Malawi

Groundnut

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Introduction

Production

Groundnut (*Arachis hypogaea*) is among the major valuable and versatile grain legume crops with tremendous contributions to improving household food security, nutrition, soil health and fertility in Malawi. Additionally, groundnut thrives under low rainfall and poor soils, and can be grown with minimum capital investment. The average annual cultivated area for groundnut for the period 1991–2006 (17000 ha) accounted for 27% of the total legume area. Groundnut production per year during the same period accounted for 28% of Malawi's total legume production. The area planted to groundnut was about 14% of the area planted to maize (Simtowe et al. 2009).

Importance of the crop to Malawi's economy

Within Malawi, groundnut is the most important legume and oilseed crop both in terms of the total area cultivated as well as production. Groundnut has huge untapped potential for contributing to the socioeconomic development in the country (Edriss and Simtowe 2002). It serves as a good source of both protein (generally 12–36%) and vegetable oil (generally 35–54%), and provides a good source of minerals (calcium, phosphorus, iron, zinc and boron as well as vitamin E and small quantities of vitamin B complex) to the rural households that usually find it difficult to access other forms of nutritious foods. Over 25% of agricultural cash income among smallholder farmers is realized from groundnut (Chirwa 2005). However, due to numerous constraints groundnut productivity remains low as evidenced (Table 1).

Table 1. Current and projected status of groundnut in Malawi[1].

Parameter	2002–11	2014	2017
Average area (ha)	254,578	267,561	310,621
Average production (tons)	227,089	244,121	303,271
National demand (tons)	168,294	176,372	203,008
Average yield (kg ha^{-1})	863	1,211	1,573
Proportion sold commercially (%)	40	45	50
Average ROG in area (%)	5.1	NA	NA
Average ROG in production (%)	7.5	10	15
Expected annual ROG in demand (%)	4.8	4.8	46
Expected average ROG in yield (%)	1.5	2.0	2.5

1. ROG = Rate of growth; NA = Not available.

Research and development

Focus

The major goal of the Groundnut Improvement Program of the Department of Agricultural Research Services in the Ministry of Agriculture and Food Security, Malawi is to develop groundnut production technologies that meet requirements of the farmers and other producers, processors, consumers, exporters and other end-users. The program partners with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to source improved germplasm because the crop is an introduced albeit important crop (Chamango et al. 2013). The program partners with several national farmer and other associated partners to ensure that products reach the farmers. The focal areas of research for the program are improving productivity in two botanical types of groundnut – Virginia and Spanish. Virginia types are generally spreading and semi-spreading (semi bunch) in growth and tend to be medium to large seeded with a relatively long maturity period of more than 120 days. Spanish types on the other hand comprise groundnut varieties that display an erect (bunch) growth habit, and tend to be relatively small seeded maturing in 90–110 days. Currently, all varieties released for production by farmers in Malawi were conventionally bred through one or a combination of any of the three approaches, namely introduction, hybridization and selection.

Variety development

Decades of research and variety development by NARS and CGIAR partners in Malawi have resulted in the development of numerous technologies for enhancing groundnut productivity (Chiyembekeza et al. 1998). The technologies developed fall into two broad categories, namely improved varieties with resistance/tolerance to major biotic and abiotic stresses, and a package of improved agronomic management practices. So far, 14 groundnut varieties have been released in two botanical or market groups since 1968 when Chalimbana and Malimba were first released (Saka et al. 2006). Current activities have concentrated on promotion of recent releases of three Virginia type and three Spanish type varieties with each group comprising varieties that combine high yield, disease resistance and other market preferred traits (Table 2). The available package of agronomic practices highlights recommendations on time of planting, plant population, weed management, and harvesting and postharvest practices for increasing yield, and reducing both quantity and quality losses. Despite variation across years, the groundnut production trend in Malawi has generally been increasing while yield has remained low averaging less than 1 t ha^{-1}.

Table 2. Groundnut varieties released in Malawi and their adoption.

Variety	Market type[1]	Year released	Adoption (%)	Attributes and use
CG7	VB	1990	30.0	High yield, wide adaption, confectionery, oil
Nsinjiro	VB	2000	20.0	High yield, rosette resistant, confectionery
Chalimbana 2005	VB	2005	0.1	High yield, rosette resistant, confectionery
Kakoma	SB	2000	7.0	High yield, confectionery
Baka	SB	2001	0.5	High yield, rosette resistant, confectionery
Chitala	SB	2005	0.2	High yield, rosette resistant, confectionery
Chalimbana	VB	1968	39.0	High yield, rosette resistant, confectionery
Chitembana	VR	1982		High yield, rosette resistant, confectionery
Mawanga	VR	1982		Oil
Mani Pintar	VR	1969	3.2 (trace)	Oil
RG1	VR	1975		Confectionery

1. VB = Virginia bunch; SB = Spanish bunch; and VR = Virginia runner.

Malawi promotes Virginia type varieties in the mid altitude agroecology and Spanish types in the lowland agroecology. However, overlap of varieties occurs across agroecologies as farmers become more knowledgeable about varietal characteristics, market preferred traits, management recommendations and market demand. Dominant varieties include Chalimbana, CG7, Nsinjiro and Kakoma in mid altitude, and CG7 and Malimba in lowlands.

Key constraints to groundnut production

The current national groundnut yield trend reveals a yield gap of 53% between the national average and realizable productivity at research stations. The yield gap is attributed to several biotic and abiotic factors (Naidu et al. 1999), including institutional, policy and other value chain related constraints (Tchale 1997). Major biotic factors comprise the groundnut rosette virus disease and other fungal foliar diseases (early and late leaf spots, and groundnut rust), *Aspergillus* infection and aflatoxin contamination, and insect pests such as aphids, the leaf hopper (*Hilda patruelis*), termites, cutworms and leaf-eaters. The abiotic factors include drought, low soil fertility (low Ca and P) and poor agronomic practices (low plant density, late planting and late weeding). Tangible evidence exists to suggest low adoption of improved varieties and certified seed by farmers. The majority of poor smallholder farmers use poor quality own-saved seed of unimproved varieties owing to limited availability of adapted improved varieties and good quality certified seed, and because seed is either overpriced or inaccessible. Other socioeconomic factors include lack of labor-saving technologies, lack of technologies for processing and utilization, lack of clear policies on marketing and associated regulatory frameworks, and limited domestic and international marketing opportunities.

Planned Phase 2 activities and their contribution to national efforts

Phase 2 activities will aim to harness gains made in the previous phase and hasten outcomes from continued farmer participatory varietal selection (FPVS) to identify traits preferred by farmers and markets. Efforts will concentrate on implementing seed roadmaps to avail adequate and easily accessible high quality seed of preferred varieties to as many farmers as possible, expand and intensify use of improved varieties and certified seeds through targeted development of options (productivity, quality and demand guided by preferences), explore and validate technology options (varieties and agronomic management), integrate formal and informal seed systems components, build capacity of partners through training and infrastructure support and carryout rigorous monitoring, evaluation and assessment of impact.

Target yield and beneficiaries by 2015

Phase 2 efforts target raising the national groundnut yield to 1205 kg ha^{-1}. The attained level of productivity increase will translate into a 15% increase in the number of beneficiaries of improved groundnut varieties and use of good quality seed.

Possible interventions to increase production and productivity

The interaction between the NARS and their CGIAR counterparts will be strengthened through joint evaluation of breeding materials in hotspot screening sites for specific stresses. The NARS will continue selection of segregating materials and evaluating international breeding nurseries to identify suitable lines for local needs, and initiate crossing programs. Rigorous FPVS will be implemented to identify farmer and market preferred varieties and traits. Concerted efforts will focus on seed production training of partners in improved production technologies and availing of market information.

Institutional and technical innovations that will be enhanced in Phase 2

The existing network of institutions with an agricultural orientation will be explored to enhance linkages and exploit synergies among NGOs, community-based organizations (CBOs) and the private sector to avail improved seed and better marketing opportunities to farmers. The existing farmer associations (NASFAM, ASSMAG and GALA), the Legume Platform and the Legume Development and Marketing Association will serve to spearhead technical innovations and dialogue with farmers.

Processing and storage requirements in aid of market opportunities

Aflatoxin contamination is a major constraint reducing international trade benefits from groundnut. Areas with late rains suffer postharvest contamination. Therefore, proper drying procedures and technologies for handling produce are necessary to minimize risk of postharvest contamination. The minimum standards set for traded groundnut have greatly restricted access to international markets by many African countries including Malawi.

Key innovations for enhancing smallholder farmer competitiveness in the groundnut value chain

Raising groundnut yield by accurate targeting of varieties to appropriate agroecologies remains a key strategy for increasing production and reducing losses due to various risk factors. For the mid altitude and plateaus there is a need to focus on high-yielding, rosette and early leaf spot resistant varieties, while drought resistant, early-maturing, early leaf spot resistant varieties will be the focus in lowlands and lakeshore areas. Concerted effort is required to enhance productivity of confectionery groundnut varieties in both agroecologies guided by current trends in market demand. The development of improved farmer and market preferred varieties and agronomic packages that reduce aflatoxin risk will be emphasized for farmers to access high value markets. Support for farmer–research–extension–market linkages will facilitate market information flow and value chain coordination and enable farmers respond to market signals. Transformation of production system components will be advocated through enhanced private sector involvement in processing and marketing of groundnut, and mechanization of production activities to reduce drudgery and labor costs.

Expected outcomes from Phase 2 improvement for production and productivity

Phase 2 activities will contribute high-yielding varieties with resistance to major diseases and tolerance to drought, and other farmer and market preferred traits, enhanced availability of good quality seed and improved agronomic management. The efforts will result in increased productivity and production of groundnut, translating into nutritional security, increased volume of agro-processing, increased exports and more income to poor smallholder farmers.

Agroecologies for groundnut cultivation

Malawi has a total land area of 119140 km^2 (11.78 million ha), 20% of which is covered by surface water resources dominated by Lake Malawi while 34% is arable and the remainder is forest land. Three main agroecologies are recognized based on climatic conditions and differences in altitude: the mid altitude or plateau areas (900–1200 m amsl), the lakeshore and the Shire Valley. The lakeshore and the Shire Valley are often regarded as one lowland agroecology (up to 899 m amsl). Agriculturally, the country is further divided into eight agricultural development divisions based on physiography and weather

conditions. Legumes cover about 27% of cultivated area while groundnut covers 31% of the total legume area (2010/11 crop statistics). Groundnut is primarily a rainfed crop almost exclusively grown by 20% of the rural poor smallholder population, particularly women. However off-season production is also possible in some parts of Nkhatabay and Karonga districts. The crop is either grown as sole or intercropped with other crops (maize, sorghum, millets, soybean and pigeonpea). Groundnut is grown from near sea level to >1500 m amsl, but over 70% is produced in the mid altitude and plateau areas, covering Lilongwe and Kasungu in central Malawi, and Mzimba district in northern Malawi (Table 3). The lowland agroecology (Fig. 1) also contributes substantially to the groundnut economy.

Table 3. Groundnut share of the total production by agricultural development division[1].

Ecology/ District	Production (t)	Yield (kg ha^{-1})	Area (%)	Production (%)	Dominant varieties
Karonga	4346	639.96	2.5	1.6	Chalimbana
Mzuzu	26128	896.42	10.9	9.8	Chalimbana, CG7
Kasungu	76547	1122.7	25.6	28.7	Chalimbana, Chalimbana 2005, CG7, Nsinjiro, Kakoma
Lilongwe	96828	1118	32.5	36.2	Chalimbana, Chalimbana 2005, CG7, Nsinjiro
Salima	8789	878.55	3.8	3.3	Kakoma, Malimba, CG7
Machinga	26775	751.58	13.4	10.0	Kakoma, Malimba
Blantyre	25363	945.46	10.1	9.5	Chalimbana, CG7
Shire Valley	2302	692.81	1.2	0.9	Malimba, Kakoma, Baka

1. About 75% of groundnut produced is sold in local markets.

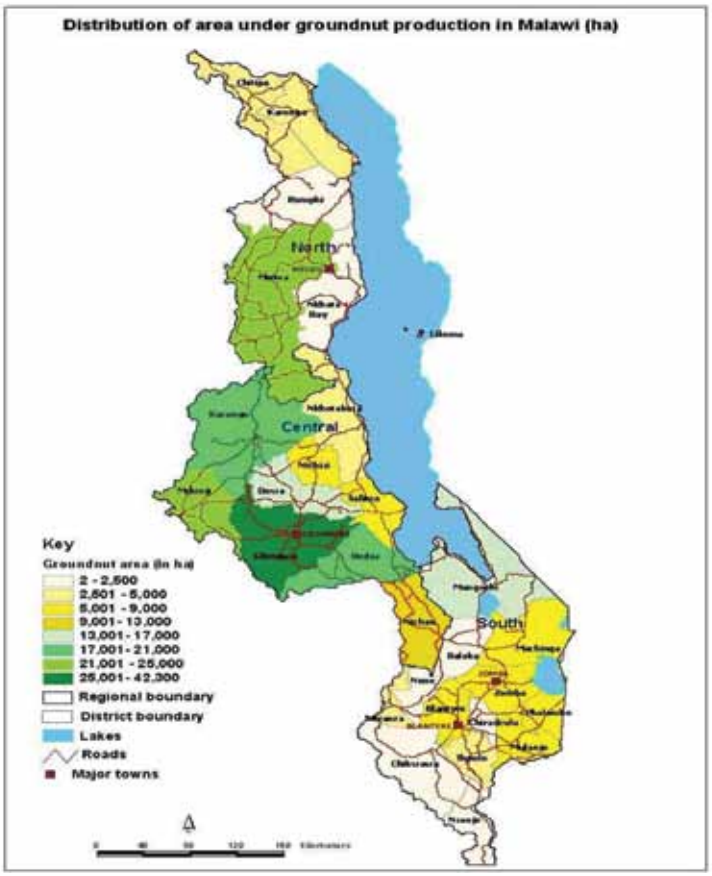

Figure 1. Groundnut production potential by district in Malawi (Adapted from Simtowe et al. 2009).

Seed systems for groundnut green revolution in Malawi

The groundnut sub-sector in Malawi is driven by both the formal and informal seed delivery systems. Besides breeder seed production, the formal system regulates basic and certified seed production while informal seed delivery systems operate through CBOs. This is critical for self-pollinated crops such as most grain legumes as for a long time the private sector has had no interest in these crops because of low profit margins. Malawi under TL-II Project continues to carefully integrate the formal and informal seed production and delivery systems through operational modifications to ensure seed quality by facilitating certification of various categories of seed producers (STAM members, individual growers, CBOs, community-based seed banks, farmer research groups and associations).

Strategic partners and their roles

In order to consolidate gains from previous investment in groundnut research, new innovative approaches to ensure aggressive promotion of technologies is a fundamental requirement. Partnerships among NARS, NGOs, private sector and farmers' organizations (Table 4) will help to popularize preferred improved varieties and improved crop production practices.

Table 4. Key partners in the groundnut value chain and their roles.

Partner	Role
Department of Agricultural Research Services; Ministry of Agriculture and Food Security	Undertake variety development, evaluation and release; produce breeder and foundation seeds; develop integrated crop management technologies; and provide aflatoxin testing services
Seed Services, Malawi	Seed systems support to help collaborating NGOs and CBOs in monitoring quality seed production
Department of Crop Production; Ministry of Agriculture and Food Security	Provide guidance in integrated groundnut production technologies and associated packages; facilitate groundnut value chain coordination
Department of Agricultural Extension Services; Ministry of Agriculture and Food Security	Undertake farmer education and technology dissemination
Ministry of Industry and Trade	Identify opportunities in regional and international groundnut trade
Farmers	Use products and services
Farmers Union and Associations (FUM, NASFAM, GALA, ASSMAG, MLDA)	Capacitate farmers formation of associations for collective production and marketing; facilitate linkages to other agro-industries
NGOs (CISANET, CARE-Malawi, Plan Malawi)	Support farming communities by imparting knowledge and skills for increased production; facilitate farmer friendly agricultural policies
ICRISAT, CGIAR	Provide improved germplasm; build capacity through training; conduct research on effective methods for technology dissemination
Private sector (market intermediaries, seed enterprises, processors and agro-input dealers)	Facilitate processing and commercialization

Major initiatives and key policies (recently implemented/needed) to promote legumes

Several initiatives and policy interventions have been initiated in support of the agricultural sector in Malawi. Interventions with a direct influence on the performance of the groundnut sub-sector are discussed.

The Farm Input Subsidy Program (FISP)

Malawi has embarked on an ambitious agricultural input (maize seed and fertilizer) subsidy program. The initiative has significantly revolutionized agricultural productivity turning the country from being food insecure in the past five years to recording surplus maize production for three consecutive years (2007–09). The program has been extended to legume seed (groundnut, beans, soybean), stimulating private sector participation into legume enterprise development because of ready market.

The Greenbelt Initiative

To benefit from underutilized water resources in Malawi, the government conceptualized the "Greenbelt Initiative" with the aim of increasing production and productivity of various agricultural crops, livestock and fish farming both inland and along the shores of Lake Malawi, and banks of major rivers including Shire River. The initiative will benefit the legume sector through development of irrigation schemes.

The Presidential Initiative to end Hunger and Poverty

The government has currently introduced the initiative in order to increase production and productivity of six legume crops including groundnut, and small stock livestock to enhance export opportunities, diversify forex generation and household nutritional security.

The Agriculture Sector Wide Approach Support Project (ASWAp-SP)

As a priority investment framework to achieve the Malawi Growth and Development Strategy (MGDS) targets and the Millennium Development Goals (MDGs), Malawi is implementing the ASWAp-SP to improve food security and nutrition, increase agricultural incomes and ensure sustainable use of natural resources. The recent incorporation of legumes in the mainstream of activities to receive support from the project will help to promote groundnut.

Agricultural Policy Advocacy through Farmers Union of Malawi (FUM) and Civil Society Agricultural Network (CISANET)

The contribution of FUM and CISANET backed by legume-based associations (Legume Development and Marketing Association) and platforms (Legume Platform) in advocating for farmers equitable rights in agriculture, particularly in policy spheres of input-output pricing, market access, land rights and farm levies will facilitate agricultural policy reforms and attract farmers and potential investors in legume enterprise development.

Regional projects on harmonization of seed policies and seed trade

Malawi is a partner in implementing projects aiming at promoting harmonization of policies to facilitate variety registration and movement of seed in the SADC region. Notable projects include: the Harmonized Seed Security Project (HASSP), the Seed Policy Enhancement in the Africa Region (SPEAR) Project and the Malawi Seed Industry Development Project (MSID) by ICRISAT in Malawi, but with potential spill-overs to other countries in the region. These efforts will contribute to increased productivity of groundnut.

Capacity needs of key stakeholders (NARS, NGOs, farmer organizations, traders and processors) in value chain coordination

The legume sub-sector currently faces a great deal of inefficiency due to inadequate staffing (only 126 research scientists and support staff currently) and limited infrastructure, translating into significant losses to farmers through increased transaction costs. There is need to increase the number of

trained grain legume scientists through on job training in various aspects including modern breeding methodologies (molecular marker technology) to enhance breeding efficiency. Through skills transfer, the farmers' capacity to organize and access improved agricultural technologies, and technical aspects of collective marketing will be enhanced. Capacity building in enterprise development for traders and processors will ensure success of the private sector in input-output marketing, value-addition and processing.

Special cross-cutting issues (cultural, gender and HIV/AIDS considerations)

Groundnut is generally considered not only as a woman's crop but also labor-intensive. Enhancing the crop's potential to generate income through increased yield and reduced labor requirement entails raising the status of women in society. The high rate of HIV/AIDS prevalence among rural communities entails reduced labor available for farming activities. Promotion of labor-saving devices will help to ease labor shortage, and promotion of household level value-addition will enhance rural nutrition. Poorer households and women farmers attempting to participate in market value chains face multiple restrictions to access factors of production as well as agricultural inputs, credit and information.

Environmental/sustainability issues

Legumes can fix substantial amounts of nitrogen through biological nitrogen fixation (BNF) activities. Groundnut fixes atmospheric nitrogen and contributes an equivalent of 325 kg ha^{-1} of urea fertilizer (150 kg N ha^{-1}) to nourish subsequent cropping. This would translate into sustainable cropping systems, increased productivity, raised GDP through surplus produce sales, and enhanced forex from exports and import substitution. Use of rosette, early leaf spot and rust resistant varieties will ensure environmental safety minimizing the need for chemical sprays.

Seed production plan

The seed production and delivery plan is presented in Table 5.

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

Ecology (Zone)	Demand area (ha)	Promoting varieties	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)
Mid altitude	129,600	CG7	2,131.2	16	13	338	270	1,620	2,430	1,680	2,520
	64,800	Nsinjiro	1,094.4	6	5	113	90	540	810	540	810
	10,800	Chalimbana 2005	230.4	14	11	110	88	528	792	540	810
	10,800	ICGV-SM 01711	0.0	6	5	13	10	60	90	90	135
Lowland	27,000	Kakoma	432.0	1	0	45	36	216	324	270	405
	27,000	Chitala	432.0	1	1	56	45	270	405	330	495
Total	270,000		4,320	44	35	674	539	3,234	4,851	3,450	5,175

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Common bean

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Introduction

Importance of the crop in Malawi

Common bean *(Phaseolus vulgaris)* is an important legume crop for the resource-poor small-scale farmers in Malawi. It is an important source of protein for many people both in rural and urban areas, especially those who cannot afford animal protein. Beans are high in calcium, magnesium, vitamin B, iron and zinc which are essential for immune function in human beings. Common bean is also a source of income to many small-scale farmers who are major producers. Beans improve soil fertility when grown in rotation with other crops such as maize or tobacco. Another important role that beans play is the gap filling when food shortages reach a climax and people depend on beans alone for their survival.

Production and demand

In 2012, common bean area in Malawi was estimated at 243,700 ha and production at 127,464 tons (Table 1). In the major bean growing areas, 74% to 90% of farmers grow beans as their main cash crop; also beans are second only to maize as a food crop (Source: Scott and Maideni 1998). About 35% of the production is marketed contributing about 25% of total household income for over 68% of the households who sell their surplus (Source: Kalyebara et al. 2005). Both production and demand for beans in Malawi are trending upwards, with an annual growth rate of 4% in production during 2002 to 2011. Area under common bean increased tremendously in 2009 by about 51,844 ha in response to the government mobilization of farmers to include legume in their cropping system, when some NGOs intervened with provision of seeds as inputs to farmers and additional area under irrigation system.

Projections for 2014–20 suggest continued growth in both national demand and production of beans. Common bean experiences high fluctuations in production associated with high variability in rainfall conditions, often resulting in excess demand. There is an indication of demand for improved high-yielding common bean varieties to stabilize yields.

Table 1. Production of beans during 2002 to 2012 in Malawi.

Year	Area (ha)	Production (t)	Yield (kg ha^{-1})
2002	227917	99828	438
2003	239476	109832	459
2004	204515	76964	376
2005	233845	85759	367
2006	242568	117808	486
2007	268688	132689	494
2008	268995	129948	483
2009	220770	120084	544
2010	228880	106219	464
2011	232638	124184	534
2012	243700	127464	523
Average	237454	111889	470

Research and development

Variety development

The bean improvement program in the Department of Agricultural Research Services, Malawi started developing bean varieties in 1996. This research is conducted in collaboration with the International Center for Tropical Agriculture (CIAT) and through PABRA, and other NARS partners, such as the University of Malawi-Bunda College of Agriculture. So far, a total of 30 bean varieties have been released in Malawi, of which 18 of them were released by the Department of Agricultural Research Services and 12 by the University of Malawi-Bunda College of Agriculture (Table 2).

Production constraints

The current bean yields are very low estimated at about 500 kg ha^{-1} (Table 1). There are many factors that are responsible for low yield. These include:

- Lack of availability and accessibility of good quality seed of improved varieties;
- Poor market access for inputs and grain associated with poor marketing structures; and
- Diseases, insect pests, drought and low soil fertility.

The problem of poor accessibility to bean seed is further exacerbated by the low investment by the private seed companies in the production and marketing of bean seed. Therefore, strategies are needed to address this gap.

Planned Phase 2 activities

The project objectives will be achieved through strategic planning involving partners, indulging in available opportunities and capacity building while mainstreaming culture and gender into project work plans.

Access to sufficient quantities of bean seed of preferred improved varieties will be enhanced, as well as other eco-efficient non-variety bean production technologies will be employed.

Knowledge empowerment for farmers on bean production technologies will play a big role in production and productivity increase. This will be achieved through training of extension personnel and lead farmers. Farmer participatory variety selection (FPVS) will be implemented to identify farmer and consumer preferred varieties and traits. Field days and demonstrations will be conducted to create awareness and demand for the newly released improved varieties and associated bean production technologies.

Expected outcomes

Phase 2 of the project aims at ensuring national self-sufficiency in bean and surplus for sale. This is expected to translate into improved household food and nutrition security and more income from bean sales at local as well as regional markets.

Agroecological zones

The bean crop is grown across the country in the agroecologies categorized according to altitude as high, medium and low (Table 3). Figure 1 presents the major bean growing areas in Malawi by

Table 2. List of released varieties in Malawi.

Variety	Year of release	Institution	Optimal production altitude range (m amsl)	Time to maturity (days)	Grain yield (t ha^{-1})	Special attributes
Namajengo	1980	University of Malawi-Bunda College	1000–1200	90	2.5	High yielding
Saperekedwa	1980	University of Malawi-Bunda College	1000–1200	90	2	Good taste, attractive seed color
Kanzama	1980	University of Malawi-Bunda College	1000–1650	95	2.5	High yielding, wide adaptation
Kalimtsiro	1980	University of Malawi-Bunda College	1000–1200	90	2.5	High yielding
Nasaka	1980	University of Malawi-Bunda College	1000–1200	80	1.5	Early maturity, cooks fast
Bwenzilaana	1980	University of Malawi-Bunda College	1000–1200		2.5	High yielding
Kalima	1993	University of Malawi-Bunda College	1000–1400	90	2	Large seed
Bunda 93	1993	University of Malawi-Bunda College	1000–1400	90	2	Wide adaptation
Chimbamba	1993	University of Malawi-Bunda College	1000–1400		2	Large seed
Bunda 1	2005	University of Malawi-Bunda College	1000–1200	85	2	Resistant to bean common mosaic virus
Bunda 2	2005	University of Malawi-Bunda College	1000–1200	85	2	Resistant to bean common mosaic virus
Bunda 3	2005	University of Malawi-Bunda college	1000–1200	85	2	Resistant to bean common mosaic virus
Kambidzi	1996	Department of Agricultural Research Services	1400–1650	85	2.5	High yielding, tolerant to angular leaf spot
Maluwa	1996	Department of Agricultural Research Services	1000–1300	90	2	Tolerant to common bacterial blight
Mkhalira	1996	Department of Agricultural Research Services	1400–1650	85	2.5	High yielding, tolerant to low soil fertility
Napilira	1996	Department of Agricultural Research Services	1400–1650	90	2	Resistant to angular leaf spot, halo blight, powdery mildew
Sapatsika	1996	Department of Agricultural Research Services	1000–1300	90	2	Dark red kidney (attractive seed color), wide adaptation
Nagaga	1996	Department of Agricultural Research Services	1000–1300	90	2	Tolerant to low soil fertility, resistant to bean common mosaic virus
Kabalabala	2002	Department of Agricultural Research Services	1000 –1650	90	2.5	Tolerant to angular leaf spot and common bacterial wilt, wide adaptation

Continued

Table 2. *Continued.*

Variety	Year of release	Institution	Optimal production altitude range (m amsl)	Time to maturity (days)	Grain yield (t ha^{-1})	Special attributes
Kholophethe	2002	Department of Agricultural Research Services	1000–1650	90	2	Resistant to bean common mosaic virus and angular leaf spot, tolerant to low soil fertility
NUA 45	2009	Department of Agricultural Research Services	1000–1200	69	1.5	Early maturity, high iron and zinc
NUA 59	2009	Department of Agricultural Research Services	1000–1200	70	1.7	Early maturity, high iron and zinc
VTTT 924/4-4	2009	Department of Agricultural Research Services	1000–1650	90	2	Large seed, good color, good taste
KK03/KK25/68	2011	Department of Agricultural Research Services	1000–1650	90	2	High yielding, large seed
KK03/KK25/68	2011	Department of Agricultural Research Services	1000–1650	90	2	High yielding, large seed
MAL/KK25/112	2011	Department of Agricultural Research Services	1000–1650	90	2	High yielding, large seed
MAL/KK25/9	2011	Department of Agricultural Research Services	1000–1650	90	2	High yielding, large seed
MAL/KK35/443	2011	Department of Agricultural Research Services	1000–1650	90	2	High yielding, large seed
KK25/NAG/184	2011	Department of Agricultural Research Services	1000–1650	90	2	High yielding, large seed
KK25/MAL/19	2011	Department of Agricultural Research Services	1000–1650	90	2	High yielding, large seed

Table 3. Bean production zones in Malawi[1].

Bean production zone	Agroecological conditions	Bean area (ha)	Dominant varieties
High altitude (districts: Chitipa, Livingstonia, Viphya, Dedza)	Subhumid, >1500 m amsl, >400 mm of unimodal rainfall and acid soils	124,971	Kholophethe, Kalima
Mid altitude (districts: Mzimba, Lilongwe, Dowa, Nmawera, Shire)	Subhumid 1000–1500 m amsl, >400 mm, unimodal rainfall	114,198	Muluwa, Napilira
Low altitude (Lake Basin, Phalombe)	<1000 m amsl, unimodal rainfall	26,158	Kabulengeti, Kayela

1. Source: Adapted from Wortmann et al. (1998) and updated for bean area and dominant varieties.

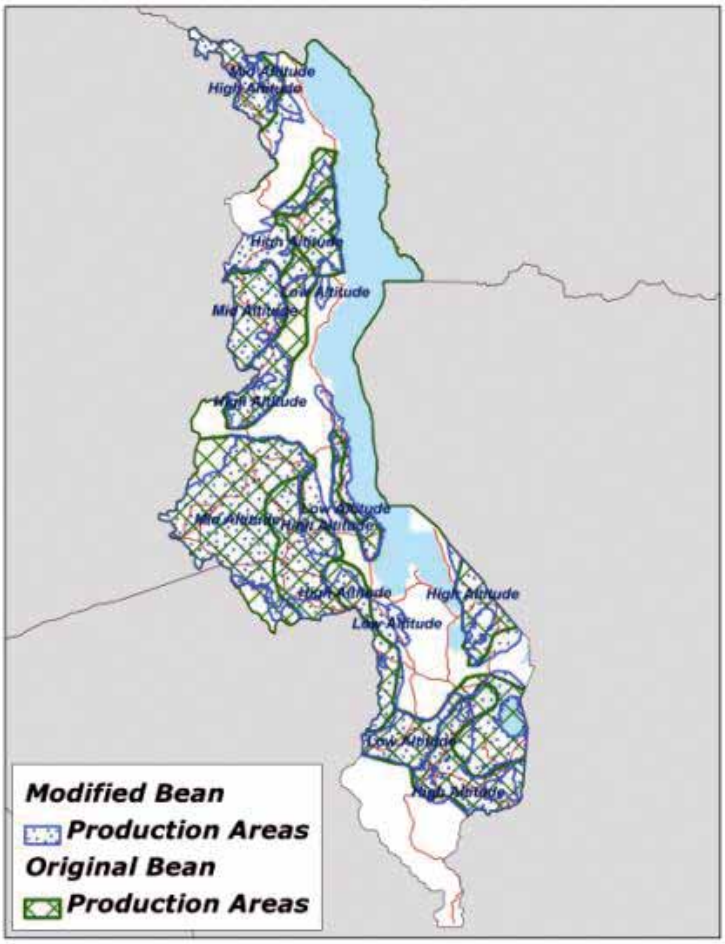

Figure 1. A map of the bean production zones of Malawi showing "original" (estimated in 1998) and current ("modified") areas.

production zones. Along the lakeshores and in the Shire Valley, beans are less cultivated because the crop is not adapted to these areas.

Farmers and consumers prefer bean varieties based on seed size, color, taste and cooking time. The commonly preferred varieties are the large-seeded, red or red speckled in color and the sugar (cream striped) types. Common varieties include Phalombe (local variety), Kholophethe (Sugar 131), Maluwa (CAL 113) and Napilira (CAL 143). The importance of these varieties across the agroecological zones is indicated in Table 3.

Seed systems

Opportunities

- Extension of small pack strategy
- Engaging diverse partners for production of foundation and certified seeds
- Strengthening of breeder seed production

Constraints

- Unavailability of improved varieties
- High input costs

Strategic partnerships and roles

Partners will be involved to enhance organization of proper target groups in the targeted areas and to popularize improved high-yielding bean varieties with acceptable end-user traits and associated improved bean production technologies. Partners and their roles are presented in Table 4.

Table 4. Key partners in the bean value chain and their roles.

Partner	Role
Department of Agricultural Research Services	Variety development, evaluation and release; production of breeder and foundation seeds; develop integrated crop management technologies
Seed companies – Seed Co, Pannar	Facilitate processing and commercialization of bean seed and products
Farmers organization/associations (ASSMAG, GALA)	Capacitate farmers formation of associations for collective production and marketing seed systems support, help collaborating NGOs and CBOs with quality seed production and monitoring
NGOs – CRS, CARE World Vision	Provision of guidance in crop production technologies and associated packages
CGIAR center – CIAT	Provide improved bean germplasm/breeding populations; capacity building through training; research on effective methods for technology dissemination
Seed trade association of Malawi – Demeter, Peacock	Support to farming communities to impart knowledge and skills for increased on-farm production; facilitate farmer friendly agricultural policy advocacy
Farmers	End-users of technologies in terms of high-yielding varieties and management practices
Department of Crop Development Planning and Extension	Support to farmer field schools to impart knowledge and skills for increased production on-farm

Seed production plan

Total bean area in Malawi is estimated at 225,000 ha, of which 40% or 90,000 ha is targeted. At a seed rate of 80 kg ha^{-1}, this will require 7,200 tons. The goal yield is 1 t ha^{-1}, for a national production of 225,000 tons, and these estimates have been used to develop the bean seed roadmap (Table 5).

Table 5. Seed production system plan to reach 40% adoption by 2015.

Agroecology	Area (%)	Variety	Seed rate (kg ha^{-1})	Productivity (t ha^{-1})	Area (ha)	Target area (40%)	Breeder seed (2013)		Foundation seed (2014)		Certified seed (2015)	
							Area (ha)	Production (t)	Area (ha)	Production (t)	Area (ha)	Production (t)
High altitude	10	Napilira	80	1.5	22500	9000	5	5	58	58	720	720
	30	Kholophethe	80	1.5	67500	27000	14	14	173	173	2160	2160
	15	VTTT 924/4-4	80	1.5	33750	13500	7	7	86	86	1080	1080
	5	Kabalabala	80	1.5	11250	4500	2	2	29	29	360	360
	5	KK 112	80	1.5	11250	4500	2	2	29	29	360	360
	5	KK 68	80	1.5	11250	4500	2	2	29	29	360	360
	5	KK 168	80	1.5	11250	4500	2	2	29	29	360	360
	5	Maluwa	80	1.5	11250	4500	2	2	29	29	360	360
Medium altitude	5	NUA 45	80	1.5	11250	4500	2	2	29	29	360	360
	5	NUA 59	80	1.5	11250	4500	2	2	29	29	360	360
	5	Ser 45	65	2	11250	4500	2	2	29	29	360	360
	5	Ser 85	65	2	11250	4500	2	2	29	29	360	360
Total					225000	90000	46	46	576	576	7200	7200

Pigeonpea

Geoffrey Kananji, Ganga Rao and Said Silim

Introduction

Pigeonpea is the most versatile grain legume grown by smallholder farmers in Malawi for both local consumption and export. It ranks as the third most important legume crop after groundnut and beans. The crop is now planted on 196,516 ha producing about 216,716 tons per year during 2010 to 2012 (Ministry of Agriculture, crop estimates data, 2012) having increased from 78,000 tons per year during 1991 to 2006. These statistics clearly show that there is a great potential to increase production and expand area of pigeonpea in Malawi. Although the crop is now grown in all the agricultural development divisions (ADDs), Blantyre and Machinga ADDs remain major growing areas accounting for more than 90% of the total area planted to pigeonpea (Fig. 1). Farmers prefer growing pigeonpea either as an intercrop or pure stand because it provides food at the time when all the other legumes have been harvested from the field. It provides cash to the farmers and it is one of those legumes that can be produced with fewer inputs. Available estimates indicate that 65% of the pigeonpea produced is consumed on-farm, 25% is exported, while 10% is traded on the domestic markets. Pigeonpea also provides fodder/feed for livestock and has the potential to improve soil fertility. The plant is deep rooted and is adapted to withstand the intermittent or terminal droughts depending on the type of varieties grown.

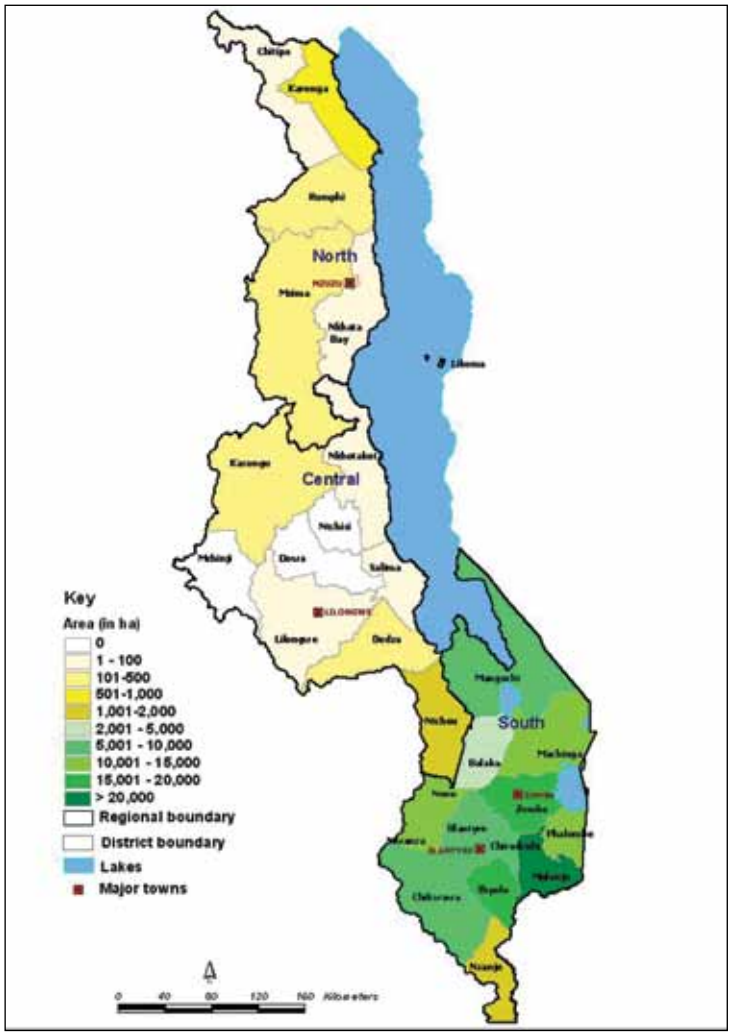

Figure 1. Area under pigeonpea production in Malawi.

Research and development

The pigeonpea improvement program has been working in partnership with ICRISAT to develop superior pigeonpea lines and evaluate them at national and regional multilocational sites for adaptability and acceptance of the new improved pigeonpea varieties. Historically, desirable traits in pigeonpea have been selected by farmers from landraces to suit their production systems and uses. ICRISAT along with the national programs in Malawi, has focused on developing short-, medium- and long-maturing pigeonpea varieties. Two short-, two medium- and two long-duration pigeonpea varieties have been released during 1987 to 2011 (Table 1). Although varieties released from these breeding programs have served the immediate need of farmers, major deficiencies still exist. There is an urgent call for national programs in partnership with ICRISAT to focus on breeding for insect pest resistance and resilience to effects of climate change.

Table 1. Pigeonpea varieties released and their characteristics.

Variety	Pedigree	Year of release	Special varietal attributes	Recommended agroecologies	Yield potential (kg ha^{-1})
Sauma	ICP 9145	1987	Long duration, fusarium wilt resistant	High altitude areas	1500
Kachangu	ICEAP 00040	2000	Long duration, large seeded, fusarium wilt resistant, easy to dehull	High altitude areas	2000
ICPL 87105	ICPL 87105	2003	Short duration, multiple cropping	Low to medium altitude areas	2000
ICPL 93027	ICPL 93027	2003	Short duration, multiple cropping	Low to medium altitude areas	2000
Mwaiwathualimi	ICEAP 00557	2010	Medium duration	Low to medium altitude areas	2500
ICEAP 01514/15	ICEAP 01514/15	2011	Medium duration, high yielding	Low to medium altitude areas	2500

Each of the released cultivars has economically important traits that make it attractive to smallholder farmers. Sauma and Kachangu are resistant to fusarium wilt and have high yield potential. The short-duration varieties are less tolerant to fusarium wilt but have an added advantage in that they can be consumed as grain as well as a vegetable. Their capacity to mature early also makes them more suited for the semi-arid regions and provides an opportunity for double cropping in regions with long or bimodal rainfall season.

Agroecologies of pigeonpea cultivation

Southern region of Malawi with Blantyre and Machinga ADDs is traditionally the major pigeonpea growing area accounting for 92% of the total pigeonpea area (Table 2), and contributing up to about 20% of farmers' income. Pigeonpea is widely grown as an intercrop with maize in southern Malawi, but it is mainly grown as a boundary marker in northern Malawi although lately pigeonpea has developed great potential in Karonga and Chitipa districts. In the central region, Salima, Kasungu, Lilongwe and Mchinji districts have seriously taken up cultivation of the medium-maturing varieties.

Dominant varieties

Over the years, six improved pigeonpea varieties (2 short, 2 medium and 2 long duration) were released in Malawi. They are: short-duration varieties ICPL 87105 and ICPL 93027; long-duration varieties ICP 9145 (Sauma) and ICEAP 00040 (Kachangu); and medium-duration varieties ICEAP 00557 (Mwaiwathualimi) and ICEAP 01514/15. Presently the popular varieties with farmers are ICP 9145, ICEAP 00040 and local landrace Mthawajuni. The medium-duration varieties ICEAP 00557 and

Table 2. Trends in pigeonpea area in major growing divisions in Malawi.

ADD	2008/09	2010/11	% change over 2 seasons
Southern region	164,502	192,457	14.5
Blantyre	108,245	127,263	14.9
Machinga	46,829	53,390	12.3
Shire Valley	9,428	11,804	20.1
Central region	2,583	3,165	18.4
Lilongwe	2,343	2,768	15.4
Kasungu	148	142	–4.2
Salima	92	255	63.9
Northern region	702	894	21.5
Karonga	483	628	23.1
Mzuzu	219	266	17.7
Grand total	167,787	196,516	14.6

ICEAP 01514/15 which were released through TL-II Phase 1 are spreading very fast in all pigeonpea agroecologies (the three regions of the country).

Seed systems

In Malawi, lack of awareness and limited or no access to quality seed is attributed to consistent failure of public sector in supplying good quality breeder/foundation seed in desired quantities. The private sector has shown little interest in investing in pigeonpea seed production and marketing. Most often seed production areas are far away from its area of utilization because of isolation requirements and availability of infrastructure for storage and processing leading to high transaction seed costs. Through this project selective investments have been made to overcome these constraints in breeder and foundation seed production, and seed sale proceeds used to create seed revolving funds especially in Malawi (ICRISAT model) for future use.

Private seed companies and NGOs took the lead in acquiring foundation seed for further seed increase and dissemination. Most of the farmers rely on own-saved seed and access to seed of improved varieties through informal networks. The baseline survey also points out existence of two seed supply systems, namely informal, which are usually non-market based and the quasi-formal, mainly market-based seed supply systems. The informal seed supply sources included own-saved seed, gifts from family and friends, farmer-to-farmer seed exchanges and others. The importance of quasi-formal system seems to increase with formal release of new farmer- and market-preferred varieties, which helps in augmentation of seed demand and seed markets for superior varieties.

Seed production target

Total area: 196,516 ha

Seed rate (mean): 10 kg ha^{-1}

National seed demand: 1965 tons (2012–14) to cover 196,516 ha

Capacity to deliver 25% of total area: 49,200 ha

Total seed required to cover targeted area of 49,200 ha: 580 tons

Opportunities, constraints and partnerships

The target is to produce seed required to cover 25% of area.

Opportunities

- Pigeonpea is one of the crops included in Malawi government's input subsidy scheme and is also in the Presidential Initiative for poverty and hunger reduction. It is considered a strategic crop that can contribute towards the economic recovery program plan for the Malawi government. These programs require substantial amount of good quality pigeonpea seed.
- Expansion into new areas in central and northern regions after release of two medium-duration varieties
- Policy environment that enhances innovative seed system
- Availability of suitable varieties for different agroecologies and high demand for quality seed

Challenges/constraints

- Insect pests and poor crop management practices
- Fusarium wilt and cercospora leaf spot
- Lack of knowledge on pigeonpea use in non-traditional potential areas
- Lack of organized markets
- Seed accessibility issues
- Limited technical know-how by frontline extension staff
- Terminal droughts where farmers use local varieties

Partners

The strategic partners and their roles are given in Table 3.

Seed production plan

The seed production plan for Malawi is given in Tables 4 and 5.

Vision of success

Pigeonpea area is increasing and with the release of medium-duration varieties the crop is spreading into parts of central and northern regions of Malawi. Low seed rate and high multiplication ratio are the major advantages of pigeonpea. The revolving seed scheme has been successfully implemented in Malawi by ICRISAT in close collaboration with various stakeholders including NASFAM. Farmers have seen the production potential of the new set of varieties and they are already reaping yields of more than 1 t ha^{-1}. With the development of vibrant seed production strategy and ever growing demand for pigeonpea from Asian markets, there will definitely be good growth of pigeonpea sub-sector in Malawi.

Table 3. Strategic partners and their roles.

Partner	Role
Department of Agricultural Research Services, Ministry of Agriculture and Food Security	Variety development, evaluation and release; production of breeder and foundation seed
ICRISAT	Provide improved pigeonpea germplasm/breeding populations; capacity building through training; research on effective methods for technology dissemination
Seed Services-Malawi	Seed systems support, help collaborating NGOs and CBOs with quality seed production and monitoring
Department of Crop Production, Ministry of Agriculture and Food Security	Provision of guidance in crop production technologies and associated packages
National Smallholder Farmers' Association of Malawi (NASFAM)	Capacitate farmers formation of associations for collective production and marketing
CARE-Malawi or Plan-Malawi	Support to farmer field schools to impart knowledge and skills for increased production on-farm
Farmers	End-users of technologies in terms of high-yielding varieties and management practices
Agro-processors (Export Trading, Grain Traders & Processors Association)	Marketing and value-addition
Seed Traders Association of Malawi	Coordination of pigeonpea seed trade to ensure quality delivery
Legume Platform (Legumes Development Trust)	Promote production and marketing of pigeonpea

Table 4. Pigeonpea seed roadmap for Malawi.

Ecology (Zone)	Total demand (ha)	Promising varieties	On-farm yield potential (t ha^{-1})	Seed rate (kg ha^{-1})	Area (ha) to be covered for 25% adoption		Breeder seed in 2012		Foundation seed in 2013		Certified seed in 2014		Seed required to reach 25% adoption (t)
					Total	Per variety	Area (m^2)	Production (kg)	Area (ha)	Production (t)	Area (ha)	Production (t)	
Southern	192,457	4			48,100		630	63	6	6	566	566	566
	67,340	Mwaiwathualimi	1	10		16,835	220	22	2.1	2.1	198	198	198
	67,340	ICEAP 01514/15	1	10		16,835	220	22	2.1	2.1	198	198	198
	38,480	Kachangu	1	10		9,620	130	13	1.2	1.2	113	113	113
	19,240	Sauma	1	10		4,810	60	6	0.6	0.6	57	57	57
Central	3,165	2			800		10	1	0.1	0.1	10	10	10
	1600	Mwaiwathualimi	1	10		400	5	0.5	0.05	0.05	5	5	5
	1600	ICEAP 01514/15	1	10		400	5	0.5	0.05	0.05	5	5	5
Northern	894	2			300		4	0.4	0.04	0.04	4	4	4
	450	Mwaiwathualimi	1	10		150	2	0.2	0.02	0.02	2	2	2
	450	ICEAP 01514/15	1	10		150	2	0.2	0.02	0.02	2	2	2
Total	196,516				49,200	49,200	644	64.4	6.14	6.14	580	580	580

Table 5. Certified seed production (t) plan over three years.

Variety	2012	2013	2014
Mwaiwathualimi	31.25	50.75	123
ICEAP 01514/15	31.25	50.75	123
Kachangu	17	28	68
Sauma	9	14	34
Total	88.5	143.5	348

Soybean

Geoffrey Kananji, Francis Maideni and Hesham Agrama

Importance of soybean in Malawi

Soybean (*Glycine max*) is an important legume crop in Malawi as a source of high quality protein for both human and animal nutrition. The typical smallholder farming system in Malawi is based on maize production. Intercropped with maize, soybean provides a strategy for crop diversification, food security and soil fertility replenishment. Increased maize productivity from most of the depleted cultivated soils managed by the smallholder farmer, demands the use of inorganic fertilizers which are costly, surpassing an average farmer's purchasing power. Soybean constitutes an important component of the smallholder cropping systems and holds considerable potential for arresting soil fertility decline, enhancing household nutrition security as a cheap source of essential protein and minerals, raising rural incomes as an important cash crop, and reducing poverty. Use of soybeans in the smallholder farming systems, provides a potential technological option to improve soil fertility for Malawian farmers.

Nutritionally, soybean is very rich in protein and can therefore be utilized to combat severe nutrition deficiency and enhance household food security. In malnourished children, especially under the age of five, provision of highly nutritious baby foods made from soybean can be a better option to combat such nutritional deficiency problems. Soybean is the only grain legume that contains 40% protein and 20% unsaturated fat very much desirable for human nutrition. In addition to nutritious weaning foods, whole soybeans can form important ingredients in recipes for preparing adult meals. This provides an important benefit to the relatively carbohydrate maize-based Malawian diets. Soybean also serves as an alternative source of cash in those areas where groundnut pops is a problem. The crop is well adapted to a range of agroecologies and unlike beans and pigeonpea very few insect pests attack soybean to significantly affect their potential yield. Soybean therefore has an important role to play in establishing household food security in Malawi.

Soybean can help to halt the precipitous decline in soil fertility. In Malawi, the declining agricultural productivity especially of crops like maize is largely due to soil fertility depletion. The benefits of including grain legumes such as soybeans, in rotation with maize, have been verified. Promiscuous soybean varieties remain green for an extended period of time enabling the crop to fix more nitrogen in the soil. Self-nodulating soybean varieties reportedly add approximately 20 kg nitrogen per hectare per season. This is added benefit to the farmer considering that inorganic fertilizers are untimely available and if available are very expensive. Increased soybean production can therefore help to overcome serious problems of malnutrition, address loss of soil fertility and reduce rural and urban poverty.

Soybean can help mitigate worsening rural poverty. Besides improving soil fertility, soybean intercropped with maize or grown in pure stand also provides a supplementary source of income to smallholder farmers especially rural women. Domestic demand for soybean by the processing agro-industries is high. A number of factors have now generated fresh and growing demands for soybean – for export to the regional markets and for domestic processing to meet the rising domestic demand for soybean meal and soybean oil.

History of soybean research and development in Malawi

Soybean is not a new crop in Malawi. Reports by the Ministry of Agriculture and Food Security indicate that this crop has been grown in Malawi since 1909. It was being grown as a minor crop in association with *tung*. When varietal and agronomic research work was conducted on the crop, some useful

information was generated that made soybean to be a more important crop. Research work conducted on soybean has shown that the crop is well adapted for production in all agroecological zones in Malawi. Key studies on agronomic practices have been done. Full-fledged and focused research program on soybean was done in the 1980s leading to release of improved varieties such as Impala, Kudu, Geduld, Bossier, Hernon 147, Hardee, etc. However, these varieties had short shelf life, high rate of shattering and were not attractive to the processors. Efforts were therefore required to develop new soybean varieties that were high yielding with acceptable characteristics by the processors such as cream/white hilum and large seed size.

In partnership with several local and international institutions such as INSOY, AVRDC, IITA and Seed Co the above soybean varieties as well as those currently in the market were developed. New improved varieties under commercial production include Makwacha, Nasoko, Ocepara-4, Soprano, Solitaire, Squire and Tikolore. Specific varietal attributes for each of the varieties including their recommended agroecologies are presented in Table 1.

Table 1. Characteristics of soybean varieties currently grown in Malawi.

Variety	Source of material	Year of release	Special varietal attributes	Recommended agroecologies	Yield potential (kg ha^{-1})
Makwacha	Zimbabwe	2003	Cream/white hilum, large seed size	Medium to high altitude areas	3000
Nasoko	Zimbabwe	2002	Cream/white hilum, large seed size	Medium to high altitude areas	3000
Ocepara-4	USA	1993	Nematode resistant	Medium altitude areas	2500
Tikolore	IITA	2011	Early maturing	Low, medium and high altitude areas	2500
Solitaire	Seed Co-Malawi	2003	High yielding, tolerant to frogeye	Widely adapted to most agroecologies	3000
Soprano	Seed Co-Malawi	2003	High yielding, tolerant to frogeye	Medium to high altitude areas	3000

Soybean production trends in Malawi

Research results show that soybeans are well adapted for production in all agroecological zones in Malawi. Soybean yields are still low as farmers obtain 40% less (800 kg ha^{-1}) on average than the potential yield of 2000–2500 kg ha^{-1}. This however, is an increase in yield from 600 kg ha^{-1} which is attributed to efforts made to develop and promote use of new high-yielding soybean varieties currently grown by farmers in Malawi over the last six years.

Increased production through area expansion may not be possible in most parts of the country because of population pressure on the land; development of improved varieties with preferred market traits therefore remains a viable pathway to achieve increased soybean production and productivity. Soybean production in Malawi has fluctuated over the years (Table 2) largely due to poor farm-gate prices offered to farmers and other production challenges/constraints.

Table 2. Soybean production in Malawi during 2002–12.

Year	Area (ha)	Production (t)	Yield (kg ha^{-1})
2002	45428	29568	651
2003	53579	40889	763
2004	47128	33758	716
2005	68524	40396	590
2006	71652	55248	771
2007	79465	71295	897
2008	73942	64489	872
2009	82217	79615	968
2010	70654	67873	961
2011	70955	69596	982
2012 (R2)[1]	96950	99980	970
Average	76050	65271	914

1. R2 means second round crop estimates made at vegetative stage of plant growth; R3 estimates are more accurate.

Seed production target

Average production: 65,271 tons (2012 national data)

National demand: 111,000 tons

Expected growth in demand: 4.6% per year

National projected demand in 2015: 139,000 tons

Proportion of production sold commercially: >85%

Dominant varieties: Makwacha, Solitaire, Nasoko, Soprano and Ocepara-4

Malawi is agroecologically divided into eight agricultural development divisions (ADDs). Five main landforms are evident in most of these agroecologies: Highlands, Escarpments, Plateau, Lakeshore, Upper Shire Valley and the Lower Shire Valley. The Plateau represents three quarters of Malawi at elevations of 750–1300 m amsl. Although the major soybean production districts are concentrated in the Plateau, soybean virtually grows well in all ADDs. However, taking into account production and hectarage of the eight ADDs, Kasungu, Lilongwe and Mzuzu produce more soybeans and together represent approximately 91% of the total area (Table 3).

Table 3. Main soybean production sites in Malawi[1].

ADD	Area (ha)	Production (t)	Yield (kg ha^{-1})
Kasungu	29,414	33,729	872
Lilongwe	26,780	24,805	1080
Mzuzu	8,410	7,044	1194

1. Based on 2011 national data, Ministry of Agriculture, Food Security and Water Development.

Seed system

Key constraints to soybean production

- Soybean rust and other diseases
- Drought (terminal and low moisture stress)
- Poor soil fertility (low phosphorus)
- Leaf-eating caterpillars and leaf rollers
- Limited access to seed of improved varieties and other inputs such as fungicides
- Poor market access (infrastructure), price volatility and lack of organized markets
- Weak extension services
- Poor crop management practices
- Lack of knowledge on soybean processing and utilization
- Low farm-gate prices and unpredictable demand

Opportunities for increased soybean production

- High demand for soybean due to expansion of the poultry and fish industry in Malawi
- Private sector interest, especially processors to support and enhance soybean production to meet local demand
- Availability of suitable varieties adaptable to almost all agroecological zones
- Formation of the Soybean Association of Malawi that is equipped to drive the soybean industry

Key partners

The key partners and their roles are given in Table 4.

Capacity building needs (staff, infrastructure)

- Postgraduate training in the areas of breeding and pathology is needed (only one PhD level staff available to work on many legumes)
- Short-term training for research technicians in specialized areas
- Inoculant production lab requires equipment to improve its quality
- A legume entomologist is also required to look at entomological aspects of all legumes
- Research technicians in various research centers also need on the job short-term training. There is need for infrastructure upgrading such as improving irrigation facilities, upgrading the inoculant production facility and infrastructure for seed increase and long-term seed storage; also vehicles for field work are necessary for Malawi NARS.

Table 4. Key partners along the soybean value chain and their roles.

Partner	Role
IITA-Malawi	Soybean breeding, variety development, technical backstopping and training
Ministry of Agriculture and Food Security	Agricultural policies
Department of Agricultural Research Services (DARS)	Research on varietal development
Bunda College of Agriculture	Research and training
National Smallholder Farmer's Association of Malawi (NASFAM)	Production of quality declared seeds and linking farmers to markets
Association of Smallholder Seed Multiplication Action Group (ASSMAG)	Farmer owned and controlled rural seed production and marketing organization
Department of Agricultural Extension Services (DAES)	Extension of technologies
Seed Co-Malawi (private seed company)	Production and marketing of seeds
Central Poultry Feeds (CP Feeds) and Rab Processors	Buy soybean grain from farmers, process soybeans into human food and animal feed
Soybean Association of Malawi (SOYAMA)	Address soybean trading and marketing issues as well as lobby financing institutions to support the soybean industry
Grain Legumes Development and Marketing	Enhance production and marketing of legumes
Department of Crop Development	Provide guidance in crop production

Special cultural/gender considerations

Women's role in soybean production, processing and utilization is high.

Processing and storage requirements and market opportunities

- Unlike other legumes, soybean can be stored without insect damage.
- Depending on storage conditions, soybean loses viability very fast and with respect to seed, this can be costly as replanting becomes inevitable.
- Farmers need to be trained in processing of this crop for household consumption as well as small-scale processing to generate income.
- There are large-scale processors like Export Trading Company, Central Poultry Feeds (CP Feeds) and Rab Processors who buy grains from farmers to produce human food (such as maize–soy blend, weaning baby food), feed for livestock and cooking vegetable oil.
- Although there is market farmers need to be linked with processors for mutual benefits with trust. Farmers need to be organized into groups to collect their produce and have bargaining power in marketing soybean grains.

Key policies (recently implemented/needed)

- The Government of Malawi has included soybean seed subsidy program to promote its production since 2007/08 season.

- The Presidential initiative on promotion of grain legumes (soybean, groundnut, pigeonpea and beans) production and marketing is aimed at doubling legume production in the country thereby generating income for farmers and also forex for the country.
- Malawi has developed the "Greenbelt Initiative" concept with the aim of increasing production and productivity of agricultural crops, livestock and fish farming both inland and along the shores of Lake Malawi and the banks of the Shire River through the development of small-scale and large-scale irrigation schemes.
- Protectionist trade policy measures intended for protecting the poultry industry – import quota for poultry meat – have resulted in a substantial increase in demand for soybeans primarily to supply the feed industry, with positive prospects for edible oil. This change in trade policy encouraged the rapid growth of the local feed industry, with increased derived demand for soybean and soybean cake.
- The private sector has established the Soybean Association of Malawi which is likely to drive production and use of soybean locally.
- The stakeholders in the entire legume value chain in partnership with the government of Malawi have also formed "Grain Legumes Development and Marketing Association" aimed at massively increased production and marketing of legumes in Malawi.

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

- Raising yields (high yield potential, improved crop management, etc) to reduce per unit production cost. Indeed, increasing the productivity of the crop per unit area is key to reducing cost of production and enhancing competitiveness. Seeds of improved varieties with good agronomic management practices and other inputs like P fertilizer and inoculants are key to enhancing productivity.
- Producer capacity strengthening as well as producer organization for meeting quality standards and reducing transaction costs through group marketing activities.

Mechanization as it relates to timely planting/harvesting and processing

- Since all agricultural operations of small-scale farmers are by hand hoe, it will definitely improve efficiency and productivity if there is some level of mechanization.
- Availability of rented tractors for plowing and small combiners for threshing could be desirable.
- Availability of soybean processing equipment such as Vitagoat and oil pressers would be desirable to start small-scale businesses by household, particularly women.

Environmental/sustainability issues

- Promoting soybean production has beneficial effect on the environment.
- Soybean cultivation has a paramount effect in reversing land and soil degradation due to cereal monoculture.
- Yield of cereal crops like maize increases when grown after soybean in rotation due to residual N availability either from the roots, fallen plant parts of soybean or nitrate-sparing effect.
- Increased soybean production will help to improve soils in Malawi in a more sustainable and natural way where up to 90% of the farmland is allocated for maize culture.

- Using soybean in the farming systems would help reduce dependence on mineral N fertilizer for maize, which reduces cost of production for farmers.
- Soybean is also known to reduce *Striga* seed bank from the soil, which helps to increase yield of subsequent cereals.

Monitoring and evaluation component

- Annual sub-regional review and planning meetings
- Half-yearly and annual reports
- Monitoring visits during the cropping season
- Farmers–scientist–extension staff interaction meetings to assess impact
- Annual Department Review and Monitoring Programs

Seed production plan

Seed production plan for soybean in Malawi is given in Table 5.

Table 5. Seed production plan and total demand for soybean by 2014.

					Breeder seed		Foundation seed		Certified seed	
Agroecology	Area (%)	Variety	Area (ha)	Production (t) for 40% target area	Area (ha)	Production (t)	Area (ha)	Production (t)	Area (ha)	Production (t)
Potential: Mid	100		83000	33200	5	8	94	142	1771	2656
	40	Makwacha	33200	13280	2	3	38	57	708	1062
	40	Tikolore	33200	13280	2	3	38	57	708	1062
	15	Ocepara-1	12450	4980	1	1	14	21	266	398
	5	Nasoko	4150	1660	0.3	0.4	4.7	7.1	88.5	133

Target average yield by 2015

Targeting an adoption rate of 20% and employing strategies to promote use of new improved soybean varieties through demonstrations, field days and the media, it is envisaged that average production of 1,500 kg ha^{-1} can be achieved.