

Mozambique

Groundnut

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Importance of the crop to Mozambique's economy

Production

Groundnut occupies the largest area among the grain legumes; it is ranked the fourth most important crop after cassava, maize and sweet potato. About 99% of the area under groundnut is cultivated by small-scale peasant farmers on traditional farms and the crop is important both as a subsistence food crop as well as a source of cash (Diop et al. 2003). The oilseeds sector in Mozambique has been expanding, especially through the interventions of various NGOs, principally in Manica, Zambezia and Nampula (Diagnostic Integration Trade 2004). In Mozambique, markets for diverse crops such as legumes especially groundnut are limited to local or provincial outlets (Bias and Donovan 2003). Indeed groundnut has an important marketing channel from the northern to the southern provinces of Mozambique.

Economic importance

Mozambique has a total area of 789800 km², with approximately 45% of the country considered suitable for agriculture. The population of Mozambique is expanding rapidly from 21 million people in 2007 to an estimated 28 million in 2020; hence agricultural productivity must accelerate in order to improve rural incomes and satisfy the growing demand for food in both rural and urban areas. Among the most important legumes cultivated in Mozambique, groundnut occupies 42% of the total area (Table 1). Agriculture accounts for 22% of the gross domestic product (GDP) and provides employment for 81% of labor force. Mozambique's agricultural sector has steadily grown over the last decade with recent data showing that during 2000 to 2011 the sector grew at an average rate of 8.4% per year (World Bank 2012). Groundnut makes a significant contribution to GDP and has in the postwar period been targeted as one of the growth poles for improving livelihoods of the vast majority of Mozambique's populations (USAID 2002). Due to its pivotal place in food security groundnut has been prioritized for investments in the country.

Table 1. Relative importance of the different grain legumes grown in Mozambique.

Crop	Area (ha)	% of total area of the main legumes
Groundnut	315,000	42
Pigeonpea	190,000	25
Cowpea	126,000	17
Common bean	106,000	14
Soybean	15,000	2
Total	752,000	100

Research and development

During the civil war in Mozambique, research and development (R&D) was similarly affected. Before 1975, research on legumes was neglected in Mozambique. However, prior to the war during colonial times R&D was conducted on legumes. The main focus of R&D at that time was variety selection and postharvest control.

After 1975, research on groundnut was carried out at the Instituto Nacional de Investigacao Agronomica (INIA). Research efforts at INIA resulted in development of some improved groundnut production technologies in the country (Ramanaiah et al. 1988). During the prolonged civil war, much of the country's infrastructure and expertise in research was debilitated to a great extent. As a result, valuable genetic resources were lost forever. The strategy used to overcome this constraint was emphasis on capacity building, collection of local landraces and introduction of improved groundnut varieties generated by ICRISAT. The current average yield of groundnut is very low, with a nation-wide mean of about 450 kg ha⁻¹, which is one of the lowest in the world. The dominant varieties are Bebiano Branco, Mamane and Nametil. The target is to move from 450 to 850 kg ha⁻¹ in 2015. Most recently new groundnut varieties were released, with good traits for farmers' use. The new varieties are: ICGV-SM 99541, ICGV-SM 99568, ICGV-SM 01513, ICGV-SM 01514, JL 24 and CG 7 (Table 2).

Table 2. Major characteristics of the new groundnut varieties.

Variety (kg ha ⁻¹)	Type	Yield (kg ha ⁻¹)	100-seed weight (g)	Seed color	Disease resistance ¹	Annual rainfall (mm)
ICGV-SM 99541	Spanish	3,000	25	Tan	Rosette	600–800
ICGV-SM 99568	Spanish	2,000	25	Tan	Rosette	600–800
ICGV-SM 01513	Spanish	3,000	25	Tan	ELS, LLS	600–800
ICGV-SM 01514	Spanish	3,000	25	Tan	ELS, LLS	600–800
CG 7	Virginia	2,800	52	Red		>800
JL 24	Spanish	2,500	25	Tan		600–800

1. ELS = Early leaf spot; LLS = Late leaf spot.

There is distinct difference between groundnut production in the northern and the southern regions of Mozambique. In the South, small-seeded groundnut (Spanish type) is popular while in the North a large proportion of the area is allocated to the planting of the large-seeded groundnut (Virginia, runner type) (Table 3).

Table 3. Differences between the two most important groundnut growing regions in Mozambique.

Description	South	North
Objective of production	Food (Family)	Market
Characteristics of the varieties	Short duration (90–120 days) Small grain Erect plants Non-dormant seeds Low yield (200–300 kg ha ⁻¹) Spanish type Pure or intercropped with maize	Medium–long duration (120–180 days) Large grain Semi-erect to prostrate plants Dormant seeds High yield (500–700 kg ha ⁻¹) Virginia type Pure or intercropped with cassava

Major constraints to groundnut production

Groundnut is grown by smallholder farmers, especially women farmers, under very low input conditions, without any fertilizers and pesticides, largely as mixed crop with bambara groundnut, cowpea, cassava, maize and sorghum. Groundnut yield in Mozambique is relatively low and can easily be doubled through adoption of varieties resistant to the most common diseases in most of tropical Africa, ie, rosette, rust and leaf spots (Ndunguru et al. 1994, Naidu et al. 1999) and by following basic cropping practices. Production constraints differ between the contrasting agroecologies. Other challenges include non-availability of improved varieties adapted to various production systems, lack of organized seed production and delivery systems, drought, poor soil fertility and cultural practices. Aflatoxin contamination is a serious quality problem of groundnut in Mozambique. Loss of international/regional export markets is attributed to low quality of nuts due to aflatoxin contamination.

Planned Phase 2 activities and their contribution to national efforts

TL-II project aims to increase the productivity and production of six major grain legumes: chickpea, common bean, cowpea, groundnut, pigeonpea and soybean. For this particular strategy the focus is on groundnut particularly Objective 2. The aim is to improve availability and access of improved seed by Mozambique farmers and the particular activities are outlined below:

1. Continue introduction of farmer- and market-preferred varieties with resistance/tolerance to major biotic and abiotic stresses.
2. Develop a sustainable seed systems model (both community-based and medium-scale private producers) for the newly released varieties.
3. Popularize new and high-yielding varieties.
4. Introduce good agronomic practices in groundnut producing areas.

Project results: The expected outcomes and outputs

Vision of success for groundnut in Mozambique

Promotion and wide adoption of improved groundnut varieties will increase production and productivity which will ultimately lead to improved household food, nutrition and income security. Identification of key stakeholders and willingness of all the partners involved in the project coupled with the conducive environment for R&D will make this vision a reality.

Expected outcomes

The expected outcomes from the project will include but are not limited to: (i) increased farmers' groundnut productivity in various agroecological areas contributing to their improved overall food and nutrition security and household incomes; (ii) increased quantity and quality of groundnut produced, consumed and sold by farmer/communities and others (increase in household incomes); enhanced knowledge and skills of seed producers, NARS and other participating partners in decentralized,

farmer-led seed production and delivery system; (iii) increased access to and utilization of high-yielding groundnut varieties and information by a wide range of farmers/farming communities in the various agroecologies; (iv) stronger partnership and linkages forged among the key stakeholders for better sharing of available resources for wider coverage and dissemination of high-yielding groundnut varieties; and (v) increased social benefits resulting from change of attitude towards production of groundnut seeds and grain as profit making enterprise.

Expected outputs

The project is expected to generate a number of outputs including the establishment of a practical, functional and sustainable community-based, farmer-led seed enterprise; increased access by the farming communities and other stakeholders to high-yielding, improved varieties; increased knowledge and skills of stakeholders and intended beneficiaries in seed production (management and utilization), institutional and organizational development, and entrepreneurship and business skills; enhanced knowledge in establishing and supporting decentralized seed production and supply schemes; multiplication of adequate foundation/breeder seed of the improved high-yielding varieties that are accessible by the farmer groups for production of quality seeds and the establishment of pilot site platform for interactions among stakeholders to create strong and sustainable partnerships and linkages among stakeholders and allow for sharing of experiences on decentralized seed production and supply with other interested organizations.

Agroecologies for groundnut cultivation

The agroclimatic conditions in Mozambique allow growing a broad range of diverse crops (cereals, legumes, root and tubers, oilseeds, horticulture, fruit and others). Most of the groundnut are produced in the northern provinces of Nampula, Zambezia and Cabo Delgado and in the southern provinces of Inhambane, Gaza and Maputo. Shorter duration early-maturing cultivars are more popular in the south where it is relatively drier with erratic rainfall (≤ 600 mm per year). In the central and northern regions that receive more rainfall (800–1200 mm), medium to late-maturing varieties are grown. Groundnut is grown mostly as an intercrop or in rotation with maize, cassava, sorghum, millet and plantation crops. The rainfall patterns and agroecologies for groundnut production in Mozambique are presented in Figure 1. As indicated in the map, the crop is grown in almost throughout the country, but more than 70% is grown in north and central provinces of Nampula, Zambezia, Cabo Delgado and Niassa.

Seed systems for a groundnut green revolution in Mozambique

An effective seed production and delivery system is necessary to make good quality seed available to farmers at the right time and at low cost. In Mozambique, there is no formal groundnut seed production and supply system. Approximately 90% or more of the planting material used is from farmers' own-saved seed. Usually, the few seed companies operating in Mozambique prefer to produce and sell hybrid seed. Seed companies do not show interest in production of self-pollinated crops. Some constraints with farmers'-saved seed of groundnut are listed.

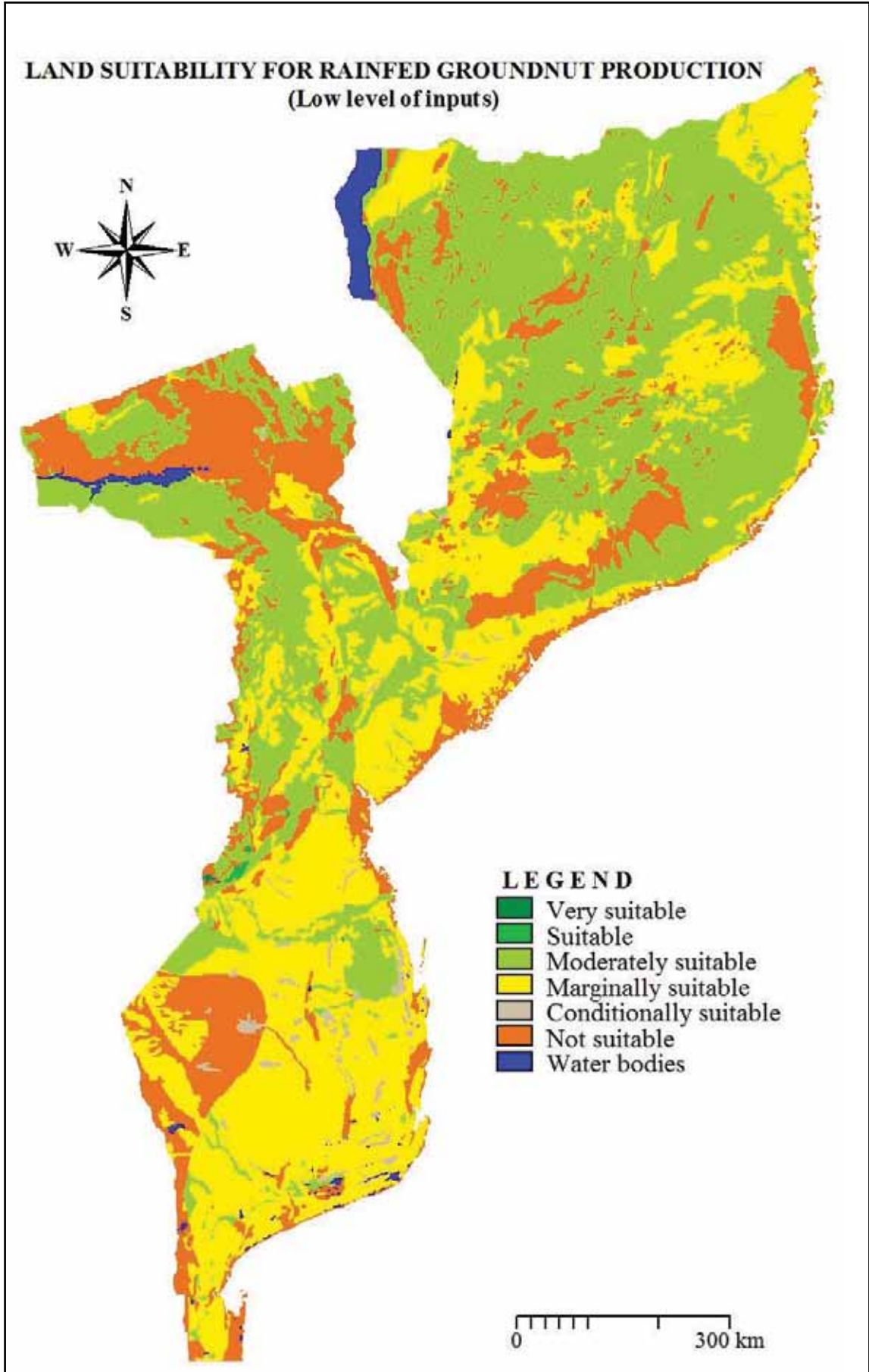


Figure 1. Land suitability for rainfed groundnut production in Mozambique.

- Groundnut seed is not stored for use in the following year due to the perceived threat of pod borer thus forcing the smallholder farmers to sell their produce and depend on external seed sources for the next crop.
- Recurrent use of own-saved seed for sowing results in lower returns to farmers.
- Lack of storage facilities and the non-awareness regarding opportunity cost to increase their incomes.
- Recurrent drought influence produces pods with shriveled kernels leading to inferior quality seeds.

For sustainability of seed production and distribution in Mozambique, it is important that the public research sector be linked with locally operating institutions, such as NGOs, extension services, farmers' associations and other community-based organizations (CBOs). For these interventions to be sustainable, they must be based on training and market development and not on direct government subsidies. During Phase 2 of the project, 20% of the current area will be planted with new improved and high-yielding varieties, with the participation of strategic partners.

Opportunities for assuring delivery of impact

The new strategic plan for agriculture development considers groundnut as one of the strategic crops for Mozambique, both for local consumption as well as for its contribution to the GDP through export. In terms of markets, in many areas local retailers and itinerant traders make up for the bulk of the marketed groundnut, which may then be linked to larger wholesalers and transporters with the responsibility of carrying the product to the final markets, mostly larger cities like Beira, in central Mozambique, and Maputo and other southern towns. Additionally, larger companies (like V & M wholesalers in Nampula) also buy, store and truck groundnut to the south. Sometimes groundnuts are shipped in containers by coastal shipping from Nacala to Beira and Maputo. In Nampula and Zambezia, supported by NGOs like CLUSA, AFRCARE and World Vision, a few farmer associations have been established and became involved in the production and marketing process of groundnut. The lessons learned and knowledge gained during the first phase of TL-II would be an important vehicle to introduce new and high-yielding varieties in major groundnut growing areas in the central northern parts of the country. IKURU, a business company partly owned by producers' associations of Nampula province and the south of Niassa, is promoting groundnut production and marketing.

Strategic partners and their roles

In addition the project will engage a number of partners both in R&D as well as in service delivery to promote use of improved seed in the project target areas. The partners available and their roles are listed in Table 4.

Seed production plan

The seed production plan for groundnut in Mozambique is given in Table 5.

Table 4. Strategic partners and their roles in seed systems.

Partner	Role
National Seed Services, Mozambique	Seed systems support, help collaborating NGOs and CBOs with quality seed production/monitoring
IIAM (Instituto Investigação Agrária de Moçambique)	Variety development, evaluation and release; production of breeder and foundation seeds
Department of Agricultural Extension Services	Provision of guidance in crop production technologies and associated packages
Farmers	Users
IKURU	Capacitate farmers formation of associations for collective production and marketing
ICRISAT	Provide improved groundnut germplasm; capacity building through training; research on effective methods for technology dissemination
Private sector (market intermediaries and emerging small-scale seed enterprises and processors)	Processing and commercialization of seed and products

Table 5. Seed delivery plan to cover the required area (20% of national area under groundnut).

Ecology	Demand (ha)	Promising variety	Seed required to reach 20% adoption (t)		Breeder seed 2012		Foundation seed 2013		Certified seed 2014		Certified seed 2015	
			Area (ha)	Production (t)	Area (ha)	Production (t)	Area (ha)	Production (t)	Area (ha)	Production (t)	Area (ha)	Production (t)
Semi-arid savanna (Nampula, part of Zambezia, Cabo Delgado and part of Niassa)	82,800	Nomeitil	1324.8	0.05	0.06	0.05	2.7	4.0	24.0	36	240.0	360
	55,200	ICGV-SM 01513	883.2	0.15	0.19	0.15	16.3	13.0	167.1	117	726.0	1089
	41,400	ICGV-SM 01514	662.4	0.05	0.06	0.05	5.0	4.0	51.4	36	240.0	360
	41,400	ICGV-SM 99568	662.4	0.15	0.19	0.15	16.3	13.0	167.1	117	726.0	1089
	55,200	JL 24	883.2	0.10	0.13	0.10	10.6	8.5	109.3	76.5	483.0	724.5
Tropical humid savanna (North of Zambezia, Tete and part of Niassa)	18,400	Mamane	294.4	0.05	0.06	0.05	5.0	4.0	51.4	36	240.0	360
	18,400	CG 7	294.4	0.15	0.19	0.15	16.3	13.0	167.1	117	726.0	1089
	9,200	Nomeitil	147.2	0.01	0.01	0.01	0.6	0.5	5.8	4.05	21.3	31.95
Semi-arid savanna (Inhambane, Gaza and Maputo)	55,200	ICGV-SM 99541	883.2	0.05	0.06	0.05	5.0	4.0	51.4	36	240.0	360
	41,400	ICGV-SM 99568	662.4	0.15	0.19	0.15	16.3	13.0	167.1	117	726.0	1089
	41,400	Nomeitil	662.4	0.01	0.01	0.01	1.3	1.0	12.9	9	21.3	31.95
Total	460,000		7360.0	0.91	1.14	0.91	95.1	77.95	974.8	701.6	4389.6	6584.4

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Cowpea

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Introduction

Importance of the crop in Mozambique

The population of Mozambique is expanding rapidly (from 21 million in 2007 to an estimated 28 million in 2020) and for this reason, agricultural productivity must be accelerated in order to improve rural income and satisfy the growing demand for food in both rural and urban areas. Cowpea is widely grown in Mozambique, mainly in warm regions, such as along the coastal sand areas and in the lowlands. About 63,000 tons of cowpea is produced annually on 126,000 ha. The grains and tender leaves are eaten. The tender leaves are regularly picked and eaten as spinach. In many areas of the country, farmers grow spreading varieties, which are photosensitive, low grain yielding, but with high biomass which is harvested as vegetable over a long period. This situation can be attributed to the importance that farmers give to the leaves for their household consumption as well as for market. In many parts of the country the importance given to leaves is higher compared to grain. Cowpea provides considerable protein in the people's diet; hence it is often called "meat for poor people" since this protein is the cheapest. From production of this crop, rural families derive food, animal feed and cash together with spillover benefits to their farmlands. Cowpea is an important component of cropping systems in the drier regions and marginal areas of the country. In collaboration with the International Institute of Tropical Agriculture (IITA), the Instituto de Investigação Agrária de Moçambique (IIAM) is testing a range of improved cowpea breeding lines combining multiple disease and insect resistance, drought tolerance and dual-purpose trait with preferred seed types. Maize, cassava and sweet potato are the most common food crops cultivated in the country. Among the most important legumes cultivated in Mozambique, cowpea occupies 17% of the total area.

Cowpea's contribution to national GDP, farmer income, food and nutrition security

Agriculture accounts for 22% of the GDP and provides employment for 81% of labor force. Although the contribution of cowpea to GDP is fairly small, the importance of the crop in rural areas is quite significant. Cowpea is grown in almost all provinces, with Nampula and Zambezia provinces accounting for about 40% of the total cowpea production in the country. No figures are available on the per capita consumption of cowpea probably because it is the leaves that are mostly picked and consumed as vegetable than grains.

Research and development

Variety development

Before 1975, research on legumes was neglected in Mozambique. However, literature references indicate that there was some work conducted on groundnut (Source: Baptista 1934, Wilson 1944, Ferreira 1958) and beans (Carvalho 1970). The two crops were mainly for export to France, Portugal, the Netherlands and South Rhodesia (Source: Baptista 1934, Ferreira 1958). The main focus was variety selection and postharvest handling and storage. Also, it was mentioned that some work was done on organic fertilizer, using cowpea. Ferreira (1958) observed that cowpea was very important in the diet

of the local people and was daily consumed by the household. However, not much has been found in the literature on cowpea research in the country.

Cowpea research at IIAM started in 1982, with the technical assistance of FAO. Emphasis was given to collection of local germplasm. Later there was massive introduction of germplasm from IITA. These are characterized by different attributes such as dual-purpose, resistance to pests, extra-early maturing, resistance to *Striga* and *Alectra*, etc. An IITA selected dual-purpose (leaves and grain) variety IT 18 was released in 1994 (Table 1). This variety is still being grown by many farmers. Recently, the following varieties were released: IT 16, IT97K-1069-6 and IT00K-1263.

Table 1. Characteristic features of common cowpea varieties developed by the Mozambican research system.

Official name of release	Year of release	Source of the materials	Genetic background (parentage, pedigree, ancestry)	Area of potential coverage (ha)	Area of actual adoption estimate (ha)	Spillover national boundaries	Average yield potential on-farm (kg ha ⁻¹)	Varietal traits (selected characteristics)
IT 18	1994	IITA	IT82E-18	7,060	4,000	Yes	450	High yield
IT 16	2011	IITA	IT82E-16	21,180	8,000	Yes	400	Drought tolerance
IT 1069	2011	IITA	IT97K-1069-6	21,180	3,000	Yes	500	Better yield, drought tolerance and dual-purpose
IT 1263	2011	IITA	IT00K-1263	21,180	3,000	Yes	500	Better yield, drought tolerance and dual-purpose

Major constraints to cowpea production in Mozambique

The major constraints of cowpea production include social, biological, physical and technological environments. Accordingly the major constraints are:

- Biotic stresses: Insect pests (aphids, flower thrips, pod sucking bugs and bruchids), diseases (fungal, bacterial and viral), *Alectra*
- Abiotic stresses: Drought, heat, low soil fertility
- Lack of inputs and poor cultural practices
- Poor pricing and lack of facilities for long-term storage

Planned Phase 2 activities and their contribution to national efforts

In TL-II Phase 2 we plan to bring about a mega impact approach where available cowpea technologies would be implemented in the most important cowpea production environment or agroecologies. We will continue introduction of farmer and market preferred varieties with resistance/tolerance to major biotic and abiotic stresses. A sustainable seed systems model (both community-based and medium-scale private producers) will be developed for the newly released varieties. With the popularization of the new and high-yielding varieties and the introduction of good agronomic practices, we hope to achieve more than 1 t ha⁻¹ productivity of cowpea in intervention area which will influence the national productivity from 0.4 t ha⁻¹ in 2012 to 0.7 t ha⁻¹ by 2015.

Expected outcomes from Phase 2 cowpea improvement

Cowpea farmers and farm practitioners will have higher income. The national cowpea production will increase more than 62,000 tons with productivity of 0.9 t ha⁻¹. There would be excess production over the national demand, which should allow for export to other countries.

Agroecologies for cowpea cultivation in Mozambique

Cowpea is more drought-tolerant than many other crops. It can grow under rainfall ranging from 400 to 700 mm per annum. Adequate rainfall is important during the flowering/podding stage. Cowpea is grown on a wide range of soils but the crop shows a preference for well drained soils, which tend to be less restrictive on root growth. This adaptation to lighter soils is coupled with drought tolerance through reduced leaf growth, less water loss through stomata, and leaf movement to reduce light and heat load under stress. The optimum temperature for growth and development is around 30°C. Varieties differ in their response to daylength, some being insensitive by flowering within 30 days after sowing when grown under any daylength at a temperature around 30°C. Cowpea is more tolerant to infertile and acid soils than many other crops. It is mostly grown in sandy soils of the coastal area, which is marginal for other crops. There are several regions that have more than 40,000 ha of cowpea area but the yield is only 0.25 t ha⁻¹ in highest productive regions (data from 2006 to 2008) (Fig. 1).

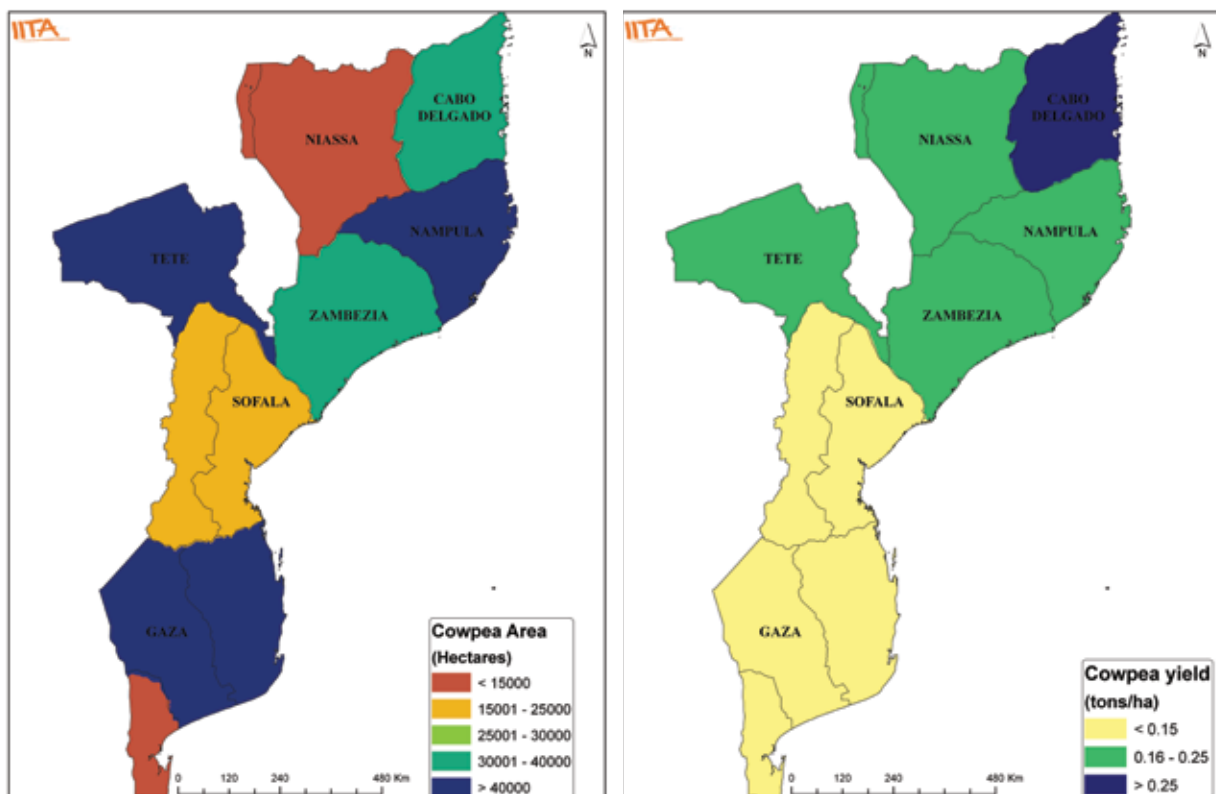


Figure 1. Cowpea production areas and yields in Mozambique.

Seed systems for a legumes green revolution in Mozambique

An effective seed production and delivery system is necessary to make good quality seed available to farmers at the right time and at affordable cost. In Mozambique, there is no formal cowpea seed

production and supply system. Approximately 90% or more of the planting material used is from farmers' own-saved seed. Usually, the few seed companies operating in Mozambique prefer to produce and sell hybrid seed. Seed companies do not show interest in production of self-pollinated crops such as cowpea.

For sustainability of seed production and distribution in Mozambique, it is important that the public research sector be linked with locally operating institutions, such as NGOs, extension services, farmers' associations and other community-based organizations (CBOs). For these interventions to be sustainable, they must be based on training and market development and not on direct government subsidies.

Mozambican seed system strategy (2012–14)

During Phase 2 of the TL-II project, 20% of the current area will be planted with new improved and higher yielding varieties, with the participation of strategic partners.

Area: 335,800 ha

Seed rate (mean): 20 kg ha⁻¹

National demand: 6,716 tons (2012–14)

Capacity to deliver 20% area (67,160 ha) \approx 1,340 tons

Target of productivity: 1 t ha⁻¹ at intervention sites and 0.7 t ha⁻¹ at national level

Total production target: >255,200 tons

Opportunities, constraints, partnership and seed production plan

The opportunities, constraints, partners and their role and plan of the seed required to cover 20% of each important cowpea agroecology in Mozambique with improved seed are discussed.

Opportunities

- Functional informal seed system exists
- Good market setup for cowpea in general and cowpea seed in particular
- The new strategic plan for agriculture development considers (cowpea as one of the strategic crops for Mozambique)
- Policy environment that enhances innovative seed system
- Assured availability of suitable varieties with the presence of IITA in Mozambique
- Sufficient land mass suitable for cowpea (millions of ha)
- High consumption level/culture in the country
- Enhanced linkages to NGOs, CBOs and private sector to leverage investments in availing improved legume technologies to farmers
- Work with farmers' associations (eg, IKURU and others), farmer groups through Farmer Field School mode of operation

Constraints

- Dominated by informal system that has technical and infrastructural gaps
- Certification process is not clear for informal seed system
- Total non-existence of mechanization at all steps
- Unpredictability of market price
- Lack of quality seed at all times in an adequate quantity by variety of demand

Partners and their role

- National Seed Services, Mozambique seed systems support, help collaborating NGOs and CBOs with quality seed production/monitoring
- IIAM (Instituto de Investigação Agrária de Moçambique): Variety development, evaluation and release; production of breeder and foundation seeds
- Department of Agricultural Extension Services: Provision of guidance in crop production technologies and associated packages
- Farmers: Users
- IKURU, CLUSA: Encourage farmers to form associations for collective production and marketing
- IITA: Provide improved cowpea germplasm; capacity building through training; research on effective methods for technology dissemination
- Private sector (Lozano Farm, Dengo Comercial, Moz Seed, Fenix Seeds, Semoc): Seed production and distribution

Table 2. Cowpea seed production in Mozambique.

Agroecological demand (ha)	Variety demand	Yield (kg ha ⁻¹)	Breeder seed in 2012		Foundation seed in 2013		Certified seed for use in 2014	
			Area (ha)	Production (t)	Area (ha)	Production (t)	Area (ha)	Production (t)
35300	IT 18	1000	0.056	0.056	2.824	2.824	141.2	141.2
105900	IT 16	1000	0.169	0.169	8.472	8.472	423.6	423.6
105900	IT97K-1069-6	1200	0.082	0.098	5.883	7.060	353.0	423.6
105900	IT00K-1263	1200	0.082	0.098	5.883	7.060	353.0	423.6
	Total		0.389	0.422	23.063	25.416	1270.8	1412.0

Table 3. Certified seed production (t) plan over three years.

Variety	2012	2013	2014
IT 18	83	117	141.2
IT 16	249	349	423.6
IT97K-1069-6	249	349	423.6
IT00K-1263	249	349	423.6
Total	830	1164	1412.0

Seed production plan

The seed production plan for cowpea in Mozambique is presented in Tables 2 and 3. The seed delivery will be handled mainly in a seed revolving or seed loan approach until the bigger impact and demand are established. The higher demand will then be satisfied by seed growers who eventually grow the crop along with technology promotion. By 2014 at least 50% of cowpea farmers at national level will have access to improved seed through the informal seed system organized in a decentralized way. Effective monitoring and support to validate seed quality in a decentralized manner will be carried out by the Seed Department of the Bureau of Agriculture, mandate research centers and the seed enterprises affiliated to the seed scheme in a contractual agreement.

Vision of success for cowpea in Mozambique

The vision of success for cowpea in Mozambique is to attain highest productivity level of more than 1 t ha⁻¹ at national and global levels that attributes to the wealth of producer farmers with significant contribution to the home food consumption. The overall production will satisfy the national demand to significantly contribute to the GDP with significant amount of exports and/or agro-processed products.

Soybean

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Introduction

The population of Mozambique is increasing and it is estimated that it will grow from 21 million in 2007 to 28 million in 2020. For this reason, agricultural productivity must increase and crop diversification should be encouraged in order to improve rural income and satisfy the growing demand for food in both rural and urban areas. Mozambique has 10 major agroecological zones varying from arid climate in the south with less than 500 mm mean annual rainfall to tropical humid climate where mean annual rainfall is more than 1800 mm in the central and northern regions stretching from parts of Zambesia, Lichinga, Nampula and Tete provinces. These high rainfall areas have the highest potential for agriculture and the region where various crops grow well. Soybean is among the crops with huge growth potential in the region (Fig. 1) and is becoming a major cash crop for smallholder farmers. It is relatively a new crop in Mozambique and cultivated mainly by smallholder farmers on an average of one-ha farms. Current production is estimated at 31,000 ha (Table 1); however, production is expected to increase over the coming years due to the high demand driven by the domestic poultry and livestock industries, available regional market, attractive prices and a commitment of the government of Mozambique to introduce alternative crops for smallholder crop diversification as farm-gate real prices for important staple food crops including maize have been declining over the past years. In addition, the recent investment support by donors and NGOs in developing and disseminating technological packages have made the soybean a profitable crop and attractive to smallholder farmers. Thus, the contribution of soybean to GDP is likely to be significant in the next few years.

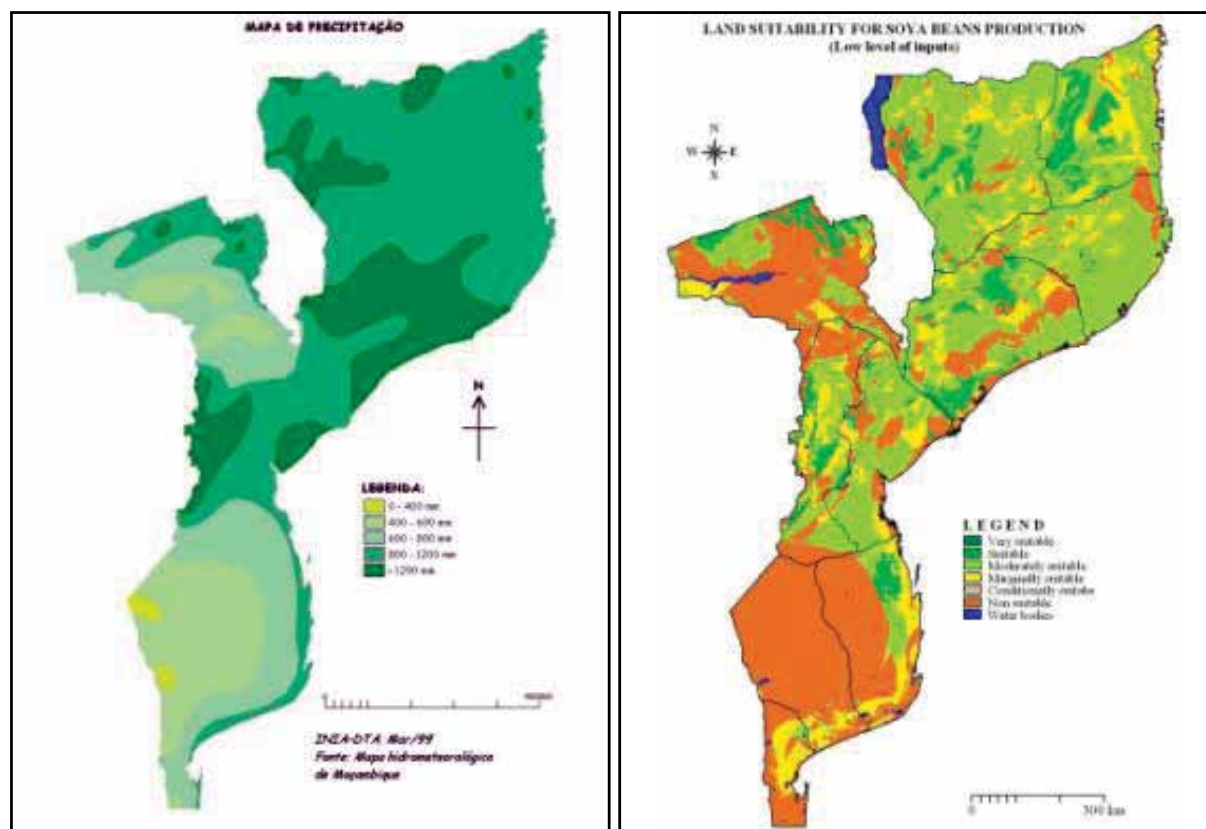


Figure 1. Rainfall pattern (left) and suitable areas for soybean production (right) in Mozambique.

Table 1. Relative importance of the different grain legumes grown in Mozambique.

Crop	Area (ha)	% of total area of the main legumes
Groundnut	315,000	41
Pigeonpea	190,000	25
Cowpea	126,000	16
Common bean	106,000	14
Soybean	31,000	4
Total	768,000	100

State of soybean research in Mozambique

Soybean research in Mozambique started in the early 1980s, in northern highlands of Zambesia Province. This research activity was part of the overall program of the state commercial farm CAPEL (Lioma Agro-Industrial Enterprise). However, the seventeen-year civil war stopped the program and the varieties grown at that time disappeared. These varieties were brought into the country from elsewhere notably Brazil. In the late 1990s, the Instituto de Investigação Agrária de Moçambique (IIAM) (The Agricultural Research Institute of Mozambique) reintroduced some varieties from IITA for evaluation. During the cropping season 2002/03 some promising lines from neighboring countries like Malawi, Zambia and Zimbabwe were introduced for both on-station and on-farm evaluation, in different agroecological zones. The varieties used were: TGx 1740-2F, TGx 1485-1D, TGx 1448-2E, Soya, 427/5/7 and Ocepara-4. The varieties TGx 1740-2F and 427/5/7 performed well.

Farmers who began growing soybean in the late 1990s used the varieties Santa Rosa, Solitaire and Storm, which were introduced from neighboring countries (Zambia, Malawi and Zimbabwe). As a result of the combined effort of IITA and IIAM, the first varieties were released and farmers have more variety options. The released varieties are: Wãmìni (TGx 1740-2F), Sana (TGx 1485-1D), Zamboane (TGx 1904-6F), Wima (TGx 1908-8F), Olima (TGx 1937-1F), Ocepara-4, H7, H17 and 427/5/7. The main characteristics of these varieties are presented in Table 2.

Table 2. Major characteristics of the new varieties of soybean.

Variety	Type	Yield (kg ha ⁻¹)	100-seed weight (g)	Seed color	Region
Wãmìni	Determinate	3,000	15	Cream yellow	Central and Northern
Sana	Indeterminate	2,500	15	Cream yellow	Central and Northern
Zamboane	Indeterminate	3,500	15	Cream yellow	Central and Northern
Wima	Indeterminate	3,500	15	Light yellow	Central and Northern
Olima	Indeterminate	3,500	14	Cream yellow	Central and Northern
Ocepara-4	Indeterminate	2,500	14	Cream yellow	Central and Northern
427/5/7	Indeterminate	2,800	15	Cream yellow	Central and Northern
H7	Determinate	3,000	18	Cream yellow	Central and Northern
H17	Determinate	3,500	15	Cream yellow	Central and Northern

Seed production

Area: 36,000 ha

Seed rate (mean): 60 kg ha⁻¹

National demand: 2160 tons (2012–14)

Capacity to deliver 20% additional requirement: $2160 \times 0.2 = 432 \times 1.2 = 518.4$ tons

Target of productivity: 2 t ha^{-1} at intervention sites and 1 t ha^{-1} at national level Total production target: 17280 tons

Major constraints to soybean production

Production constraints are many and diverse due to contrasting agroecologies and include the following:

- Non-availability of improved varieties adapted to various production systems until recently
- Lack of seeds for the farming communities
- Lack of varieties resistant to foliar diseases such as rust
- Inadequate nitrogen fixation of varieties due to non-availability of inoculants
- Limited use of P fertilizers due to limited availability and high prices
- Lack of organized seed production and delivery systems
- Poor seed viability from one season to the next
- Frequent drought in some regions; weak market linkage with producers, processors and consumers.

Opportunities

- The poultry and livestock industries in Mozambique demand more than 100,000 tons of soybean for feed every year. The gap between current production and domestic demand is largely met by imports from Argentina and Brazil.
- Good climatic conditions for soybean production coupled with available land for expansion.
- The major interest and support from donors to improve income and food security and enhance livelihoods of smallholder farmers through research and dissemination of technological packages to boost crop yields.
- The presence of IITA and the collaboration with IIAM on all aspects of soybean research.
- The current government policy is favorable to soybean production. There is shortage of edible oil and the government is looking for local production and processing. In this regard, the government is encouraging the production of oilseed crops.
- There is significant market for edible oil and the annual industrial production is estimated to be as high as 110,000 tons.
- Presence of several NGOs promoting soybean production.
- The regions are currently benefiting from increased investments not only in agricultural production but also through a great opportunity for vertical coordination with a processing unit under installation in central Nampula.

R&D emphasis in Phase 2

- Continue introduction of farmer- and market-preferred varieties with resistance/tolerance to major biotic and abiotic stresses
- Develop a sustainable seed systems model (both community-based and medium-scale private producers) for the new released varieties
- Popularize the new and high-yielding varieties
- Introduce and promote good agronomic practices in soybean production

Seed systems for a legumes green revolution in Mozambique

An effective seed production and delivery system is necessary to make good quality seed available to farmers at the right time and at affordable cost. In Mozambique, there is no formal soybean seed production and supply system. Approximately 60% or more of the planting material used is from farmers' own-saved seed. Usually, the few seed companies operating in Mozambique prefer to produce and sell hybrid maize seed. Seed companies do not show interest in production of self-pollinated crops such as soybean.

For sustainability of seed production and distribution in Mozambique, it is important that the public research sector be linked to locally operating institutions, such as NGOs, extension services, farmers' associations and other community-based organizations (CBOs). For these interventions to be sustainable, training of farmers and stakeholders as well as market development are critical.

During Phase 2 of the project, 20% of the current area will be planted with new improved and high-yielding varieties, with the participation of strategic partners (Table 3). The seed production plan up to 2014 is presented in Table 4 and the key partners for seed distribution in Table 5.

Table 3. Strategic partners and their role in seed systems.

Partner	Role
National Seed Services, Mozambique	Seed systems support, help collaborating NGOs and CBOs with quality seed production and monitoring
IIAM (Instituto de Investigação Agrária de Moçambique)	Variety development, evaluation and release; production of breeder and foundation seeds
Department of Agricultural Extension Services	Provision of guidance in crop production technologies and associated packages
Farmers	Users of released varieties and associated packages
IKURU	Capacitate farmers in formation of associations for collective production and marketing
IITA	Provide improved soybean germplasm; capacity building through training; develop and disseminate technology
Private sector (market intermediaries and emerging small-scale seed enterprises and processors)	Processing and commercialization of seed and products

Table 4. Soybean production plan for soybean in Mozambique.

Ecology	Traits		Seed production (t)		Promising varieties	Seed to reach 20% adoption (t)		20% additional requirement (*1.2%)	Seed production (t)			
	Demand (ha)	Productivity	Market	Market		Breeder seed	Foundation seed		Year 1 (2012)	Year 2 (2013)	Year 3 (2014)	
Semi-arid, 800–1200 mm rainfall (Nampula)	3,000	Early maturing, promiscuous	Oil and protein	Oil and protein	Sana (TGx 1485-1D)	0.024	0.720	18	21.6	7.2	7.2	7.2
Tropical humid savanna, 1800–2500 mm rainfall (Nampula, Zambezia, Cabo Delgado)	25,000	Early maturing, promiscuous, drought tolerant Late maturing, promiscuous, drought tolerant, high yielding Early maturing, promiscuous, drought tolerant, high yielding Medium maturing, promiscuous, drought tolerant	Oil and protein Oil and protein Oil and protein	Oil and protein Oil and protein Oil and protein	Wámini (TGx 1740-2F) Olina (TGx 1937-1F) Sana (TGx 1485-1D) Zamboane (TGx 1904-6F)	0.019 0.08 0.080 0.054	0.648 2.40 2.40 1.96	18 60 60 60	21.6 72 72 72	7.2 24 24 24	7.2 24 24 24	7.2 24 24 24
Humid savanna 900–1400 mm rainfall (Zambezia)	8,000	Early maturing, promiscuous, drought tolerant, high yielding Early maturing, promiscuous, drought tolerant, high yielding Medium maturing, promiscuous, drought tolerant, high yielding	Oil and protein Oil and protein Oil and protein	Oil and protein Oil and protein Oil and protein	Wámini (TGx 1908-8F) Wámini (TGx 1740-2F) Wámini (TGx 1740-2F)	0.054 0.065 0.026	1.96 2.16 0.864	60 60 24	72 72 28.8	24 24 9.6	24 24 9.6	24 24 9.6
Total						0.476	15.65	432	518.4	172.8	172.8	172.8

Table 5. Key partners for soybean production and distribution.

Seed production	Distribution	Markets
IIAM, IKURU, USEBA, Dengo Commercial, Moz Seeds, Lozane Farm, Phoenix Seeds, SEMOC	IKURU, CLUSA, Technoserve, SDAE, SEMOC	IKURU, SEMOC, Lozane Farm, Moz Seeds