Bulletin of Tropical Legumes
21
2013

A BULLETIN OF THE TROPICAL LEGUMES II PROJECT

About the Bulletin

The Bulletin of Tropical Legumes is a monthly publication of the Tropical Legumes II (TL II) project, funded by the Bill & Melinda Gates Foundation, and jointly implemented by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Center for Tropical Agriculture (CIAT) and the International Institute of Tropical Agriculture (IITA) in close collaboration with partners in the National Agricultural Research Systems) of target countries in sub-Saharan Africa and South Asia. TL II aims to improve the livelihoods of smallholder farmers in drought-prone areas of the two regions through enhanced grain legumes productivity and production.

Tropical legume farming in Malawi

Groundnut farming

Importance of the crop to Malawi's economy

Groundnut (*Arachis hypogaea* L.) 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 of groundnut during 1991-2006 (171 thousand hectares) accounted for 27% of the total land grown to legumes. Annual groundnut production during the same period accounted for 28% of Malawi's total legume production. The area under groundnut cultivation was about 14% of the area under maize cultivation (Simtowe et al., 2009).

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 socio-economic development of the country. It serves as a good source of both protein (generally between 12-36%) and vegetable oil (generally between 35-54%), and is also a good source of minerals (calcium, phosphorus, iron, zinc and boron as well as vitamin E and small quantities of vitamin B complex) for the rural households that have difficulties in accessing other forms of nutritious foods. Over 25% of the agricultural cash income among smallholder farmers is realized from groundnut (Chirwa, 2005). However, due to numerous constraints, its productivity remains low (Table 1).

Table 1: Current and projected status of groundnut in Malawi.

Parameter	Year/projection		
	2002-2011	2014	2017
Average area (ha)	254,578	267,561	310,621
Average production (MT)	227,089	244,121	303,271
National demand (MT)	168,294	176,372	203,008
Average yield (kg/ha)	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

*ROG= Rate of growth.
NA= Not available.

Varietal development

Decades of research by NARS and CGIAR partners in Malawi has resulted in the development of numerous technologies for enhancing groundnut productivity (Chiyembekeza et al.,1998). The technologies developed fall into two broad categories: 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 are concentrated on promoting recent releases of 3 Virginia type and 3 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 post-harvest 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 MT/ha.

Malawi promotes Virginia type varieties in the mid altitude agro-ecology and Spanish types in the lowland agro-ecology. However, overlaps of varieties occur across agro-ecologies 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.

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

Variety	Market type	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	3.2 (trace)	High yield, rosette resistant, confectionery,
Mawanga	VR	1982		Oil
Mani Pintar	VR	1969		Oil
RG1	VR	1975		Confectionery

Key constraints to production.

The current national 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, leaf hopper (*Hilda patruelis)*, termites, cutworms, and leaf-eaters. 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, evidenced by the majority of poor smallholder farmers' use of poor quality own saved seed of unimproved varieties. This is owing to limited availability of adapted improved varieties and good quality certified seed, and because seed is either overpriced and/or inaccessible. Other socio-economic factors include lack of labour-saving technologies and those for processing and utilization; lack of clear policies on marketing and associated regulatory frameworks; and limited domestic and international marketing opportunities.

Planned phase II activities and their contribution to national efforts

Phase II activities of the project will aim to harness gains made in the previous phase and hasten outcomes from continued Participatory Variety Selection to identify traits preferred by farmers and markets. Efforts will concentrate on implementing seed roadmaps (Table 3) 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 system components; build capacity of partners through training and infrastructure support; and carry out rigorous monitoring, evaluation and assessment of impact.

Target yield and beneficiaries by 2015

Phase II efforts target raising the national groundnut yield to 1205 kg/ha. This 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.

Table 3: Seed delivery plan to 2014 – to cover the required area (20% of national area under Groundnuts).

Demand (ha)	Promising varieties	Area to be covered (20% adoption)		Seed Production (t)					
				Breeder seed 2012		Foundation seed 2013		Certified seed 2014	
		Total (ha)	Per variety (ha)	Area (ha)	Production (kg)	Area (ha)	Production (t)	Area (ha)	Production (t)
216,000	CG7	216,000	129,600	116	104,000	924.4	832	3,600	3,240
	Nsinjiro		64,800	44	40,000	355.6	320	1,056	950
	Chalimbana 2005		10,800	98	88,000	782.2	704	2,500	2250
54,000	Kakoma	54,000	27,000	3	3,000	28.9	26	194	175
	Chitala		27,000	4	4,000	35.6	32	417	375
		270,000	259,200	266	239,000	2,127	1,914	7,767	6,990

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 the selection of segregating material and evaluating international breeding nurseries to identify suitable lines for local needs, and initiate crossing programs.

Rigorous farmer participatory variety selection (PVS) 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.

Enhancing institutional and technical innovations

The existing network of institutions will be explored to enhance linkages and exploit synergies among NGOs, CBOs, and the private sector to avail improved seed and offer better marketing opportunities to farmers. The existing farmer associations [(National Smallholder Farmers' Association of Malawi (NASFAM), Association of Smallholder Seed Multiplication Action Group (ASSMAG), and Grain and Legumes Association (GALA)], the Legume platform and the Malawi Legume Development Association will spearhead technical innovations and dialogues 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 post-harvest contamination. Proper drying procedures and produce handling technologies are necessary to minimize such risk. The minimum standards set for traded groundnuts have greatly restricted access to international markets by many African countries including Malawi.

Key innovations to improve smallholder competitiveness in the value chain

Raising groundnut yield by accurate targeting of varieties to appropriate agro-ecologies remains a key strategy for increasing production and reducing losses due to risk factors. For the mid altitude and plateaus there is 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 agro-ecologies guided by the 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 to respond to market signals. Transformation of production system components will be advocated through enhanced private sector involvement in processing and marketing of groundnuts, and mechanization of production activities to reduce drudgery and labour costs.

Expected outcomes of phase II

Phase II 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.

Table 4: Groundnut's share in total production by agricultural development division.

Ecology/ district	Production (MT)	Yield (kg/ha)	Area (%)	Production (%)	Proportion sold (%)	Dominant varieties
Karonga	4,346	639.96	2.5	1.6	75% in local markets	Chalimbana
Mzuzu	26,128	896.42	10.9	9.8		Chalimbana, CG7
Kasungu	76,547	1,122.7	25.6	28.7		Chalimbana, Chalimbana 2005, CG7, Nsinjiro, Kakoma
Lilongwe	96,828	1,118	32.5	36.2		Chalimbana, Chalimbana 2005, CG7, Nsinjiro
Salima	8,789	878.55	3.8	3.3		Kakoma, Malimba, CG7
Machinga	26,775	751.58	13.4	10.0		Kakoma, Malimba
Blantyre	25,363	945.46	10.1	9.5		Chalimbana, CG7
Shire Valley	2,302	692.81	1.2	0.9		Malimba, Kakoma, Baka

Agro-ecologies suitable for groundnut cultivation in Malawi

Malawi has a total land area of 119 140 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. Three main agro-ecologies are recognized based on climatic conditions and differences in altitude: the mid altitude or plateau areas (900-1200 masl), the lakeshore, and the Shire valley. The lakeshore and the Shire Valley are often regarded as one lowland agro-ecology (up to 899 masl).

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 (2010/2011 crop statistics). Groundnut is primarily a rain-fed 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 masl, 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 4).

Seed systems

The groundnut sub-sector in Malawi is driven by both formal and informal seed delivery systems. Beyond breeder seed production, the formal system regulates basic and certified seed production while informal seed delivery systems operate through community-based organizations.

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 (STAM members, individual growers, CBOs, community-based seed banks, farmer research groups, and associations) of seed producers.

Strategic partners and their roles

In order to consolidate gains from previous investment in groundnut research, new innovative approach to ensure aggressive promotion of technologies is a fundamental requirement. Partnerships among NARS, NGOs, private - sector and farmers' organization (Table 5) will help popularize preferred improved varieties and improve crop production practices.

Table 5: 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 seed; develop integrated crop management technologies; provide Aflatoxin testing services
Seed Services Malawi	Seed systems support to help collaborating NGOs and CBOs with quality seed production monitoring
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 of technology dissemination
Private sector (market intermediaries, seed enterprises, processors and agro-input dealers)	Facilitate processing and commercialization

Common bean farming

Importance of the crop in Malawi

Common bean *(Phaseolus vulgaris* L*)* is an important legume crop for 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, have large amounts of vitamin B, iron and zinc which are essential for immune function in humans. Common bean is also a source of income to many small-scale farmers who happen to be major producers. Beans, when grown in rotation with other crops such as maize or tobacco, improves soil fertility. Another important role that common bean plays is the gap filling when food shortages reach a climax and people depend on beans alone for their survival.

In 2012, common bean area was estimated at 243,700 ha and production at 127,464 MT (Table 6). In the major bean growing areas, from 74% to 90% of farmers grow beans as their main cash crop, and beans are second only to maize as a food crop (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 (Kalyebara et al., 2005). Both production and demand for beans in Malawi are rising, with an annual growth rate of 4% between 2002 and 2011 in production. 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 by providing seeds as inputs to farmers and additional hectares under irrigation).

Projections for 2014-2020 suggest continued growth in both national demand and production. 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 6: Status of common beans from 2002 to 2012 in Malawi.

Year	Area (ha)	Yield (kg/ha)	Prod (MT)
2002	227,917	438	99,828
2003	239,476	459	109,832
2004	204,515	376	76,964
2005	233,845	367	85,759
2006	242,568	486	117,808
2007	268,688	494	132,689
2008	268,995	483	129,948
2009	220,770	544	120,084
2010	228,880	464	106,219
2011	232,638	534	124,184
2012	243,700	523	127,464
Average	237,454	470	111,889

Variety development

The bean improvement program in the Department of Agricultural Research Services started developing bean varieties in 1996. This research is conducted in collaboration with CIAT and through Pan-Africa Bean Research Alliance (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, with 18 of them released by the Department of Agricultural Research Services and 12 by the University of Malawi-Bunda College of Agriculture.

Production constraints

Current bean yields are very low estimated at slightly below 500 kg/ha. There are many factors that are responsible for low yield.

These include:

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

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

Planned phase II activities

The project objectives will be achieved through strategic planning involving partners; 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, while employing other eco-efficient non-variety bean production technologies.

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

Expected outcomes

Phase II 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.

Agro-ecological zones

Common bean is grown across the country in the agro-ecologies categorized according to altitude as high, medium and low (Table 7). Along the lake shores and in the Shire valley, beans are cultivated less because the crop does not adapt there. 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, and the sugar (cream-striped) type. Common varieties include Phalombe (local variety), Kholophethe (sugar 131), Maluwa (CAL 113) and Napilira (CAL 143).

Strategic partnerships and roles

Partners will be involved in enhancing 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. The type of partners and their roles are presented in Table 8.

Total bean area in Malawi is estimated to be at 225,000 ha, of which 40% or 90,000 ha is targeted. At a seed rate of 80 kg/ha, this will require 7,200 tons. The goal yield is 1 t/ha, for a national production of 225,000 tons, and this estimate has been used to develop the bean seed road map (Table 9).

Table 7: Common bean production zones in Malawi, their agro-ecological conditions and dominant varieties grown.

Production zone	Agro-ecological conditions	Bean area (ha)	Dominant varieties
High altitude (districts of Chitipa, Livingstonia, Viphya, Dedza)	Sub-humid, > 1500 masl, >400 mm of unimodal rainfall and soils acid	124,971	Kholophethe, Kalima
Mid altitude (districts of Mzimba, Lilongwe, Dowa, Nmawera, Shire)	Sub-humid, 1000-1500 masl, >400 mm, unimodal rainfall	114,198	Muluwa, Napilira
Low altitude (Lake basin, Phalombe)	<1000 masl, unimodal rainfall	26,158	Kabulengeti, Kayela

Source: Adapted from Wotmann et al., 1998 updated for bean area and dominant varieties

Table 8: 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 seed; develop integrated crop management technologies
Seed companies - Seedco, 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/ monitoring
NGOs - CRS, CARE World vision,	Provide 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, management practices
Department of crop development planning and extension	Support to farmer field schools to impart knowledge and skills for increased production on-farm

Table 9: Common bean seed production plan to reach 40% adoption by 2015.

Agro-ecology		Variety	Seed rate (kg/ha)	Productivity (MT/ha)	Area (ha)	Target area (40%)	Breeder seed (2013)		Foundation seed (2014)		Certified seed (2015)	
							Area (ha)	Prod (t)	Area (ha)	Prod (t)	Area (ha)	Prod (t)
High altitude	10%	Napilira	80	1.5	22,500	9,000	5	5	58	58	720	720
	30%	Kholophethe	80	1.5	67,500	27,000	14	14	173	173	2,160	2,160
	15%	VTTT 924/4-4	80	1.5	33,750	13,500	7	7	86	86	1,080	1,080
	5%	Kabalabala	80	1.5	11,250	4,500	2	2	29	29	360	360
	5%	KK112	80	1.5	11,250	4,500	2	2	29	29	360	360
	5%	KK 68	80	1.5	11,250	4,500	2	2	29	29	360	360
	5%	KK 168	80	1.5	11,250	4,500	2	2	29	29	360	360
	5%	Maluwa	80	1.5	11,250	4,500	2	2	29	29	360	360
Medium altitude	5%	NUA 45	80	1.5	11,250	4,500	2	2	29	29	360	360
	5%	NUA 59	80	1.5	11,250	4,500	2	2	29	29	360	360
	5%	Ser 45	65	2	11,250	4,500	2	2	29	29	360	360
	5%	Ser 85	65	2	11,250	4,500	2	2	29	29	360	360
Total	100%				225,000	90,000	46	46	576	576	7,200	7,200

Pigeonpea farming in Malawi

Pigeonpea is the most versatile grain legume grown by smallholder farmers in Malawi for both local consumption and export. It ranks third among the important legume crops after groundnut and beans. The crop is now planted on 196,516 ha producing about 216,716 tons of pigeonpea between 2010 and 2012 (Ministry of Agriculture Crop estimates data, 2012) up from a total of 78,000 tons produced per year between 1991 and 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 under pigeonpea cultivation. 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. It also provides fodder/feed for livestock and has the potential to improve soil fertility. The crop is deep rooted as such it is adapted to withstand the intermittent or terminal droughts depending on the type of varieties grown.

Pigeonpea 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 multi-locational sites for adaptability and acceptance. Historically, desirable traits in pigeonpea have been selected by farmers from landraces to suit their production systems and uses. ICRISAT, together 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 were released between 1987 and 2011 (Table 10). 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.

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 harbor 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 seasons.

Agro-ecologies of pigeonpea cultivation

Blantyre and Machinga agricultural development divisions in the southern region of Malawi are traditionally major pigeonpea growing areas accounting for 92% of the total pigeonpea area (Table 11), and contributing up to about 20% of farmer's 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 medium-maturing varieties.

Dominant varieties

Over the years, six improved pigeonpea varieties were released in Malawi. They are short-duration ICPL 87105 and ICPL 93027; long-duration ICP 9145 (Sauma) and ICEAP 00040 (Kachangu); and medium-duration varieties ICEAP 00557 (Mwaiwathualimi) and ICEAP 01514/15. Presently popular varieties with farmers are ICP 9145, ICEAP 00040 and local landrace Mthawajuni. ICEAP 00557 and ICEAP 01514/15 which were released through TL II phase-I, are spreading very fast in all pigeonpea agro-ecologies.

Table 10: Pigeonpea varieties released in Malawi and their characteristics.

Variety	Pedigree	Year of release	Special varietal attributes	Recommended agro-ecologies	Yield potential
Sauma	ICP 9145	1987	Long duration, Fusarium wilt resistant	High altitude areas	1500
Kachangu	ICEAP 00040	2000	Long duration, large seeded, 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 maturing	Low to medium altitude areas	2500
ICEAP 01514/15	ICEAP 01514/15	2011	Medium maturing, high yielding	Low to medium areas	2500

Table 11: Pigeonpea area trends in major growing divisions in Malawi.

Agricultural development divisions	Year		Change over 2 seasons (%)
	2008-09	2010-11	
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

Seed systems

In Malawi, due to lack of awareness and limited or no access to quality seed due to the consistent failure of the 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 from area of utilization because of isolation requirements and availability of infrastructure for storage and processing leading to high transaction costs. The project has made selective investments to overcome these constraints in breeder and foundation seed production, and in 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. Most of the farmers rely on self-saved seed and access to seed of improved varieties through informal networks. The baseline survey also points out the existence of two 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 the quasi-formal system seems of seed demand and seed markets for superior varieties. The road map for pigeonpea seed production and certified seed production over 3 years are given in Tables 12 and 13.

Table 12: Pigeonpea seed roadmap for Malawi.

Ecology (zone)	Total demand (ha)	Promising varieties	On-farm yield potential (t/ha)	Seed rate (kg/ha)	Area to be covered for 25% adoption		Seed production (tons)						Seed required to reach 25% adoption (t)
					Total (ha)	Per variety (ha)	Breeders seed in 2012		Foundation seed in 2013		Certified seed in 2014		
							Area (ha)	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	Mwaiwathu alimi	1.0	10		16,835	220	22	2.1	2.1	198	198	198
	67,340	ICEAP 01514/15	1.0	10		16,835	220	22	2.1	2.1	198	198	198
	38,480	Kachangu	1.0	10		9,620	130	13	1.2	1.2	113	113	113
	19,240	Sauma	1.0	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	Mwaiwathu alimi	1.0	10		400	5	0.5	0.05	0.05	5	5	5
	1600	ICEAP 01514/15	1.0	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	Mwaiwathu alimi	1.0	10		150	2	0.2	0.02	0.02	2	2	2
	450	ICEAP 01514/15	1.0	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 13: Certified seed production plan over the three years (t).

Variety	2012	2013	2014
Mwaiwathu alimi	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

Seed production targets

Total Area: 196,516 ha
Seed rate mean: 10 kg/ha
National seed demand 1965 t (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 t

Opportunities, constraints and partnerships to produce seed required to cover 25% of area in Malawi

Opportunities

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

Challenges/constraints

- Insect pests and poor crop management practices
- Fusarium wilt and *Cercospora* leaf spot diseases
- Lack of knowledge on pigeonpea use in non-traditional potential areas
- Lack of organized markets
- Seed accessibility issues
- Limited technical knowhow of frontline extension staff
- Terminal drought where farmers use local varieties

Vision of success

Pigeonpea area is increasing and with the release of medium-duration varieties, it is spreading to parts of the central and northern regions. Low seed rate and high multiplication ratio are the major advantages with 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 new varieties and they are already reaping yields of more than 1 t/ha. The development of a vibrant seed production strategy and ever growing demand for pigeonpea from Asian markets will definitely be good for the growth of the pigeonpea sub-sector in Malawi.

Table 14: 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; helping collaborating NGOs and CBOs with quality seed production/monitoring
Department of Crop Production, Ministry of Agriculture and Food Security	Provide guidance in crop production technologies and associated packages
NASFAM	Capacitate farmers formation of associations for collective production and marketing
CARE Malawi/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, 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

Soybean farming in Malawi

Importance of soybean, *r*esearch and development

Soybean is not a new crop in Malawi. Reports by the Ministry of Agriculture and Food Security indicate that it has been grown in the country since 1909. It was cultivated as a minor crop in association with tung. Varietal and agronomic research on the crop and the generation of useful information has increased its importance. Research on soybean has shown that the crop is well adapted for production in all agro-ecological zones in Malawi. Key studies on agronomic practices have been done. Fully fledged and focussed research programmes on soybeans in the 1980s led to the release of improved varieties such as Impala, Kudu, Geduld, Bossier, Hernon 147 and Hardee. However, these varieties had a 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 and with characteristics such as cream white hilum and large seed size which are acceptable to processors.

In partnership with several local and international institutions such as INSOY, The World Vegetable Center (AVRDC), International Institute of Tropical Agriculture (IITA) and Seed Co, these soybean varieties were developed along with those currently in the market. 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 agro-ecologies are presented in Table 15.

Soybean production trends in Malawi

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

Increased production through area expansion may not be possible in most parts of the country because of population pressure on the land. Developing improved varieties with market preferred traits therefore remains a viable pathway. Soybean production in Malawi has fluctuated over the years (Table 16) largely due to poor farm gate prices offered to farmers and other production challenges/constraints.

Table 15: Characteristics of soybean varieties currently grown in Malawi.

Variety	Source of material	Year of release	Special varietal attributes	Recommended agro-ecologies	Yield potential
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	2003	High yielding, tolerant to frogeye	Widely adapted to most agro-ecologies	3000
Soprano	Seed Co	2003	High yielding, tolerant to frogeye	Medium to high altitude areas	3000

Table 16: Soybean production statistics in Malawi from 2002-2012.

Year	Area (ha)	Yield (kg/ha)	Production (MT)
2002	45,428	651	29,568
2003	53,579	763	40,889
2004	47,128	716	33,758
2005	68,524	590	40,396
2006	71,652	771	55,248
2007	79,465	897	71,295
2008	73,942	872	64,489
2009	82,217	968	79,615
2010	70,654	961	67,873
2011	70,955	982	69,596
2012 (R2)*	96,950	970	99,980
Average	76,050	914	65,271

* R2 = Second round crop estimates made at vegetative stage of plant growth.

Area: 76,050 ha (average of 2002-2012)

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

Proportion of production sold commercially: >85%

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

National production: 65, 271 t (2012 national data)

National demand: 111,000 MT

Expected annual growth in demand: 4.6%

National projected demand in 2015: 139,000 MT

Malawi is agro-ecologically divided into eight agricultural development divisions (ADDs). Five main landforms are evident in most of these agro-ecologies namely: Highlands, Escarpments, Plateau, Lakeshore, Upper Shire Valley and the Lower Shire Valley. The Plateau represents three quarters of Malawi at elevations of 750-1300 masl. Although the major soybean producing 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 17).

Table 17: Main soybean production sites in Malawi.

Agricultural development divisions	Area (ha)	Production (MT)	Yield (kg/ha)
Kasungu	29,414	33,729	872
Lilongwe	26,780	24,805	1,080
Mzuzu	8,410	7,044	1,194

(Based on 2011 national data, Ministry of Agriculture, Food Security and Water Development)

Key constraints to soybean production

- Soybean rust and other diseases
- Drought (terminal and low moisture stress)
- Poor soil fertility (low P)
- 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 agro-ecological zones
- Formation of the Soybean Association of Malawi that is equipped to drive the soybean industry.

Capacity building needs

- Postgraduate training in breeding and pathology is needed (only one PhD level staff is available to work on many legumes)

Table 18: 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	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

- Short-term specialized training for Research Technicians
- A legume entomologist is required to look at entomological aspects of all legumes
- Research Technicians in various research centers also need on the job short-term training.
- Infrastructure upgrading for the Malawi NARS in irrigation facilities, in the inoculants production facility, for long-term seed storage, and vehicles for field work.

Cultural/gender considerations

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

Target average yield by 2015

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

Processing & storage requirements/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 soybean 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.
- Farmers need to be linked with processors for mutual benefit. 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 a soybean seed subsidy program to promote production since the 2007/08 season.There is a Presidential initiative on the promotion of grain legumes (soybean, groundnuts, pigeonpea and beans) production and marketing aimed at doubling legume production to generate income for farmers and foreign exchange 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 of 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 Soybean Association of Malawi set up by the private sector is likely to drive local production and use.
- The stakeholders in the entire legume value chain in partnership with the government of Malawi have also formed a "Grain Legumes Development and Marketing Association" aimed at massively increasing production and marketing of legumes in Malawi.

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

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 are important.

Mechanization for timely planting, harvesting and processing

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

Environmental/sustainability issues

- Promoting soybean production is beneficial to the environment.
- Soybean cultivation reverses land and soil degradation due to cereal monoculture.
- The yield of cereal crops like maize increases when grown in rotation with soybean due to residual N available either from the roots, fallen plant parts of soybean or the 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 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 the *Striga* seed bank from the soil, which helps to increase yield of subsequent cereals.

Monitoring & Evaluation

- These include annual sub-regional review and planning meetings, half-year and annual reports, monitoring visits during the cropping season, farmer-scientist-extension staff interactions to assess impact, annual departmental reviews and monitoring programmes.

For more information, contact: Dr Emmanuel S Monyo (TL-II Project Coordinator): Email: e.monyo@cgiar.org; Tel +254 207224566; Mobile +254729176844.

Dr Geoffrey Kananji (National Grain Legumes Coordinator): Email: gkananji@yahoo.com

Website: http://www.icrisat.org/TropicallegumesII/Bulletin-of-Tropical-Legumes.htm