Mali

Groundnut

Ondie Kodio, Bonny Ntare and Jupiter Ndjeunga

Introduction

Mali is a major groundnut producer in West Africa with production estimated at 332,000 tons in 2004–10. Growth in production is estimated to be about 4.41% per annum mainly due to area growth of 4.44% per annum (Source: Ndjeunga et al. 2010). Groundnut area and production in Mali are presented in Table 1 and Figure 1.

Table 1. Groundnut production in Mali[1].

Parameter	Value
Average area (ha)	347,791
Average production (t)	328,730
Average yield (current) (kg ha^{-1})	944
Average yield (2015) (kg ha^{-1})	1200–1500
Expected growth of production (%)	5.1
Proportion of production sold (%)	68

1. Source: FAOSTAT (2007–11).

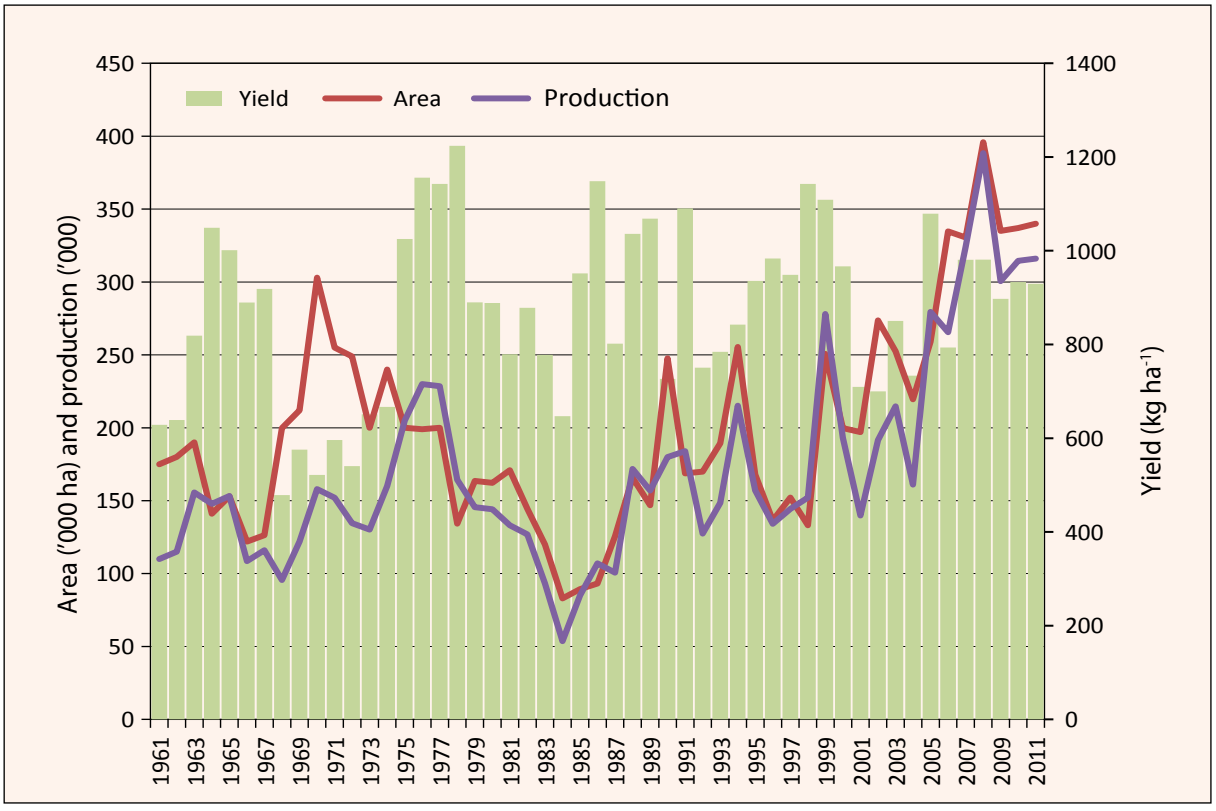

Figure 1. Trends in area, production and yield of groundnut in Mali (1961–2011).

Crop improvement

There has been no research on groundnut improvement in the national program of Mali. However since 1995, ICRISAT has introduced a wide range of new varieties which have been evaluated both on station and on-farm resulting in the release of several varieties, including ICG (FDRS) 10, ICG (FDRS) 4), ICG 7878, Fleur 11, ICGV 86015 and ICGV 86124. These have not yet been largely adopted by farmers and are planted on about 3% of the groundnut area. Since 1998, the ICRISAT breeding program has been conducting joint research with the national program and attempts made to enhance capacity through training of technicians and most recently by appointing a groundnut breeder at MSc level. It is hoped that the national breeding program will be able to benefit from these efforts. Old varieties such as 47-10 (Kalasobani) and 28-206 are still grown by farmers.

Agroecologies

Groundnut production is concentrated in the west, south and parts of the center, covering the regions of Kayes, Koulikoro, Sikasso and Segou. These regions account for 97% of the area and 98% of groundnut production in Mali. Average annual rainfall ranges from 400 to 800 mm. Kayes is the most important groundnut producing region, accounting for 33% of area and 35% of groundnut production in Mali. This is followed by Koulikoro which accounts for 21% of groundnut area and 24% of groundnut production.

Major constraints

These can be grouped in biotic/abiotic and socioeconomic constraints. The main abiotic constraint is drought especially in the Sahel/dry savanna regions of Kayes, Koulikoro and Segou and low soil fertility. Among the biotic constraints are foliar diseases, termites and aflatoxin contamination.

The socioeconomic constraints include:

- Lack of availability and access to seed of new improved varieties
- Poor access to agricultural equipment to expand production areas
- Difficulties in accessing fertilizers and pesticides
- Labor constraints for weeding, harvesting and threshing
- Poorly developed markets and volatile prices
- Lack of organized input delivery system
- Poor road infrastructure to transport produce to markets
- Poorly developed processing industry
- Lack of coordination of actors along the value chain

Strategic partners

The strategic partners and their role in the seed system are given in Table 2.

Table 2. Strategic partners and their role.

Partner	Role
National Seed Service	Seed systems support, helping community-based organizations (CBOs) and farmers' associations with seed storage infrastructure
Institut d'Economie Rurale (IER)	Variety development, evaluation and release, breeder and foundation seed production
Department of Agriculture	Seed regulation and quality control
Rural Development Projects, non-governmental organizations (NGOs), CBOs and Farmer organizations	Technology testing and delivery, production of certified seed, processing and marketing
Farmers	Users
Banque Nationale de Développement Agricole (BNDA) du Mali and Savings and Loan Associations	Providing credit to organized producers
LABOSEM	Ensure seed quality and certification
IARCs (ICRISAT)	Provide enhanced germplasm and capacity building through training in priority skills of NARES; produce breeder seed of released varieties
Private sector (market intermediaries and emerging small-scale seed enterprises and processors), including Faso Kaba and Comptoir 2000	Processing and commercialization of seed and products

Capacity building needs

There is in general a lack of critical mass of researchers for groundnut research in Mali. There is a need to train breeders, seed technologists and crop protection specialists to reinforce the current staff. There is insufficient infrastructure for routine phenotyping such as screen houses, meteorological station and irrigation facilities to enhance crop improvement.

Special cultural/gender considerations

Both men and women are involved in the production and marketing of legumes. Women are responsible for almost 100 percent of harvesting and processing of groundnut. Women often lack good land to produce groundnut and are usually not involved in decision-making on variety choices.

Processing and storage requirements and market opportunities

There are processing opportunities for groundnut for oil extraction and production of cake for animal feed. Groundnut paste is a major ingredient in sources accompanying cereal-based meals. Considering the adverse effects of aflatoxin contamination on human health, policy makers need to be sensitized to impose food safety regulations. A national campaign is needed to sensitize the population about the dangers of aflatoxin. The bottom line is minimizing aflatoxin contamination through use of best-bet pre- and postharvest management. Domestic and regional market opportunities for groundnut seed and other products exist and need to be tapped.

Key policies (recently implemented/needed)

- The 10-year plan to achieve the Millennium Development Goals (2006–15)
- The Poverty Alleviation/Reduction strategy (2007–11)
- The economic and social development program (2008–12)
- The Agricultural Orientation Law (adopted by parliament in 2006)
- The agricultural research strategic plan
- Harmonized seed policies and regulations awaiting act of parliament
- Co-organization of capacity building activity for the sustainable agriculture project (PRECAD), and CPDS participation in the national cereals and legumes market at Ségou in 2009 and 2010
- The Feed the Future Program supported by USAID is anchored on value chains

In all the above national initiatives, research on legume crops and in particular groundnut is well emphasized for semi- and industrial development. They also aim to provide an enabling environment to encourage private sector to invest in agro-processing and seed production for several crops.

Key issues for competitiveness (reducing production costs, increasing market value)

- Large-scale adoption of improved (and market preferred) varieties
- Increasing yields and meeting basic quality standards
- Seed supply arrangements should emphasize schemes with low transaction investment costs targeting village seed system to maintain and distribute seed
- Warehousing facilities to allow farmers keep their produce until prices are favorable as they tend to collapse at harvest.

Mechanization as it relates to timely planting/harvesting and processing

Farmers are largely poorly equipped with agricultural implements. Most (about 80%) own hand tools and less than 5% own a complete set of animal traction equipment (ie, a pair of bullocks, a plow and multipurpose equipment and a seeder) for production. Harvesting is largely done by hand and processing is done with rudimentary tools not amenable to large-scale processing at the local level. The low level of equipment has significant implications on the potential for expanding groundnut cultivation in the country. Groundnut is labor intensive such that returns to labor for groundnut crop enterprise may be lower than the opportunity cost of labor. In this case the returns to investment in small mechanization in the form of simple animal traction may be high. Access to production and processing equipment is essential to increase productivity and profitability of groundnut.

Monitoring and evaluation

Monitoring and evaluation is done at several administrative levels: production, area and yield from national statistics, household surveys and reports. Socioeconomists at ICRISAT and IER monitor adoption of improved technologies and innovations and especially varieties at national level. There are annual work planning and review meetings at sub-regional and national levels where progress of work is reported.

Perspectives for Phase 2

Building on the solid foundation made in Phase 1, successful intervention will be scaled up to other regions of Mali. Linkages with similar programs such as PASS and the West Africa Seed Program (WASP) will be strengthened to maximize synergies. The opportunities to sustain the outputs of Phase 1 exist.

Seed systems

A range of improved varieties selected by farmers is available and the national research program is responsible for production of breeder seed of preferred varieties. Subsequent stages from foundation seed production to distribution of certified seed is managed mainly by commercial cooperatives and community enterprises. Small and medium-scale seed suppliers such as Faso Kaba and Comptoir 2000 have emerged and are potential producers of foundation seed. The presence of CBOs and individual entrepreneurs empowered on variety selection and maintenance should ensure a continuous supply of good quality seed. However, farmers' groups will need to be better organized, with more effective leadership at national level to achieve more coordinated production and marketing of legume seeds. NGOs will have an important role to play in facilitating stronger coordination, and in helping stimulate value addition at the local level through agro-processing activities and innovation platforms. Currently ICRISAT is the major source of breeder seed of recently released varieties in the major two regions of Mali. The groundnut seed production plan for Mali is given in Table 3.

Table 3. Groundnut seed production roadmap for Mali.

Ecology	Demand (ha)	Promising varieties	Seed available (t)		Seed production (t)		Seed to reach 20% adoption (t)	Seed production (t)
			Breeder seed	Foundation seed	Breeder Seed	Foundation seed		
Kayes/ Sudan/ Sahel	148,369	Fleur 11 JL 24 ICGV 86015 ICGV 86124	0.05 0.08 0.1 0.12	0.5	23.74	237.4	2374	1900
Sikasso/ Guinea	80,128	ICGV 86124, Fleur 11 28-206 JL 24 ICGV 86015						
Koulikoro/ Sudan	74,007	ICG (FDRS)4 ICGV 86015 Fleur 11 ICGV86124	1	0.8 1	10.84	117.4	1183	946
Ségou/ Sudan	34,425	Fleur 11 JL 24 ICGV 86124			5.51	55.1	551	441
Mopti/ Sahel	16,647	Fleur 11 JL 24 ICGV 86124			0.67	24.6	264	211
Toumbouctou/ Sahel	100	Fleur 11			0.016	0.16	1.6	2
Total	353,679		1.35	2.3	40.776	434.66	4373.6	3500

Cowpea

Mamadou Touré, Christian Fatokun, Ousmane Coulibaly, Alpha Kamara and Ousmane Boukar

Introduction

Importance of cowpea in Mali

Cowpea is one of the major legumes grown in Mali. It is the most consumed and most cultivated food legume in Mali after groundnut. It is an important source of protein in the diet and cash income. Crop residues of this crop are important sources of animal feed, especially for ruminants. Cowpea is mainly grown as an intercrop with pearl millet and sorghum, especially in the drought-prone areas of Ségou and Mopti regions. However, monocropping cowpea is becoming popular as its economic importance is increasing. For example, cowpea monocrop has taken off in Central Mali through an integrated rural development project, which supplied improved seeds, fertilizers and pesticides on credit to farmers (Source: Coulibaly 1987). It plays an important role in food security of rural and urban populations. Cowpea is consumed throughout the year. The demand of cowpea in Mali is estimated at 23,000 tons per year. Mali produces 75,000 tons annually on about 261,000 ha (Fig. 1). The rate of growth for the period from 1985–87 to 2005–07 for cowpea area, yield and production were estimated at 3.2%, 3.3% and 8.8%, respectively. It has been projected that production of cowpea would grow at the rate of 5.9% during 2010 to 2020. Producer prices for Mali were relatively stable throughout the period during 1991 to 2008 (Source: Abate et al. 2012).

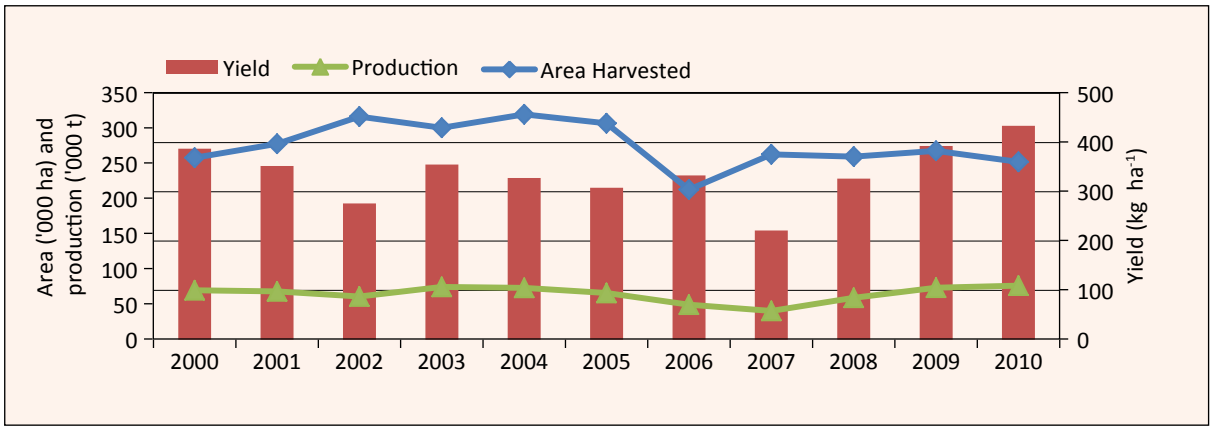

Figure 1. Cowpea area, production and yield in Mali during 2000 to 2010 (Source: FAOSTAT 2012).

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

The value chain of cowpea starts with the production by small-scale farmers; and in the Sahelian countries like Mali, farmers typically sell their marketable surplus grains to rural assemblers, who in turn sell to urban wholesalers directly or through commission agents (Source: Langyintuo et al. 2003). Commission agents sell grain on behalf of their clients (rural assemblers), and provide storage but do not take any price risk associated with the storage function as the commission fee paid to the commission agent by rural assemblers varies. It is often about 2% of the wholesale price (Source: Langyintuo et al. 2003). Impact assessment studies in Mali showed that cowpea production and protection research products have reached large number of people and this is generating a substantial economic benefit. The average income per hectare of cowpea is about 178,000 FCFA per year at a cost of production of 54,000 FCFA (input and seed costs). Moreover, the price of cowpea could vary from 275 to 500 FCFA

during the year. The CRSP storage technologies developed in Cameroon are now extended in many Sub-Saharan African countries including Nigeria, Niger, Burkina Faso, Mali, Senegal, Chad, Zimbabwe and Mozambique. These technologies will allow farmers to sell their crop during the period when the price will be high. The consumption per capita per year is about 1.6 kg. The expected growth of production is 5.9% (Source: Abate et al. 2012) while the proportion of production sold is 50%.

Research and development

Variety development

Cowpea breeding in Mali is conducted mainly by the Institute of Rural Development (IER), which was created in 1960. IER's cowpea program has the responsibility to conduct research activities including breeding, agronomy and crop protection. The main objective of the cowpea breeding program is to develop high-yielding varieties with drought tolerance and *Striga* resistance. Several varieties were released by the cowpea breeding unit, which has a harmonious collaborative relationship with IITA's cowpea breeding unit (Table 1).

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

Official name of release	Year of release	Source of the material	Genetic background (parentage, pedigree, ancestry)	Area of potential coverage (ha)	Area of actual adoption estimate (ha)	Spillover national boundaries	Average yield potential (on-farm) (t ha^{-1})	Varietal traits (selected characteristics)
Korobalen	1998	IITA	IT89KD-374	29,444	43,264	Yes	1–1-5	Medium maturing, resistant to *Striga*
Suvita2	1994	INERA	Local from Burkina	21,031	21,632	Yes	1.5	Medium maturing, resistant to *Striga*
Cinzana Telimani	2003	IER	Suvita2/Tvu 79/Suvita 2	21,031	21,632	Yes	1.5	Early maturing, resistant to *Striga*
Djèmani	1993	IER	IAR 1696/ NIBAN	29,444	28,843	Yes	1.5	Late maturing, resistant to yellow mosaic virus
Dounanfana	1993	IER	IAR 1696/ NIBAN	29,444	28,843	Yes	2	Late maturing, resistant to yellow mosaic virus
IT90K-372-1-2	2002	IITA	IT90K-372-1-2	29,444	14,421	Yes	1–1.5	Medium maturing, resistant to *Striga*
Jiguiya	2011	IITA	IT97K-499-35	33,650	28,843	Yes	1.5	Early maturing, resistant to *Striga*
Sangaraka	1998	IITA	IT89KD-245	29,444	36,053	Yes	2	Medium maturing, resistant to *Striga*
Yèrè Wolo	1993	IER	IAR 1696/ NIBAN	29,444	28,843	Yes	2	Late maturing, resistant to yellow mosaic virus

Major constraints to cowpea production

The major constraints to cowpea production include social, biological, physical and technological environments:

- Biotic stresses: Insect pests (aphids, flower thrips, pod sucking bugs and bruchids), diseases (bacterial, viral and fungal) and *Striga*
- Abiotic stresses: Drought, heat, low soil fertility

- Difficulties in accessing inputs (improved seed, pesticides and fertilizers), poor cultural practices
- Labor constraints for weeding and harvesting

Planned Phase 2 activities and their contribution to national efforts

In TL-II Phase 2, we plan to bring about a major impact through improved cowpea technologies that would be implemented especially in the important cowpea production environments or agroecologies. At the end of this project it is expected that the productivity of cowpea should reach at least >1 t ha^{-1} and to increase the national productivity from 0.3 in 2012 to 0.8 t ha^{-1} by 2014.

Expected outcomes from Phase 2 cowpea improvement for production and productivity

Cowpea farmers and farm practitioners will have higher income. National cowpea production will increase to more than 23,000 tons with productivity of 1 t ha^{-1}. There would be an excess production over the national demand, which should allow for export to other countries.

Agroecologies for cowpea cultivation in Mali

Cowpea production in Mali is concentrated in the Sudan Savanna and Sahel Savanna agro-zones. Data from 2006 to 2008 were used to map the area under cowpea and cowpea productivity in these areas (Figs. 2 and 3). There are regions with more than 75,000 ha under cowpea cultivation and there are some with average productivity level up to 1 t ha^{-1}.

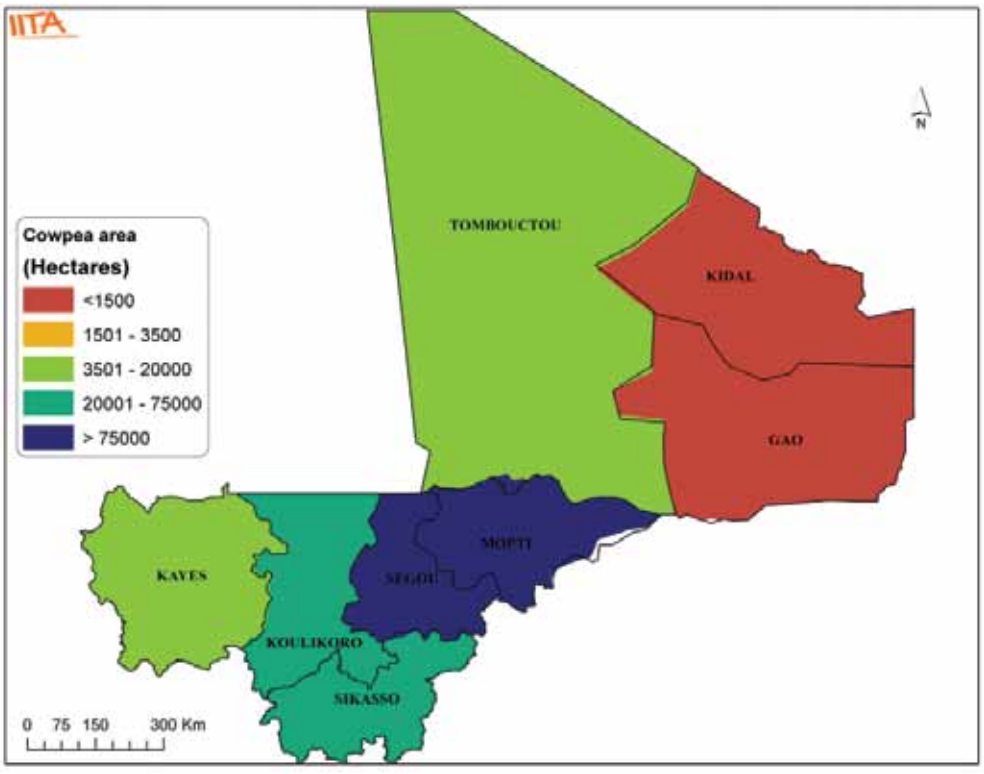

Figure 2. Cowpea production areas in Mali.

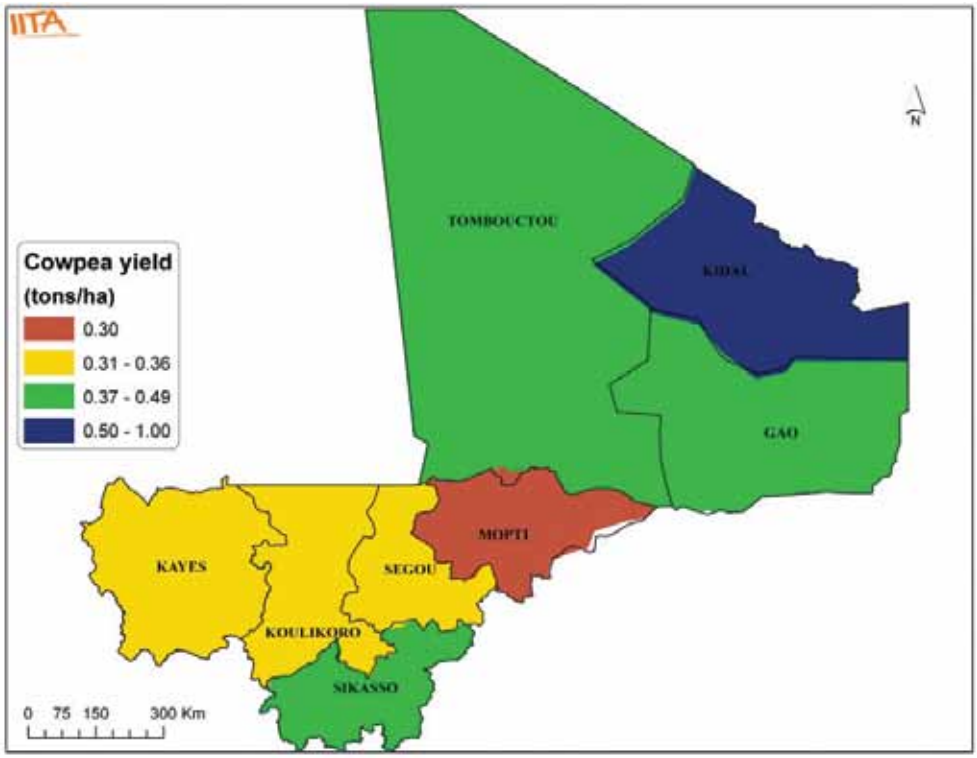

Figure 3. Cowpea yield distribution in Mali.

Seed systems for a legume green revolution in Mali

In Mali, grain markets have been liberalized with measurable success, but the liberalization of seed markets for sorghum, millet and cowpea (the staple crops) has proven to be more difficult. Despite continuous progress by scientists in breeding well-adapted, high-yielding commercial seed varieties, only an estimated 10% of Mali's millet and cowpea area and less than 20% of its sorghum area has been planted with certified seed. This is because many smallholders have limited or no access to certified seeds and they have also been long accustomed to generating their own seed or supplying each other with seed according to clan or ethno-linguistic group. Traditionally, these informal seed systems work quite well, but researchers were surprised to discover that in areas subject to harsh agroclimatic conditions, successive crop failures have caused village seed systems to break down, and local grain markets have become important sources of seed. This finding led IFPRI researchers to examine seed transactions in a dozen weekly markets in the Sahel region of Mali. They found that no certified seed is available in these markets, but that grain suitable for seed is being sold primarily by female vendors who are also farmers. Because the vendors bring unmixed seed directly from their granaries, the purchasers know the provenance and can depend on their quality, which is especially important in harsh environments where the range of adaptability is very limited. Grain color plays an important role in the preference of consumers. The predominant grain color in visited markets is white. Sixty-four percent of cowpea varieties used by farmers are white and 79% are black eyes.

Over the years, scientists at IER have developed a number of cowpea varieties that are resistant to *Striga* and tolerant to drought. These varieties require a minimum spray with insecticides to protect them against insect attack. These varieties are however, not widely adopted because of lack of high quality seeds. At planting, there is a shortage of quality seeds and farmers plant whatever grain they get, which leads to poor stands and low yields. Private seed companies that produce and market cowpea seed are not many. Only one seed company (Faso Kaba) is producing and marketing improved cowpea seed in Mali. Farmers mostly rely on NGOs to source and distribute improved cowpea seeds in

the main producing areas. However, recently other companies are getting involved in seed production. These include: Comptoir 2000, Nako Shi and Coop Semence.

With the increased adoption of improved (and market preferred) varieties, seed system needs to be established to increase the production of cowpea in Mali. Seed supply arrangements should emphasize schemes with low transaction investment costs targeting village seed system to maintain and distribute seed.

Malian seed system strategy (2012–14)

The TL-II has facilitated an innovation platform in Mali to enhance cowpea seed production in the various regions of Mali. The platform consists of NGOs, a major seed company (Faso Kaba) and IER. IER evaluates and adapts high-yielding varieties and produces foundation seed of selected varieties after their official release. The NGOs are involved in large-scale demonstration and dissemination of the improved varieties across the regions. They also strengthen community seed schemes to produce and market seeds of improved cowpea varieties. Cowpea area, demand and other parameters are given below.

- Area: 251,390 ha
- Seed rate (mean): 20 kg ha^{-1}
- National demand: 5,028 tons (2012–14)
- Capacity to deliver 20% area: 50,278 ha ≃ 1,000 tons
- Target of productivity: 1 t ha^{-1} at intervention sites and 0.8 t ha^{-1} at national level
- Total production target: >211,160 tons

Opportunities, constraints, partnership and seed production plan

The target is to cover 20% of each important cowpea agroecology in Mali with improved seeds.

Opportunities

- New law that enhances innovative seed system
- High demand for cowpea as part of the daily staple
- Good market access for cowpea
- Availability of suitable varieties in major cowpea growing areas
- Favorable ecology (drylands) for cowpea production

Constraints

- Low yield because of biotic and abiotic stresses
- Lack of insecticides to protect the cowpea crop
- Limited seed production and marketing opportunities
- Low capacity of national seed certification laboratory
- Insect pests from field to the store
- Poor seed distribution systems (lack of seed dealers in communities)

Partners and their role

- IER: Responsible for the improvement of cowpea; provides laboratory and other technical services to agricultural organizations, farmers, agro-based industries and others needing these services
- National Seeds Service: Seed policy
- Labo Sem: Regulatory seed laboratory
- IITA: Technology development, backstopping in training, technical skills in priority areas, development of joint projects and production of foundation seed
- NGOs such as SNV, World Vision, CRS, Millennium Development Village Project: Carry out technology dissemination activities especially in rural areas and promote community seed production and seed marketing
- Departments of Ministry of Agriculture in the various regions: Field demonstration, farmer training and varietal dissemination
- Seed companies (Faso Kaba, Comptoir 2000): Produce and market certified seeds
- World Vision, Africare, Millennium Development Village, SG2000: Extension
- Farmers and farmers' organizations, CPDS (Cooperative Seeds Producers Association): End-users

Seed production plan

Cowpea seed production plan for Mali is presented in Tables 2 and 3.

Table 2. Cowpea seed production plan for Mali.

			Breeder seed in 2012		Foundation seed in 2013		Certified seed for use in 2014	
Region (Demand ha)	Variety demand	Yield (kg ha^{-1})	Area (ha)	Production (kg)	Area (ha)	Production (t)	Area (ha)	Production (t)
Mopti (83150)	Korobalen	1000	1299.22	129.92	5.20	5.20	207.88	207.88
	Suvita2	1000	1299.22	129.92	5.20	5.20	207.88	207.88
Ségou (67288)	Korobalen	1000	700.92	70.09	2.80	2.80	112.15	112.15
	Sangaraka	1000	700.92	70.09	2.80	2.80	112.15	112.15
	Cinzana Telimani	1000	700.92	70.09	2.80	2.80	112.15	112.15
Koulikoro (67233)	Djèmani	1000	525.27	52.53	2.10	2.10	84.04	84.04
	Dounanfana	1000	525.27	52.53	2.10	2.10	84.04	84.04
	Yèrè Wolo	1000	525.27	52.53	2.10	2.10	84.04	84.04
	Korobalen	1000	525.27	52.53	2.10	2.10	84.04	84.04
Sikasso (20790)	Djèmani	1000	162.42	16.24	0.65	0.65	25.99	25.99
	Dounanfana	1000	162.42	16.24	0.65	0.65	25.99	25.99
	Yèrè Wolo	1000	162.42	16.24	0.65	0.65	25.99	25.99
	Korobalen	1000	162.42	16.24	0.65	0.65	25.99	25.99
Kayes (12248)	Korobalen	1000	191.38	19.14	0.77	0.77	30.62	30.62
	Cinzana Telimani	1000	191.38	19.14	0.77	0.77	30.62	30.62
Tombouctou (1583)	Korobalen	1000	49.50	4.95	0.20	0.20	7.92	7.92
Gao (82)	Korobalen	1000	0.85	0.09	0.00	0.00	0.14	0.14
	Jiguiya	1000	0.85	0.09	0.00	0.00	0.14	0.14
	IT90K-372-1-2	1000	0.85	0.09	0.00	0.00	0.14	0.14
Total			7886.75	788.68	31.55	31.55	1261.88	1261.88

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

Variety	2012	2013	2014
Korobalen	200	340	468.73
Suvita2	70	140	207.88
Sangaraka	30	70	112.15
Cinzana Telimani	45	80	142.77
Djèmani	30	70	110.03
Dounanfana	30	70	110.03
Yèrè Wolo	30	70	110.03
Jiguiya	0.08	0.10	0.14
IT90K-372-1-2	0.08	0.10	0.14
Total	435.16	840.2	1261.88

The quantity of seed will be produced mainly by Faso Kaba, other small-scale seed companies and community seed producers supported by the NGOs. IER will work with NGOs to produce foundation seed. The NGOs will support seed dissemination and marketing activities.

Vision of success for cowpea in Mali

The vision of success for cowpea in Mali is to attain highest productivity level of >1 t ha^{-1} at national and global levels that attributes to the wealth of producer farmers with significant contribution to the home consumption. The overall production will satisfy the national demand (about 23,000 tons) to significantly contribute to the GDP with significant amount of exports and/or agro-processed products.