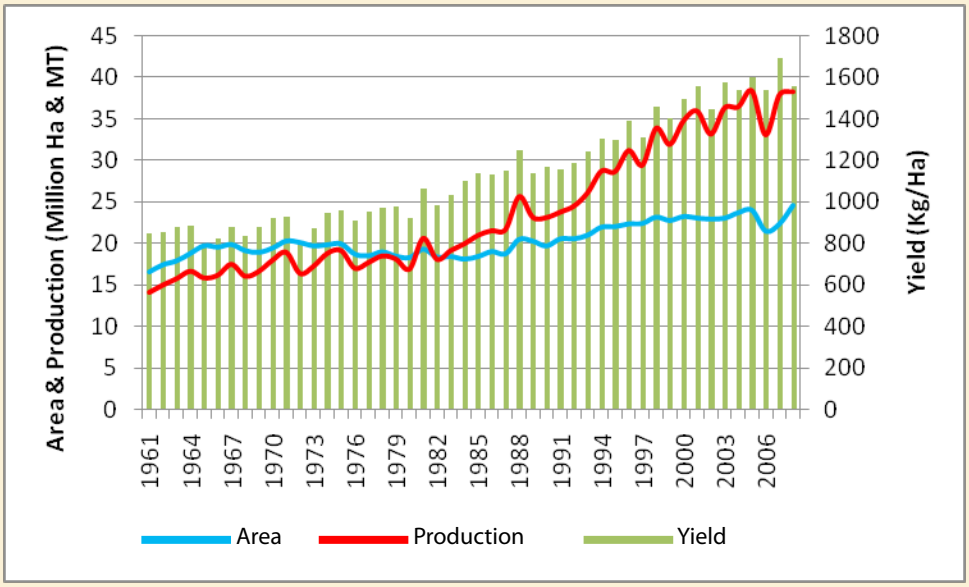

Figure 2-9:Groundnut world trends (calculated from FAOSTAT, 2010)

India occupies the largest area (well over 6 million ha) but China is the largest producer in the world because of better productivity – i.e. 3196 kg per ha as opposed to 1160 kg per ha for India (Annex Table 2-6). Other major world producers averaging more than 1 million MT include Nigeria, the USA, and Indonesia. Myanmar, Sudan, Senegal, Viet Nam, and Argentina are among the top ten producers of groundnut in the world.

The area planted to groundnut declined in five of the top 20 producing countries, including India, USA, Senegal, DRC, and Brazil whereas Egypt, Tanzania, Ghana, Nigeria, and Chad registered increases ranging from 10.4% to 6.6%. Myanmar, followed by Chad, Guinea and Argentina showed the highest rate of growth in yield; by contrast 10 of the top 20 producing countries registered negative or no growth in yield (Annex Table 2-6).

This crop is grown by 44 of the 48 SSA countries. This region occupies about 40% and nearly 25% of the world groundnut area and production, respectively (cf. Table 1-3). The average area under groundnut in Africa is estimated at about 0.4 ha per rural household, the highest among all TL II crops. More than 118 million households (nearly 87 million people) grow this crop in the SSA region.

With more than 2.2 million ha and 3.7 million MT of production, Nigeria accounts for more than 24% and nearly 42% of the total area and production, respectively, in SSA (Table 2-10). This is followed by Sudan, Senegal, Ghana,

Chad, DRC, Tanzania, Guinea, Mali, and Burkina Faso. The overall average yield for SSA is 1007 kg per ha. The area planted to groundnut has increased in all but four countries (DRC, Cameroon, Mozambique and Senegal); Sierra Leone, Tanzania, Niger, Ghana, Nigeria and Chad registered increases ranging from 9.8% to 6.6%. Thirteen of the top 20 countries showed increases in yield, with Cameroon and Guinea registering 5.6% and 4.8%, respectively. Niger, Tanzania, Sierra Leone, Nigeria and Guinea registered the highest growth rates of production ranging from 9.7% to 8.3% (Table 2-10). The average ROGs for area, yield and production, were 3%, 1.3%, and 4.3%, respectively (Table 2-10). See Annex Figures 2-5 to 2-7 for further details.

South Asia accounts for roughly 31% and 23% of the world's cultivated area and production, respectively, of groundnut (Table 1-3). The average area under groundnut in the SA region is estimated at about 1.03 ha per rural household (estimate for India only). The total number of households growing groundnut in this region is estimated at about 6.7 million (close to 27 million people).

The crop here is grown in India, Myanmar, Pakistan, Bangladesh, and Sri Lanka (Table 2-10). The total area is estimated at more than 7 million ha and total production is nearly 8.5 million MT. Production and productivity in SA have not changed very much over the 20-year period. For example, the average ROGs for the area, yield, and production were -1.1%, 1%, and 0.2%, respectively (Table 2-10). The current yields are lower than they were in the mid 1960s.

India accounts for more than 83% of the area and nearly 87% of production in this region. Groundnut area for India declined at the rate of 1.3% per year but productivity increased at 1.2% (Table 2-10). Annex Figure 2-5b presents production trends in the SA region. It can be seen from the figure that the region's production and productivity are characterized by heavy fluctuations from year to year perhaps because of fluctuations in the monsoon rain. The highest rate of growth in production (3.3%) was recorded in Myanmar.

2.4.2 Projections

Groundnut production in SSA is projected to grow at about 2.5% per annum whereas the national demand would expand by about 1.9% each year (Table 2-11). In other words, the overall production for SSA would jump to nearly 13 million MT in 2020 from about 10.4 million MT in 2010. Nigeria, Sudan, and Senegal are projected to continue to be the most important countries for groundnut production in the SSA region. Similarly, the demand is estimated at nearly 12 million MT in 2020 from about 10 million MT in 2010. High ROGs in demand are expected for Uganda, DRC, Niger, Mali, and Burkina Faso (Shiferaw et al 2008b).

Table 2-10: Groundnut trends in Sub-Saharan Africa and South Asia

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG	1985-87	2005-07	ROG	1985-87	2005-07	ROG
Sub-Saharan Africa									
Nigeria	661	2,214	6.6	1,109	1,677	1.7	735	3,713	8.4
Sudan	551	718	4.4	666	806	1.0	366	546	5.5
Senegal	753	658	-0.8	1,059	744	-1.4	802	498	-2.3
Ghana	144	467	6.8	1,202	984	-0.7	173	460	6.1
Chad	147	437	6.6	702	837	0.9	103	374	7.6
DRC	539	474	-1.3	757	778	0.0	408	369	-1.4
Tanzania	99	411	7.5	600	716	1.2	59	295	8.8
Guinea	123	207	3.3	554	1,408	4.8	68	292	8.3
Mali	103	308	4.2	967	951	-0.5	98	290	3.7
Burkina Faso	190	333	3.3	685	696	0.6	130	227	4.0
Malawi	174	250	3.9	865	804	0.5	149	202	4.4
Cameroon	322	305	-0.9	302	608	5.6	97	186	4.7
Uganda	154	230	1.7	723	693	-0.6	111	159	1.1
CAR	88	128	2.3	973	1,167	0.9	86	150	3.2
Niger	132	338	7.4	408	435	2.2	52	146	9.7
Benin	89	124	2.5	672	958	1.6	60	118	4.1
Sierra Leone	21	146	9.8	994	766	-1.2	20	112	8.5
Gambia	78	111	2.2	1,310	892	-1.5	102	98	0.7
Mozambique	327	294	-0.8	312	319	0.6	102	94	-0.2
Zimbabwe	148	217	1.9	478	405	-0.4	69	89	1.6
Others (24)	667	686	0.1	783	871	0.6	487	525	0.4
Total/avg.	5,507	9,057	3.0	782	1,007	1.3	4,277	8,942	4.3
South Asia									
India	6,984	6,214	-1.3	805	1,171	1.2	5,617	7,346	-0.1
Myanmar	564	688	1.1	1,046	1,434	2.2	590	985	3.3
Pakistan	61	94	1.9	1,042	802	-1.1	63	75	0.8
Bangladesh	29	31	-1.0	1,153	1,334	0.7	34	41	-0.2
Sri Lanka	9	11	0.6	606	871	1.6	6	10	2.2
Total	7,647	7,038	-1.1	930	1,122	1.0	6,310	8,457	0.2

Source: Calculated from FAOSTAT (2010)

Table 2-11: Production and national demand projections for groundnut in Sub-Saharan Africa and South Asia

Country	Production			National Demand		
	2010	2015	2020	2010	2015	2020
Sub-Saharan Africa						
Nigeria	3,275	3,563	3,784	3,335	3,497	3,726
Senegal	1,330	1,537	1,771	1,054	1,167	1,297
Sudan	1,243	1,394	1,533	1,235	1,336	1,454
DRC	508	589	681	488	558	644
Chad	491	550	605	573	642	734
Ghana	293	339	392	267	293	323
Burkina Faso	314	352	387	307	345	392
Guinea	276	320	370	254	286	323
Cameroon	257	298	345	216	235	256
Mali	242	271	298	252	282	322
Others (31)	2,158	2,466	2,798	2,012	2,179	2,392
Sub-total	**10,387**	**11,678**	**12,963**	**9,994**	**10,821**	**11,862**
ROG (%)	2.5	1.9				
South Asia						
India	7,397	8,104	8,792	7,914	8,835	9,724
Myanmar	719	791	870	789	919	1,041
Pakistan	109	117	125	131	157	185
Bangladesh	39	43	46	46	53	61
Sri Lanka	0	0	0	14	14	15
Nepal	7	8	8	Negligible	1	1
Sub-total	**8,272**	**9,063**	**9,842**	**8,894**	**9,979**	**11,027**
ROG (%)	1.9			2.4		
Grand total	**18,659**	**20,741**	**22,805**	**18,888**	**20,800**	**22,889**

Source: Calculated from Shiferaw et al (2008b)

Production and demand in SA are estimated to grow at about 1.9% and 2.4%, respectively. India, distantly followed by Myanmar, dominates groundnut production in SA. The higher ROG for demand in this region suggests a possibility for export opportunities from the SSA region (Table 2-11).

2.4.3 Trade

The world groundnut trade involves more than US$ 1 billion, with volumes estimated between 1.3 and 1.7 million MT, according to the FAOSTAT 2005-07 averages (Annex Table 2-7). There are 180 countries worldwide that import groundnut and 158 that export it. The Netherlands accounts for more than 16% of the world's groundnut import; Indonesia, Mexico, the UK, Russian Federation, Germany, Canada, the Philippines, Spain, and Algeria are also among the top-ten importing countries in the world. On the other hand, China accounts for about 27% of the world's total groundnut export; other top-ten exporting countries include India, USA, Argentina, Nicaragua, Brazil, Viet Nam, the Gambia, Uzbekistan, and Egypt.

Table 2-12: Groundnut trade in Sub-Saharan Africa and South Asia (2005-07 averages)

Import			Export		
Country	Volume (MT)	Value (US$ 1000)	Country	Volume (MT)	Value (US$ 1000)
Sub-Saharan Africa			Sub-Saharan Africa		
S. Africa	14,159	8,672	Gambia	17,811	5,692
Gambia	8,000	0	S. Africa	14,045	13,115
Kenya	7,883	93	Malawi	9,073	4,295
Nigeria	4,887	3,346	Tanzania	5,969	2,241
Swaziland	3,341	3,371	Mali	5,199	2,366
Mali	3,090	455	Mozambique	4,546	1,671
Tanzania	2,872	697	Ghana	3,701	2,004
Mozambique	2,437	1,243	Swaziland	2,586	778
Sudan	2,037	1,402	Sudan	1,298	888
Mauritius	1,518	1,307	Rwanda	1,115	781
Others (33)	5,862	6,217	Others (29)	4,637	2,136
Total	**101,143**	**53,764**	**Total**	**76,332**	**42,085**
South Asia			South Asia		
Pakistan	6,702	3,183	India	237,023	182,741
Sri Lanka	3,460	935	Myanmar	1,840	307
Nepal	1,317	797	Pakistan	1,499	695
Bangladesh	206	152	Nepal	Negligible	2
Bhutan	23	15	Sri Lanka	Negligible	1
India	20	16	**Total**	**240,362**	**183,745**
Myanmar	18	9			
Total	**11,745**	**5,107**			

Source: Calculated from FAOSTAT (2010)

SSA is net importer of groundnut. Annual imports here include more than 101,000 MT worth close to US$ 54 million (Table 2-12). There are 43 countries that import groundnut in SSA. South Africa is the largest importer of groundnuts (14%) in SSA, followed by the Gambia, Kenya, Nigeria, Swaziland, Mali, Tanzania, Mozambique, Sudan, and Mauritius. SSA's export trade includes more than 76,000 MT of groundnut worth more than US$ 42 million (Table 2-12).

At present, the SSA region is a net importer of groundnut. The export suffered severe declines over the years. For example, the average export was nearly 1.3 million MT in 1965-67, compared to 70 thousand MT in 2005-07 (Figure 2-10a). The average value fell from US$ 218 million to US$ 38 million during the same period. This meant a total loss of US$ 424 million over the 40 years period.

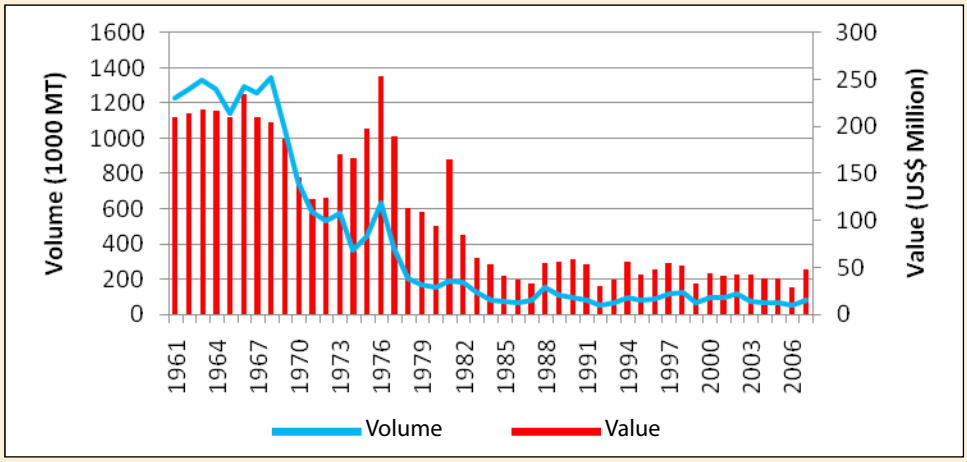

Figure 2-10a: Groundnut export trends in Sub-Saharan Africa (calculated from FAOSTAT, 2010)

The SSA region is projected to be net exporter of nearly 957,000 MT of groundnuts by 2020, with Senegal accounting for nearly 35% of the total (Table 2-13), followed by South Africa, Sudan, Cameroon, Ghana, Gambia, Mali, Niger, Burkina Faso, Chad and 31 other countries (Table 2-13). By contrast, Chad, Burkina Faso, Niger, and Mali are predicted to be major importers by 2015 and 2020.

Table 2-13: Net-trade projections (1000 MT) for groundnut in Sub-Saharan Africa and South Asia

Country	2010	2015	2020
Sub-Saharan Africa			
Senegal	132	225	330
South Africa	46	63	82
Sudan	8	57	79
Cameroon	26	48	74
Ghana	25	46	69
Gambia	34	47	62
Others (31)	57	319	427
Mali	-10	-12	-24
Niger	-11	-14	-25
Burkina Faso	-14	-13	-25
Chad	-44	-53	-91
Sub-total	250	713	957
South Asia			
India	-284	-498	-700
Myanmar	-70	-128	-170
Pakistan	-22	-40	-61
Bangladesh	-6	-10	-14
Sri Lanka	-6	-6	-6
Nepal	Negligible	-1	-1
Bhutan	Negligible	Negligible	Negligible
Sub-total	-388	-683	-952

Source: Calculated from Shiferaw et al (2008b)

The SA region is a net exporter of groundnut. Average annual exports amount to more than 240,000 MT valued at nearly US$ 184 million (Table 2-12). Groundnut export in this region fluctuated frequently but showed steady growth in recent years (Figure 2-10b). By contrast, average annual imports stand at less than 12,000 MT with a value of just over US$ 5 million. India accounts for nearly 97% of all exports in the region. Pakistan, Sri Lanka and Nepal are the major importers.

All countries in the SA region are predicted to be net importers of groundnut from 2010 to 2020. The estimated total imports for 2010, 2015 and 2020 are approximately 388,000 MT, 682,000 MT, and 951,000 MT, respectively. India, Pakistan, Myanmar, and Bangladesh are expected to be the major importing countries (Table 2-13).

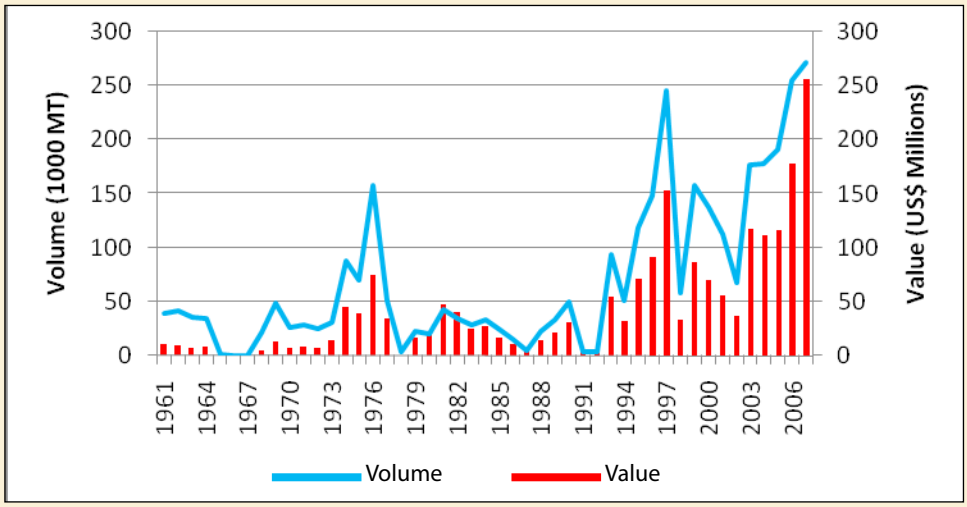

Figure 2-10b: Groundnut export trends in South Asia (calculated from FAOSTAT, 2010)

Producer prices suffered sharp fluctuations and declines in some countries between mid and late 1990s. Particularly affected were Nigeria, Ghana and Mali. Prices for Ghana showed upward trends since the early 2000s but those for other countries are still low compared to the mid 1990s (Figure 2-11a). Prices in SA also varied from country to country but fluctuations were less severe than in SSA (Figure 2-11b).

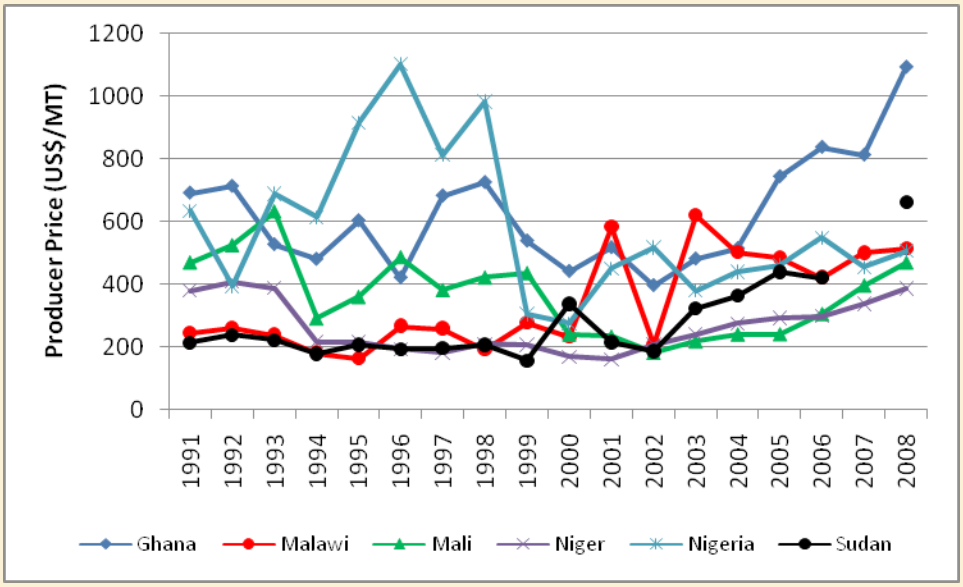

Figure 2-11a: Producer prices of groundnuts in selected Sub-Saharan African countries (source: calculated from FAOSTAT, 2010)

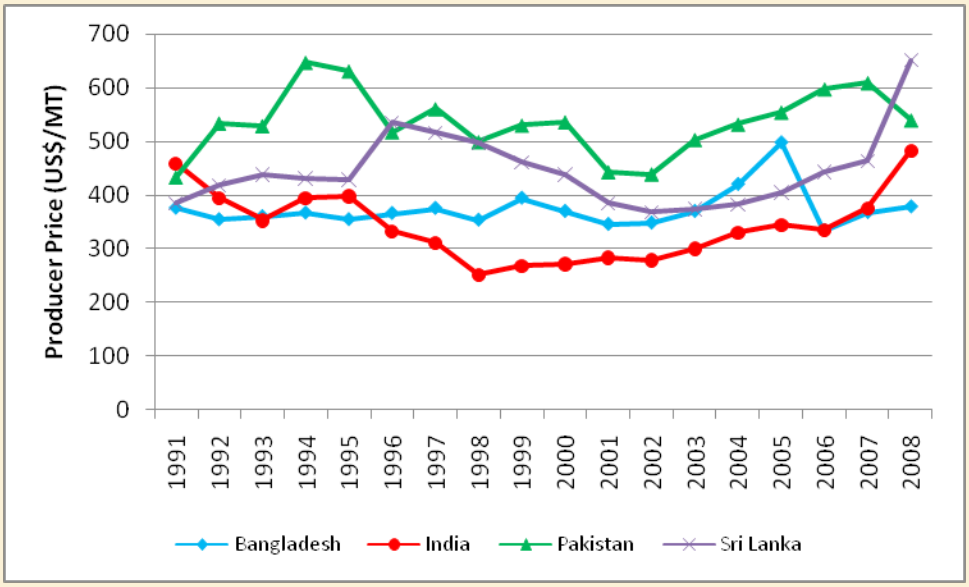

Figure 2-11b: Producer prices of groundnuts in South Asia (calculated from FAOSTAT, 2010)

2.5 Pigeonpea

2.5.1 Production trends

Pigeonpea is the least widely grown crop among the six major tropical legumes. Some 22 countries, mainly across SSA, SA, and the Caribbean grow this crop. The annual world area is nearly 4.7 million ha, with a production total of nearly 3.5 million MT. The world average yield is estimated at 885 kg per ha (cf. Table 1-1). Area, yield and production have declined in many of the countries, particularly in South America and the Caribbean (Annex Table 2-8). Myanmar registered the highest rates of growth in area and production of 12.7% and 15.4%, respectively. Overall, the world area, yield and production grew by 1.1%, 0.5%, and 1.1%, respectively.

India and Myanmar account for about 72% and 16% of the world production, respectively. Malawi, Kenya, Uganda, Tanzania, Dominican Republic, Nepal, DRC, and Haiti are among the top-ten pigeonpea producing countries in the world. Figure 2-12 depicts long-term world production trends for pigeonpea.

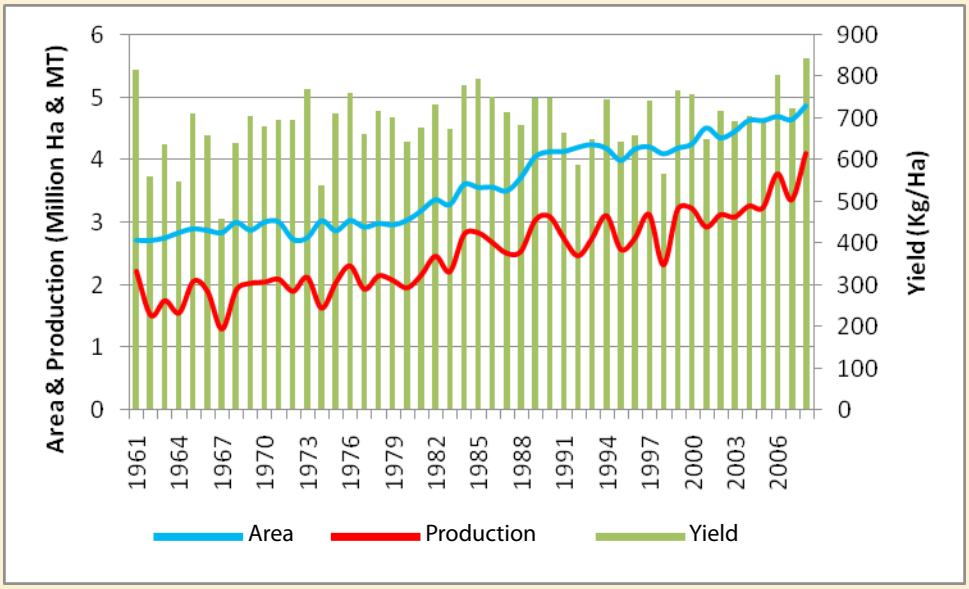

Figure 2-12: Pigeonpea world trends (calculated from FAOSTAT 2010)

The SSA region accounts for approximately 11% of the world total area and production. The average farm size for pigeonpea in the SSA region is estimated at 0.12 ha per rural household. Well over 1.6 million rural households (about 7.8 million people) produce pigeonpea in this region. The area planted to pigeonpea in SSA is estimated at 499,000 ha with a production estimate of 363,000 MT; the average yield is estimated at about 729 kg per ha (Table 2-14). Malawi, Kenya, Uganda, Tanzania, DRC, Burundi, and the Comoros are pigeonpea-producing countries in SSA. Production showed a steady increase in ROG beginning from the mid 1980s but this has been brought about by expansion in the area rather than increases in productivity (Annex Figure 2-8a). The average ROG for the area, yield and production is 3.1%, 0.5% and 4.3%, respectively. Uganda has shown the highest growth rate in yield of 5.3% per year, with the area and production growing at 1.8% and 3.4%, respectively (Table 2-14).

Table 2-14: Pigeonpea trends in Sub-Saharan Africa and South Asia

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 Ha)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
Sub-Saharan Africa									
Malawi	114	156	1.9	638	756	0.9	73	118	2.9
Kenya	NA	177	1.2	NA	572	2.3	NA	101	3.6
Uganda	62	86	1.8	456	1,015	3.4	28	87	5.3
Tanzania	64	68	0.6	628	724	0.7	40	49	1.3
DRC	7	10	2.3	615	582	-0.2	4	6	2.1
Burundi	2	2	-0.9	1,072	900	-1.0	2	2	-1.9
Comoros	0	0	1.0	0	727	0.6	0	0	1.6
Total/avg.	249	499	3.1	593	729	0.5	148	363	4.3
South-Asia									
India	3,162	3,554	0.3	769	694	-0.5	2,433	2,466	-0.2
Myanmar	70	542	12.7	654	1,075	2.4	45	582	15.4
Nepal	16	20	1.7	753	920	1.7	12	19	3.5
Bangladesh	6	2	-4.7	744	673	-0.6	5	1	-5.3
Pakistan	1	0	-	-	-	-	0	0	NA
Total/avg.	3,255	4,118	1.0	710	672	-0.1	2,495	3,068	0.9

Source: Calculated from FAOSTAT (2010)

The SA region contributes more than 4.1 million ha (89%) and 3 million MT (89%) of pigeonpea production in the world (cf. Table 1-3). The average area under pigeonpea in the SA region (only India) is about 0.8 ha per rural household. The number of households producing this crop in India is more than 5 million (more than 30 million people). The crop is grown in India, Myanmar, Nepal, Bangladesh and Pakistan (Table 2-14). The production parameters for the region showed little change over the 20 years period (Annex Figure 2-8b). For example, the average ROG for area, yield and production was 1%, -0.1%, and 0.9%, respectively (Table 2-14). All the parameters declined for Bangladesh while India registered a 0.3% increase in area and declines of 0.5% in yield and 0.2% in production. By contrast, Myanmar has achieved spectacular growth rates over the years (Annex Figure 2-8c). The ROG for the cultivated area, yield, and production for this country was 12.7%, 2.4%, and 15.4%, respectively (Table 2-14). Yields here have been above the 1 MT per ha mark since 2006.

2.5.2 Projections

Pigeonpea production in the SSA region is predicted to register an average ROG of 6.1% (from 482,000 MT in 2010 to 841,000 MT in 2020) whereas the national demand is expected to grow at 2.7% per annum, as presented in Table 2-15. Countries with high ROGs for production include Kenya, Tanzania and Uganda with 6.3% each, followed by Burundi (6%), and Malawi (5.5%).

Table 2-15: Production and national demand projections (1000 MT) for pigeonpea in Sub-Saharan Africa and South Asia

Country	Production (1000 MT)			National Demand (1000 MT)		
	2010	2015	2020	2010	2015	2020
Sub-Saharan Africa						
Uganda	145	196	253	105	124	151
Malawi	128	171	225	97	108	124
Tanzania	88	119	154	60	66	74
Burundi	3	5	6	3	3	3
Kenya*	117	157	203	-	-	-
Sub-total	**482**	**648**	**841**	**264**	**301**	**352**
ROG (%)	7.5			3.3		
South Asia						
India	3,250	3,650	4,015	3,484	4,067	4,651
Myanmar	329	420	532	185	233	282
Nepal	23	24	25	17	21	25
Bangladesh	3	3	4	4	5	6
Bhutan	0	0	0	2	2	2
Sub-total	**3,605**	**4,098**	**4,576**	**3,692**	**4,328**	**4,966**
ROG (%)	2.7			3.5		
Grand total	4,087	4,745	5,417	3,956	4,629	5,318

*Demand data not available

Source: Calculated from Shiferaw et al (2008b)

The ROGs for the SA region are estimated at 2.6% and 3.2% for production and national demand, respectively. India, with Myanmar as a very distant second, is forecast to continue to dominate pigeonpea production and demand (Table 2-15). The higher rate of demand compared to production of pigeonpea in SA suggests a possibility for the ESA countries to export to this region, particularly India and Pakistan.

2.5.3 Trade

Available data on pigeonpea trade indicate that there have been declines over the years. Overall imports dropped from nearly 4600 MT in 1985-87 to just over 2100 MT in 2005-07, an average decline of nearly 2.7% per annum. Annual import values are estimated at a mere less than US$ 1.6 million. According to the latest figures, Mauritius accounts for 99.7% of all pigeonpea imports. India, Venezuela, Nepal, Trinidad and Tobago, Barbados, Grenada, and Jamaica are important historically, but their shares have shown significant drops over the last two decades.

Pigeonpea world exports dropped from over 29,000 MT in the mid 1980s to a mere 330 MT in 2005-07 (Fig 2-13a), an average decline of greater than 4.9% per year (a total decline of nearly 99%). Myanmar, Malawi, and Dominican Republic combined account for more than 98% of the world's pigeonpea exports. Historically, Malawi used to be the largest exporter of pigeonpea in the world; its share has fluctuated over the years, hitting its lowest ebb in recent years (Fig 2-13b). India and Nepal also used to be important exporters of pigeonpea through the mid 1980s.

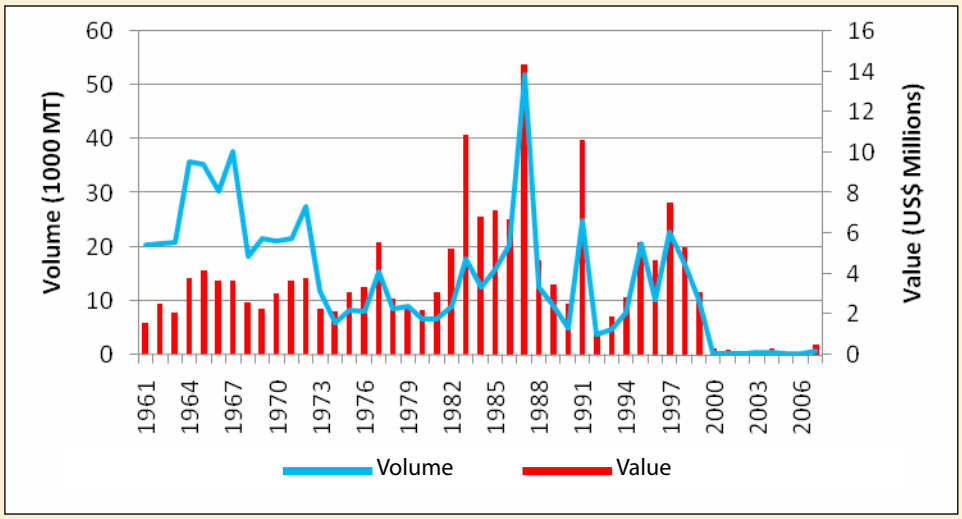

Figure 2-13a: Pigeonpea world export (calculated from FAOSTAT 2010)

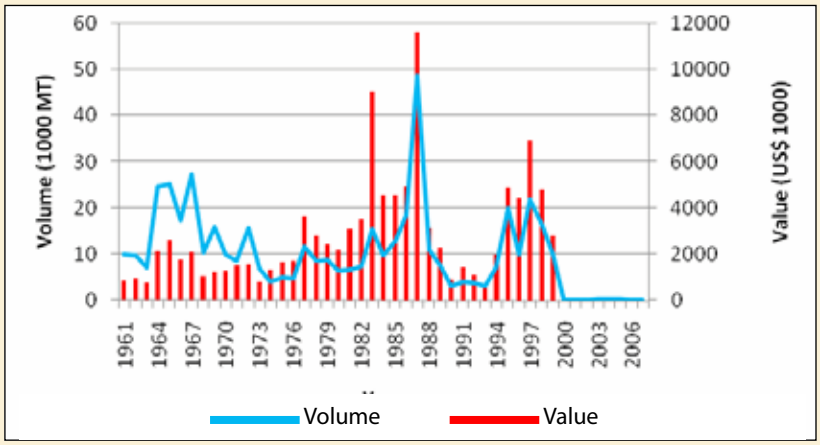

Figure 2-13b: Pigeonpea export in Malawi (calculated from FAOSTAT 2010)

Producer prices for pigeonpea in the SSA region are available from FAOSTAT only for Burundi, Kenya, and Malawi. Producing countries experience violent fluctuations in producer prices (Figure 2-14a). For example, in Malawi, the price jumped from US$ 65 per MT in 1995 to US$ 727 per MT in 1996. The price for Burundi fluctuated from US$ 2136 per MT in 1991 to US$ 1284 per MT in 2003 and US$ 2460 in 2008. Prices for Kenya have not fluctuated very much over the 1991-2008 period, with the most recent prices hovering around US$ 500 per MT (Figure 2-14a).

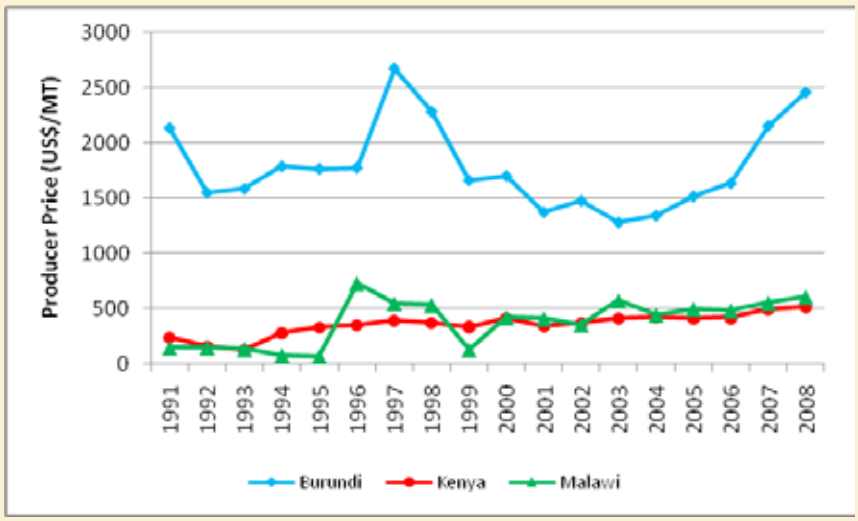

Figure 2-14a: Producer prices of pigeonpea in selected Sub-Saharan African countries (source: calculated from FAOSTAT, 2010)

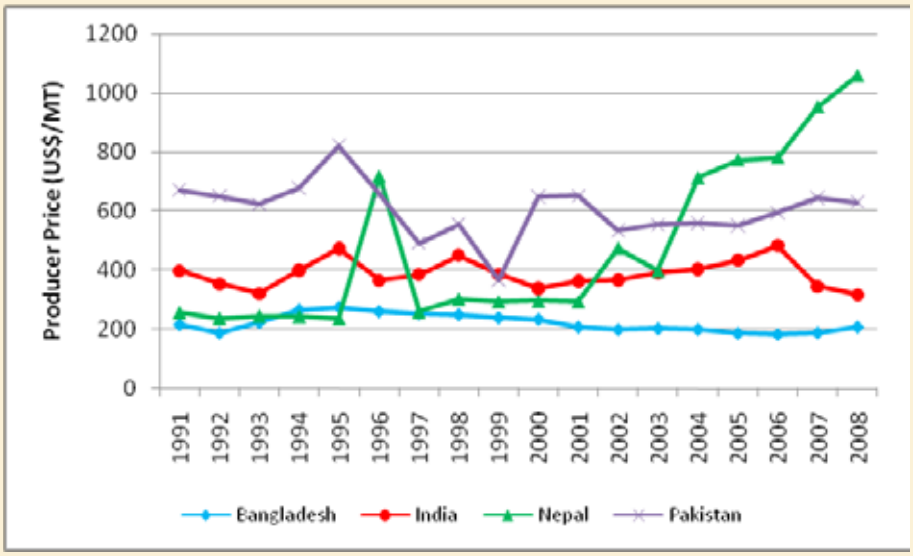

Figure 2-14b: Producer prices of pigeonpea in South Asia (source: calculated from FAOSTAT, 2010)

The SSA region is projected to continue to be net exporter of pigeonpea through the next 20 years (Table 2-16). The major exporters are expected to be Kenya, Uganda, Malawi, and Tanzania; Burundi would also have a small amount of surplus production. Malawi's export of pigeonpea is projected to grow at 22.8% per annum over the period from 2010 to 2020. Africa's total export by 2020 is estimated at nearly 427,000 MT.

Producer prices varied from country to country in the SA region as well but were not as severe as in the SSA region (Figure 2-14b). For example, producer prices in India ranged from US$ 391 per MT in 2003 to US$ 317 per MT in 2008 (the average for 1991 to 2008 was approximately US$ 388 per MT).

Just as in common bean, the major drawback for producer price of pigeonpea is the lack of grading and standards. Prices are usually set by buyers who collect all grades (including varietal mixtures and high levels of foreign material) and pay the same price for all. They do the cleaning and get premium prices. Farmers have no incentive to bring to the market purified grain as there is no premium for quality. Impurities emanate from poor post-harvest handling of the crop at the farm level. Farmers use human labor or domestic animals to transport and thresh the harvest; the harvesting ground is not plastered and no canvas is used in almost all instances. The grain thus collects a lot of dust and dirt, and at times gets mixed up with animal dung and urine.

Table 2-16: Net-trade projections (1000 MT) for pigeonpea in Sub-Saharan Africa and South Asia

Country	2010	2015	2020	ROG (%)
Sub-Saharan Africa				
Kenya	55	95	141	15.9
Uganda	41	72	102	15.2
Malawi	31	62	100	22.8
Tanzania	29	53	80	17.9
Burundi	1	2	2	16.3
Sub-total	156	284	427	17.4
South Asia				
India	-233	-416	-636	17.2
Nepal	-3	-5	-8	17.5
Bangladesh	-1	-1	-2	18.2
Bhutan	Negligible	-1	-1	15.5
Myanmar	65	108	172	16.3
Sub-total	-172	-316	-476	17.6

Source: Calculated from Shiferaw et al (2008b)

The SA region is projected to be net importer of pigeonpea over the coming 20 years (2010 to 2020). India, Nepal, Bangladesh and Bhutan would import varying amounts of pigeonpea whereas Myanmar would be a major exporter in the region (Table 2-16). The region's net import is estimated at nearly 476,000 MT by the year 2020.

2.6 Soybean

2.6.1 Production trends

Soybean is grown in 102 countries around the globe, with an estimated total area of more than 92.5 million ha and more than 217.6 million MT of production (Table 1-1 and Annex Table 2-9). The average yield is estimated at 2346 kg per ha. This is the one tropical legume that showed sustained growth in all the production parameters over the years (Figure 2-15). The cultivated area, yield, and production grew at the annual rate of 3%, 1.4%, and 4.4%, respectively (cf. Table 1-1; Annex Table 2-9). It should be emphasized here that, unlike all the crops discussed above, the fast growth in soybean production has been achieved mainly through increases in productivity rather than merely area expansion (Figure 2-15). The USA, Brazil and Argentina combined account for nearly 81% of the world total production. Other major producers include China, India, Paraguay, Canada, Bolivia, Ukraine, and Indonesia (Annex Table 2-9).

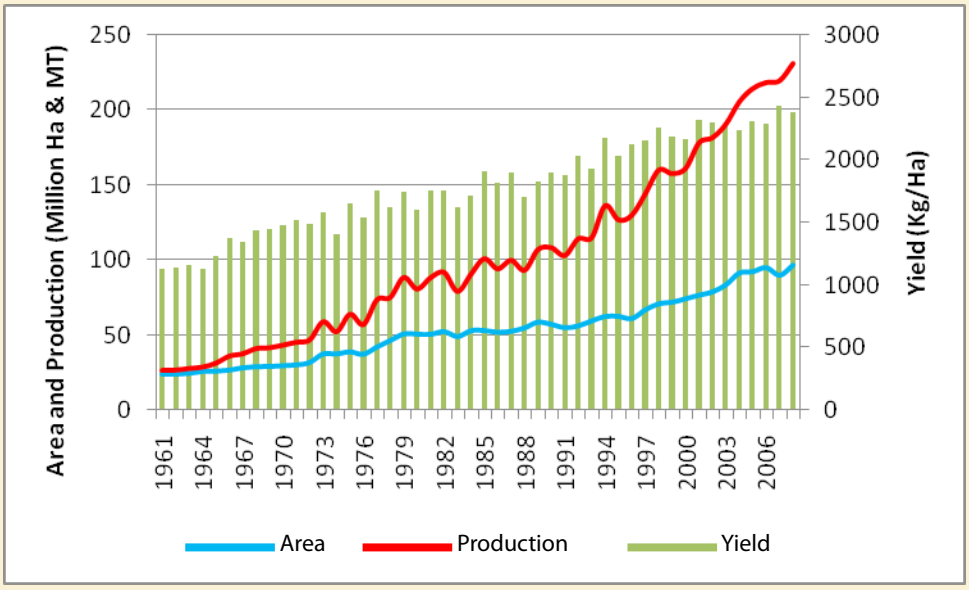

Figure 2-15: Soybean world trends (calculated from FAOSTAT 2010)

Area planted to soybean increased in all but four (Italy, Romania, Serbia and DPR Korea) among the top 20 soybean-producing countries. Highest increases in area (along with corresponding increases in production) were observed in Ukraine, Bolivia, Uruguay, India, South Africa, Argentina, Paraguay; Canada and Brazil; and Brazil. However, it was Nigeria and Romania that showed the highest ROGs in productivity of 6.9% and 4.8%, respectively (Annex Table 2-9).

Soybean is grown in 20 of the 45 SSA countries; however, this region accounts for 1.3% of total world area and 0.6% of production. Average area under soybean per household is estimated at 0.11 ha and there are more than 6.6 million households (28.6 million people) growing soybean in this region. Soybean yields in SSA are about 45% of the world average (cf. Table 1-3). Nigeria, South Africa, and Uganda combined account for nearly 77% of total production in SSA. Zimbabwe, Malawi, Rwanda, DRC, and Zambia also produce more than 10,000 MT each year. Benin, Uganda, and Burkina Faso have registered fastest growth rates in production over the 20-year period. This has been achieved not only by area expansion but through improvements in productivity. By contrast, eight of the 20 SSA countries had negative growth rates in productivity (Table 2-17).

All of the top 20 soybean-producing countries in this region but two (Zambia and Cote d'Ivoire) registered increases in the area planted to soybean over the 20 years (Table 2-17); those with the highest rate of increase in area and corresponding production were Benin, Uganda, Burundi, South Africa and Rwanda. The overall average ROGs for area, yield and production were 3.7%, -0.9%, and 7.1%,

respectively. Annex Figures 2-9a and 2-9b show long-term soybean production trends in SSA and SA, respectively.

Table 2-17: Soybean trends in Sub-Saharan Africa and South Asia

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2000-07	ROG (%)	1985-87	2000-07	ROG (%)	1985-87	2000-07	ROG (%)
Sub-Saharan Africa									
Nigeria	246	623	1.9	316	957	6.7	78	583	8.7
South Africa	29	191	8.0	1,352	1,761	1.0	38	301	9.1
Uganda	11	145	12.1	795	1,169	1.6	9	170	13.9
Zimbabwe	44	53	0.7	2,034	1,514	-1.0	90	81	-0.3
Malawi*	0	73	3.5	0	739	2.1	0	55	5.5
Rwanda	9	45	7.9	780	676	-1.4	7	30	6.4
DRC	8	32	6.0	722	483	-3.6	6	16	2.2
Zambia	14	10	-4.9	1,148	1,233	1.9	15	12	-3.0
Cameroon	2	12	7.2	568	613	0.1	1	7	7.3
Benin	0	10	23.4	650	822	1.1	0	7	24.7
Burkina Faso	3	5	5.8	661	1,657	4.4	2	6	10.4
Ethiopia	1	5	2.8	3,469	1,046	-8.2	5	5	-5.6
Liberia	5	8	3.9	400	423	0.4	2	3	4.4
Mali	1	2	6.3	1,622	1,440	-0.9	1	3	5.3
Burundi	1	3	10.2	1,000	822	-1.7	1	3	8.4
Tanzania	4	7	1.6	180	366	1.9	1	3	3.4
Kenya	NA	3	NA	NA	866	NA	NA	2	NA
Gabon	2	3	1.2	1,061	686	-2.7	2	2	-1.5
Côte d'Ivoire	1	1	-3.1	650	972	-0.5	0	1	-3.5
Madagascar	0	0	3.5	1,200	509	-4.5	0	0	-1.1
Total/avg.	380	1,233	3.7	1034	893	-0.9	257	1,290	7.1
South Asia									
India	1,470	8,307	8.7	644	1,124	1.9	938	9,366	10.8
Myanmar	29	149	9.6	846	1,230	1.9	24	184	11.6
Bangladesh	0	35	23.3	0	1,467	2.0	0	52	25.7
Nepal	16	23	1.3	533	891	2.8	9	20	4.1
Sri Lanka	3	3	-1.9	1,041	1,662	1.9	3	5	0.0
Bhutan	3	1	-7.1	655	1,796	3.1	2	1	-4.3
Pakistan	5	0	-12.4	488	970	4.7	3	0	-8.2
Total	1,526	8,519	8.6	701	1275	3.3	979	9,629	10.7

*Base data start from 2003
Source: Calculated from FAOSTAT (2010)

The SA region occupies more than 8.5 million ha with an estimated production figure of more than 9.6 million MT (Table 2-17). An estimated 9.1 million households (48.3 million people) grow soybean in this region (cf. Table 1-2). This region has shown very rapid and consistent growth in all the production parameters (Annex Figure 2-9b). The ROG for area, yield and production was 8.6%, 3.3%, and 10.7%, respectively. Bangladesh, Myanmar and India registered the highest ROGs for area and production while Pakistan, Bhutan and Nepal had the highest ROG of yield (Table 2-17). The area for Pakistan, Bhutan and Sri Lanka shrank over the 20 years period; production also declined in Pakistan and Sri Lanka. Soybean production in the SA is dominated by India, with annual production of nearly 9.4 million MT (nearly 98% of the total for the region). Productivity for this country has grown at the rate of 1.9% per annum, with area and production showing nearly 8.7% and 10.8%, respectively (Table 2-17).

2.6.2 Projections

Soybean production in the SSA region is projected to grow at the rate of 2.3% per annum with the ROG for national demand estimated at 3.1%. Nigeria, South Africa, Uganda, and Zimbabwe are the leading producers (Table 2-18). This means that production would increase to 1.9 million MT in 2020 compared to 1.525 in 2010. In a similar fashion, the national demand would reach 2 million MT in 2020 compared to about 1.6 million MT in 2010. Among the major producers the fastest ROGs are predicted for Uganda both in terms of production and national demand.

The projections for the SA region are estimated at 3% and 3.2% for production and demand, respectively (Table 2-18). As in all the other crops, India would continue to be the largest producer and with the largest national demand. Fastest ROGs for demand are predicted for Nepal, Pakistan and Myanmar. The ROGs for India are estimated at 2.8% and 3.1% for production and demand, respectively. There appear to be good opportunities for soybean producing countries in the SSA region (particularly those in ESA) to capitalize on the higher national demands in India, Pakistan and Nepal for exporting their produce.

Table 2-18: Production and national demand projections (1000 MT) for soybean in Sub-Saharan Africa and South Asia

Country	Production			Demand		
	2010	2015	2020	2010	2015	2020
Sub-Saharan Africa						
Nigeria	633	709	793	643	748	869
South Africa	340	380	425	414	481	559
Uganda	189	211	236	186	216	251
Zimbabwe	103	115	129	139	161	188
Zambia	61	68	76	14	17	19
Malawi	53	60	67	43	50	58
Ghana	46	51	58	1	1	2
Rwanda	29	32	36	30	34	40
DRC	17	19	22	18	20	24
Benin	12	13	15	14	17	19
Others (21)	43	47	53	58	67	78
Sub-total	1,525	1,706	1,910	1,559	1,812	2,106
ROG (%)		2.7			2.1	
South Asia						
India	10,528	12,227	14,481	10,040	11,748	13,748
Myanmar	206	240	284	203	237	278
Nepal	23	26	31	23	27	32
Sri Lanka	5	6	7	5	6	8
Bhutan	2	3	3	2	3	3
Pakistan	0.18	0.20	0.24	31	36	42
Sub-total	10,975	12,747	15,097	11,560	13,527	15,830
ROG (%)		2.4			2.9	
Grand total	12,284	14,208	16,716	11,863	13,869	16,217

Source: IFPRI IMPACT model results for 2020 (Rosegrant et al. 2001) with a base year of 1997 updated with a new base year of 2006/08

2.6.3 Trade

Soybean is the largest traded commodity among the tropical legumes in the world. Approximately 69 million MT valued at US$ 19 billion are traded each year. More than 170 countries are known to import soybean (Annex Table 2-10). China accounts for nearly 45% of all the world imports (approximately 31 million MT). The Netherlands, Japan, Germany, Mexico, Spain, Italy, Thailand, Indonesia, and Belgium are among the top-ten soybean importing countries. Nearly 130 countries

export a little less than 69 million MT of soybean valued at well over US$ 18 billion each year. This is an increase of 148% over 20 years (average: 7.4% per annum). The USA, Brazil, and Argentina account for about 41%, 35%, and 14% of the world soybean export, respectively. Other major exporting countries are Paraguay, Canada, the Netherlands, China, Ukraine, Belgium, and Bolivia (Annex Table 2-10). Overall, soybean trade has shown uninterrupted growth over the years (Figure 2-16).

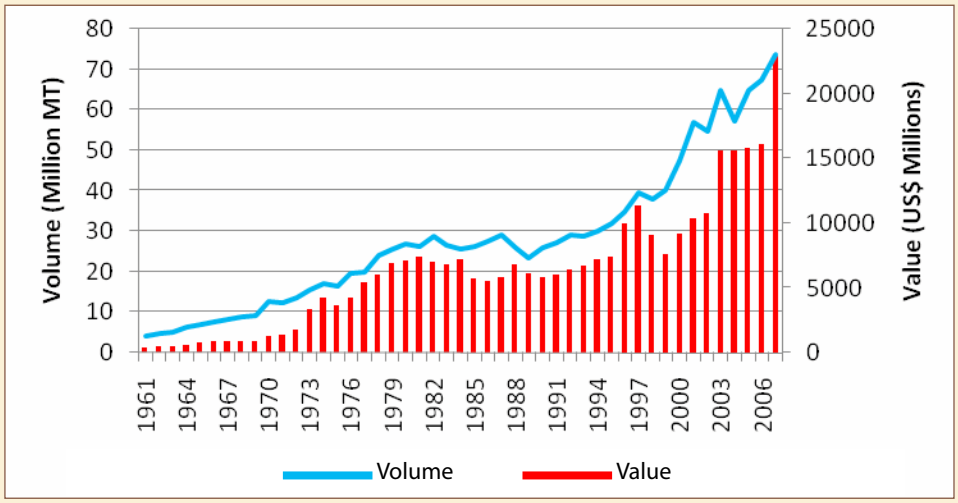

Figure 2-16: World soybean export trend (source: calculated from FAOSTAT, 2010)

Soybean import to the SSA region is estimated at nearly 112,000 MT valued at a little less than US$ 34 million (Table 2-19). South Africa, Nigeria, and Kenya account for nearly 43%, 21%, and 18%, respectively, of the total import volume in this region. Ethiopia, Zambia, Zimbabwe, Seychelles, Botswana, Tanzania, and Gabon also import significant amounts of soybean each year. Soybean export in SSA is relatively small, well below 29,000 MT worth less than US$ 11 million each year. This region is net importer of soybean.

The SA region imports nearly 147,000 MT of soybean at an estimated value of over US$ 41 million each year (Table 2-19). Bangladesh and Pakistan account for about 81% and 18%, respectively, of all soybean imports in SA. The total export is estimated at just over 8,000 MT. India and Myanmar are the major exporters contributing about 62% and 38% of the total for the region, respectively. These two countries are net exporters whereas the region as a whole is net importer.

Table 2-19: Soybean trade in Sub-Saharan Africa and South Asia (2005-07 averages)

Import			Export		
Country	Volume (MT)	Value (US$ 1000)	Country	Volume (MT)	Value (US$ 1000)
Sub-Saharan Africa			Sub-Saharan Africa		
South Africa	47,640	13,271	Nigeria	7,291	1,975
Nigeria	23,124	5,800	Malawi	4,560	1,220
Kenya	19,539	5,940	Kenya	3,817	1,946
Ethiopia	3,531	964	Zambia	3,424	1,114
Zambia	3,255	820	Uganda	3,139	689
Zimbabwe	3,116	1,294	S. Africa	2,980	805
Seychelles	1,994	739	Ethiopia	1,760	2,626
Botswana	1,803	562	Tanzania	757	204
Tanzania	1,732	601	Benin	445	188
Gabon	1,611	1,167	Swaziland	212	72
Others (25)	4,564	2,483	Others (14)	798	362
Total	**111,910**	**33,642**	**Total**	**28,525**	**10,940**
South Asia			South Asia		
Bangladesh	118,659	33,699	India	5,348	2,098
Pakistan	26,841	7,320	Myanmar	3,233	1,860
Sri Lanka	713	242	Sri Lanka	14	21
Nepal	334	117	Nepal	3	8
India	122	37	Bhutan	0	114
Total	**146,669**	**41,416**	**Total**	**8,598**	**4,101**

Source: Calculated from FAOSTAT (2010)

Some countries in the SSA region experienced volatile producer prices for soybean during the 18 years period between 1991 and 2008 (Figure 2-17a). For example, producer prices in Nigeria varied from US$ 305 per MT in 1992 to US$ 1501 in 1998 (Fig. 2-17a). Similarly, the producer price for soybean in Rwanda was US$ 258 per MT in 1992, compared to US$ 1307 in 1996. Furthermore, the price in Burundi fell from US$ 1062 per MT in 1996 to US$ 546 per MT in 2003.

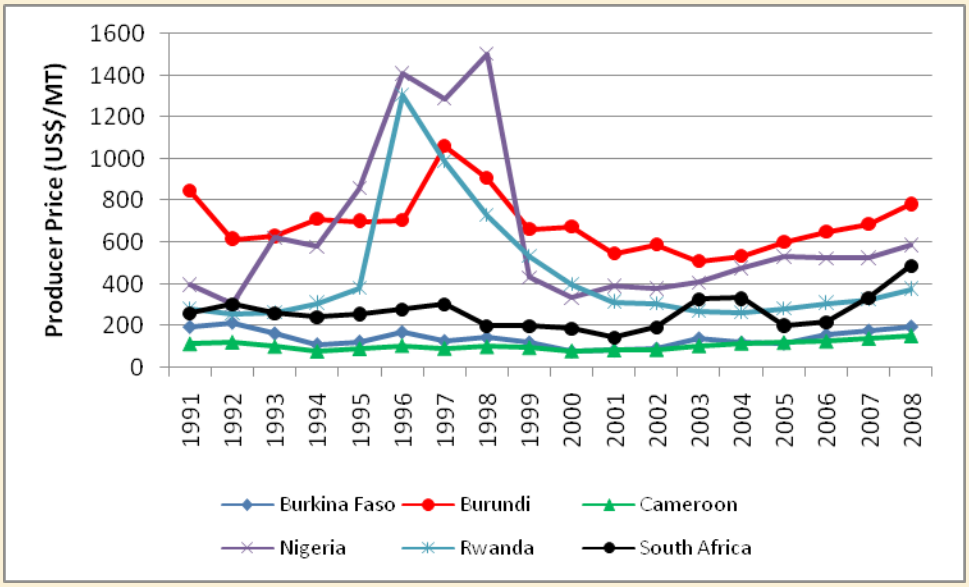

Figure 2-17a: Producer prices of soybean in selected Sub-Saharan African countries (calculated from FAOSTAT, 2010)

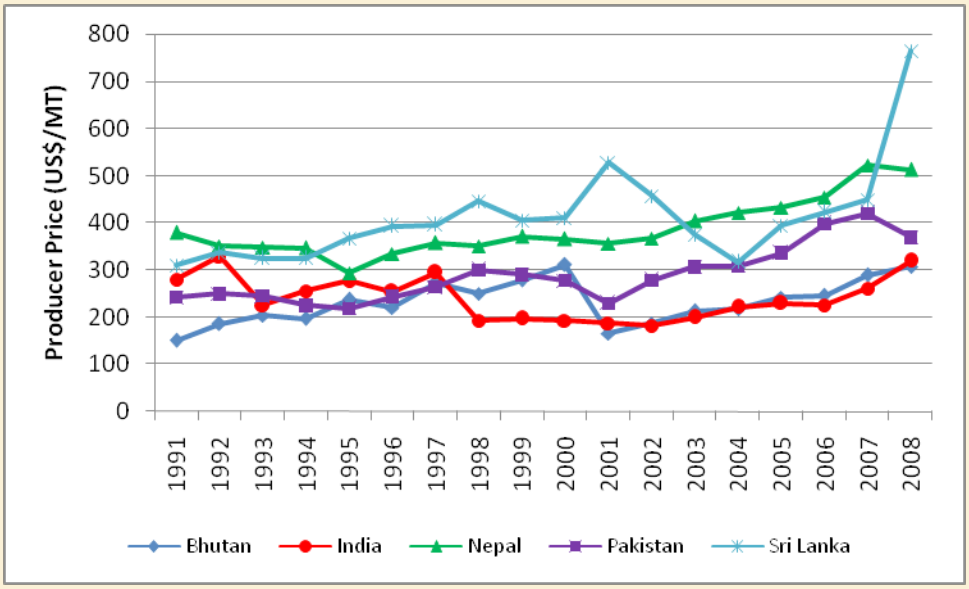

Figure 2-17b: Producer prices of soybean in South Asia (calculated from FAOSTAT, 2010)

Projections suggest that the SSA region would be net exporter of soybean starting from 2013. Exports would jump from a deficit of nearly 38,000 MT in 2010 to a surplus of more than 10,000 MT in 2015 and nearly 32,000 MT by 2020 (Table 2-20). Nigeria and South Africa would be the major exporters whereas Tanzania, Somalia, Kenya and 22 other countries would be net importers of varying amounts of soybean by 2020 (Table 2-20).

Table 2-20: Net-trade projections (1000 MT) for soybean in Sub-Saharan Africa and South Asia

Country	2010	2015	2020	ROG (%)
Sub-Saharan Africa				
Nigeria	20.21	42.65	55.62	17.5
South Africa	-10.64	12.00	34.68	42.6
Benin	0.13	0.55	0.89	57.5
Rwanda	-0.42	0.11	0.56	23.4
Cameroon	-0.01	0.30	0.41	480.1
Kenya	-4.21	-4.96	-5.74	3.6
Somalia	-4.98	-5.77	-6.57	3.2
Tanzania	-5.18	-6.17	-7.21	3.9
Others (22)	-16.23	-14.25	-20.41	-2.6
Sub-total	-37.54	10.21	31.82	34.5
South Asia				
India	-718.93	-964.48	-1,170.96	6.3
Pakistan	-97.17	-127.40	-160.42	6.5
Myanmar	-15.31	-41.42	-71.98	37.0
Nepal	-8.53	-15.60	-23.61	17.7
Sri Lanka	-4.25	-5.54	-6.87	6.2
Bhutan	-0.82	-1.34	-1.94	13.8
Bangladesh	-0.04	-0.05	-0.06	5.3
Sub-total	-845.05	-1,155.83	-1,435.85	-7.0

Source: Calculated from Shiferaw et al (2008b)

Fluctuations in producer prices in the SA region have not been as dramatic as they were in the SSA region (Figure 2-17b).

All countries in the SA region are projected to be net importers of soybean throughout the 2010 to 2020 period (Table 2-20). The total imports for the region would increase from more than 845,000 MT in 2010 to nearly 1.2 million in 2015 and more than 1.4 million MT in 2020. The major importers are India, Pakistan, Myanmar and Nepal.

3.0 Constraints to Tropical Legumes Development

Constraints to tropical grain legumes development in the SSA and the SA regions can be categorized as technical and institutional. The technical constraints are attributed to abiotic and biotic factors as well as issues related to cropping patterns.

3.1 Abiotic factors

The major abiotic and biotic factors limiting the development of tropical legumes are summarized in Table 3-1. Drought (or low moisture stress) and low soil fertility affect the wellbeing of all tropical legumes across the countries in the two regions.

Drought is not necessarily a lack of moisture but rather it is the result of erratic distribution of rainfall in many situations. Different crops have different critical periods in their demand for adequate rainfall. Some crops like pigeonpea are particularly sensitive to low moisture stress, especially near maturity stage. In many circumstances (e.g. common bean), the impact of drought is exacerbated by low soil fertility and soil pathogens.

Drought may be expressed in the form of mid-season gaps of rains, or rains ending too early or low amounts of rainfall, or rains coming late, as has been expressed by common bean farmers in the central rift valley of Ethiopia or eastern Kenya (Katungi et al 2010). Common bean farmers in eastern Kenya estimate yield losses ranging from approximately 60% due to rains ending too early in the season, to 42% due to the rains coming late; similarly, farmers in Ethiopia reported yield losses ranging from about 47% due to mid-season gap to 32% due to the rains coming late (Katungi et al 2010). Farmers' coping mechanism with drought include, among others, growing resistant varieties, crop diversification, investing on livestock, and reverting to local varieties (even though these have inferior yield potential).

Extreme heat is another abiotic factor that threatens the development of tropical legumes. At present chickpea and cowpea are the most affected crops. The importance of heat is expected to worsen with the impact of climate change.

Soil degradation is a common phenomenon in most of the countries that grow tropical legumes in the two regions. This has been caused by continuous cropping of the land without adequate soil conservation methods. Furthermore, traditionally, grain legumes are usually grown in marginal land, with the more fertile areas being allocated to crops that are perceived to be more important – mostly cereals (Abate et al. 2011). This is partly because of the lack of commercialization for grain legumes until recent years; these crops are mainly produced by subsistence farmers.

Table 3-1: Major abiotic and biotic constraints to tropical legumes in Sub-Saharan Africa and South Asia

Constraint	Crop					
	Chickpea	Common bean	Cowpea	Ground-nut	Pigeon-pea	Soy-bean
Abiotic factors						
Drought	+++	+++	+++	+++	+++	+++
Low soil fertility	+++	+++	+++	+++	+++	+++
Heat	+++	++	+++	++	++	++
Biotic factors (Diseases)						
Ascochyta blight	+++	-	+	-	-	-
Fusarium wilt	+++	-	+	-	+++	-
Bean common mosaic potyvirus	-	+++	-	-	-	-
Common bacterial blight	-	+++	-	-	-	-
Angular leaf spot	-	+++	-	-	-	-
Anthracnose	-	+++	-	-	-	-
Cowpea viruses (several)	-	-	+++	-	-	-
Aflatoxin producing fungi	-	-	-	+++	-	-
Early leaf spot	-	-	-	+++	-	-
Late leaf blight	-	-	-	+++	-	-
Groundnut rosette virus	-	-	-	+++	-	-
Groundnut rust	-	-	-	+++	-	-
Sterility mosaic disease	-	-	-	-	+++	-
Cercospora leaf spot	-	-	+	-	+++	-
Soybean rust	-	-	-	-	-	+++
Frogeye leaf spot	-	-	-	-	-	+++
Bacterial pustule	-	-	-	-	-	+++
Red leaf blotch	-	-	-	-	-	++
Biotic factors (Insects)						
Pod borer (*Helicoverpa armigera*)	+++	++	-	-	+++	-
Bean stem maggot	-	+++	+	-	-	+
Bruchids (*Acanthoscelides, Callosobruchus, Zabrotes*)	++	+++	+++	+	+	+
Cowpea aphid	-	-	+++	+++	-	-
Pod bugs	-	+	+++	-	++	-
Cowpea thrips	-	-	+++	-	-	-
Cowpea pod borer	-	++	+++	-	-	-
Red tea bug	-	-	-	++	-	-
Termites (several species)	-	++	++	++	-	-
Biotic factors (Parasitic weeds)						
Witch weed (*Striga*)	-	-	+++	-	-	-
Alectra	-	-	+++	-	-	-

Notes: -=not important; +=low priority; ++=medium priority; +++=high priority.

3.2 Biotic factors

A large number of diseases, insects and parasitic weed pests attack all of the tropical legumes in one region or another; a few examples are shown in Table 3-1. Most of the diseases are caused by fungal pathogens. Many of these cause death to the plant and reduce yield; others (such as *Aspergillus* spp. in groundnut) have both direct effect during growth stages of the crop and aflatoxin contamination of the seed that makes it unacceptable at international markets. Aflatoxins are very strong carcinogens and quality requirements in many countries are very stringent. Maximum tolerance levels range between 5 and 30 nano grams per kg of seed; some of the European countries have zero tolerance level (Oliveira et al 2009). Viral diseases are particularly important on cowpea in the western and central Africa zone. An IPM approach based on host plant resistance and good crop husbandry is the most practical practice to reduce the impact of plant diseases in tropical grain legumes.

A host of arthropod pests also attack tropical grain legumes and cause varying levels of loss across countries in the two regions. Most important examples are shown in Table 3-1. The African bollworm *Helicoverpa armigera* is particularly important on chickpea and pigeonpea. Shanower et al. (1999) estimated an annual loss of US$ 310 million due to damage caused by this and other pod borers to pigeonpea in India and eastern Africa. In Karnataka state of India 100% of farmers said *H. armigera* is the most important insect pest and about 53% said root wilt is the most important disease; here, crop yield losses due to the pod borer and disease are estimated at approximately 42% and 35%, respectively (Kiresur et al 2009a,b). Nearly 55% of the farmers interviewed in Andhra Pradesh also said *H. armigera* is the most important insect pest, with more than 84% of the households reporting root wilt as the most important disease; yield loss due to the disease here is estimated at more than 10% (Suhasini et al 2009a,b).

Insecticidal spray has been used as a major control measure in India. Work on IPM approach has helped to reduce the frequency of spray in chickpea in India from up to 10 to about 3-5 per season, but there is still room to further reduce both economic and environmental costs by bringing it down to a maximum of two sprays per season and ensure sustainability. The use of diversionary crops and crop diversity has long been demonstrated to encourage natural enemy numbers and reduce *H. armigera* damage to crops (Abate 1988, 1991b; Ali et al 2008). Recent studies in India and Bangladesh also show the positive effects of intercropping systems in chickpea and other crops (Hossain et al 2009; Reena et al 2009; Priya et al (2009). However, these findings have yet to be scaled up and scaled out.

Various species of aphids, including the cowpea aphid *Aphis craccivora* are important as vectors of virus diseases in common bean (BCMV), cowpea (CPMV and others) and groundnut (GRV). There is empirical evidence showing the positive effects of crop diversity in reducing crop infestation by aphids.

Infestation by the bean stem maggot complex (*Ophiomyia phaseoli*, *O. spencerella* and *O. centrosematis*) can result in total crop loss of common bean under severe conditions in many parts of eastern and southern Africa (Abate 1991a; Abate & Ampofo 1996; Abate et al., 2000). Effective and economical control can be achieved with seed dressing (Abate 1991c) but such insecticides are not environmentally safe. IPM, based on improved cultural practices, combined with host plant resistance, is the most practical control measure available to date.

The bruchids in the genera *Acanthoscelides*, *Callosobruchus*, and *Zabrotes* are cosmopolitan pests that cause heavy losses particularly in stored common bean and cowpea. The use of pirimiphos-methyl-based insecticides, combined with storage hygiene, is the recommended practice to control these pests (Abate & Ampofo 1996; Abate et al. 2000). However, this practice is more applicable under more organized, large-scale storage systems than at subsistence level. Host plant resistance is also available but has yet to be scaled up and out.

The witch weed *Striga gesnerioides* and *Alectra vogelii* are two most important parasitic weeds that pose great challenges to the production of cowpea in western Africa. An IPM approach based on developing host plant resistance, combined with crop rotation, is the recommended method of management.

3.3 Institutional and policy constraints

3.3.1 Declines in investment in and capacity for AR4D

Agricultural research investment and capacity in SSA (consisting of 45 countries) is characterized by heavy dependence on donor funding, and declines in numbers of scientists, and aging population, among other things. Investment in agricultural research for development in SSA has declined at an annual rate of about 0.2% in the 1990s after showing positive growth in the previous decade (Beintema & Stads, 2010). For example, the 2000 spending (in 2005 PPP$) on agricultural research and development for the whole of SSA countries (1.239 billion) was less than that for China ($ 2.25 billion), India ($ 1.301 billion), and Brazil ($ 1.247 billion). A comprehensive review of investment in African agricultural research and development can be found in McIntyre et al (2009) and Sundberg (2009).

In general, expenditures per researcher declined during the period from 1971 to 2000 in Ethiopia, Kenya, Malawi, Mali, Niger and Nigeria (see Beintema & Solomon 2003; Beintema et al 2003a, 2003b; Stads & Kouriba 2004; Stads et al 2004; Beintema & Ayoola 2004) in spite of high rates of return on investments made in AR4D in Africa (Alston et al. 2000; Thirtle et al. 2003) and elsewhere (Mullen 2007). A recent GCARD meeting called for countries to spend 1.0% to 1.5% of their agricultural output on AR4D, a far cry from the current average investment of 0.7% for SSA (Beintema 2010), which has shown a declining trend between 1981 and 2000 (Beintema & Stads 2008). Tropical legumes suffer from not just the general decline in investment in agriculture, but also from proportionately less investment than cereals and traditional cash crops such as tobacco, as witnessed in Malawi (Simtowe et al. 2010).

Capacities for investment in AR4D are extremely variable among the TL II target countries. For instance, the intensity ratio (amount per $100 of AgGDP) for early 2000s varied from 0.17% for Niger to 1.30% for Kenya (Table 3-2). Similarly, the latter country spends about PPP $5.79 per ha of cultivated land whereas the former invests a mere PPP $0.13. By contrast, India invests roughly $7.91 per hectare of cultivated land. Many countries in the SSA region depend on donor funding to carry out agricultural research for development. For example, 13 of 23 countries in the early 2000s had more than 40% of their research funded by donors, with the balance covered by national government funding; only Sudan, Botswana and Malawi had more than 95% of their funding covered by governments (Beintema and Stads 2004).

Just as in investment mentioned above, the capacity of TL II target countries to carry out effective research and development is variable. The data for early 2000s show that India has more than 13,000 researchers whereas the number of researchers for SSA ranged from 120 for Mozambique to 1,352 for Nigeria, with Kenya, Malawi, Mali, Ethiopia, Tanzania, and Niger in between (in descending order), as shown in Table 3-2. This would mean that one researcher serves 27,000 households in Mozambique compared to 3,000 in Mali. Similarly, Kenya spends an average of US$ 28.73 per ha of cultivated land, compared with US$ 0.35 per ha for Niger (Table 3-2).

It is true that the overall research and development capacity has shown significant increases in some countries, notably Nigeria and Ethiopia, between 2000/01 and 2007/08 (Beintema & Di Marcoantonio, 2009), but the overall capacity for AR4D in SSA still leaves a lot to be desired. Actual numbers of professional staff in some countries (e.g. Kenya and Niger) have actually declined. The number of female professionals in some countries (e.g. Ethiopia and Niger) is very low, even though women account for 60% to 80% of the agricultural workforce in some SSA countries.

Table 3-2: Public sector investment in AR4D in selected SSA Africa countries (2008 data)

Country	Total spending[5]	Research staff (FTEs)[6]	Intensity ratio[7]	Spending per researcher[8]	Spending per farmer[9]	Researchers per million farmers
Nigeria	239.6	2062.0	0.42	0.20	32.88	168
Kenya	171.5	1011.5	1.30	0.17	13.36	79
Ghana	94.6	537.1	0.90	0.18	16.33	93
Uganda	88.0	288.5	1.24	0.29	8.35	28
Tanzania	77.2	673.5	0.50	0.11	4.78	42
Ethiopia	68.6	1318.3	0.27	0.05	2.24	43
Mali	24.6	312.6	0.64	0.08	9.66	123
Burkina	19.4	239.9	0.43	0.08	3.05	38
Mozambique	17.7	263.3	0.38	0.07	2.12	32
Niger	6.2	93.4	0.25	.0.07	1.53	23

Source: ASTI (2011)

3.3.2 Poorly developed seed and other inputs systems

Seed is such a vital part of boosting agricultural productivity and production and yet lots need to be done to make the seed systems, particularly in SSA, work for smallholder farmers. Seed systems in Africa can be broadly divided into formal and informal seed systems. The formal seed system includes parastatals (mainly owned by governments) and private seed companies whereas the informal system is made up of farmers, farmers' community organizations, and NGOs. Tropical legumes have not benefited very much from the private companies mainly because the margin of profit from grain legumes seed business is very low, particularly in comparison to hybrid maize. Traditionally, smallholder farmers recycle grain legume seeds for 4-5 years. Recent studies show that about 75% of farmers in Malawi use recycled seed of legumes. Approximately 86% of farmers in Niger, 80% in Mali, and 71% in Nigeria use recycled seed (Ndjeunga et al 2010). Seed production by parastatals also usually does not meet the demand for grain legumes seed, partly because priority is given to seeds of cereals. For example, only 0.4% land planted to grain legumes in Ethiopia was covered by improved seed, compared with 4% for cereals in 2005/06 crop season (Thijssen et al 2010).

The lack of improved seed is one major cause for the lack of adoption of new varieties of grain legumes as shown by examples from Malawi (NSO 2008; Simtowe

5 Million 2005 PPP$
6 FTE = full time equivalent
7 Intensity ratio is percentage of Agricultural GDP invested on AR&D
8 Million 2005 PPP$
9 2005 PPP$

et al 2010), from Ethiopia and Tanzania (Asfaw et al 2010), and from Mali, Niger and Nigeria in West Africa (Ndjeunga et al 2010). For example, Shiferaw et al (2008c) have demonstrated that net gains from research benefits would increase by up to 30% if farmer access to improved seed could be assured. Sixty percent of farmers in Malawi reported that they did not grow new varieties of groundnut and pigeonpea because of lack of seed and 10% said because of lack of cash to buy seed (Simtowe et al 2010). Baseline household survey results show that 83% of farmers in Mali, 60% in Niger, and 56% in Nigeria attributed their non-use of improved varieties to the unavailability of seed (Ndjeunga et al 2010).

The use of fertilizers in grain legumes production in Africa is very low, compared to that in maize. For example, the amount of DAP used in groundnut, pigeonpea, and maize during the 2006/07 crop season in Malawi was, approximately 6 kg per ha, 10 kg per ha, and 45 kg per ha, respectively (Simtowe et al 2010). Similarly, approximately 20% of grain legumes received mineral fertilizers in the 2005/06 crop season in Ethiopia, compared to 51% for cereals (Thijssen et al 2010). In Mali, only about 2.3% of farmers apply mineral fertilizers to their groundnut plots; and in Niger about 16% of the farmers surveyed said they applied mineral fertilizers to groundnut plots (Ndjeunga et al. 2010). In a similar fashion, about 14% of farmers in Mali and 18% in Niger said they applied organic fertilizers. By contrast, mineral fertilizer and organic fertilizer usage in Nigeria is estimated at 41% and 67%, respectively. On average, farmers in Niger, Mali, and Nigeria use inputs worth less than US$ 20, $ 21 and $ 123 per ha, respectively (Ndjeunga et al 2010).

3.3.3 Volatile markets

Markets for tropical legumes are characterized by heavy fluctuations for producer prices over the years, as shown in Figure 3-1a, b (also see sections for each crop above). There have been variations among countries, but average producer prices in Sub-Saharan Africa peaked in the mid 1990s and slumped late that decade (Figure 3-2a). For example, chickpea prices fell from about US$ 302 per MT in 1991 to about US$ 183 per MT in 1994. It rose again to US$ 610 per MT in 1997 and went down to US$ 183 per MT just two years later. Walker et al (2006) reported that prices in 2003 for groundnut, cowpea, and pigeonpea in Mozambique fell by 7.7%, 13.3%, and 45.5%, respectively, in comparison to 2002.

In south Asia, however, producer prices stayed relatively stable through the early 2000s (Figure 3-2b). They started rising again in the mid 2000s, reaching the peak in 2008 in both regions. One of the major reasons for the heavy fluctuations in producer prices is the lack of quality control and standards. Such instability in price discourages farmers from adopting improved technologies of tropical legumes.

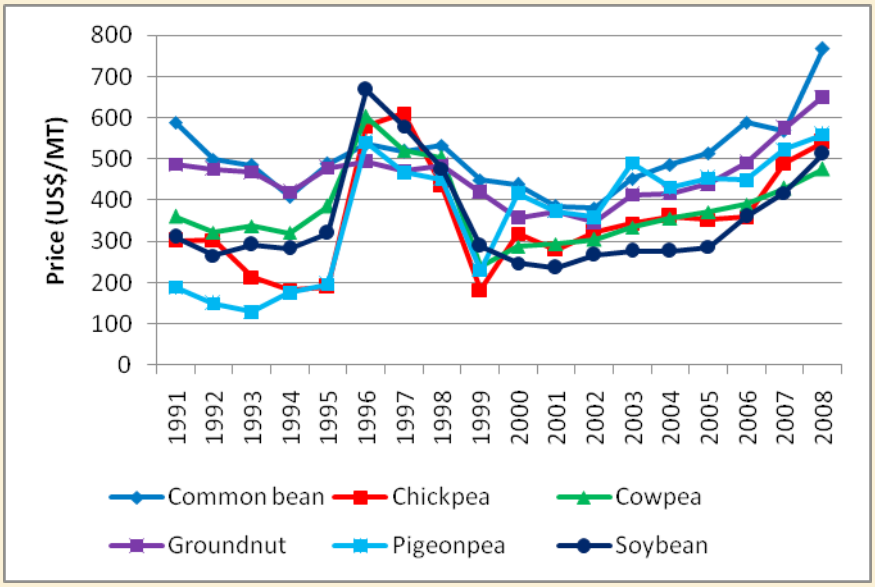

Figure 3-1a: Producer prices of tropical legumes in Sub-Saharan Africa (source: FAOSTAT, 2010)

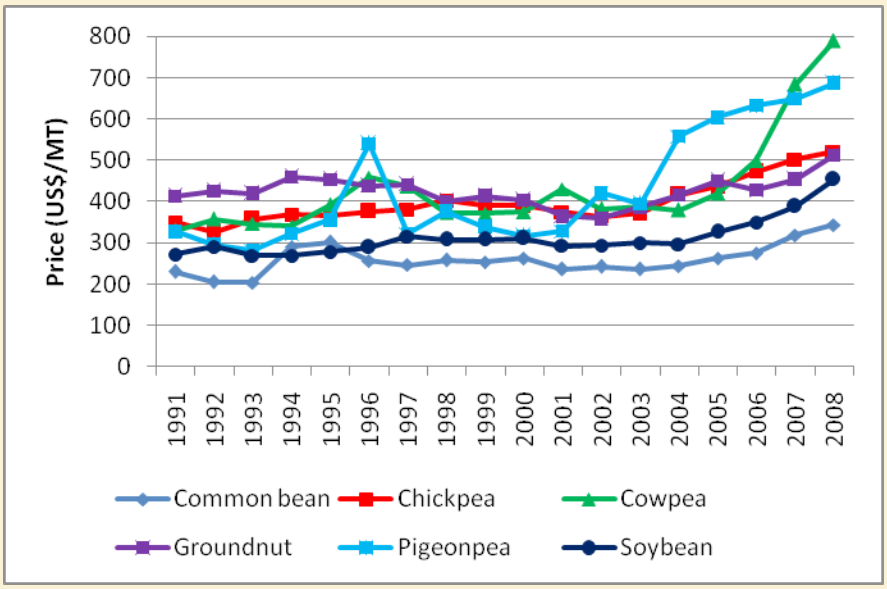

Figure 3-1: Producer prices of tropical legumes in South Asia (source: FAOSTAT, 2010)

3.3.4 Land-related constraints

Smallholder farmers suffer from unfair and unproductive landholding systems, scarcity, and fragmentation of land. In some countries land is owned by the state and farmers have only use-right. This discourages farmers from investing in sustainable management of land, thus resulting in serious land degradation.

In many instances, the national average landholding is about 1 ha per household, or even less. This is especially true for countries in the Eastern and Southern Africa region. For example, the national average farm size in Ethiopia is estimated at 1.03 ha per rural household. A 2006/07 census report by the government of Malawi indicates that the national average landholding per rural household is 0.964 ha; about 60% of farmers have less than 1 ha per rural household (NSO 2008). A recent report by Simtowe et al (2010) shows that the average landholding in Malawi is estimated at about 1.05 ha per rural household (based on 594 household surveys in Balaka, Chiradzulu, Mchinji and Thyolo). Here, 75% of the farmers surveyed have less than 1 ha per household, and more than 50% have less than 0.5 ha per household. This means that smallholder farmers have little chance of exercising their traditional practices of improving soil fertility. For example, only 14% smallholder farmers left their land fallow and crop rotation was practiced on about 25% of the total parcels during the 2006/07 crop season in Malawi (NSO 2008).

Land fragmentation is another important factor that hampers the development of tropical legumes in Sub-Saharan Africa. It is not uncommon for smallholder farmers to have small plots in more than one parcel. Tropical legumes occupy about a third or less of the total farm, with much larger proportions allocated to cereal production as shown by a recent survey in Western Africa (Ndjeunga et al 2010). Plot sizes are already very small and are further exacerbated by increasing population pressure. For example, the national average area under pigeonpea, common bean, soybean, and groundnut in Uganda was 0.12 ha, 0.13 ha, 0.14 ha, and 0.15 ha per rural household, respectively, during the 2005/2006 crop season (UBOS 2007). Plot sizes per rural household for common bean here fell from 0.21 ha in 1995/96 to 0.17 ha in 1999/00 and 0.13 ha in 2004/05. In a similar fashion, groundnut plot sizes fell from 0.25 ha per rural household in 1999/00 to 0.15 in 2004/05 (UBOS 2007). It is estimated that common bean and chickpea national average plot sizes in Ethiopia are approximately 0.1087 ha, and 0.2276 ha per rural household, respectively (CSA 2009).

Land fragmentation is known to lead to sub-optimal usage of factor inputs and hence results in lower overall returns to land, due to losses incurred by extra travel time, wasted space along plot borders, difficulty with monitoring, and inability to use modern machinery such as tractors, planters, harvester (Simtowe et al 2010).

3.3.5 Land and soil degradation

It is not very uncommon to see extremely depleted soils due to over-exploitation resulting from increased population pressure, shortage of land (among others) and lack of investment in natural resources management by smallholder farmers. This is particularly common in parts of ESA countries with dense populations (e.g. Burundi, Ethiopia, Malawi, Rwanda, and Uganda). There is a realization that genetic improvement should be accompanied by natural resources management (Shiferaw et al 2007; Twomlow et al 2008) for smallholder farmers to benefit from adoption of improved crop varieties.

3.3.6 Poor infrastructure

Access to infrastructure such as roads and storage facilities has positive impacts on poverty reduction (Dercon et al 2008). Many countries are ill-prepared to provide such services. For example, chickpea farmers in Karnataka state of India have to walk about 2.85 km to the nearest village market whereas distance to the main market is estimated at 9.14 km (Kiresur et al 2009b). In addition, the roads to village market are accessible for less than 6 months per year. Likewise, chickpea farmers in Ethiopia have to walk 3.09 km to the village market and 9.85 km to the main market (Asfaw et al 2010). Roads to the village market here are accessible by vehicle only for 5.38 months per year.

3.3.7 Inadequate and inefficient extension services

Extension services in much of Sub-Saharan Africa and elsewhere in the developing world are under-staffed and under-skilled, and are therefore inefficient and ineffective. This has been particularly true following the early 1980's structural adjustment policies. Agricultural extension in most developing countries is funded by national governments and inevitably follows a top-down approach (Gebremedhin et al 2006; Azadi and Filson 2009; Davis et al 2009; Mogues et al 2009). Furthermore, there is a lack of strong partnership between extension and research in many of the national agricultural research and development systems (Abate 2007).

Figures on extension staff strength in SSA are scanty. Data from limited samples in Ethiopia show that the average extension agent to farmer ratio is approximately 1 agent to nearly 800 households, ranging from 1 agent to 533 households in some districts to 1 agent to 2101 households (Gebremedhin et al 2006). In Malawi, only 4% of farmers attended extension course or visited on-farm demonstrations, and 12% attended village meetings, during the 2006/07 crop season (NSO 2008). Access to extension varies from country to country and among regions within countries; there is also variation between genders (World Bank 2010). For example, access to

agricultural extension services in Ethiopia and India is described as "moderate" while that for Ghana is said to be "low". An estimated 27% male- and 20% female-headed households in Ethiopia have access to extension services. The figures for India are approximately 29% for male-headed and 18% for female-headed households. In Ghana, only about 10-15% of male-headed households have access to extension services with the share for female-headed households close to 1% (World Bank 2010). In some cases there might be adequate number of extension workers but their mobility is limited due to limitations of resources (such as transportation and per diems) to carry out even routine activities such as visiting farmers (Gebremedhin et al 2006; Mogues et al 2009).

3.3.8 Challenges with partnerships and integration of various initiatives

There are close to two dozen species of important legumes grown in the tropics (Baldev et al. 1988; Raemaekers 2001) that include Bambara groundnut (*Vigna subterranea*), hyacinth bean (*Lablab purpurea* – also known as *Dolichos lablab*), Kerting's groundnut (*Macrotyloma geocarpum*), lima bean (*Phaseolus lunatus*), yam bean (*Sphenostylis stenocarpa*), mung bean or green gram (*Vigna radiata*), black gram or black bean (*Vigna mungo*), moth bean (*Vigna aconitifolia*), rice bean (*Vigna umbellata*), horse gram (*Macrotyloma uniflorum*), faba bean (*Vicia faba*), lentil (*Lens culinaris*), field pea (*Pisum sativum*), lima bean (*Phaseolus lunatus*), yam bean (*Sphenostylis stenocarpa*), and hyacinth bean (*Lablab purpureus*), in addition to the six major tropical grain legumes discussed in detail in previous sections. Five international research centers, namely, AVRDC, CIAT, ICARDA, ICRISAT, and IITA are involved in the research and development of one or more of these legume crops. Each center has its own long established culture of conducting research. Concerted efforts are needed to bring together these centers to harmonize their research agenda and forge strong partnerships with each other.

Currently there exist several initiatives that focus on improving agricultural production and productivity in SSA and beyond (see box below). The main purpose of all of these initiatives is to bring about sustainable improved production and productivity of tropical legumes mainly in SSA. The initiatives have both geographical as well as crop overlaps. There is lots of merit to bring about integration among them to use comparative and competitive advantages of each initiative for a better synergy. With the exception of SIMLESA (funded by the Australian government) all initiatives are funded by the Bill & Melinda Gates Foundation.

The Tropical Legumes initiatives have already established mechanisms for integration; some of the technologies developed by TL I are being applied in TL II to accelerate the introgression of desirable traits in various crops. The development of more tools is expected to be completed and the two initiatives integrated in the coming years. Progress is also being made with the other initiatives.

Box 1: Examples of initiatives towards improving agricultural production and prductivity in SSA and SA

Initiative	Purpose	Target region (countries)	Funding
DTMA	To develop drought-tolerant maize	SSA (Angola, Benin, Ethiopia, Kenya, Nigeria, Uganda, Mozambique, Tanzania, Zambia, Zimbabwe)	B&MGF
N2Africa	To develop rhizobial inoculants technologies	SSA (DRC, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Zimbabwe)	B&MGF
AGRA (PASS & Soil Health Program)	Agro-dealer development, education, crop improvement & adoption, seed production, markets, soil health	SSA (Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Tanzania, Uganda, Zambia)	B&MGF
P4P	Connecting farmers to markets	Burkina Faso, DRC, Ethiopia, Ghana, Kenya, Liberia, Malawi, Mali, Mozambique, Rwanda, Sierra Leone, South Sudan, Tanzania, Uganda	B&MGF
PICS	To develop bruchid control on stored cowpea	Benin, Burkina Faso, Cameroon, Chad, Ghana, Mali, Niger, Nigeria, Senegal, Togo	B&MGF
SIMLESA	To foster cereal-legume integration	Ethiopia, Kenya, Malawi, Mozambique, Tanzania, South Africa	ACIAR
Soil Health	To develop techs for improved soil fertility	Burkina Faso, Kenya, Malawi, Mozambique, Niger, Tanzania, Uganda	B&MGF
TL I	To develop tools for accelerated breeding of legumes	Burkina Faso, Cameroon, Ethiopia, Malawi, Senegal, Tanzania, Zimbabwe, India	B&MGF
TL II	To develop/implement improved techs for increased productivity and production	Mali, Niger, Nigeria, Ethiopia, Kenya, Malawi, Mozambique, Tanzania, Zimbabwe, and India	B&MGF

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List of annex tables

Annex Table 2-1: Chickpea world trends

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
India	7,231	7,035	-0.1	684	823	1.0	4,960	5,793	1.0
Pakistan	1,043	1,058	0.0	513	685	1.4	534	729	1.5
Turkey	529	527	-0.8	1,097	1,048	-0.1	585	552	-0.9
Iran	284	683	4.5	500	445	-0.3	142	300	4.1
Myanmar	177	218	1.3	869	1,157	1.5	154	252	2.8
Ethiopia	137	204	2.5	640	1,114	2.3	84	227	4.8
Australia	50	218	6.0	1,096	1,047	-0.7	51	223	5.3
Canada*	0	125	47.1	0	1,333	-	0	164	-
Mexico	155	100	-0.8	1,123	1,490	1.3	176	149	0.4
Iraq	12	172	23.0	792	524	-2.2	9	90	20.3
USA*	0	48	NA	0	1,328	NA	0	63	NA
Syria	67	78	1.9	623	723	1.1	40	56	3.0
Yemen*	0	20	NA	0	2,369	NA	0	48	NA
Morocco	79	77	-0.4	748	578	-1.3	59	44	-1.6
Malawi	44	92	2.9	478	406	-0.3	20	37	2.6
Tanzania	62	70	0.4	344	447	1.6	21	31	2.0
Spain	90	39	-1.5	664	681	-0.4	60	23	-2.0
Russian Fed.*	0	14	NA	0	1,071	NA	0	15	NA
Algeria	59	22	-5.1	336	626	3.3	20	14	-2.0
Israel	4	6	2.1	1,420	2,135	1.9	6	12	4.0
Others (37)	272	110	-3.0	515	1,100	5.7	212	108	5.7
Total/avg.	**10,294**	**10,914**	**0.4**	**692**	**818**	**1.3**	**7,136**	**8,929**	**1.2**

*Base data for Canada, USA, Yemen, and Russian Federation start from 1992, 1999, 1988, and 1998, respectively
Source: Calculated from FAOSTAT (2010)

Annex Table 2-2: Chickpea world trade (2005-07 averages)

Country	Import		Export		
	Volume (MT)	Value (US$1000)	Country	Volume (MT)	Value (US$1000)
India	184,893	93,965	Australia	204,848	96,904
Pakistan	108,993	55,532	Mexico	105,117	99,120
Bangladesh	66,548	32,770	Turkey	99,157	63,655
Spain	59,852	62,225	India	89,045	69,303
Algeria	50,536	48,136	Canada	75,718	45,555
UAE	30,811	19,418	Ethiopia	75,521	30,005
Saudi Arabia	30,293	10,013	Myanmar	53,885	26,890
UK	29,578	35,671	Iran	35,062	19,099
Jordan	24,491	16,816	Pakistan	31,978	11,553
Italy	22,749	20,745	USA	21,197	14,904
Lebanon	14,014	11,115	Tanzania	20,570	7,012
USA	13,241	11,595	Russian Fed	14,481	4,197
Tunisia	13,138	4,120	Syria	7,670	2,449
Sri Lanka	12,856	8,170	UAE	5,510	2,589
Portugal	12,648	12,051	Kazakhstan	5,127	2,480
Sudan	11,247	3,705	Spain	3,898	4,110
Iran	11,182	4,819	Argentina	2,866	2,437
France	9,837	8,095	Portugal	2,829	3,717
Colombia	9,818	5,717	Belgium	2,625	2,158
Norway	8,132	2,410	Italy	2,148	1,840
Others (145)	96,065	74,221	Others (97)	22,902	15,445
Total	**724,857**	**467,088**	**Total**	**882,153**	**509,979**

Source: Calculated from FAOSTAT (2010)

Annex Table 2-3: Common beans/dry beans world trends

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		ROG (%)
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	
India	9,181	8,865	-0.8	1,031	1,102	0.2	3,150	3,277	-0.6
Brazil	5,338	3,857	-1.9	1,269	2,500	3.4	2,258	3,216	1.5
Myanmar	408	2,309	10.5	2,607	3,105	1.1	354	2,392	11.7
China	1,416	1,069	-0.4	3,269	4,281	1.7	1,543	1,533	1.3
USA	626	614	-0.5	5,161	5,680	0.5	1,078	1,162	0.0
Mexico	1,792	1,491	-0.5	1,685	2,127	1.5	1,007	1,069	1.0
Tanzania	386	720	3.6	2,010	1,986	0.2	257	477	3.8
Kenya	520	959	3.0	1,864	1,412	-2.4	323	448	0.5
Uganda	368	849	4.0	2,272	1,577	-1.8	278	446	2.1
Indonesia	385	311	-2.0	4,414	3,115	-2.5	567	323	-4.5
Canada	46	166	7.6	4,772	5,817	0.8	75	322	8.5
Korea, DPR	342	350	0.0	2,619	2,571	-0.2	298	300	-0.2
Argentina	192	210	0.9	2,809	3,866	1.2	181	273	2.1
Rwanda	329	343	1.3	2,583	2,211	-1.0	283	254	0.3
Burundi	310	245	-1.2	3,015	2,691	-0.8	312	220	-1.9
Iran	102	108	0.0	2,764	5,995	4.4	94	215	4.4
Cameroon	78	231	6.2	2,018	2,628	1.3	53	202	7.6
Nicaragua	80	243	6.2	1,740	2,307	1.6	47	187	7.9
Turkey	161	126	-0.8	3,417	4,420	1.5	183	187	0.6
Ethiopia	49	209	7.9	572	836	0.7	28	174	8.7
Others (108)	4,124	4,166	0.1	686	1,226	3.9	2,889	3,201	0.5
Total/avg.	**26,185**	**27,232**	**0.1**	**582**	**723**	**0.8**	**15,230**	**19,705**	**1.2**

Source: Calculated from FAOSTAT (2010)

Annex Table 2-4: Dry beans world trade (2005-07 averages)

Import			Export		
Country	**Volume (MT)**	**Value (US$ 1000)**	**Country**	**Volume (MT)**	**Value (US$ 1000)**
India	470,266	287,751	China	779,245	417,859
USA	156,996	112,687	Myanmar	510,677	268,310
Cuba	134,829	64,860	USA	312,171	211,714
UK	120,626	80,633	Canada	302,066	185,105
Japan	119,971	95,069	Argentina	235,628	135,277
Italy	101,389	79,020	UK	52,894	15,006
Mexico	100,824	68,534	Kyrgyzstan	41,072	19,445
Brazil	89,010	40,644	Thailand	36,579	25,704
Pakistan	77,312	34,111	Australia	35,687	17,069
South Africa	69,635	36,611	Nicaragua	32,470	23,959
Venezuela	68,001	51,631	Ethiopia	32,014	16,080
Spain	54,168	47,307	Egypt	31,571	18,245
South Korea	51,667	20,488	Colombia	26,551	32,728
Algeria	50,785	36,345	Peru	26,436	23,867
France	48,073	45,987	Bolivia	25,181	12,895
China	48,056	22,524	Indonesia	21,802	8,941
Malaysia	41,655	27,017	Belgium	19,905	14,568
Kenya	39,693	8,463	Uganda	18,727	5,586
Portugal	39,297	28,329	Netherlands	18,225	35,341
Costa Rica	37,877	24,815	Mexico	17,747	18,816
Others (166)	843,460	565,687	Others (135)	177,706	138,134
Total	**2,763,590**	**1,778,512**	**Total**	**2,754,354**	**1,643,921**

Annex Table 2-5: Cowpea world trends

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (100 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
Nigeria	1,435	4,346	5.8	451	664	0.8	647	2,885	6.6
Niger	1,649	4,132	3.5	123	183	1.4	202	764	4.9
Brazil	671	2,121	5.9	273	355	1.3	184	752	7.2
Burkina Faso	435	804	3.0	400	470	1.0	174	378	4.0
Cameroon	24	206	15.4	673	1,201	2.0	16	247	17.4
Ghana	159	156	1.1	101	904	9.7	16	143	10.8
Myanmar	24	148	12.0	492	966	3.9	12	143	15.9
Benin	84	118	2.1	512	844	2.3	43	98	4.4
Mali	160	261	1.9	173	288	4.9	27	75	6.7
Uganda	45	71	2.6	819	1,014	1.2	37	72	3.8
Kenya*	0	122	2.3	NA	560	-1.4	NA	69	0.9
Senegal	103	195	5.5	471	349	-2.6	50	69	2.9
Tanzania	150	150	-0.4	265	445	3.1	40	67	2.7
Mozambique*	NA	364	-3.3	NA	168	2.9	NA	61	-0.3
Togo	117	175	2.1	246	323	2.5	29	57	4.6
DRC	88	121	1.7	626	460	-1.9	55	55	-0.2
Malawi	74	79	0.3	648	685	0.1	48	54	0.4
Haiti	83	42	-2.5	494	696	1.3	41	29	-1.2
Peru*	NA	18	17.9	NA	1,285	0.5	NA	23	18.4
Chad	51	28	0.1	401	666	0.9	20	19	1.1
Others (25)	114	144	1.3	15,861	32,385	5.2	78	95	1.1
Total	**5,466**	**14,500**	**4.5**	**333**	**454**	**1.4**	**1,718**	**6,155**	**5.9**

The base data for Kenya, Mozambique and Peru start from 1988, 2003 and 1999, respectively.
Source: FAOSTAT (2010) and national statistics

Annex Table 2-6: Groundnut world trends

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
China	3,253	4,211	2.3	1,948	3,196	-0.6	6,332	13,428	5.1
India	6,984	6,214	-1.3	805	1,171	0.8	5,617	7,346	-0.1
Nigeria	661	2,214	6.6	1,109	1,677	-1.1	735	3,713	8.4
USA	614	544	-1.2	2,822	3,360	-0.4	1,729	1,827	0.0
Indonesia	554	696	0.9	1,798	2,071	-0.2	997	1,440	1.7
Myanmar	564	688	1.1	1,046	1,434	7.1	590	985	3.3
Sudan	551	718	4.4	666	806	2.6	366	546	5.5
Senegal	753	658	-0.8	1,059	744	-1.2	802	498	-2.3
Viet Nam	225	257	0.9	951	1,898	1.7	214	487	4.5
Argentina	186	197	1.2	2,211	2,341	2.5	407	464	1.0
Ghana	144	467	6.8	1,202	984	-0.6	173	460	6.1
Chad	147	437	6.6	702	837	2.7	103	374	7.6
DRC	539	474	-1.3	757	778	-0.5	408	369	-1.4
Tanzania	99	411	7.5	600	716	1.2	59	295	8.8
Guinea	123	207	3.3	554	1,408	2.7	68	292	8.3
Mali	103	308	4.2	967	951	0.6	98	290	3.7
Brazil	164	120	-0.6	1,494	2,296	-2.1	249	276	1.2
Burkina Faso	190	333	3.3	685	696	-1.5	130	227	4.0
Malawi	174	250	3.9	865	804	1.0	149	202	4.4
Egypt	11	61	10.4	2,107	3,284	0.0	22	200	13.1
Others (98)	2,746	3,168	0.8	1,244	1,487	1.0	2,115	2,659	1.3
Total	**18,784**	**22,633**	**1.0**	**1,252**	**1,520**	**1.0**	**21,363**	**36,379**	**2.9**

Source: Calculated from FAOSTAT (2010)

Annex Table 2-7: Groundnut world trade (2005-07 averages)

Import			Export		
Country	**Volume (MT)**	**Value (US$ 1000)**	**Country**	**Volume (MT)**	**Value (US$ 1000)**
Netherlands	270,215	243,376	China	356,696	281,536
Indonesia	160,126	51,936	India	237,023	182,741
Mexico	106,137	89,515	USA	165,255	150,685
UK	104,574	99,514	Argentina	161,625	121,141
Russian Fed.	95,708	65,767	Nicaragua	66,070	46,257
Germany	90,445	95,159	Brazil	46,316	28,597
Canada	88,264	74,619	Viet Nam	39,146	26,506
Philippines	48,497	33,524	Gambia	17,811	5,692
Spain	40,917	40,276	Uzbekistan	12,018	6,616
Algeria	40,122	25,994	Egypt	11,974	7,573
Japan	39,698	42,410	Israel	9,256	17,416
Poland	36,658	33,751	Malawi	9,073	4,295
Malaysia	36,027	18,608	Belgium	8,619	8,434
Ukraine	33,664	23,405	UAE	8,579	4,850
Italy	33,539	41,216	Germany	7,872	8,747
Thailand	33,064	12,502	Singapore	7,581	6,137
UAE	28,452	23,297	Paraguay	6,198	4,718
France	24,137	25,339	Tanzania	5,969	2,115
Belgium	16,398	16,642	Mali	5,199	2,459
Turkey	15,668	15,777	South Africa	4,967	13,115
Others (160)	321,369	251,057	Others (138)	56,267	135,720
Totals	**1,663,680**	**1,087,743**	**Total**	**1,320,966**	**1,065,350**

Source: Calculated from FAOSTAT (2010)

Annex Table 2-8: Pigeonpea world trends

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
India	3,162	3,554	0.3	769	694	-0.5	2,433	2,466	-0.2
Myanmar	70	542	12.7	654	1,075	2.4	45	582	15.4
Malawi	114	156	1.9	638	756	0.9	73	118	2.9
Kenya	0	177	NA	NA	NA	NA	0	101	NA
Uganda	62	86	1.8	456	1,015	3.4	28	87	5.3
Tanzania	64	68	0.6	628	724	0.7	40	49	1.3
Dominican Rep.	17	22	-0.5	1,082	958	0.0	16	21	-0.5
Nepal	16	20	1.7	753	920	1.7	12	19	3.5
DRC	7	10	2.3	615	582	-0.2	4	6	2.1
Haiti	9	6	-1.6	494	401	-1.0	4	3	-2.6
Venezuela	9	3	-7.6	554	829	2.4	5	2	-5.4
Panama	3	5	2.6	865	406	-3.2	2	2	-0.7
Burundi	2	2	-0.9	1,072	900	-1.0	2	2	-1.9
Philippines	0	1	NA	NA	NA	NA	0	1	NA
Bangladesh	6	2	-4.7	744	673	-0.6	5	1	-5.3
Trinidad & Tobago	1	0	-5.0	1,461	2,402	3.2	2	1	-1.9
Jamaica	2	1	-5.0	946	1,141	1.0	2	1	-4.0
Grenada	0	1	1.1	1,489	962	-1.9	1	1	-0.8
Comoros	0	0	NA	NA	NA	NA	0	0	NA
Puerto Rico	4	0	-16.0	686	804	2.9	3	0	-13.6
Bahamas	1	0	-5.8	1,298	685	-3.7	1	0	-9.3
Pakistan	1	0	NA	NA	NA	NA	0	0	NA
Total/avg.	**3,549**	**4,655**	**1.1**	**845**	**885**	**0.5**	**2,679**	**3,463**	**1.1**

*Base data for Kenya, the Philippines, and Comoros start from 1990, 2004, and 1990, respectively (calculated from FAOSTAT, 2010)

Annex Table 2-9: Soybean world trends

Country	Area (1000 Ha)			Yield (Kg per Ha)			Production (1000 MT)		
	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)	1985-87	2005-07	ROG (%)
USA	23,883	28,328	1.4	2,271	2,821	1.2	54,244	79,913	2.7
Brazil	9,488	21,854	4.2	1,704	2,474	2.2	16,196	53,835	6.4
Argentina	3,373	15,048	7.8	2,009	2,793	1.6	6,767	42,103	9.4
China	8,161	9,198	0.9	1,401	1,653	1.1	11,448	15,217	2.0
India	1,470	8,307	8.3	644	1,124	1.6	938	9,366	10.0
Paraguay	644	2,200	6.5	1,693	2,054	0.7	1,097	4,548	7.2
Canada	417	1,179	5.2	2,583	2,631	0.0	1,081	3,106	5.3
Bolivia	65	950	13.8	1,817	1,723	-0.3	118	1,636	13.5
Ukraine*	NA	573	17.3	NA	1,312	2.1	NA	742	19.4
Indonesia	1,084	554	4.8	1,001	1,293	1.1	1,086	716	(3.7)
Russian Fed*	NA	725	0.3	NA	988	2.7	NA	716	3.0
Uruguay	24	318	11.2	1,644	1,964	1.7	40	630	12.9
Nigeria	246	623	1.7	316	949	6.9	78	591	8.6
Italy	269	154	-5.0	3,276	3,354	0.0	894	515	-5.0)
Korea, DPR	335	298	-0.7	1,297	1,151	-0.8	434	343	-1.5
South Africa	29	191	8.3	1,352	1,566	1.0	38	301	9.3
Viet Nam	109	193	3.1	199	201	3.4	87	275	6.5
Romania	329	139	-5.4	1,067	1,860	4.8	350	265	-0.6
Serbia*	NA	101	-2.4	NA	1,603	-6.0	NA	245	-8.4
Japan	145	138	0.1	1,749	1,644	-0.1	254	227	0.1
Others (82)	2,579	1,573	-0.5	853	1,336	0.7	3,673	2,582	-0.4
Total	**52,503**	**92,507**	**3.0**	**1,877**	**2,346**	**1.4**	**98,568**	**217,644**	**4.4**

Source: Calculated from FAOSTAT (2010)

Annex Table 2-10: Soybean world trade (2005-07 averages)

Import			Export		
Country	**Volume (MT)**	**Value (US$ 1000)**	**Country**	**Volume (MT)**	**Value (US$ 1000)**
China	30,947,231	9,653,714	USA	27,872,719	7,754,387
Netherlands	4,504,786	1,229,025	Brazil	23,708,941	5,905,951
Japan	4,127,743	1,457,515	Argentina	9,892,504	2,503,280
Germany	3,697,885	1,067,533	Paraguay	2,914,758	631,869
Mexico	3,696,840	1,017,684	Canada	1,506,172	463,910
Spain	2,485,484	731,404	Netherlands	1,309,439	386,396
Italy	1,536,020	456,514	China	410,827	170,926
Thailand	1,514,620	466,223	Ukraine	264,679	67,886
Indonesia	1,486,372	362,338	Belgium	217,523	68,216
Belgium	1,391,920	432,793	Bolivia	94,257	21,954
Argentina	1,235,188	319,688	Romania	42,029	10,597
Korea, Republic	1,214,082	375,831	Italy	41,175	21,634
Turkey	1,134,106	334,329	Austria	30,959	15,924
Portugal	1,079,951	320,511	Germany	30,451	9,006
Iran	894,692	265,986	France	27,761	11,973
UK	772,345	251,445	Cambodia	22,662	5,665
Egypt	761,040	261,614	Malaysia	20,521	6,111
Malaysia	572,155	186,011	Moldova	19,541	4,609
Israel	570,032	178,450	Croatia	18,427	5,647
Morocco	488,075	156,889	Ireland	12,289	6,627
Others (153)	5,101,122	1,549,578	Others (109)	138,445	208,090
Totals	**69,211,690**	**21,075,072**	**Total**	**68,596,079**	**18,280,658**

Source: Calculated from FAOSTAT (2010)

Annex Table 2-11a: Projections for area under tropical legumes in Sub-Saharan Africa and South Asia

Year	Area (1000 Ha)						
	Chickpea	Common bean	Cowpea	Groundnut	Pigeonpea	Soybean	Total
Sub-Saharan Africa							
2010	597	4,569	13,149	11,281	601	1,037	**31,234**
2011	617	4,660	13,549	11,448	620	1,038	**31,932**
2012	636	4,753	13,950	11,619	640	1,040	**32,638**
2013	656	4,848	14,353	11,790	660	1,041	**33,349**
2014	677	4,945	14,759	11,962	681	1,042	**34,066**
2015	698	5,044	15,170	12,135	702	1,044	**34,793**
2016	717	5,138	15,586	12,282	721	1,046	**35,489**
2017	736	5,234	16,009	12,429	740	1,047	**36,195**
2018	755	5,332	16,440	12,577	758	1,049	**36,911**
2019	773	5,431	16,881	12,726	777	1,052	**37,640**
2020	791	5,532	17,335	12,876	797	1,054	**38,384**
ROG (%)	**2.86**	**1.93**	**2.79**	**1.33**	**2.87**	**0.16**	**2.08**
South Asia							
2010	7,293	10,464	144	7,268	3,925	6,927	**36,020**
2011	7,266	10,479	144	7,285	3,932	6,967	**36,073**
2012	7,217	10,485	144	7,301	3,939	7,007	**36,094**
2013	7,176	10,493	144	7,316	3,945	7,048	**36,121**
2014	7,137	10,501	144	7,330	3,949	7,088	**36,150**
2015	7,094	10,507	145	7,342	3,952	7,129	**36,169**
2016	7,043	10,503	145	7,349	3,951	7,165	**36,156**
2017	6,987	10,496	144	7,355	3,948	7,201	**36,133**
2018	6,926	10,486	144	7,359	3,944	7,238	**36,098**
2019	6,860	10,473	144	7,362	3,939	7,275	**36,053**
2020	6,789	10,457	144	7,363	3,931	7,312	**35,997**
ROG (%)	**-0.70**	**0.00**	**0.00**	**0.13**	**0.02**	**0.54**	**0.00**

Sources: Common bean for SSA is based on Enid Katungi and common bean and cowpea for SA are calculated by the authors; cowpea data for SSA are from Alene; all other data are from Shiferaw et al (2008b)

Annex Table 2-11b: Projections for yields of tropical legumes in Sub-Saharan Africa and South Asia

Year	Yield (Kg/Ha)					
	Chickpea	Common bean	Cowpea	Groundnut	Pigeonpea	Soybean
Sub-Saharan Africa						
2010	1,017	694	463	887	934	1,243
2011	1,053	700	473	897	960	1,271
2012	1,088	705	483	906	986	1,299
2013	1,124	713	493	916	1,013	1,328
2014	1,163	720	504	925	1,040	1,357
2015	1,202	825	516	935	1,068	1,387
2016	1,242	853	528	946	1,096	1,410
2017	1,282	872	542	957	1,125	1,433
2018	1,323	892	556	967	1,155	1,456
2019	1,364	914	570	978	1,184	1,480
2020	1,405	933	586	989	1,214	1,504
ROG (%)	**3.30**	**3.54**	**2.38**	**1.09**	**2.66**	**1.92**
South Asia						
2010	897	1,082	1,074	1,075	835	1,489
2011	920	1,116	1,100	1,092	853	1,531
2012	941	1,151	1,127	1,109	872	1,573
2013	964	1,188	1,155	1,125	891	1,617
2014	988	1,226	1,183	1,142	910	1,663
2015	1,011	1,265	1,212	1,159	930	1,709
2016	1,035	1,305	1,242	1,177	949	1,749
2017	1,060	1,346	1,272	1,194	969	1,789
2018	1,084	1,389	1,304	1,212	990	1,831
2019	1,108	1,433	1,335	1,230	1,010	1,873
2020	1,132	1,478	1,368	1,247	1,031	1,916
ROG (%)	**2.36**	**3.17**	**2.45**	**1.50**	**2.13**	**2.56**

Sources: Common bean for SSA is based on Enid Katungi and common bean and cowpea for SA are calculated by the authors; cowpea data for SSA are from Alene; all other data are from Shiferaw et al (2008b)

Annex Table 2-11c: Projections for production of tropical legumes in Sub-Saharan Africa and South Asia

Year	Production (1000 MT)						
	Chickpea	Common bean	Cowpea	Groundnut	Pigeonpea	Soybean	**Total**
Sub-Saharan Africa							
2010	548	6,302	4,823	10,387	482	1,274	**23,816**
2011	591	6,477	5,049	10,638	512	1,310	**24,577**
2012	633	6,654	5,290	10,893	544	1,347	**25,362**
2013	680	6,836	5,545	11,152	577	1,385	**26,175**
2014	731	7,021	5,817	11,413	612	1,424	**27,019**
2015	785	7,209	6,106	11,678	648	1,465	**27,891**
2016	839	7,389	6,415	11,931	684	1,497	**28,755**
2017	897	7,571	6,744	12,186	721	1,531	**29,650**
2018	956	7,755	7,096	12,444	760	1,565	**30,576**
2019	1,018	7,941	7,473	12,703	800	1,600	**31,535**
2020	1,082	8,129	7,877	12,963	841	1,636	**32,529**
ROG (%)	**7.06**	**2.58**	**5.02**	**2.24**	**5.73**	**2.53**	**3.17**
South Asia							
2010	8,074	6,690	173	8,272	3,605	7,752	**34,566**
2011	8,357	6,848	177	8,430	3,703	7,956	**35,471**
2012	8,604	7,032	182	8,588	3,801	8,168	**36,374**
2013	8,873	7,209	187	8,746	3,899	8,387	**37,300**
2014	9,157	7,393	191	8,905	3,998	8,613	**38,257**
2015	9,439	7,583	196	9,063	4,098	8,848	**39,225**
2016	9,712	7,774	201	9,221	4,195	9,045	**40,148**
2017	9,981	7,953	206	9,378	4,291	9,248	**41,057**
2018	10,240	8,133	211	9,535	4,387	9,456	**41,961**
2019	10,491	8,311	215	9,689	4,482	9,669	**42,858**
2020	10,732	8,487	220	9,842	4,576	9,888	**43,744**
ROG (%)	**2.90**	**2.44**	**2.44**	**1.75**	**2.42**	**2.47**	**2.39**

Sources: Common bean for SSA is based on Enid Katungi and common bean and cowpea for SA are calculated by the authors; cowpea data for SSA are from Alene; all other data are from Shiferaw et al (2008b)

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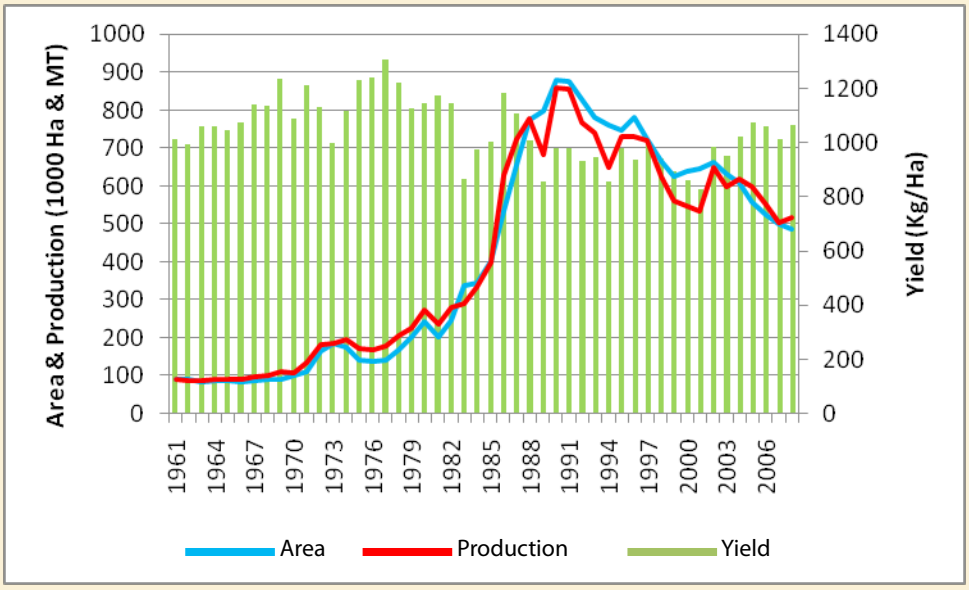


Annex Figure 2-1: Chickpea trends in Turkey (calculated from FAOSTAT, 2010)

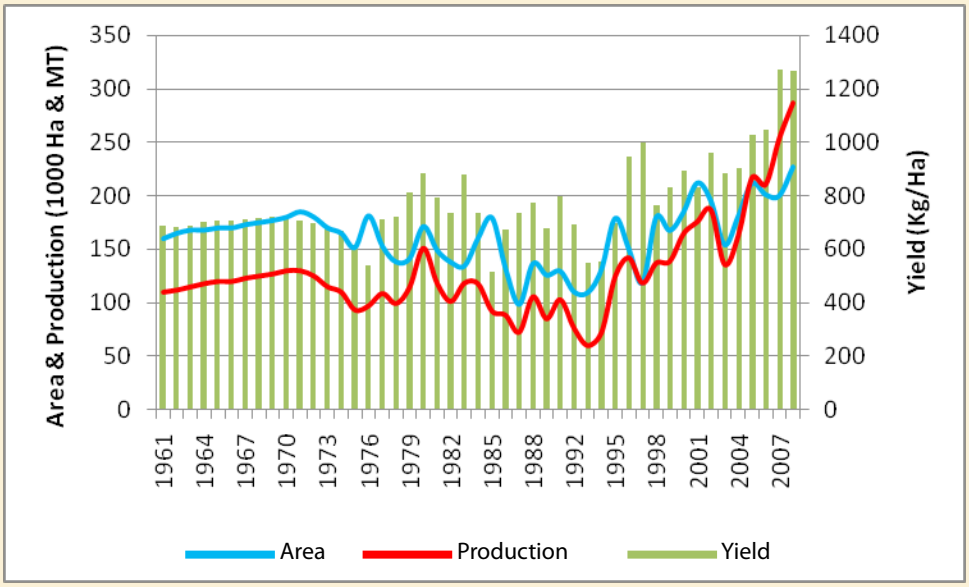
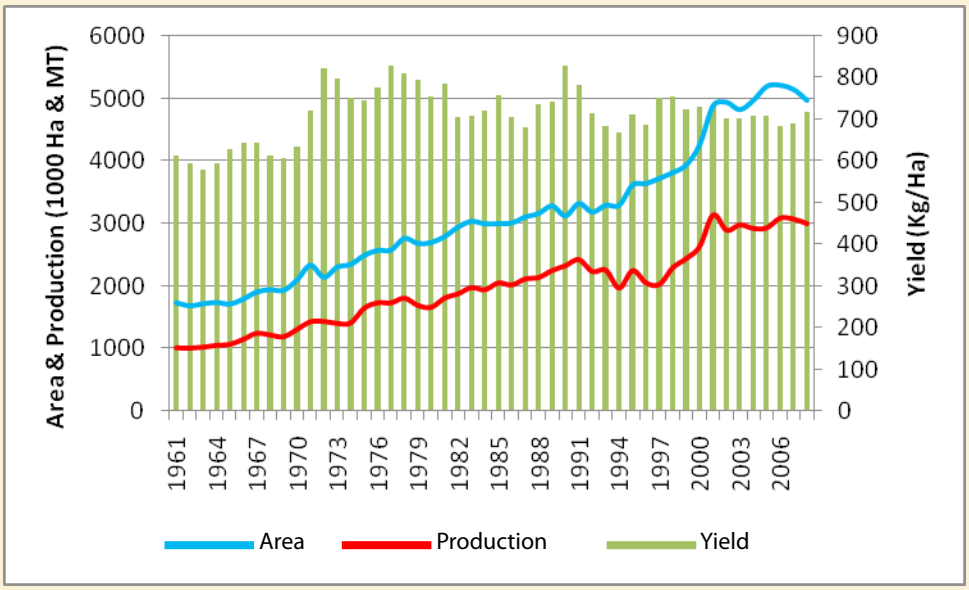
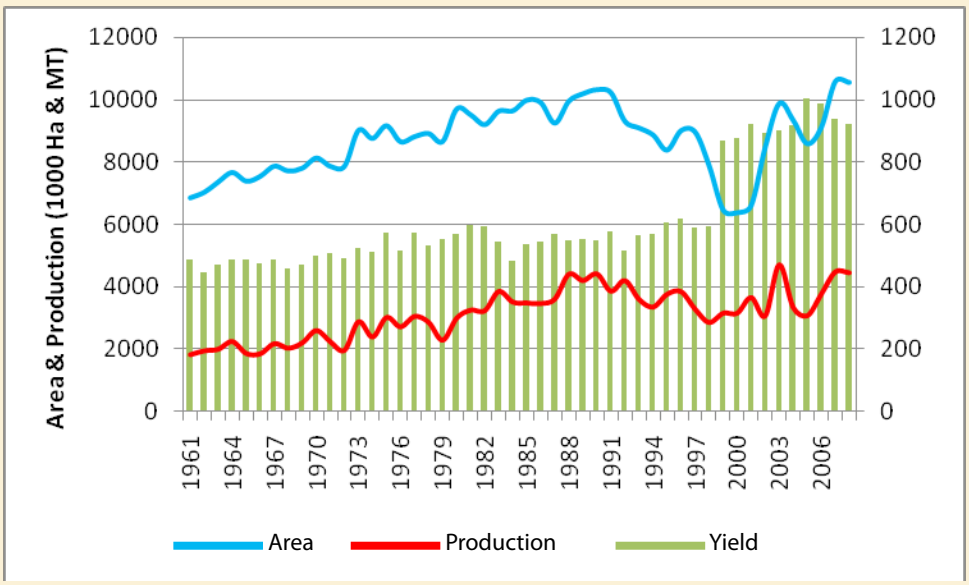


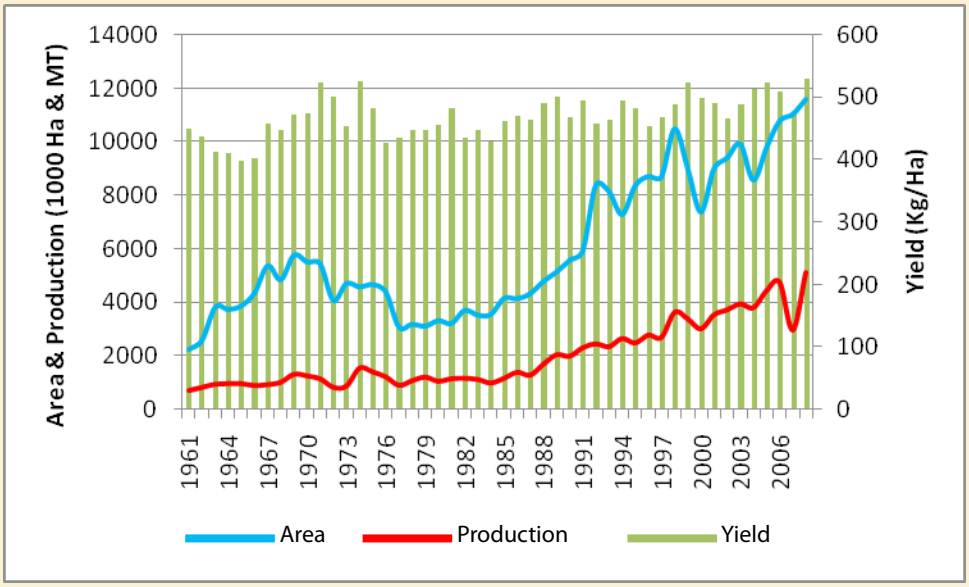
Figure 2-2: Chickpea trends in Ethiopia (calculated from FAOSTAT, 2010)



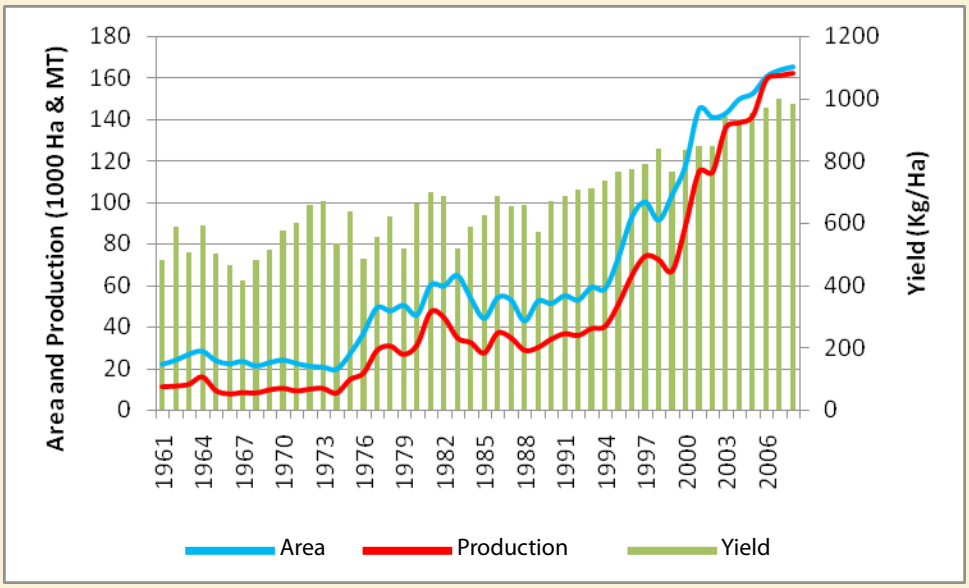
Annex Figure 2-3a: Common bean trends in Sub-Saharan Africa (calculated from FAOSTAT, 2010)



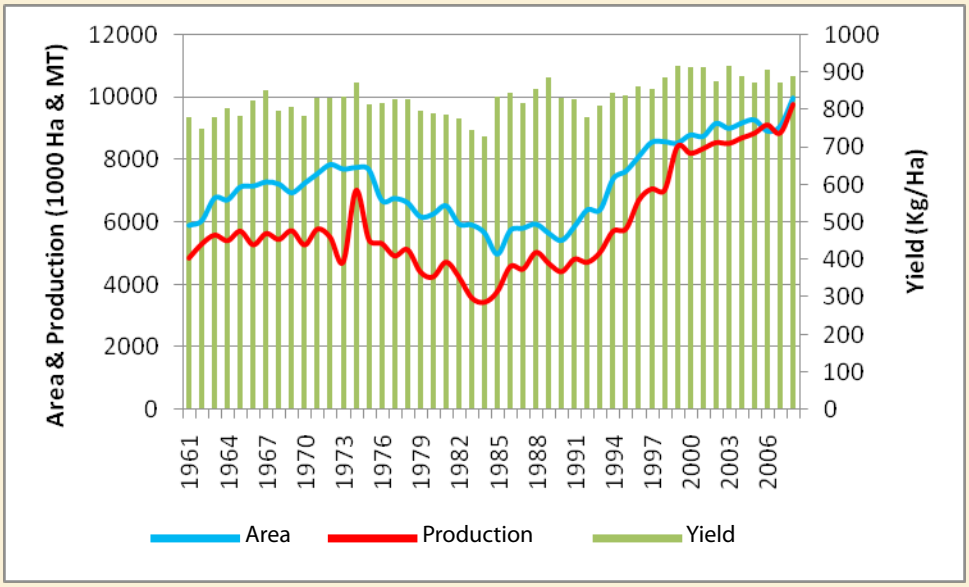
Annex Figure 2-3b: Dry bean trends in South Asia (calculated from FAOSTAT, 2010)



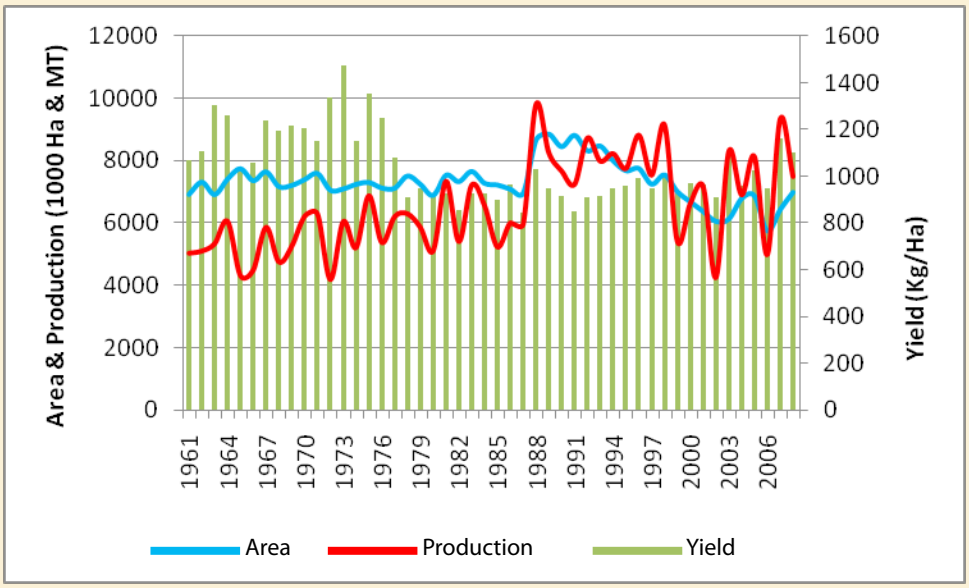
Annex Figure 2-4a: Cowpea trends in Sub-Saharan Africa (calculated from FAOSTAT, 2010)



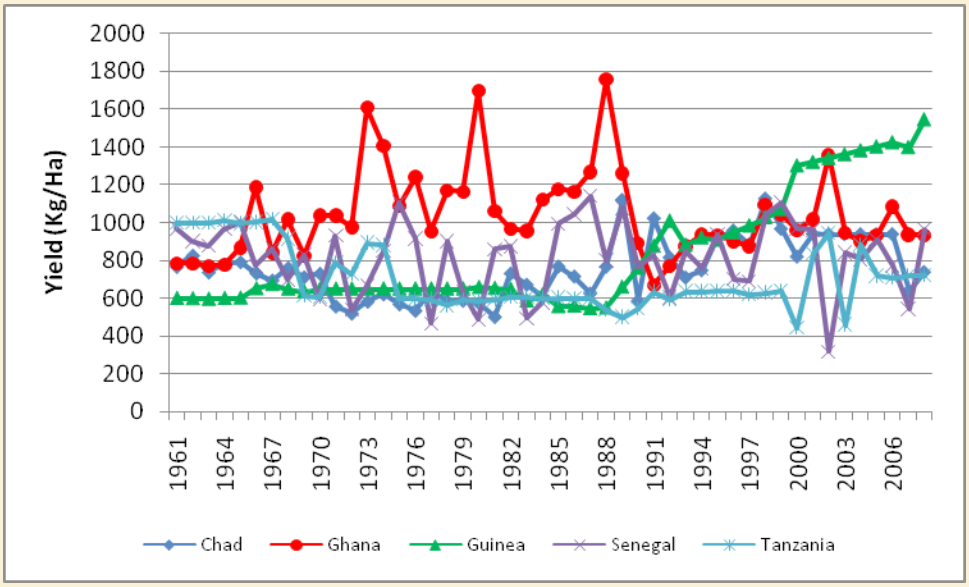
Annex Figure 2-4b: Cowpea trends in Myanmar (calculated from FAOSTAT, 2010)



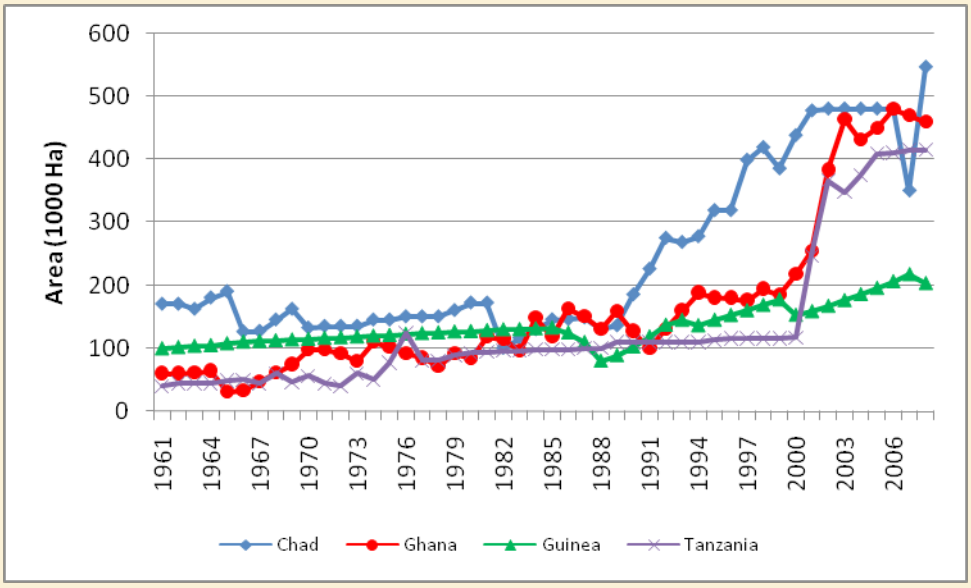
Annex Figure 2-5a: Groundnut trends in Sub-Saharan Africa (calculated from FAOSTAT, 2010)



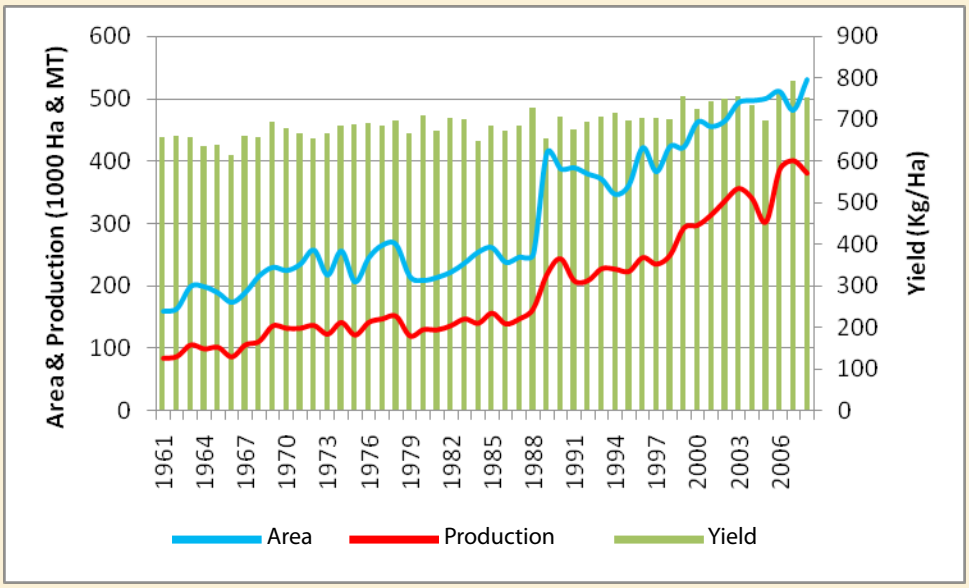
Annex Figure 2-5b: Groundnut trends in South Asia (calculated from FAOSTAT, 2010)



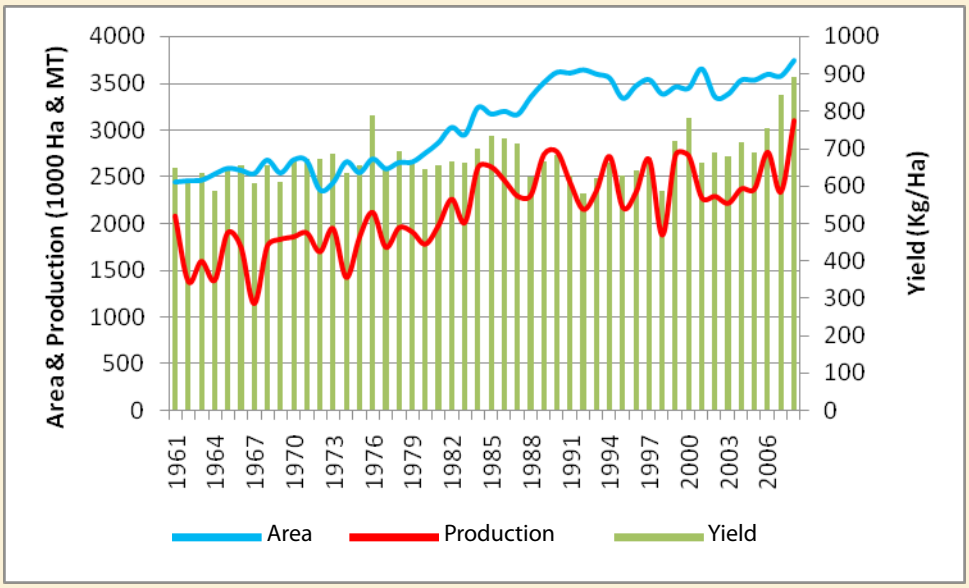
Annex Figure 2-6: Groundnut yields in selected Sub-Saharan Africa countries (calculated from FAOSTAT, 2010)



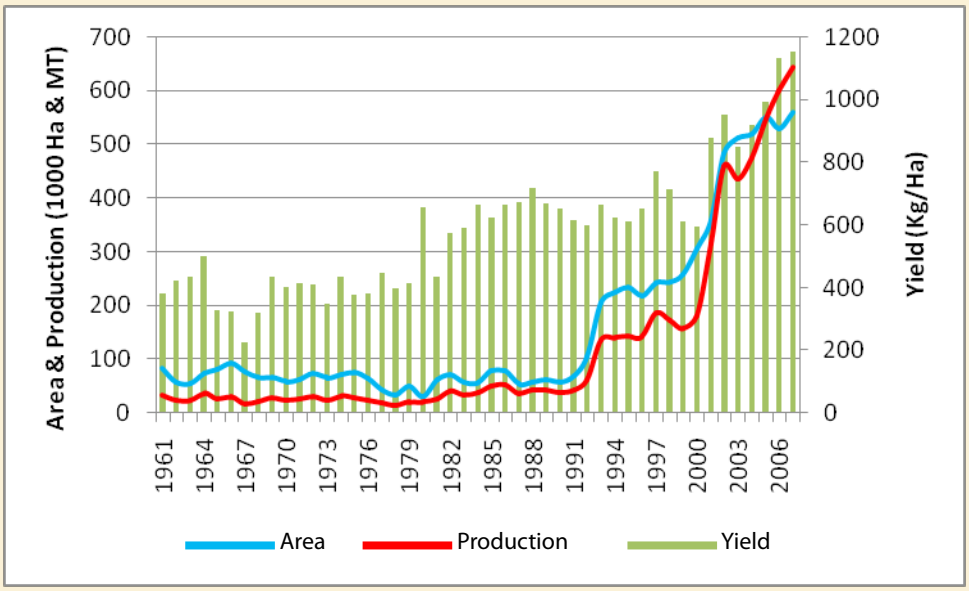
Annex Figure 2-7: Groundnut area trends in selected Sub-Saharan Africa countries (calculated from FAOSTAT, 2010)



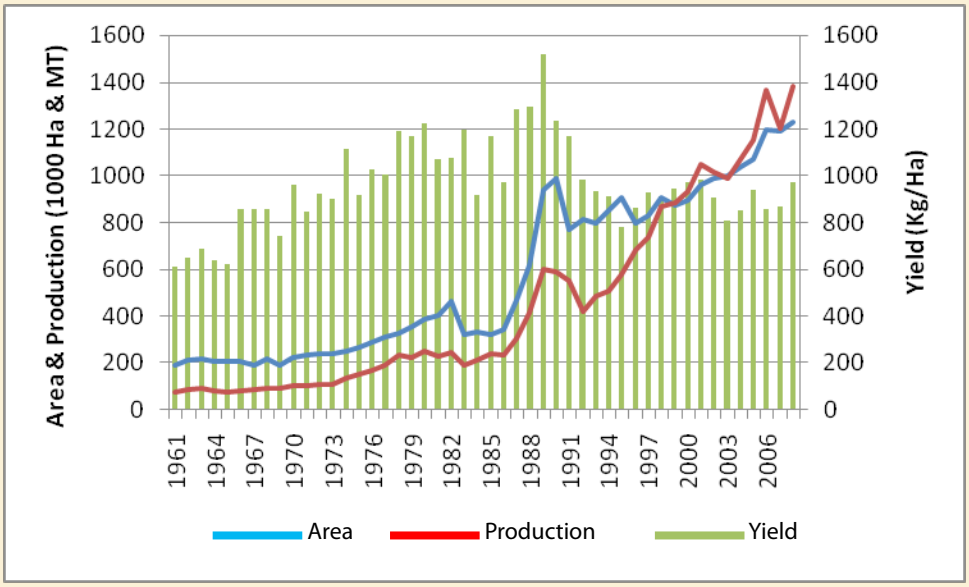
Annex Figure 2-8a: Pigeonpea trends in Sub-Saharan Africa (calculated from FAOSTAT, 2010)



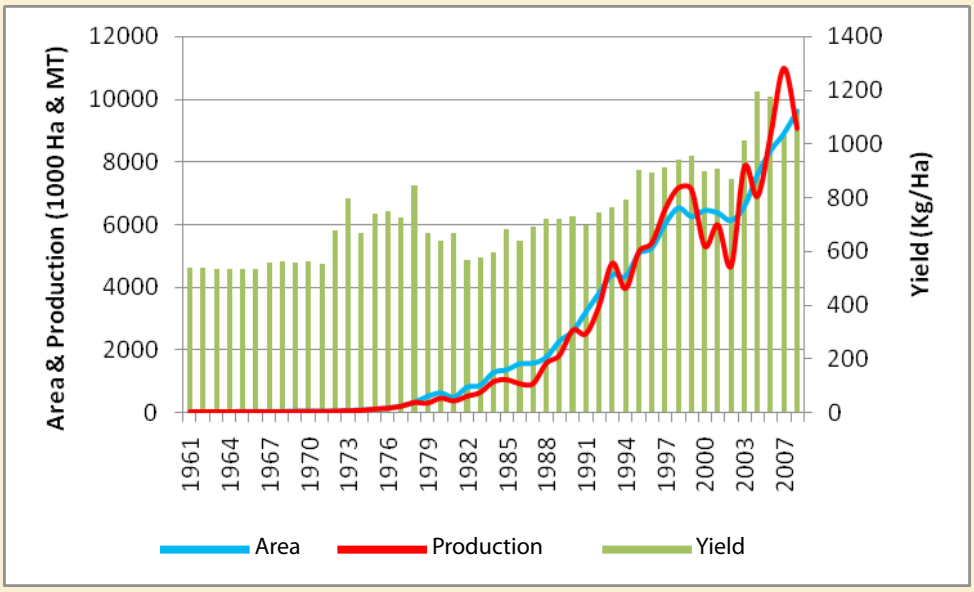
Annex Figure 2-8b: Pigeonpea trends in South Asia (calculated from FAOSTAT, 2010)



Annex Figure 2-8c: Pigeonpea trends in Myanmar (calculated from FAOSTAT, 2010)



Annex Figure 2-9a: Soybean trends in Sub-Saharan Africa (calculated from FAOSTAT, 2010)



Annex Figure 2-9b: Soybean trends in South Asia (calculated from FAOSTAT, 2010)



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