



EVALUATION OF THE MALAWI SEED SECTOR FOR THE COMMON MARKET FOR EASTERN AND SOUTHERN AFRICA (COMESA) HARMONIZED SEED REGULATIONS AND POLICIES

FINAL REPORT

14 OCTOBER 2010

H. R. Mloza-Banda
with
G. Kaudzu and I. Benesi

Undertaken for the African Seed Trade Association (AFSTA)
Funded by COMESA

Acknowledgements and Disclaimer

The Evaluation Team would like to express their thanks to members of staff of the Ministry of Agriculture and Food Security, the Ministry of Industry and Trade, FewNet, Seed Traders Association of Malawi, FANRPAN, and members of the seed industry who generously gave time and information for the compilation of this report. Any errors or omissions remain the responsibility of the authors. The views expressed in this report imply no endorsement by the contributors of information or any other party.



EXECUTIVE SUMMARY

Background

The study recognizes that of all the inputs used in agriculture, none has the ability to affect productivity as much as seed. Through its genetic properties, seed places the upper limit on yield potential and influences the productivity of other inputs by determining the ability of plants to convert radiation, water, carbon dioxide and other nutrients into biomass. Unless farmers are provided with access to good quality seed of improved varieties, it would be uneconomic for Sub-Saharan African countries to spend precious foreign exchange on fertilizers which have a high imported content. Easy and sustainable access of farmers to quality seed is essential for farmers to reap the benefits of fertilizers. It is observed however, that farmers' seed systems provide an important component of seed security, which allows diversity and space for the further evolution of plant genetic resources. Policymakers have to realize this and carefully balance incentives and regulations to safeguard an ever-changing optimal mix of private, civil and public roles given the call for seed harmonisation and standards in the region.

The Common Market for Eastern and Southern Africa (COMESA) observed that effective seed marketing is an essential component of activities to improve food security in the region. However, a number of factors that include: trade restrictions, restrictive regulations and standards, lack of access to improved seed, diseconomies of scale arising from small national seed markets, long payback periods and lack of credit have inculcated inefficiencies in agricultural seed marketing. With a mission to harmonise regional seed laws, policies and procedure to attend to these issues, COMESA commissioned national baseline studies on the seed sector intended to give general background information on the seed sector including seed statistics (production and import/export), availability and status of seed infrastructure, and assessment of capacity of the country to implement requirements in the following five areas: (1) seed certification, (2) variety evaluation, release and registration, (3) phytosanitary measures, (4) plant variety protection (intellectual property rights), and, (5) seed import/export documentation and procedures.

Seed certification

The Amended Seed Act of 1996 was again amended in 2004 but not enacted. The reviewed draft requires fresh review after being shelved for 6 years. The subsequent revision of the amended Seed Act of 1996 made provision for the establishment of a seed certification scheme (after the OECD format) which is currently in use. The scheme needs review and enactment together with the revision of the amended Seed Act of 1996 and processes towards affiliation to OECD Certification Scheme. In this regard the Act should encourage cooperation among member States

by recognizing certification schemes in other COMESA countries and the seed produced under such schemes.

NGOs that support farmers further reported that there are fewer government seed inspectors than the demand. This can be alleviated through training at Bunda College which has programmes in seed science and technology at all levels. However, the training institution requires capacity building in terms of infrastructure, basic seed laboratory equipment, and software for maintaining different levels of clientele in seed industry.

Variety evaluation, release and registration

There is need to document, prepare and publish guidelines for variety development and testing in all important crops. In fact, for Malawi, national register for varieties has not been systematic to allow for cross referencing when variety has been released elsewhere in the region. There are also inconsistencies in descriptors and the naming and coding for varieties developed locally or derived from the CGIAR system. There is therefore need to review and upgrade characterisation and evaluation for distinctness, uniformity and stability (DUS) and value for cultivation and use (VCU), develop a national register of varieties and an information system to support the same.

Phytosanitary measures

The Plant Protection Act of 1964 is outdated and needs technical and financial support for its comprehensive review. Current efforts have so far been piecemeal. In addition, there is need to review regulations and procedures including pest lists to update and align them with regional protocols so that the country is able to participate fully in seed trade. There is need to provide infrastructural facilities and equipment at entry points and the training of Plant Health Inspectors to enhance monitoring of seed movement.

Plant variety protection (intellectual property rights)

A study of seed legislation in Malawi shows that it does not yet have the legislation for the awarding of plant variety protection to permit plant breeders to protect intellectual property rights. New plant varieties should be protected by legislation through the Malawi Plant Breeders' Rights Act which was drafted but is yet to be enacted requiring further technical and financial support. It is important that analyses and training workshops be conducted on the effects of the introduction of PBRs in importing COMESA countries on the value of exports of agricultural seeds and planting material from exporting COMESA countries. This study argues for increased research investments in molecular biology and genetic engineering that implies a high degree of collaboration between private and national institutions, especially in monitoring future research demands and areas of mutual interest. The study noted arguments that the present trends in the securing of intellectual property rights for innovations, especially those over processes of

molecular biology and genetic engineering applied to plant breeding have gone much too far in the direction of allowing monopolization to the detriment of future innovation.

Seed import/export documentation and procedures

There is need for the three branches of government responsible for regulatory functions in Malawi's seed sector to work together in order to ensure that farmers in Malawi are planting high quality seed and planting materials through comprehensive monitoring not only during production, but also through premeditated monitoring of seed movement. There is a need to support strategies where the private sector, and in particular agrodealers and farmer associations, shall continue towards the development of rural market infrastructure and eventually to export marketing coordination. There is need to determine international (unmonitored) trade in seed as well as seed movement through cross-border trade.

The shift in development through this harmonization should be from a deficiency model, based on needs assessment and problem identification, to a capacity building model where the focus is on creating the future instead of concentrating only on fixing the past. There appears a dire need for increased numbers and training of personnel in all areas of endeavor to support the harmonization process. It is expected that the harmonization will create interconnections and active and responsible involvement within countries and between countries in seed trade.

TABLE OF CONTENTS

1	Introduction	10
	1.1 Harmonisation of regional seed market	10
	1.2 Objectives of Study	10
	1.3 The Republic of Malawi	11
	1.4 Seed industry in Malawi	13
2	Seed certification and quality control	15
	2.1 Background information and body responsible for seed certification	15
	2.2.Name and contact addresses of the head of body responsible for seed certification	16
	2.3 Existing seed classes in Malawi	16
	2.4 Process for seed certification	16
	2.5 Conformity with regional standards adopted by SADC	18
	2.6 Seed related information at national level	22
	2.7 Institutions and organizations involved in the national seed sector	22
	2.8 Future plan of the country for standards for seed certification	27
	2.9 Additional information on Standards for the seed certification	29
3	Variety evaluation, release and registration	31
	3.1 Variety evaluation, release and registration	31
	3.2 Name and contact addresses of the head responsible for variety evaluation, release and registration	31
	3.3 Variety evaluation, release and registration system/process	32
	3.4 Developers of agricultural technologies	32
	3.5 Crops included in release process	33
	3.6 Conformity with SADC protocol	34
	3.7 Future plan of the country for variety evaluation, release and registration	34
4	Phytosanitary measures	39
	4.1 Background information and body responsible for phytosanitary measures	39
	4.2 Name and contact addresses of the head of this body	40
	4.4 Phytosanitary measures including the overall processes necessary	40
	4.4 Conformity with regional phytosanitary measures in SADC if there is harmonized quarantine pest list or any other harmonized standards on phytosanitary measures	40
	4.5 Future plan of the country for phytosanitary measures	43
5	Plant Variety Protection	45

5.1	Background information and body, which is responsible for Plant Variety Protection	45
5.2	Name and contact addresses of the head of body responsible for Plant Variety Protection	46
5.3	Conformity with proposed regional Plant Variety Protection in SADC	46
5.4	Future plan of the country for Plant Variety Protection	46
5.5	Any additional information on Plant Variety Protection measures necessary for the purpose of harmonization at COMESA level	46
		47
6	Seed import and export	49
6.1	Background information on seed import and export	49
6.2	Name and contact addresses of the head responsible for seed import and export	50
6.3	Seed import/ export procedures	
6.4	Seed import and export documentation	51
6.5	Future plan of the country for seed import and export	53
6.6	Any additional information on Plant Variety Protection measures necessary for the purpose of harmonization at COMESA level	56
7	Membership to International Organisations	59
7.1	International Seed Testing Association (ISTA)	59
7.2	Organization of Economic Cooperation and Development (OECD)	59
7.3	The Convention on Biological Diversity (CBD)	60
7.4	The Catagena Protocol	60
7.5	The SADC Protocol on Trade	61
8	References	62
9	Appendix	66

LIST OF TABLES

- Table 1.1: Some key indicators of smallholder agriculture in Malawi
- Table 1.2: Officers under the Seed Certification and Quality Control Services Unit in the Ministry of Agriculture & Food Security, Government of Malawi
- Table 2.1: Classes and labels used for SADC and Malawi
- Table 2.2: Standards for seed certification of major crops handled
- Table 2.3: Laboratory seed testing standards for Malawi and SADC
- Table 2.4: Quantity of seed sampled and tested during 2009/2010 season
- Table 2.5: Quantity of certified seed for major crops required in Malawi
- Table 2.6: A list of organizations involved in the Malawi Seed Industry
- Table 3.1: Released varieties by institution from 2000 to 2009
- Table 4.1: Examples of intractable constraints to production among small-scale farmers for seven important African crops
- Table 4.2: Quarantine and Phytosanitary measures for seed. Pest List for SADC and Malawi
- Table 6.1: Quantity of seed imported into Malawi and registered by SSU
- Table 6.2: Seeds imported into Malawi in 2009 as registered by Ministry of Industry & Trade
- Table 6.3: Quantity of seed exported by Malawi and registered by SSU
- Table 6.4: Seeds exported (kg) by Malawi in 2007-2009 as registered by Ministry of Industry & Trade.
- Table 6.5: SADC's exports and imports products
- Table 9.1: Personnel Serving Under Plant Protection and Seed Services Commodity by Section, Post and Location in the Ministry of Agriculture & Food Security, Government of Malawi
- Table 9.2: The crop production statistics for Malawi for the period 2005/06 to 2009/10. Production in metric tones and area in hectares.

LIST OF FIGURES

- Figure 1.1: Principal physiographic units of Malawi
- Figure 9.1: Major physiographic regions of Malawi
- Figure 9.2: Cassava breeding scheme followed in Malawi

ACRONYMS AND ABBREVIATIONS

ASSMAG	Association of Smallholder Seed Multiplication Action Group
ASTA	African Seed Trade Association
ADD	Agricultural Development Division
ADMARC	Agricultural Development and Marketing Cooperation
ATCC	Agricultural Technology Clearing Committee
ARET	Agricultural Research and Extension Trust
ADP	Area Development Programme
CIAT	International Center for tropical Agriculture
COMESA	Common Market for Eastern and Southern Africa
CONGOMA	Council for Non-Governmental Organizations in Malawi
CPAR	Canadian Physicians for Aid and Relief
CARE	Cooperation Assistance and Relief Everywhere
CBO	Community Based Organization
CRSP	Collaborative Research Support Programme
DAES	Department of Agricultural Extension Services
DARS	Department of Agricultural Research and Technical Services
DCP	Department of Crop Production
DUS	Distinctness, Uniformity and Stability
EPA	Extension Planning Areas
EU	European Union
FAO	Food and Agricultural Organization
FANRPAN	Food, Agriculture and Natural Resources Policy Analysis Network
GOM	Government of Malawi
GDP	Gross Domestic Product
GMO	Genetically Modified Organism
IARC	International Agricultural Research Centre
ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crop Research Institute for Semi-Arid Tropics
IFDC	International Center for Soil Fertility and Agricultural Development
IITA	International Institute for Tropical Agriculture
MCCI	Malawi Confederation of Chambers of Commerce and Industry
MPRS	Malawi Poverty Reduction Strategy Paper
MoAFS	Ministry of Agriculture and Food Security
NGO	Non-Governmental Organization
NASFAM	National Association for Smallholder Farmers in Malawi
NCST	National Commission of Science and Technology
NSCM	National Seed Company of Malawi
OECD	Organization of Economic Cooperation and Development
OIC	Orange International Analysis Certificate
OPV	Open Pollinated Variety
PBR	Plant Breeders Rights
QDS	Quality-declared seed
QPM	Quality protein maize
SADC	Southern African Development Community

SPS	Sanitary and Phytosanitary Services
SSSN	SADC Seed Security Network Project
SSU	Seed Services Unit
STAM	Seed Trade Association of Malawi
TIP	Targeted Input Programme
TRF	Tea Research Foundation
UPOV	International Union for the Protection of New Varieties of Plants
USAID	United States Agency for International Development
VCU	Value for Cultivation and Use
WVI	World Vision International

1.1 Harmonisation of regional seed market

Crop improvement is a key area of agricultural research. It involves selective breeding to identify and develop crop varieties, promoting these varieties and associated management strategies through extension, and providing seed (and other inputs) through supply systems (DeVries and Toenniessen, 2001). The emphasis on breeding reflects seed's importance as an essential input for agriculture, whose physical and genetic quality affect crop performance throughout the season. Seed is generally considered to be the most affordable external input for farmers, and many of its benefits are assumed to be 'scale-neutral', so investments in crop improvement potentially can reach a wide range of farmers. While many other areas are also important for agricultural development – such as markets, credit supply, support institutions, and policies – access to appropriate seed is clearly the first step.

The concept of a Common Market for Eastern and Southern Africa (COMESA) regional seed market anticipates a situation where seed companies and traders would be able to operate across national borders, testing and distributing seed based on agro-ecological zones and market demand. For seed, the development of a regional market will depend on changes in legislation allowing seed companies to move varieties and seed from one country to another with a minimum of government control. It is considered that disparities in seed laws have led to trade barriers, delays in the release of new varieties and high seed costs leading to low crop yields. Harmonised seed regulations are expected to help farming communities benefit from high yielding and locally adapted crop varieties creating the ability to maximize food production per unit of labour and other inputs (FANRPAN, 2010).

The targeted groups in the harmonization process are stakeholders in the seed value chain and they include government departments of agriculture, national agricultural research institutes (NARIs), the Consultative Group on International Agricultural Research (CGIAR), seed breeders, universities, early warning systems, policy networks, farmer groups, women's groups, international seed research organizations, and agents involved in the marketing of seed.

1.2 Objectives of Study

The main specified objectives of this consultancy were to review the Malawi Seed Sector. The study was designed to give general background information on the Malawi seed sector including seed statistics (production and import/export), availability and status of seed infrastructure, and

assessment of capacity of the country to implement harmonization requirements with respect to the following five areas of focus: (i) standards for seed certification, (ii) variety evaluation, release and registration, (iii) phytosanitary measures, (iv) plant variety protection (Intellectual Property Rights), (v) seed import/ export documentation and procedures, and (vi) membership to international organizations.

The study used literature, data and information from the Ministry of Agriculture and Food Security, the USAID-funded FewNet, Seed Certification and Quality Control Unit at Chitedze Agricultural Research Station, and the Ministry of Industry and Trade. The study also benefited from interviews held with a cross-section of people from these institutions who participated at meetings at various levels and stages of the key areas for harmonisation.

1.3 The Republic of Malawi

1.3.1 Physical Features

Malawi lies between 09° 25' and 17° 08' latitude South and 32° 40' and 34° 55' longitude East. The country's territorial area is slightly over 118,000 square kilometers, of which 61% is arable land, 20% is taken up by the lakes and the remaining 19% is covered by forest reserves, human settlement and public infrastructure. Topography is heterogeneous derived from the East African Rift Valley in which lies Lake Malawi that covers three quarters of the entire length of the country from North to South (Fig. 1) (Malawi Government, 2002).

Malawi has been divided into four physiographic regions as follows: (i) the Highlands which are extensive highland tracts at 1600-3000 m.a.s.l; (ii) the Plateaux at 1000 to 1600 m.a.s.l with gently undulating extensive tracts in the north and centre regions of the country; (iii) the Rift Valley Escarpment at 600-1000 m.a.s.l, a highly dissected zone with precipitous slopes; and, (iv) the Rift Valley Plain at 33 to 600 m.a.s.l. formed in large part by the deposition of material and characterised by subdued relief and gentle slopes. With an altitude ranging from 50 m above sea level in the lower Shire Valley to over 3 000 m on Mount Mulanje in the south and 2 600 m on the Nyika in the north, and with slopes that vary from steep escarpments to plains, a wide variety of agro-ecosystems exist (Malawi Government, 2002). Modifications to the ecosystems have occurred due to population pressures. Open canopy woodlands are interspersed with maize, tobacco, cassava and other crops so that very little of the original vegetation remains.

The climate is tropical continental but significantly moderated by the heterogeneous topography, in particular, highlands, Lake Malawi, and proximity to the influence of westerly frontal systems which move eastwards from the Indian Ocean. There are two main seasons: the rainy season from November to March and the dry season from April to October. The mean annual rainfall ranges from 500 mm in the dry and hot valleys to 3000 mm over highlands. It is often interspaced with one to two weeks dry spell, when some farmers lose their crop or sustain drastic reduction in crop yields. The annual mean temperature ranges from 12 ° C to 32 ° C (Malawi Government, 2002).

1.3.2 Agriculture

Malawi has a total land area of 9.43 million ha of which about 4.7 million ha is arable. About 80% of the arable land is available to smallholder farmers as customary land. About 2.82 million ha are cultivated under dry-land (i.e. rely solely on natural rainfall) and about 40 000 ha are irrigated during the dry season (May to October). About 2.42 million ha are cultivated by smallholders. This compared to 30,000 estates cultivating 1.1 million hectares with an average landholding of between 10 to 500 hectares (World Bank, 2003). Agriculture employs over 85% of the population that resides in rural areas, normally accounts for 35-40% of GDP and contributes over 90% to total export earnings (Malawi Government 2002). The estate sub-sector contributes only about 20% to total national agricultural production, but provides over 80% of the agricultural exports.

Smallholder farmers grow a variety of crops for both subsistence and cash. Maize being the country's staple food is widely grown in many parts of the country. Other crops include groundnuts, tobacco, cassava, sweet potato, pulses, sorghum, millet wheat, rice, coffee and cotton. Principal crops grown by the estate sub-sector includes tobacco, tea, coffee, sugar, and macadamia (Malawi Government, 2002). The crop production statistics for Malawi for the period 2005 to 2009 are given in Table 9.2 in the Appendix.

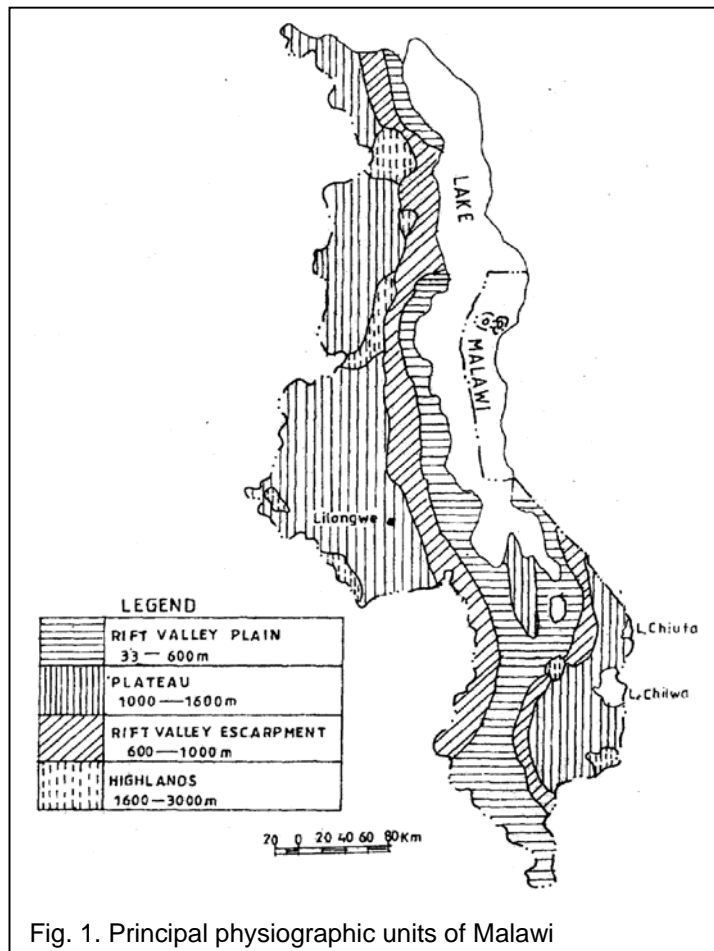


Fig. 1. Principal physiographic units of Malawi

Approximately 70-80% of the population is estimated to earn less than US\$0.50 per day. Under such conditions of poverty, food security at both the household and national levels can be ensured only through the development of an open seed market and effective procurement and distribution measures to address emergency situations. In both cases, the focus should be on improving the productivity of land and labour through the application of science and technology by using improved seeds and other appropriate agronomic and soil improvement practices.

1.4 Seed industry in Malawi

It is critical for the seed sector to take into account some key indicators shown in Table 1.1. It is argued that Malawi is beset with large numbers of very poor people working on very small areas of land which are predominantly planted to maize (Malawi Government 2007). Continual cultivation of maize on the same land without addition of organic or inorganic fertilizers leads to low yields, and 'local' varieties of maize show a much lower response to inorganic fertilizer (principally nitrogen) than hybrid and, to a lesser extent, composite or open pollinated varieties (OPVs). Low yields in turn lead to inability to afford the purchase of inputs. Purchase of inputs on credit is also not possible for most farmers because the costs of credit administration are too high, as are risks for both borrowers and lenders, and low volumes of input demand and poor infrastructure and high transport costs lead to high input costs and inhibit the development of input supply systems in less accessible areas (Malawi Government, 2007).

Table 1.1: Some key indicators of smallholder agriculture in Malawi (Source: IHS)

Indicator	North	Central	South	Malawi
Land holdings				
<0.5 ha	12.1	15.4	25.4	19.9
0.5-1.0 ha	19.3	25.2	28.7	26.3
1.0-2.0 ha	30.1	33.5	24.9	29.0
>2.0 ha	28.8	16.2	7.7	13.4
Crop cultivation				
Maize growers (%)	93	97	99	97
Local varieties (%)	38	55	62	56
Composite varieties (%)	5	6	7	7
Hybrid varieties (%)	58	67	59	55
Cassava growers (%)	45	11	24	21
Tobacco growers (%)	22	25	6	15
Fertilizer use (kg/ha)	32	45	24	34
Access to credit for food crop inputs (%)	2.5	4.2	3.0	3.4
Access to agricultural extension (%)	24	12	11	13

In order to achieve accelerated agricultural growth, a well structured seed industry development is not only necessary but very essential. A competitive seed industry well linked to the world seed industry is able to deliver a steady stream of new varieties for all the relevant crops.

Furthermore, this enhanced supply of new varieties will have to reach smallholder farmers at competitive prices, through an expanded network of local seed dealers.

The Government of Malawi (GoM) in 1988 privatised the major seed parastatal and from 1996, liberalised policies and regulations to allow a competitive seed market to emerge. The Government has however continued to assist smallholder farmers with access to seed through targeted programmes such as the Starter Pack (1998-2000), Targeted Input Programme (TIP) (2000-2005), and lately the Subsidy Programme (2005-2010) (Malawi Government, 2007). Several NGOs are also involved in the multiplication of various seeds from maize, groundnuts, cassava planting material etc. The liberalization process has also resulted in many opportunists who in the majority of cases take advantage of the open entry without the corresponding responsibility and accountability needed to ensure that quality is maintained and service is rendered to the farmers. The harmonization process being sought in the SADC and COMESA regions, respectively, may provide respite to this problem.

The National Seed Policy of 1993 documents the importance of a sustainable seed industry and elicits appropriate principles and practices to develop the local seed industry, including public and private investment, research, training, fair competition and the provision of supporting services such as seed certification and testing. The Policy also states that the Government will undertake periodic reviews of seed policy to ensure that it continues to meet the needs of the farmers. One such area that will require redress to foment a national convergence programme towards harmonization is the upgrading of human resource capacity of Malawi's seed sector. Table 1.2 shows established posts under the Seed Certification and Quality Control Services at Chitedze Agricultural Research Station and its satellite seed laboratories at Bvumbwe and Lunyangwa. Table 9.1 in the Appendix shows current establishment of personnel in the Department of Agriculture Research Services and Department of Crop Development vested with matters related to seed in the areas of seed certification and quality control, and phytosanitary measures. It is implicit that the harmonization process will require well-trained and specialist staff to cover each area of agreement necessitating upgrading of numbers and types of human resource to be in concert with the convergence programme on harmonised seed regulations and policies to which Malawi is a signatory.

Table 1.2: Officers under the Seed Certification and Quality Control Services Unit in the Ministry of Agriculture & Food Security, Government of Malawi

Seed Officers	Established positions	Filled	Vacant
Seed Analysts	15	11	4
Seed Inspectors	11	9	2
Seed scientists	4	2	2
Laboratory attendants	10	10	0
Total	40	32	8

Source: Seed Services Unit, 12/10/2010

2.1 Background information and body responsible for seed certification

The seed legislation is administered by the Department of Agricultural Research Services (DARS) under the Ministry Agriculture & Food Security (MoAFS) in accordance with the National Seed Policy of 1993. In terms of this Policy, the Seed Services Unit of DARS is responsible for the seed certification and quality control and the operation of seed testing laboratories. Activities of the Unit are coordinated at Chitedze Research Station where the main seed testing laboratory is located. The main seed testing laboratory is accredited to the International Seed Testing Association (ISTA). There are three satellite laboratories that are strategically located to cater for smallholder farmers. The laboratories are at Lunyangwa in the Northern region, Lifuwu in the Central region along the Lake Shore and Bvumbwe in the Southern region.

The Seed Services Unit (SSU) was established in 1976 to ensure that high quality seed/propagating plant materials of improved varieties of crops are produced and made available to farming community in Malawi. The Unit achieves this through seed crop registration, seed crop field inspections, seed sampling, laboratory seed testing, check plots, seed monitoring and training of farmers. The SSU certifies all crops as set out in the following seed legislation:

- Seed Act, 1988 (Act No. 5 of 1988).
- Seed Regulations, 1994 (Act No. 5 of 1988)
- Amended Seed Act, 1996 (Act No. 9 of 1996)
- Seed (Declaration of Prescribed Seed) Order, 1997.

In Malawi there are two legal documents – Acts and Regulations. Acts, which are enacted by the Parliament of Malawi, typically address major social and political issues such as taxes, civil rights, public health, and education. Regulations, which are approved by Ministers or the Cabinet, typically address the finer issues of application, administration and management. Acts and Regulations are structured in Parts, Sections and Articles and may include Annexes, Appendices and Schedules. Acts and Regulations are enforced by national, regional and district authorities.

2.2. Name and contact addresses of the head of body responsible for seed certification

The Commodity Team Leader
Seed Services Unit
Department of Agricultural Research Services
Chitedze Research Station
P.O. Box 158
Lilongwe, Malawi
Tel: +265 1 707 087/188
Email: agric-research@sdp.org.mw

2.3 Existing seed classes in Malawi

There are three classes of seed of all crop varieties recognized in Malawi and these have different requirements that meet international standards for certification.

- i. Breeders Seed- This is seed of a particular generation of an in bred line or variety which is produced under the supervision of the breeder or institution that developed the variety in conjunction with the seed certification authority
- ii. Basic/Foundation seed - This class of seed is produced from breeders seed.
- iii. Certified seed - Certified seed is produced from basic seed but it can also be produced from a higher class of seed such as breeders seed.

2.4 Process for seed certification

2.4.1 Field inspections

Field inspections are conducted to ensure that standards are met and adhered to in the field for high quality seed production of improved varieties. Field inspections are conducted to ensure purity of seed in the field. Requirements for seed inspections are as follows:

- (i) Registration/Application - Registration helps SSU to update seed data, easily locate the field or seed by inspection team, and easily direct buyers to where the required seed is located. It is important for the country to know seed quantities available to avoid emergency importation. Any field that is not registered is not inspected.

(ii) Seed source – Seed should be procured from an approved source such as from breeders in different institutions, or from other farmers who conform to set standards. Information for seed source is required during registration.

(iii) Land Requirements – Land verification checks the history of the field to be grown to seed. Farmers should select a field in which no maize was grown in the previous season for basic and certified maize seed production.

(vi) Isolation distance - Isolation of one variety from another not conforming to the certification standards is of utmost importance to avoid admixtures.

(v) Field standard – Four field inspections are conducted during the vegetative growth stage of seed production. Poor stands, lack of vigour or uniformity, weedy growth, or conditions which may hinder accurate inspections are cause for rejection.

2.4.2 Laboratory Seed Analysis

Laboratory seed analysis enables farmers to plant seed that has the capacity to produce an abundant crop of the required variety. It also helps farmers store seed at optimum moisture content to avoid deterioration in storage. In general, seed testing procedures include: sampling, moisture testing, purity analysis, evaluation of seedling germination, biochemical test for viability, seed health testing and verification of genetic purity. All four seed testing laboratories in Malawi have the appropriate equipment and facilities to carry out purity analyses, the determination of the percentage moisture and germination.

(i) Preparation of seed lots before sampling - Seed must be well processed and bagged before an official sampler from the certifying agency is consulted to draw samples for analysis

(ii) Seed Sampling - The objective of seed sampling is to obtain a sample of a size suitable for tests in which the probability of a constituent being present is determined only by its level of occurrence in the seed lot. ISTA rules on seed sampling are applied such that the sampler has the right to reject any seed lot that does not conform to standards

(iii) Seed Testing (Analysis) - Seed testing is also done in accordance with ISTA rules and national developed standards

- Purity: this determines the percentage composition by weight of the sample being tested and by inference the composition of the seed lot.

- Germination: this is the percentage of seeds capable of producing a normal seedling under ordinarily favourable conditions.
- Moisture content: this is the amount of water in the seed that if high affects the storability and quality of the seed.
- Determination of other seed by number: this estimates the number of seed of other species stated by the applicant.

(iv) Labelling - Seed when offered for sale or put on the market should have an official label. Only seed that meets the recommended certification standards is marketed. Unless otherwise specified, the label should display in clear legible writing:

- (a) The name and address of the supplier.
- (b) The kind and variety of seed
- (c) The class of seed.
- (d) Date of testing
- (e) The percentage purity and germination of the seed at time of packing
- (f) The date of packing
- (g) The lot number

2.5 Conformity with regional standards adopted by SADC

Malawi recognises only three classes of seed, viz., Breeders, Basic and Certified, other than the 5 classes indicated in the SADC protocol (Table 2.1). However in case of inadequate supply of seed, one class may be upgraded to a higher class provided it meets certain set standards. In terms of labelling, Malawi labels are all different from the SADC labels/tags. Differences are also noted in terms of field and laboratory standards as shown in Table 2.2 and Table 2.3. Some of the Malawi seed standards are higher than the SADC field and laboratory seed standard.

Table 2.1: Classes and labels used for SADC and Malawi

¹ SADC				² Malawi			
Class of seed	Code	Produced from	Colour of label	Class of seed	Code	Produced from	Colour of label
Pre-basic	A	Breeders seed	Violet band on white	Breeders		Nucleus seed	White
Basic	B	Pre-basic seed or breeders seed	White	Basic	B	Breeders seed	Purple
Certified (1 st generation)	C1	Basic or a higher seed class	Blue	Certified I	CI	Basic seed	Blue with a single stripe
Certified (2 nd generation)	C2	C1 or a higher seed class	Red	Certified II	CII	Certified Seed I where inadequate Certified Seed I exists	Blue with two stripes
Quality declared seed	QDS	Complies with special requirements	Green				

Source: ¹Technical agreements on harmonization of seed regulations in the SADC region, 2008

²Proposed seed regulations, 1996

Table 2.2: Standards for seed certification of major crops handled

Crop		Field standards for Malawi						Field standards for SADC					
		Min. Isolation dist. (m)		Max. off-types (%) based on 1000 plants		Min. No of inspection		Min. Isolation dist. (m)		Max. off-types (%) based on 1000 plants		Min. No of inspection	
Botanical name	Common name	BS	CS	BS	CS	BS	CS	BS	CS	BS	CS	BS	CS
<i>Arachis Hypogea</i>	Groundnuts	10	5	0.1	0.1	4	4	10	5	0.2	0.2	3	3
<i>Cajanus cajan</i>	Pigeon peas	400	200	0.1	0.1	4	4	400	200	0.1	0.3	3	3
<i>Glycine Max</i>	Soya beans	10	5	0.1	0.1	4	4	10	5	0.2	0.5	3	3
<i>Gossypium hirsutum (OPV)</i>	Cotton	1000	300	0.1	0.1	4	4	500	400	0.2	0.3	3	3
<i>Helianthus annus (H)</i>	Sunflower	3000	1500	0.1	0.1	4	4	3000	1500	0.2	0.5	3	3
<i>Nicotiana tobacum</i>	Tobacco	800	400	None	None	7	7	800	400	0.2	0.5	3	3
<i>Oryza sativa</i>	Rice	25	5	0.1	0.1	4	4	5	5	0.2	0.3	3	3
<i>Phaseolus vulgaris</i>	Beans	10	5	0.1	0.1	4	4	10	5	0.1	0.2	3	3
<i>Sorghum bicolor (OPV)</i>	Sorghum	400	200	0.1	0.1	4	4	400	350	0.2	0.5	4	3
<i>Vigna anguiculata</i>	Cowpeas	10	5	0.1	0.1	4	4	10	5	0.2	0.5	3	3
<i>Zea mays (OPV)</i>	Maize	400	200	0.2	0.2	5	5	400	200	0.5	1.0	4	3
<i>Zea mays (Hybrid)</i>	Maize	720	360	0.1	0.1	7	7	400	350	0.1	0.3	5	5

Source: Technical agreements on harmonization of seed regulations in the SADC region, 2008; Seed certification standards and rules in Malawi, 1996

Table 2.3: Laboratory seed testing standards for Malawi and SADC

Crop		Laboratory standards for Malawi					Laboratory standards for SADC				
		Min. Germination (%)		Pure seed (Min) %		Moisture Content (Max) %	Min. Germination (%)		Pure seed (Min) %		Moisture Content (Max) %
Botanical name	Common name	BS	CS	BS	CS	All classes	BS	CS	BS	CS	All classes
<i>Arachis Hypogea</i>	Groundnuts	75	80	98	98	10.0	75	75	98	98	9.0
<i>Cajanus cajan</i>	Pigeon peas	75	80	98	98	13.0	75	80	98	98	13.0
<i>Glycine Max</i>	Soya beans	75	75	99	99	13.0	70	70	99	99	12.0
<i>Gossypium hirsutum</i>	Cotton	70	80	99	99	10.0	70	75	99	98	10.0
<i>Helianthus annus</i>	Sunflower	75	80	99	99	10.0	80	80	98	98	10.0
<i>Nicotiana tobacum</i>	Tobacco	90	90	99	99	10.0	85	85	99	99	8.0
<i>Oryza sativa</i>	Rice	80	80	98	98	13.0	80	80	98	98	12.5
<i>Phaseolus vulgaris</i>	Beans	75	75	99	99	13.0	70	75	99	99	13.0
<i>Sorghum bicolor (OPV)</i>	Sorghum	70	70	99	99	13.0	80	80	99	98	12.0
<i>Vigna anguiculata</i>	Cowpeas	75	75	99	99	13.0	75	75	99	98	13.0
<i>Zea mays (OPV)</i>	Maize	90	90	99	99	12.5	90	90	99	99	13.0
<i>Zea mays (H)</i>	Maize	90	90	99	99	12.5	70	90	99	99	13.0

Source: Technical agreements on harmonization of seed regulations in the SADC region, 2008; Seed certification standards and rules in Malawi, 1996

2.6 Seed related information at national level: annual supply status of seed and area of registered seed crop

The Seed Certification and Quality Control Unit in Malawi has the capacity to certify all seed produced in the country. If renovated, staffed with qualified technicians and supplied with the necessary equipment, the Unit should be sufficient to meet the short-term quality control needs of the seed industry. The quantities of seed of various crops so far certified by the Unit during 2009/10 are given in Table 2.4 while Table 2.5 illustrates the quantity of seed for major crops planted in Malawi in 2009/10.

Table 2.4: Quantity of seed sampled and tested during 2009/2010 season

Crop	Quantity of seed tested (Mt)		
	Breeders	Basic	Certified
Maize	206.0	134.5	16706.0
Groundnuts	71.7	120.0	1800.0
Tobacco	0.0	3.7	8.6
Rice	0.0	3.0	35.2
Soya beans	36.2	6.0	278.2
Sorghum	0.0	0.7	0.0
Beans	4.0	33.0	256.0
Vegetables	0.0	0.5	0.0
Grasses	0.0	3.0	0.0
Total	317.9	301.4	18084.0

Source: SSU Annual report 2010

Table 2.5: Quantity of certified seed for major crops required in Malawi

Crop	¹ Area (Ha)	² Seed rate (kg/ha)	Total seed required (Mt)
Maize (Hybrid + OPV)	977577	25	24439
Rice	130 197	63	8202
Groundnuts	224 693	80	17975
Tobacco	104 522	6	627
Cotton (Delinted)	10870	15	163
Sorghum	52 273	5	261
Millet	24 347	7	170
Sugar beans	32 760	80	2621
Pigeon peas	144 399	10	1444
Soya beans	110 773	80	8862

Source: ¹MoAFS Crop estimates report, 2009

²MoAFS Guide to Agriculture Production, 2004

2.7 Institutions and organizations involved in the national seed sector

The key role-players in seed security in Malawi include the public seed sector which covers Ministry of Agriculture and Food Security (MoAFS), research institutions that conduct research in crop improvement and breeding as illustrated in Table 2.6. These are the sources of basic seed of recommended crop varieties. Scientists from these institutions have a responsibility of monitoring basic seed production or certified seed production that is produced through contract farmers or farmer associations.

There is a Seed Services Unit under MoAFS whose responsibility is to inspect and certify any seed produced to ensure acceptable seed quality. The unit therefore certifies all seed that is produced in the country. The Phytosanitary Inspection Service Unit (Produce Inspection Section) is another government key role player in the seed sector because it ensures that seed imported or being introduced into the country is disease and pest free.

The second category is that of commercial sector. This sector includes the commercial companies and has tended to produce hybrid varieties and not self-pollinators or open pollinated varieties to maintain their business.

The other category is that of non-governmental organizations that involved in supporting farmers and their associations acquisition of seed crop varieties normally not supplied by the commercial organizations. The seed includes that of self-pollinators, OPVs and vegetatively propagated crops (such as cassava and sweet potatoes).

In Malawi there are four major mechanisms for seed production and distribution of seed to farmers which can be grouped as the informal and formal sector:

- informal seed channels (farmer to farmer sale)
- individual farmers (medium scale)
- farmer associations with seed programmes
- formal seed sector (seed company distribution through retail stores and other outlets).

Table 2.6 A list of organizations involved in the Malawi Seed Industry

Public Seed Sector	Commercial Seed Sector	Voluntary Organizations
Agricultural Development & Marketing Corporation (ADMARC)	Pannar Seed Ltd	Church Action for Relief and Development
Chitala Agricultural Research Station	Monsanto	Concern Universal
Chitedze Agricultural Research Station	Pioneer Overseas Corporation of Zimbabwe	Catholic Development Commission in Malawi
Kasinthula Agricultural Research Station	Association of Smallholder Seed Multiplication Action Group	Evangelical Lutheran Development Programme
Lifuwu Agricultural Research Station	Paprika Association of Malawi	Christian Service Committee
Lunyangwa Agricultural Research Station	Maize Research Institute (MRI) of Zambia	Church of Central Africa Presbyterian (Blantyre, Livingstonia)
Bvumbwe Research Station	Demeter Agriculture	Action Aid
Bean Improvement Project	Funwe Farms	Africare
Bunda College of Agriculture	Seed Co	Canadian Physicians for Aid and Relief
CIAT	Seed Tech	Oxfam
ICRISAT	Capston Seed Company	Plan International
IITA		World Vision International
ICRAF		Self Help Africa
SARNET		Adventist for Development and Relief Agency
		CARE International
		Interaide
		Concern World wide

2.7.1. The Informal Sector

In Malawi, obtaining good seed of improved varieties for most crops, except hybrid maize and tobacco, through the normal market channels is difficult because the private seed industry does not produce and market sufficient seed, if at all. As a result there are a number of other institutions that operate locally, trying to fill the gap in the seed supply for neglected crops such as OPV maize, beans, groundnuts, soybeans and pigeon pea. Such institutions, mostly non-governmental organisations, are listed in Table 2.7. Thus, over 70% of the seed that is used by the smallholder farmers is farm-saved seed. Other seed sources include the neighbouring farmer, other local farmers, credit schemes, input free issues in the Starter Pack (SP) or Targeted Input Programme (TIP), and the Subsidy Programme. There is an active exchange of seed among households and payment is usually in kind and not necessarily for cash.

Annually, most smallholder farmers face seed insecurity because of:

- i. Drought – smallholder seed production is carried out under dryland conditions. It is important to synchronise planting with rainfall and this is often very difficult. Farmers who plant seed may lose it to drought, late or erratic rainfall or even flooding.
- ii. Inadequate storage and processing - smallholder farmers do not have the facilities to store their seed under conditions that will ensure the maintenance of seed viability. Proper drying and grading to uniform size remains a constraint. It is, therefore, difficult to carry over viable seed stocks from one season to the next.
- iii. Poor market structure – the local seed market is not well structured for smallholder seed growers and many farmers produce seed without knowing how and where to sell it. Without an effective market structure, there is little encouragement to produce seed and the generally low level of production results in seed shortages and low crop production.

In the light of the current lack of access to affordable inputs, some of the strategies that have been pursued are:

- i. Increased access to farm credit through village-based revolving credit schemes
- ii. Providing all smallholders with small packs of improved seed and fertiliser, as has been done under the SP/TIP/Subsidy programme.
- iii. Ensuring that commercial supplies of improved seed and fertiliser are readily available for purchase in all rural markets in small bags
- iv. Providing opportunities for able-bodied individuals to increase their purchasing power for seed and fertiliser through a structured fertiliser (and seed) for work programme implemented during the dry season
- v. Establishment of small scale farmer associations aimed at consolidating the informal sector so that the smallholder farmer's interests can be represented.

Examples of institutions serving to promote the interests of the smallholder farmer are briefly discussed below.

2.7.1.1. Non-governmental Organizations

Various NGOs in Malawi source basic and sometimes certified seed from government or international research centres for further multiplication and distribution to their beneficiaries. Most NGOs distribute seed on loan to farmers, and require that the farmers pay back in kind, usually the principal plus interest. The interest rates vary from 20-100%, depending on the NGO and the seed multiplication rate of the crop. The seed recovered by the NGOs is redistributed to other benefiting farmers.

2.7.1.2 International Agricultural Research Centres

A number of International Agricultural Research Centres (IARCs), such as CIAT, ICRAF, ICRISAT and IITA operate from Malawi to the benefit of the SADC region. Their mission is to support the national programmes in technology development and transfer. Much of this technology is associated with the variety improvement and seed production and dissemination. As a result, all the IARCs in Malawi, in one way or another, are involved in making seed (basic or breeder seed) of improved varieties available to farmers. Some IARCs, such as CIAT, have demonstrated the ability to produce commercial seed in partnership with small-scale farmers and market it through small rural retail outlets (agrodealers) such as grocery stores, maize mills and clinics.

2.7.1.3 Farmers Associations

The Association of Smallholder Seed Multiplication Action Group and the National Smallholder Farmer Association of Malawi (NASFAM) are typical examples of smallholder farmer associations that produce and market seed. The seed produced ranges from basic to commercial seed and covers such crops as OPV maize, rice, sorghum, groundnut, beans, soybean, cowpea, pigeon pea and paprika.

2.7.1.4 Ministry of Agriculture & Food Security

The MoAFS has accepted the concept of smallholder farmers planting good quality seed and is committed to supporting any form of smallholder seed production programme.

- i. Smallholder Seed Multiplication Schemes - Over the years, government has been assisting smallholder seed multiplication programmes by arranging for official certification of seed produced by smallholder farmers. As a result, Malawi has become self-sufficient in rice seed and has experienced an improvement in the supply of seed of other crops.

- ii. Seed Production Contract Initiative - Under this initiative MoAFS used EU money to contract estates to grow seeds for a range of crops between 1998 and 2000 when the project was phased out.

2.7.2. The Formal Sector

In the past, the formal sector was regulated by the Seeds Act of 1988. Under this Act the production of new crop varieties and their release was the responsibility of the Department of Agricultural Research Services (DARS) of the MoAFS. The production of both basic and certified seed, as well as processing and storage of seed, including seed services, was assigned to a parastatal, the National Seed Company of Malawi (NSCM). The quality control aspects were the responsibility of the Seed Services Unit at Chitedze Agricultural Research Station and seed distribution was undertaken by a statutory company, the Agricultural Marketing & Development Corporation (ADMARC).

However, after the liberalization measures taken by the government in 1996, ADMARC's share of the market decreased substantially. Under the Seed (Amendment) Act of 1996, the seed sector in Malawi was liberalized; NSCM was purchased by Cargil Seeds and later by Monsanto. At present the company is servicing both smallholder farmers (with hybrid maize seed) and the large scale commercial sector with maize seed and herbicides. Other seed companies include Pannar Seeds which entered the Malawi seed market in 1996, SeedCo from Zimbabwe, Funwe Farms, and Seed Tech.

The Agricultural Research and Extension Trust (ARET) was established in 1995 to ensure the efficient use of resources and to facilitate closer linkage of farmer-focused research and extension activities in the tobacco industry. The plant breeding section develops varieties of all types of tobacco and is concerned with cutting costs through breeding for resistance to common diseases such as Black Shank, *Fusarium* Wilt, Wildfire, *Alternaria*, Bushy Top and Root-knot nematode. ARET is involved with the production of tobacco seed.

Seed Trade Association of Malawi (STAM) was established on 24th September 2004 as a move towards making its seed industry work harmonious between the private and public sector. STAM began operations with the goals of enhancing communication between the sector and the MoAFS, promoting their products, and ensuring that seeds sold to Malawian farmers are of good quality. STAM is affiliated to the African Seed Trade Association, AfSTA (2000) which in turn, is affiliated to the International Seed Federation (2002).

A number of networks, such as RUMARK, AISAM are networks that support agrodealers for both their fertilizer, chemicals and seed trade. Among other services offered are business management, product training, credit guarantees and periodic reports on market conditions.

2.8 Future plan of the country for standards for seed certification

A major challenge facing the public and private sectors is to convince smallholder farmers to accept and appreciate the advantages of using seed of good quality and genetic purity. This means creating awareness and acceptance within the informal sector of the benefits of planting quality seed particularly of self pollinating crops and at the same time providing a framework within which the commercial sector can flourish.

2.8.1 Review and enactment of the amended Seed Act of 1996

The review of the amended Seed Act of 1996 (IFDC, 2004) showed that this Act does not make provision for:

- the registration of seed importers, seed cleaners and seed sellers.
- the authorization of seed sellers
- restrictions on the import or export of certain seed.
- cancellation of the registration of a registered seed producer
- appeal to the Minister by seed producers
- it gives little recognition to the importance of varieties.
- does not make full provision for a Certification Scheme, although this is included in the Regulations

Consequently, the Amended Seed Act of 1996 was again amended but not enacted. It is pertinent to argue that the reviewed draft requires fresh review after being shelved for 6 years.

2.8.2 Ratification of Malawi's seed certification scheme

The subsequent revision of the amended Seed Act of 1996 made provision for the establishment of a seed certification scheme (after the OECD format), the details of which should be set out in the scheme. The scheme under use needs review and enactment together with the revision of the amended Seed Act of 1996. In this regard the Act should encourage cooperation among member States by recognizing certification schemes in other COMESA countries and the seed produced under such schemes.

2.8.3 Application for affiliation to OECD

Malawi is currently using the OECD Certification Scheme for field inspection, although unofficially, because the Seed Services Unit is not yet an affiliated member of OECD. Membership to OECD opens up to the USA and EU variety and seed markets and is long overdue. The processes towards affiliation to OECD need urgent and total support.

2.8.4 Foundation seed

Research centres used not to have enough foundation seed and planting materials for the improved crop varieties for smallholder farmers to multiply due to inadequate financial resource allocation. The review of the amended Seed Act of 1996 made provision for the establishment of a Seed Services Fund to sustain the activities of seed inspectors and seed analysts while the proposed Malawi Plant Breeders Rights Act also proposes a fund. It is conceivable that the provision of foundation seed could be facilitated by one defined fund.

2.8.5 Seed storage and processing facilities for small scale seed producers

Farmer associations have emphasized that small scale seed producers do not have all the necessary facilities to ensure that the seed is properly or evenly dried and processed, treated against pests and diseases and purity. Thus, smallholder farmers do not keep seed under environments that would ensure maintenance of seed viability. Poor packaging, seed treatment (colour) have made customers perceive fellow smallholder farmers seed as of poor quality as compared to the imported OPV seed which is often treated with colored chemicals and in attractive packages. The seeds also end up of variable sizes because of lack of seed screens or sieves. The packaging of the seed is also uneven often put in relatively large packages due to lack of better packaging equipment. There is need for infrastructural capitalisation of small scale seed producers.

2.8.6 Financial constraints for routine inspection of seed

Lack of financial resources has been a big problem to ensure that government seed inspectors come to monitor and inspect the crop. As a result certification procedures of their seed have often been delayed. Farmers therefore feel that the government or the NGOs should continue supporting them in meeting the costs of seed inspection until such a time they are able to be financially independent.

This study recommends that the revised amended Seed Act of 1996 should consider proposal for two categories of Seed Inspectors; the first category would be government officials appointed as Seed Inspectors to be allocated in the Seed Services Unit to conduct seed certification and quality control of all crops , while the second category of Seed Inspector called licenced seed inspectors would be those authorized/licenced by Seed Services Unit to assist in seed certification and quality control of seed produced by smallholder farmers. The Act should also make provision for the cancellation of the authorization of Seed Inspectors in case of dereliction of duty. These provisions need to be reviewed in the light of opportunities for graduates of seed technology training at Diploma level at Bunda College, University of Malawi.

2.8.7 Training institutions and personnel

NGOs that support farmers further reported that there are fewer government seed inspectors than the demand. This has always resulted in late reporting to farmers' fields for monitoring and inspection. This can be alleviated through training at Bunda College which has programmes in seed science and technology at all levels: (i) a Diploma in Seed Technology; (ii) a Postgraduate Diploma in Seed Technology; and (iii) a Master of Science in Seed Science Degree programme. However, the training institution requires capacity building in terms of infrastructure, basic seed laboratory equipment, and software for maintaining different levels of clientele in seed industry.

2.9 Additional information on standards for seed certification

2.9.1 Application of seed quality standards in emergencies

Several practical recommendations on seed quality emerged from the FAO seed relief working group analyses: that there should be minimal quality standards adhered to—no matter what the intervention context—and it may be possible to introduce simple methods to control for these (Sperling and Cooper, 2003). For instance, if the seed is obtained through formal channels (which can be the case, for example, for most hybrid maize), it would preferably meet standards of certification (e.g., national seed certification standards) or of quality-declared seed (QDS). If the seed is obtained from farmers or local markets (for example, as bulk grain) (which is often the case for staple crops, such as sorghum and legumes), it should be cleaned and tested to ensure that it meets certain minimum standards for the parameters listed above.

Over the past few years serious pests such as the Large Grain Borer (*Trostephanus truncatus*), the Cassava Mealybug (*Phenacoccus manihoti*) and the Pod Weevil (*Piezotrachelus varius*) have been introduced into Southern Africa by the movement of infested seed and propagation material and through food aid. The enactment and enforcement of phytosanitary and plant quarantine laws and procedures can control the entry of such harmful pests. It is evident that existing seed legislation in Malawi and the region needs to be reviewed to reflect seed relief activities that should (a) meet the immediate needs of farmers for access to planting material and (b) contribute to long-term restoration, rehabilitation, or improvement of agricultural systems.

2.9.2 Agrobiodiversity and the seed sector

Despite a growing global awareness of the importance of agrobiodiversity little attention has been paid to the need for measures to manage agricultural genetic resources such that they can play a role in poverty alleviation and sustainable development. There is an inordinate amount of effort centred on debates and the issues being raised at various fora, with regard to ownership and control of various components of biodiversity, particularly relating to access

to genetic resources and equitable sharing of benefits derived from its use; rather than how the seed sector is influenced by or can influence conservation and sustainable use of agrobiodiversity. For example, actions and campaigns to raise awareness of the cultural and practical value of agricultural biodiversity have included seed fairs, community seed banking which, albeit go uncensored in seed legislation and regulations. It is critical to have a clearer picture on the role of, conditions for and possible forms of incentive measures for agrobiodiversity and on the other side to operationalize some incentives for agrobiodiversity in the SADC region while enhancing seed sector development.

Cromwell (2001) observed that conserving specific crops and varieties requires that they continue to meet farmers' livelihood objectives. This implies no change in farmers' asset base or livelihood goals that might jeopardize this. This is much harder to achieve, as it involves the national economic and development policy framework rather than the local level technical initiatives. This includes national and regional economic policy, the legislative framework and law enforcement, and multilateral and bilateral agreements. Re-examination of national agricultural development strategies may be required, which at present may be promoting a development path based on industrial-type agricultural systems, involving reliance on a few crops and high-potential yield varieties developed by the formal sector, together with high inputs of chemical fertilizer and pesticides (Mugwara et al, 2001).

3.1 Variety evaluation, release and registration

Testing the distinctness, uniformity and stability (DUS) of crop varieties is a statutory requirement before varieties can be entered into the Registers of Cultivars (National Lists) and/or granted Plant Breeder's Rights (PBR). New (candidate) varieties should be distinct from all other varieties whose existence is a matter of common knowledge, and also sufficiently uniform and stable with respect to the characteristics used to demonstrate distinctness 'Common knowledge' is broadly defined to include all known varieties, i.e. any variety entered into or subject to an application for PBR, varieties grown commercially, held in public accessible reference collections, or of which there is a published description (UPOV, 2002).

In order to protect the farmers a Variety Release Committee was set up to be responsible for releasing crop varieties in Malawi. However it was observed that other technologies like pesticides, herbicides, storage, processing and agronomic practices also needed to be cleared to protect the farmer, consumers and environment. The Variety Release committee then changed to be Agricultural Technology Clearing Committee (ATCC). This body is comprised of representatives of partners in agriculture like Department of Agricultural Research Services (DARS), Department of Crop Production (DCP), Department of Agricultural Extension Services (DAES), Agricultural Research and Extension Trust (ARET), Tea Research Foundation (TRF), Pesticide Board of Malawi, National Commission of Science and Technology (NCST), and the University of Malawi. The Secretariat for ATCC is The Department of Agricultural Research Services

3.2 Name and contact addresses of the head responsible for variety evaluation, release and registration

The Director of Agricultural Research Services
Department of Agricultural Research Services
P. O. Box 30779,
Lilongwe 3, Malawi.
Tel: +265 1 707 011
Fax: +265 1 707 374
Email: agric-research@sdpn.org.mw

3.3 Variety evaluation, release and registration system/process

Variety evaluation that includes DUS and VCU is done by the breeder as an institution. However, ATCC takes part in the evaluation by supervising or monitoring the whole breeding scheme. What happens is that ATCC is involved in the development of proposals especially for those from DARS and it also organizes an annual M&E trip to see how the technologies are being developed and how they are performing on ground. Hence, when a proposal for release is made it has an idea of the technology.

For a variety to be released the evaluation for VCU needs to be conducted for at least two seasons on station and one season on farm with many sites per target agro-ecology or three seasons on station and two years on farm with few sites per target agro-ecology. After evaluation, a proposal for release needs to be filed to ATCC following a defined format. The proposals are then circulated to members for scrutiny at least two weeks before sitting. Then a sitting is summoned for the applicant to make a presentation and defend the varieties being released. If ATCC is satisfied with the variety then it is officially released. A name is also given at the point of release. The officially released technologies go into a register of released varieties. The listed varieties have had no validity period but the breeder can withdraw as he/she wishes. However, it has now been agreed that ATCC will be making follow ups on released technologies so that those that do not perform on ground will be dropped from the list.

For varieties already released elsewhere, there is a minimum of two years of variety testing. This period may be reduced to one year if the number of test sites is increased to 20 or more, with supporting information on previous performance. A variety not yet released in Malawi requires a minimum of three years of testing on 10 to 12 sites. The owner of the variety presents the variety to the ATCC, which has the mandate to release varieties in the country.

3.4 Developers of agricultural technologies

There are many public and private sector organizations that are currently involved in the development of varieties aimed at addressing the various biotic and abiotic constraints that limit crop productivity. These include: (i) Department of Agricultural Research Services (DARS), (ii) Agricultural Research and Extension Trust (ARET), (iii) Tea Research Foundation of Central Africa (TRF), (iv) Seed Companies (SeedCo Malawi, Monsanto-Malawi, Pannar Seed Company, Pioneer Seed Company, and (v) Maize Research Institute of Zambia), and (viii) Bunda College of Agriculture, a constituent College of the University of Malawi.

The institution that has been releasing most of the varieties is DARS (Table 3.1). In terms of maize, it competes with commercial companies. However, the maize varieties are a mixture of hybrids and open pollinated varieties while companies mostly release hybrids. The rest of non commercial/orphan crops are released by DARS only. This means that commercial companies are interested in venturing into varieties that cannot be recycled for them to

maximize the profits. This is the reason why there is need to have two parallel systems of releasing and registering varieties. The elaborate release, registering and maintenance is costly and suits well for crop varieties that have commercial connotation to capture regional and international market.

Table 3.1: Released varieties by institution form 2000 to 2009

Type of Crop	Institution	Number of varieties
Maize	Department of Agricultural Research Services	13
Maize	Seed Co Malawi	12
Maize	Monsanto Malawi	8
Maize	Pannar (Pvt) Limited of South Africa	4
Maize	Pioneer Overseas Corporation of Zimbabwe	3
Maize	Maize Research Institute (MRI) of Zambia	2
Maize	Capston Seed Company	1
Rice	Department of Agricultural Research Services	4
Sorghum	Department of Agricultural Research Services	6
Wheat	Seed Co Malawi	2
Groundnuts	Department of Agricultural Research Services	4
Bambara nuts	Department of Agricultural Research Services	3
Beans	Department of Agricultural Research Services	5
Beans	University of Malawi (Bunda College of Agriculture)	3
Soya bean	Department of Agricultural Research Services	1
Soya bean	Seed Co Malawi	2
Pigeon peas	Department of Agricultural Research Services	5
Cowpeas	Department of Agricultural Research Services	2
Sunflower	Department of Agricultural Research Services	1
Cotton	Department of Agricultural Research Services	4
Tomato	Department of Agricultural Research Services	4
Macadamia	Department of Agricultural Research Services	1
Cassava	Department of Agricultural Research Services	9
Sweetpotato	Department of Agricultural Research Services	6
Yams	Department of Agricultural Research Services	4
Paprika	Department of Agricultural Research Services	2
Tobacco	Agricultural Research and Extension Trust (ARET)	4
Tea	Tea Research Foundation of Central Africa (TRF)	4 Field clones
Tea	Tea Research Foundation of Central Africa (TRF)	4 Root stocks

3.5 Crops included in release process

All crops are eligible for variety release provided the requirements as described above have been met. So far the crops whose varieties have been listed include: Maize, Rice, Sorghum, wheat, Groundnut, Bambara nut, Bean, Soybean, Pigeon pea, Cowpea, Sunflower, Cotton, Cabbage, Mango, Guava, Peaches, Apples, Pawpaw, Citrus, Tomato, Macadamia, Coffee, Cassava, Sweetpotato, Yam, Paprika, Tea and Tobacco,

Mgoja *et al.* (2004) observed that where variety registration and release is done by individual national and private breeding programs in the region, different national variety release committees have different requirements. Taking maize as an example, companies that sell maize hybrids developed by CIMMYT keep information on pedigree confidential. Information on hybrids released by these companies does not indicate or distinguish between hybrids that originally came from CIMMYT and hybrids that were developed by the

companies themselves. This increases the difficulty of tracking multi-country releases and regional adoption of specific cultivars and will need to be addressed in the harmonisation process.

Genetically modified crops (GMO) will not be eligible for inclusion in the SADC Variety Catalogue. If GM varieties are released at the national level in some countries, there is no assurance that there will not be gene flow either through seed or pollen across national borders.

3.6 Conformity with SADC protocol

Malawi has Agricultural Technology Clearing Committee (ATCC) that is responsible for variety release and registration. The SADC protocol then requires availability of a national institution for it to operate that is available in Malawi.

The only difference is on the payment of fees for maintenance of a variety on the register. ATCC also takes care of orphan crops that are useful to the nation. Hence, those applying for regional release will need to pay for fees but for those varieties that will need no protection or for local use only, these may not be liable for payment of fees for them to be maintained on the register.

Two systems need to be maintained separately since the existing one already serves national interest, while the SADC protocol would take care of regional releases when DUS/VCU issues are concerned and they have cost implications.

3.7 Future plan of the country for variety evaluation, release and registration

3.7.1 Documentation and publication of guidelines for variety development and testing systems or breeding schemes

There is need to document, prepare and publish guidelines for variety development and testing in all important crops like maize, tobacco, sorghum, millets, rice, wheat, groundnuts and cotton and also for the release or deletion of varieties in Malawi. An example of such a scheme is given in Figure 1, in the Appendix, for cassava.

3.7.2. Develop descriptors for released varieties

Characterisation involves data collection on each accession following a list of botanical *descriptors*¹, but may also comprise, for example, molecular (DNA or protein) markers. The descriptors are (hopefully) stably expressed and data independent of environments and thus comparable between countries. Collection of such data has three main uses:

¹ Published by IPGRI as crop manuals.

- For “shelf use” by curators of genebanks (most often not breeders or users) in order to have documentation.
- For classification into germplasm groups based on phenotypic similarity.
- To decide on this basis if a new accession or variety is unique and should be accepted or not.

Evaluation/VCU is related to *useful traits*, and depends on the environment, both for expression and relevance. This is the information for the breeder/user. Both activities are primarily the domain of the ATCC in Malawi, but without such data the harmonization being sought also fails in its mission. Exactly how much has been characterised at the national level is difficult to grasp from the information we have had access to. Characterisation data should, *in principle*, accompany a deposit of the application for varietal release with ATCC.

Deposition with the ATCC does not imply that characterisation data are available. This measure of uncertainty is troubling and therefore needs to be addressed. In fact, for Malawi, national register for varieties has not been systematic to allow for cross referencing when variety has been released elsewhere in the region. There are also inconsistencies in descriptors and the naming and coding for varieties developed locally or derived from the CGIAR system.

The number of registered varieties is increasing steadily; it would thus be practically impossible to grow all varieties of common knowledge in the DUS trials to test the distinctness of the candidate varieties. The need to generate databases of the reference varieties, and group new varieties and reference varieties using these databases prior to formal testing has been suggested. To assure the quality of DUS testing using this strategy, it is all the more important that databases of the reference varieties must be based on precise descriptors with clearly distinguishable classes. Descriptors with lower levels of variance should better fulfill this requirement.

Keeping in mind the inherent problem of the morphological characters related to their limited number, the precision required in recording, and high genotype x environment interaction, the use of biochemical and molecular markers for DUS testing of varieties has been suggested (Law et al, 1999). However, these are generally not accepted for DUS testing by UPOV or the registration authorities in most countries including Malawi. One of the reasons for this is the paucity of information about uniformity of varieties on plant-by-plant basis, with respect to the molecular markers. Further molecular markers may not account for all the variation actually present at the morphological level, and, at the same time, because of their greater power of resolution, particularly in respect of non-coding regions of the genome, might differentiate two similar varieties (Cook et al., 2003). Hence it would not be advisable to base DUS testing only on biochemical or molecular markers. The need is to make combined use of morphological, biochemical and molecular markers in a complementary way to arrive at valid inferences.

3.7.3 National register for varieties

This critical point ought to be the subject of a technical audit carefully comparing varietal data with ATCC and that in the hands of breeders or seed companies. Given the insecurity about the degree of characterisation of the accessions submitted to the ATCC, the bottle-neck is to be found with the ATCC and breeders or seed companies. The reasons for the discrepancy are several for which the mandate for harmonisation can provide a solution:

1. *Characterisation is very labour-intensive.* Breeders and the ATCC suffer from lack of resources, financial or staff trained in doing characterisation work. They must deal with many species and for the ATCC with other technologies in addition to seed. For comparison, characterisation work in genebanks is usually done by Crop Working Groups, who are used to working with the assigned group of species and well trained. It is therefore pertinent that the ATCC be reformed to undertake varietal release tasks using Crop Working Groups.
2. *Training institutions.* The agricultural training institution at Bunda College, University of Malawi needs to incorporate principles and practice including accession database management through technical courses or training that is already provided for in breeding and seed science at M.Sc. level. To this end, there is need to support curriculum/course review and/or development in Plant Breeding and Seed Science areas to incorporate documentation principles and practice towards improving expertise responsible for maintenance of quality of passport data to enhance varietal release, use, and management.
3. *The amount of characterisation data may be unnecessarily ambitious.* Breeders are required to measure at least ten, ideally up to 100 individuals per varietal accession. The intention is to capture the diversity present within accessions. It should be kept in mind that these are ‘shelf use’ data and should be the minimum necessary for classification. There is need for Crop Working Groups to harmonize minimum requirements including using lessons from the National Plant Genetic Resources Centre.

3.7.4. Varietal Documentation and Information Systems (VDIS)

The ease and accessibility of documentation and data storage is essential to any modern crop improvement programme. It is proposed that a VDIS be established following that practiced by the SPGRC where it is not a centralised; but rather a ‘federation’ of users of a common system. The entry of data on varietal accessions would be the responsibility of each breeder or user. All other breeders or users have access to these data, but may only edit their own. Data would be transferred manually using CDs as well as by *ftp* once a decentralised, web-based version is developed. The ATCC would be responsible for distributing updated versions to all users while the unique responsibilities of ATCC would be to keep the base data collection updated in VDIS and develop the VDIS system. The alternative to this would obviously be a web-based system, such as the present Seed Storage System (SESTO) or the ICARDA-based GRIS-system.

Analyses of characterisation data is the crucial next step recognised by all partners. Good characterisation data lend themselves to multivariate statistical analyses and through groupings determine uniqueness and redundancies among varietal accessions. This may then guide both rationalisation and admission of new varietal entries. However, it needs reasonably good data (although not of scientific publication quality) and user-friendly software with trained users. The study recommends investment in network software licenses for these purposes.

Prior to embarking upon a documentation upgrade for varietal release, the current status of existing varietal release data documentation needs to be assessed to determine whether there are gaps in the existing information. This can be accomplished by examining the quantity and quality of data for a subset of records say for different crop species taking into account the documentation history of the varietal accession deposited with ATCC.

Differences among crop species, and the inherent difficulties of interpreting historic data, make it imperative that crop-specific working groups and other experts define how varietal attributes will be defined, bearing in mind that they are establishing information standards. Staff will need to be carefully trained so they can identify crop-specific information, interpret historic documents and organize the information into the standard format.

Once sites for varietal development/release become associated with latitude and longitude values, the linkage between variety and ecology can be explored by GIS tools and ecogeographic datasets. Standard accurate documentation of varietal development data will also support the exploration of the linkage between information at the genome level with information at intra- and inter specific levels. The rapidly advancing field of bioinformatics and ongoing improvement of datasets at all levels will facilitate our understanding of how genomics relate to populations, species and the environment, the latter in particular with the advent of climate change.

Because of the poor infrastructure in some rural areas and the need for an extensive seed testing and field inspection capability in Malawi, it is suggested that the present four stations be renovated and equipped with the necessary equipment and staff to effectively carry out their primary function.

3.7.5 Research and information transfer for farmer adoption of new varieties

Research and information transfer for farmer adoption of new varieties is a challenge due to extension delivery system through demand-driven approach.

3.7.6 The role of the ATCC

The role of ATCC needs review. It is considered to put in place an Act to provide for the legal establishment of ATCC. Further to review the Seed Act to reflect the role of ATCC

instead of Variety Release Committee. This review must also take into consideration the role of existing seed networks, associations and organizations or a new overarching organization and their potential efficacy to assume some of the regulatory functions, respectively.

4.1 Background information and body responsible for Phytosanitary measures

In Malawi, crops are grown using a minimum amount of purchased inputs (i.e. seed, fertiliser, etc.). Under these conditions, crops are threatened by a daunting array of debilitating production constraints which farmers can do little to change. DeVries and Toenniessen (2001) categorised these constraints as either ‘routine’ or ‘intractable’. ‘Routine’ constraints are those which may be more or less effectively controlled through conventional crossing and selection methods. ‘Intractable’ constraints are those which are difficult or impossible to control through conventional crop improvement. Those pertaining to pest and diseases would have to be considered in phytosanitary control. Illustrative short list of intractable constraints is shown in Table 4.1 below.

Table 4.1. Examples of intractable constraints to production among small-scale farmers for seven important African crops

Focus crop	Intractable traits
Maize	Striga, stem borers,
Sorghum	Striga, anthracnose,
Millet	Striga, head miner, downy mildew
Rice	Gall midge, rice yellow mottle virus
Cowpeas	Maruca pod borers, bruchids, thrips
Cassava	Root rots, green mite
Banana	Banana weevil, nematodes, black sigatoka

Source: DeVries and Toenniessen (2001).

It is arguable that categorizing constraints as either intractable or routine is dependent on the farmer being able to alter the growing environment. The very limited investment capacity of small-scale farmers in Malawi means that many potentially routine production problems are, in fact, intractable. This increases the significance of phytosanitary measures (and elsewhere genetic crop improvement) as a strategy in their potential control.

Second, commonly found insect pests and disease pathogens moving in internationally traded grain and seed commodities are now regarded as cosmopolitan and in most countries not subject to quarantine restrictions being regarded as indigenous. However, these pests and pathogens are often harmful to the commodities they infest and their presence is decreasingly tolerated. For this reason, there is general need to strengthen phytosanitary procedures in all shipments of infestible commodities traded internationally including grain and seed-aid.

Phytosanitary measures for seed in Malawi are governed by the Plant Protection Act of 1964. The Act provides for the eradication of pests and diseases destructive to plants, prevents the

introduction and spread of pests and diseases destructive to plants, and for matters connected therewith and incidental thereto.

Phytosanitary measures are standards that are set by members of the World Trade Organization (WTO) through the Food and Agriculture Organization called the International Plant Protection Convention (IPPC). These standards govern the smooth flow of agricultural commodities including seed between countries so that materials being imported/exported are of good quality, pest and disease free. Malawi is a member of WTO and the Act is in agreement with the standards, albeit, outdated. Following the enactment of the act, the Malawi Plant Protection Services commodity group was established under the Department of Agricultural Research Services to oversee the status of pests and diseases. The Commodity group is composed of the following team;

- Integrated field insect pest management (Pre-harvest Entomology and Migratory pests)
- Integrated Field Disease Management (Pathology and Nematology)
- Storage pests Management (Post harvest Entomology and Plant Health inspection Services currently known as Produce Inspection).

4.2 Name and contact addresses of the head of this body

National Research Coordinator (NRC)
Plant Protection Services
Department of Agricultural Research Services
Chitedze Research Station
P.O. Box 158
Lilongwe, Malawi.
Tel.: +265 1 707 222
Email: agric-research@sdpn.org.mw

4.3 Phytosanitary measures including the overall processes necessary

Phytosanitary certificates issued are based on international standards set by IPPC and Malawi regulations. Commodities for export are inspected and must comply with the standards stipulated in the import permit of the importing country. Produce inspectors certify the seed upon satisfaction of the conditions stipulated by the importing country. Inspections are also done at active growth stage of the mother plant and later before shipment of the seed.

4.4 Conformity with regional phytosanitary measures in SADC if there is harmonized quarantine pest list or any other harmonized standards on phytosanitary measures

The lists of quantifiable pests and diseases (Table 4.2) vary substantially between Malawi and the region. This is partly because pest risk assessments are expensive and infrequently conducted and that Malawi has not monitored changes in pest incidence over time what with

an outdated Plant Protection Act. As a result, the national phytosanitary lists include pests and diseases that are either regionally endemic, or of little economic significance.

- Quarantine pest list and the categories – Malawi has one based on pests and another based on plant species and both are outdated.
- Definitions – SADC based on slightly latest version of ISPM 5 while Malawi is very old and outdated.
- Elements of Equivalence not properly embedded in the Plant Protection Act of Malawi.

Phytosanitary experts and stakeholders in the region reviewed pests currently subjected to import and export controls in seed trade and they have shown that most of these pests are common in all SADC Member States and neither are they seed-borne nor of economic importance (SADC Seed Update, 2003). The pests listed in the Table 4.2 are the only ones that will be checked for seed moving in regional trade. This is a much reduced pests list and inspectors will only have a few pests to check for, resulting in speeding up the process of inspections at the points of entry.

Member States are encouraged to recognize that an alternative level of protection or risk reduction may be obtained by applying alternative methods to control quarantine pests. The method used must be declared and must be technically and economically feasible for use as long as it provides the same level of protection against pests. To promote trade and speedy movement of seeds within SADC, the use of mutually recognized alternative measures should be encouraged in line with the provisions of the SPS Agreement. It is also pertinent to argue that these frameworks should have flexibility to allow countries to move sectors (crops, farming systems) from lower to higher level of regulation, or vice versa, as pest and pathogen developments dictate.

Invariably however, it is pertinent for the seed industry in Malawi to learn that the trade deficit that Malawi incurs with its SADC trading partners and SADC as a whole has consistently increased overtime (Chipeta, 2006). Non-tariff trade barriers that include sanitary and phytosanitary measures in other SADC member states have been cited as possible explanation for trade imbalance.

Table 4.2: Proposed list of pests to be checked during export and import of seed in SADC¹ and Malawi²

CROP	PEST/PATHOGEN SADC	PEST/PATHOGEN MALAWI
<i>Zea mays</i> L. (Maize)	<i>Peronosclerospora phillipensis</i> <i>Cochilobolus heterostrophus</i>	Seed treated with an approved fungicide
<i>Phaseolus</i> . (Beans)	Bean mosaic virus Tomato black ring virus <i>Dictylenchus dipsaci</i>	Bruchidae spp.
<i>Vigna</i> spp. (Cowpea)	Peanut strip virus	Bruchidae spp.
<i>Helianthus</i> spp. (sunflower)	Tobacco ringspot virus	None
<i>Nicotiana</i> spp. (Tobacco)	Tobacco ringspot virus <i>Ralstonia solanacearum</i>	Seed to be treated with silver nitrate
<i>Oryza Sativa</i> (Rice)	None	<i>Aphelenchoides besseyi</i> <i>Ditylenchus angustu</i>
Brassica (cabbage)	Tobacco rattle tobnavirus	None
<i>Arachis</i> spp. (Groundnut)	None	<i>Carydon gonora</i> Khapra beetle
<i>Glycine</i> spp. (Soybeans)	Tobacco ringspot virus	<i>Heterodera glycine</i>
<i>Gossypium</i> spp. (Cotton)	None	<i>Pseudomonas helianthi</i> p. <i>chichori</i> <i>Plasmopara halstedii</i>
<i>Sorghum</i> spp. (Sorghum)	None	<i>Pseudomonas andropogonis</i> Maize dwarf virus <i>Periconia circinata</i>
<i>Triticum</i> spp. (Wheat)	<i>Tilletia indica</i>	None
<i>Alliums</i> pp. (Onion)	Tomato ring nepovirus <i>Dictylenchus dipsaci</i>	None
<i>Capsicum</i> spp. (peppers and chilli)	Tobacco rattle tobnavirus Pepper mild mottle tobamovirus	None
<i>Lycopersicum esculentum</i> (Tomato)	Tobacco ringspot virus Tomato black ring virus	None
<i>Pisum</i> spp. (peas)	Pea seed borne mosaic virus <i>Dictylenchus dipsaci</i> <i>Phoma pinodella</i>	None
<i>Manihot esculenta</i> (Cassava)	<i>Mononychellus tonajoa</i> East African cassava mosaic virus Cassava brown streak virus African cassava mosaic virus	None
<i>Ipomea batatas</i> (sweet potato)	Synchytrium endobioticum <i>Ralstonia solanacearum</i> biovar 4 Sweet potato mild mottle ipomovirus Sweet potato feathery mottle virus <i>Aphelenchoides besseyi</i> <i>Dictylenchus dipsaci</i> <i>Dictylenchus destructor</i> <i>Radopholus similis</i> <i>Cylas puncticolis</i> <i>Agrius convolvuli</i> <i>Alternaria alternate</i>	None

Source: ¹SADC Seed Network Booklet, 2005.

²Plant Quarantine Regulations, 1969

4.5 Future plan of the country for phytosanitary measures

4.5.1 Review of the Plant Protection Act of 1964 (content and procedures) to be in line with IPPC

The Plant Protection Act of 1964 is outdated and needs technical and financial support for its comprehensive review. Current efforts have so far been piecemeal.

4.5.2 Review procedures

There is need to review regulations and inspection procedures including pest lists to update and align them with regional protocols so that the country is able to participate fully in seed trade. The implementation of new risk assessments may be both expensive and time consuming. This problem can be resolved by gathering national plant protection scientists together with a few international experts on phytosanitary controls as has been done elsewhere (Rohrbach *et al.*, 2004).

4.5.3 Equipping port of entries

There is need to provide infrastructural facilities and equipment at entry points (computer, telephone and internet connectivity, photocopiers, fax machines, and, lab equipment including Inspector's Kit. Deficiencies in plant quarantine facilities and phytosanitary regulations are said to increase the risk of entry of new pests and diseases.

4.5.4 Training and capacity building of Plant Health Inspectors

The process may lead to rigorous changes and therefore for effective and sustainable outcome there is need to build capacity in the main executors who are point of entry/exit Plant Health Inspectors. The important requirement to slow down the spread of pests and diseases of crops and thereby reduce losses and pest control costs leads to the need for a national service to the agricultural trading community. This service consists of specialists in pests and diseases plus trained technicians who provide on-site inspection services. The level and number of specialists and technicians need to be upgraded in Malawi.

4.5.5 Documentation of phytosanitary procedures for seed movement

In contract tenders for grain and seed commodities liable to insect infestation, potential suppliers of commodities and transportation must be adequately instructed in the purchaser's requirements for minimising the risks of infestation taking place. This study proposes that Malawi develops a "Seed Import Export Manual" that includes details on phytosanitary procedures in seed movement both in-country and without.

4.5.6 Public Awareness

There remains need to develop an Information, Education and Communication (IEC) strategy for public awareness of the Phytosanitary Service. Such campaign will be targeted to the public at all levels. Quarantine and phytosanitary process needs to be well understood

5.1 Background information and body, which is responsible for Plant Variety Protection

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) has continued to be fiercely debated between North and South, particularly with respect to its provisions for the agricultural sector (Eaton, 2008). Article 27.3(b) of the TRIPS Agreement requires WTO member countries to offer some form of intellectual property protection for new plant varieties, either in the form of patents (common in the U.S.) or plant breeder's rights (PBR) which were first developed in Europe.

PBRs are *a sui generis* form of IPR that can be seen as combining elements of both patents and copyright protection and which were perceived as better addressing some of the peculiar aspects of protecting biologically-reproducible material, such as plants, in a better manner than patents. PBRs have existed in many European countries for more than 40 years and the general requirements for such protection are enshrined in the International Convention on the Protection of New Varieties of Plants (UPOV Convention¹). The UPOV Convention has been revised on numerous occasions, with the most relevant versions today being those of 1972 and 1991, the latter which offers the holder of PBR far more exclusive rights than the former version².

Treaty establishing the Southern African Development Community has, in Article 22, expressly called for the conclusion of Protocols as necessary in each area of cooperation within SADC. It was noted that the Protocol on Trade established that Member States shall adopt policies and implement measures for the Protection of Intellectual Property Rights, in accordance with World Trade Organization (WTO) Agreement. This was agreed while recognizing the need to have an effective *sui generis* system of intellectual property protection of new varieties that meets the requirements of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement. It was also recognized that nationals, natural persons and legal entities of Member States shall enjoy equal treatment within the SADC Region provided that the said nationals, natural persons and legal entities comply with all conditions and formalities.

Plant variety protection is important in trying to allow farmers access to a wide range of improved varieties to contribute to the attainment of the regional goal of economic development and food security. Plant breeders' rights provide an effective system for the protection of new varieties of plants with the aim of encouraging the development of new varieties of plants for the benefit of the society. The SADC protocol will be implemented

² See <http://www.upov.org>

through National Plant Breeders' Rights (PBR). Hence, Malawi Plant Breeders' Rights Act was drafted and consultations were made. The wishes of stakeholders were diverse and some wanted the inclusion of farmers' rights. This was done but it was becoming contrary to the SADC protocol. The Ministry of Justice advised that farmers rights are already included in the access and benefit sharing bill; hence, the need to remove it from the PBR.

5.2 Name and contact addresses of the head of body responsible for Plant Variety Protection

The PBR bill establishes [in the public service] an office which shall be known as the "Malawi Plant Breeder's Rights Office" (MPBRO) which shall be responsible for registration of plant breeders rights and matters connected (MPBR draft Bill, 2008).

5.3 Conformity with proposed regional Plant Variety Protection in SADC

The plant variety protection system is similar to that of SADC protocol since it is specially established in accordance with the SADC protocol. The PBR will not replace the normal variety release and listing but those who need to protect their varieties and have the ability to pay for the accrued fees will be the ones to apply to MPBRO for protection. Malawi PBR is in line with the SADC protocol and UPOV. The only difference is that SADC protocol has specified the crops that can be listed while for Malawi all crops are eligible for protection (MPBR draft Bill, 2008).

5.4 Future plan of the country for Plant Variety Protection

5.4.1 Enactment of Plant Breeders' Rights Act

A study of seed legislation in Malawi shows that it does not yet have the legislation for the awarding of plant variety protection to permit plant breeders to protect intellectual property rights. New plant varieties should be protected by legislation through the Malawi Plant Breeders' Rights Act which was drafted but is yet to be enacted requiring further technical and financial support. UPOV provides protection to new plant varieties and about 29 countries are members, including Kenya and South Africa as required by UPOV and the WTO. Furthermore, Malawi has legislation in place to regulate the products of modern biotechnology, such as genetically improved crops for field testing and production, as well as the approval of genetic engineering products in food.

5.4.2 Establishment of body responsible for investigating infringement of MPBR Act

The study proposes that in further efforts to redefine and streamline workload of the ATCC in variety control or through the proposed review of the MPBR Act of 2008, a body will need to be established with the following mandate and well defined procedures:

- Identify and investigate transgressions of plant breeders' rights, as well as transgressions
- in terms of the Plant Breeders Act;
- Prioritize suspects and to process cases for further legal action; and
- Compile an information network for future preventative actions.

5.4.3 Other challenges associated with existing IPR legal framework in Malawi

It is argued that there is a great divide within the commercial seed industry between those favouring the patent system and those wanting to put more emphasis on plant breeder's rights as the key protection system in breeding (FAO, 2009). FAO observes that plant breeder's rights seem to lead to more competition in the sector, and can be combined more easily with the concept of farmers' rights. Therefore, trends towards globalization of IPRs, such as WIPO's Substantive Patent Law Treaty, limit the ability of countries to frame their protection system towards national societal goals. Similarly, FAO argues that UPOV's lack of flexibility in the interpretation of its clause on 'private and non-commercial use' has discouraged developing countries from joining UPOV and implementing UPOV's model for plant variety protection. It is important that all practitioners in Malawi are fully informed and knowledgeable about the tenets of various treaties. In general, other challenges associated with existing IPR legal framework in Malawi include the following:

- Lack of public awareness on the existence of relevant legislation;
- Lack of public knowledge about the importance of patents
- Poor coverage of certain areas of the IPRs; and
- Poor linkage with indigenous knowledge base

5.5 Any additional information on Plant Variety Protection measures necessary for the purpose of harmonization at COMESA level

5.5.1 Training and analysis of trends from PBR implementation

It is important that analyses and training workshops be conducted on the effects of the introduction of PBRs in importing COMESA countries on the value of exports of agricultural seeds and planting material from exporting COMESA countries. Ex-ante analysis, and where feasible post-ante analysis should demonstrate whether the PBR system is necessary or sufficient to encourage trade in seed. For instance, current imports of seeds may be largely determined by previous history of imports, indicating a form of path dependence which may be little influenced by IPRs.

Aside seed trade, analyses and training will clarify potential for perpetual discordance in the scientific community in the region based on the paucity of arguments for and against patent regimes amongst breeders and the seed industry. It is argued that the specificities of the breeding process were recognized at the time of the creation of the International Convention

for the Protection of New Varieties of Plants in 1961 (revised in 1978 and 1991) by UPOV (Santos and Lewontin, 1997). While the overall complex genetic structure of a plant variety, the result of several succeeding efforts made by breeders and farmers, is the object being protected by the terms of UPOV Convention, no exclusive rights are provided to any isolated traits or genes embodied in it. In addition, it was recognized that the variety so protected is freely available as a source of variation for the development of new plant varieties in both 78 and 91 UPOV acts. In other words, the UPOV-like legislation provides effective intellectual property protection of plant varieties while allowing genetic resources to be freely accessed for further breeding activities, including the protected variety itself. However, it is noted that the progression of patent regimes in the agricultural sector, especially in the developed seed industry, does not render justice to the various participants involved in previous breeding activities including the rural farmer and locale who remain the time-immemorial repository of genetic resources.

The country and region needs to be wary of generalizations of broad biotechnology utility procedures making room for endless legal disputes and creating uncertainty among scientists and industry on the efficacy of the legalized system in promoting innovation, in clear contradiction to the objectives for which such systems would be created.

5.5.2 Increased investment in molecular biology and genetic engineering

It is argued that elsewhere the State has participated in two ways in the innovation-generating process (Santos and Lewontin, 1997). First, it has provided public funds for research even when the research itself is carried out by institutions outside the State. Second, public institutions themselves have carried out basic research, as for example the collecting, conservation and characterization of plant genetic resources, and also the most expensive applied research such as the production of maize inbred lines with high combining ability that are then released to private seed producers. This study argues for increased research investments in molecular biology and genetic engineering that implies a high degree of collaboration between private and national institutions, especially in monitoring future research demands and areas of mutual interest. Further, the COMESA region needs to review for exclusion from patent protection all claims that would inhibit the innovation process. This includes, as a minimum, the entire range of sequence variation that occurs in nature for any gene, linked or not to novel products or processes, and plant varieties as a whole, particularly genus and species-wide patents.

6.1 Background information on seed import and export

Malawi is a signatory to several bilateral and multilateral trade arrangements. Malawi is a signatory to the Lomé Convention which accorded agricultural products and virtually all manufactured goods preferential access into the European market. The country does not have the full benefits due to supply or productive constraints. The strongest EU import regime is a strong impediment. With the expiration of the Lomé Convention in 2000, a new Partnership Agreement between the European Community and the African, Caribbean and Pacific (ACP) States was concluded. The agreement will regulate trade between the two groups of countries and define development co-operation strategies. The Partnership agreement applies to all SADC countries except South Africa, which has a separate agreement with the EC. As the EC-ACP agreement gives preferential treatment for products originating in ACP countries, a waiver has been requested from WTO. This is possible under the so-called Enabling Clause, which gives preferential treatment to products from developing countries. The Enabling Clause is the legal basis for regional arrangements among developing countries.

Malawi is also a signatory to the membership of the World Trade Organization (WTO) of which its agreement on Agricultural Trade adopted a commitment-oriented approach in the area of market access, domestic support and export competition. Malawi as a least developed country is exempt from making commitments under the agreement.

The country is also a signatory to the Southern Africa Development Community (SADC)'s Trade Protocol (SADC, 1996), the Common Market for Eastern and Southern Africa (COMESA). She is a beneficiary of the Generalized System of Preferences (GSP) and the US Africa Growth Opportunity and the Millennium Challenge Account.

The economic structure of most countries in the region except South Africa, are similar as most of them are agricultural based. This underlies the importance of agricultural products for Malawi exports. Malawi's exports to COMESA/SADC countries are mainly tobacco, tea, sugar, cotton, rice, pulses, chilies, natural rubber, cut flowers and live trees, groundnuts, agricultural implements and tools, ceramics, cotton fabrics, apparel, alcoholic beverages, timber, precious and semi-precious stones, hides and skins, aquatic fish, molasses and other small light manufactures, including craft. The contribution of the seed industry to export is at most miniscule.

Malawi imports are dominated by capital goods and industrial equipment. Malawi's main trading parties are: United States of America, South Africa, Germany, the Netherlands, Japan, the United Kingdom, Zimbabwe and Austria.

In terms of 'cross-border trade', it should be noted that Mozambique shares the longest border with Malawi and along with Tanzania provides access to the Indian Ocean trade routes. The favourable political relationship with neighbouring states has created a conducive environment for cross-border trade including smuggling. The open borders have facilitated informal trade and this contributes to employment, food security, foreign exchange and the sharing of natural resources.

In a study on the implication of cross-border trade on bean seed multiplication, dissemination, entrepreneurship and quality in East and Southern Africa, Tchale (2001) concluded that while cross-border markets provide a niche market that can ensure income and food security to millions of small-scale bean producers in the region, he cautioned that unrestricted movement of bean varieties had potential implications on the quality of the varieties released by bean breeding and dissemination programs such as the USAID-funded Bean/Cowpea Collaborative Research Support Program. He advised the need to ensure that such programs establish mechanisms to monitor the movement of varieties across borders in order to maintain the quality of the varieties being developed. In terms of impact monitoring, the collection both formal and informal trade statistics in order to estimate the economic impact of crops at the household and national levels was recommended.

6.2 Name and contact addresses of the head responsible for seed import and export

The main department responsible for trade and industry policy is the Ministry of Industry and Trade. Other government ministries involved in trade issues include the Ministry of Agriculture and Food Security, which has the main task of formulating agricultural policies and the Ministry of Finance and Economic Planning, the overseer of the overall government budget as well as expenditure and revenue measures; the Malawi Revenue Authority is responsible for tax and tariff administration. The Ministry of Foreign Affairs, the Copyright Society (under the Ministry of Sports and Culture) and the Patents Office (under the Ministry of Justice) also play an important role in trade matters. Other important public-sector players include the Malawi Bureau of Standards (MBS), the Malawi Export Promotion Council (MEPC) and the Reserve Bank of Malawi.

The Plant Protection and Phytosanitary Services, the Seed Certification and Quality Control Unit and the Ministry of Industry and Trade are jointly responsible for seed imports and exports. However, the focal point is the Ministry of Industry & Trade.

Ministry of Industry & Trade
Private Bag 30366
Lilongwe 3, Malawi
Tel: +265 1 770 244

6.3 Seed import/ export procedures

6.3.1 Seed Imports

The Malawi Government may allow importation of certified seed in case of unavailability of sufficient quantities. Any seed imported should be approved seed and not restricted seed. The seed should conform to seed standards and other requirements prescribed by importing country (Malawi). If the seed is packed in a container, the container should be clearly labeled stating the genus, species, variety and the country of origin. Upon importation into Malawi, the seed importer should inform the SSU within 7 days of its delivery, requesting a sample to be taken for a test at a seed testing laboratory. No person should sell or otherwise dispose of imported prescribed seed prior to the receipt of a report of the test from the seed testing laboratory. The report confirms that the imported prescribed seed conforms to the prescribed seed standards.

All seed and plants imported into Malawi pass through the entry ports of Lilongwe International Airport, Chileka Airport, Muloza, Mwanza, Mchinji, Dedza, and Songwe border posts where they are inspected to ensure that they are free of pests and diseases. Documents such as international seed testing certificates, import permits, phytosanitary certificates and fumigation certificates accompanying the consignment are checked and verified to ensure that they comply with regulations.

A seed importer must obtain an import permit from MoAFS. At the same time the importer would be advised concerning phytosanitary and variety requirements. Only varieties released in Malawi can be imported, but the Minister has powers to allow importation of non-released varieties under emergency conditions. The permit is valid for a stipulated period and can include more than one consignment. Import prohibitions are maintained for environmental, health and security reasons. Import licensing is required for most agricultural products including seed (Malawi Government, 2008).

Seed imports registered with SSU are shown in Table 6.1 while Table 6.2 illustrates seed imported into Malawi and registered by Ministry of Industry and Trade. It was learnt that these data in Table 6.2 and in Table 6.4 are provided by the National Statistical Office. It remains important that the initial inspecting/documenting officers are dutiful and knowledgeable enough to distinguish grain that may be registered as seed.

Table 6.1: Quantity of seed imported into Malawi and registered by SSU

Crop	Quantity (Mt)			Origin (09/10)
	2007/2008	2008/2009	2009/2010	
Cotton	6.4	586.3	0	Zambia
Soya beans	0	600.0	0	Zambia
Wheat	0	40.6	0	Zambia
G/nuts	0	120.0	0	Zambia

Table 6.2 Seeds imported into Malawi in 2009 as registered by Ministry of Industry & Trade

Commodity	Country of Origin	Value (MK)	Quantity (kgs)
Pea seeds of a kind for sowing	India	2,234,390	21,000
Pea seeds of a kind for sowing	Mozambique	120,000	10,000
Other dried legum veg.sh/skinned/split seeds of a kind used for sowing	India	187,038	725
Soya beans	Nigeria	98,001	184
Other rape or colza seeds; nes	China	372,174	4,160
Sunflower seeds	Mozambique	3,831,700	302,880
Cotton seeds	Mozambique	15,322,077	663,020
Mustard seeds	India	18,684	50
Vegetable seed, of a kind used for sowing	China	2,309,671	4,269
Vegetable seed, of a kind used for sowing	Germany	1,122,554	50
Vegetable seed, of a kind used for sowing	Denmark	13,526,938	839
Other seeds, fruit and spores, of a kind used for sowing	China	2,440	25
Other seeds, fruit and spores, of a kind used for sowing	Australia	55,520	3

Source: Ministry of Industry & Trade, 08/09/10

6.3.2 Seed Exports

Certified seed exports registered with SSU are shown in Table 6.3 and mainly consist of hybrid maize. Other crop seeds that are exported and registered with the Ministry of Industry and Trade are shown in Table 6.4. It was reported that seed exports/import statistics are provided with the assistance of the National Statistical Office on behalf of the Ministry of Industry and Trade. It is critical to interrogate data harvesters so that reportage should not include grain as seed. Second, it is evident that seed statistics of exports and imports from SSU and the Ministry, respectively must start to converge towards the same numerical values.

Table 6.3. Quantity of seed exported by Malawi and registered by SSU

Crop	Quantity (Mt)		
	2007/2008	2008/2009	2009/2010
Maize	2319.4	820.8	1023.5
Tobacco	0	0.004	0
Pigeon peas	0	4.0	0

Table 6.4 Seeds exported (kg) by Malawi in 2007-2009 as registered by Ministry of Industry & Trade.

Commodity	2007	2008	2009
Pigeon pea	80,800	6,500	3,000,000
Chick pea	1,133,139	86,215	1,097,300
Dried bean seed	18,850	-	5,000
Dried vegetable legume seed	198,176	455,110	275,000
Coriander	-	7,000	8,080
Durum wheat	-	144,141	653
Maize seed	14,065	-	108,000
Sesamum seed	-	6,653	598,616
Soya beans	-	-	30,000
Cotton seed	15,892,108	3,894,499	60,700
Sunflower	3,609,390	371,690	521,500
Safflower	118	22,070	-
Castor oil seeds	28,000	-	-
Other seeds, fruits, spores	4,713	7,319	-
Seeds of forage plants	3,272	3,350	-
Seed potato	92,900	-	-
Seeds of anise or radian	-	7,020	-

Source: Ministry of Industry & Trade, 08/09/10

6.4 Seed import and export documentation

The seed to be imported / exported must be accompanied by the following documents:

1. Import permit - Imported seed must be accompanied by a valid plant import permit that authorizes entry in accordance with Malawi Phytosanitary Regulations. A total of 45 diseases and pests are subject to import control.
2. Export permit - Companies who wish to export seed are supposed to get an export permit from the Ministry of Trade and Industry. This is done after getting an authority from MoAFS to export seed. The exporter is expected to ensure that internationally acceptable seed testing and phytosanitary certificates are obtained.

3. Phytosanitary certificate - This certifies that the imported agricultural commodities are free from insect pests, diseases, weeds and must be of good quality.
4. Orange Certificates - Orange Certificate attests the viability, purity and quality of seed being imported or exported. However seed that is imported is re-tested to ensure that it conforms to Malawi seed certification standards.
5. Certificate of origin - This ascertains the source or the origin of the seed being imported.
6. Fumigation Certificate - Fumigation certificates attest treatment if the seed is treated.
7. Malawi Revenue Authority (MRA) and Loading documents may also be required.

Many traders complain more about the apparent inefficiency of regulatory and customs authorities, rather than the procedures per se (Rohrbach *et al.*, 2004). This has led to calls for 'one-stop shops' to facilitate trade paperwork. SADC has provided a simple checklist for importing from and exporting to member states (SADC, 2008). To achieve common procedures and standards governing seed trade, national procedures must also be rationalized or simplified. This study suggests the provision of a simple checklist similar to the SADC list highlighting processes/steps and documentation with respect to the document, function, issuer and receiver, in addition to the schedule of licensing of goods circulated by the Malawi Government (Malawi Government, 2008).

6.5 Future plan of the country for seed import and export

6.5.1 Strengthening Malawi's Trade Policy National Working Group with sector-specific strategic frameworks for knowledge management of regional and international trade agreements

In Malawi, the establishment of the Trade Policy National Working Group, a body which brings together the public sector and the private sector under the Malawi Confederation of Chambers of Commerce and Industry (MCCI), has been a major step forward (Kandiero, 2005). However, there will be need for strategic coordination; firstly, close collaboration among various players in the seed import/export nexus in order to avoid any conflicts in trade and policy recommendations based on SADC/COMESA/WTO trade agreements. Second, workshops/seminars should be organised for participants working in the departments directly linked to the seed value chain. Third, there should be a monitoring or a follow-up mechanism to track the progress of participants and their sectors with respect to developments along the seed trade frameworks. This study therefore proposes strengthening Malawi's Trade Policy National Working Group with sector-specific strategic frameworks such as the seed sector, in coordination with the Seed Traders Association of Malawi (STAM) to foment national, regional and international seed trade-related knowledge harvesting, storage, processing, sharing and learning platforms.

6.5.2 Harmonization of principles and practice in regulatory functions of seed industry amongst the SSU, Phytosanitary Services Unit and Ministry of Industry & Trade

There is need for the three branches of government responsible for regulatory functions in Malawi's seed sector to work together in order to ensure that farmers in Malawi are planting high quality seed and planting materials through comprehensive monitoring not only during production, but also monitoring of seed movement.

6.5.3 Market information system

Information is vital for the efficient functioning of a dynamic and responsive seed market. Importers and retailers need information about local regional and global markets while every stakeholder needs information about prices, stocks and availability. In Malawi most of the seed trade with neighbouring countries is done by Monsanto, Pannar and Seed Co. Many of the smaller importers and exporters do not have adequate knowledge about the conditions prevailing in the global seed markets; wholesalers and retailers lack the necessary skills for enterprise management, and most importantly there are few independent seed dealers involved in marketing in rural areas. To meet this need a Market Information System was created and operated by the Malawi Commodity Exchange.

6.5.4 Market infrastructure

Agricultural markets and market infrastructure in Malawi are inadequate and underdeveloped relative to the number of smallholder farmers and the variety of commodities produced. The historic aspect is that for a long time, the major agricultural parastatal ADMARC, had a monopoly in the marketing and storage of agricultural inputs and produce. ADMARC's operations extended throughout the country including areas not found commercially viable by the private buyers.

Since the 1990's the private sector has participated in the farm input and produce trading as part of agricultural market liberalization. During the last five years, a cadre of agricultural input suppliers, agrodealers, and for crop marketing, farmer associations, respectively, has emerged as important forces in rural areas. Generally however, the marketing of most agricultural inputs and commodities lacks support services, notably, on market information, identification of new markets and products, financing, storage and risk management. There is a need to support strategies where the private sector, and in particular agrodealers and farmer associations, shall continue towards the development of rural market infrastructure and eventually to export marketing coordination.

6.5.5 Market liberalization and seed imports

The positive impact of liberalizing the seed sector in Malawi the last two decades has been that the commercial seed production (as a business) is no longer a monopoly of a single or

few companies. There is competition in the seed industry and this ensures high quality and diversity of products. The policies have given an opportunity to smallholder seed producers to take the venture as a business there by improving their income. The commercial companies stopped producing seeds of OPV and leguminous crops because they proved not profitable as farmers recycle their own seed and could not buy from the commercial companies. The OPV seeds that were once not available on the market are now readily available. On the other hand the policies have negatively affected the marketing of the smallholder farmers' seed. Liberalization of marketing has given way to seed imports of popular OPVs such as soybeans, which tend to be cheaper, than the locally produced seed. Although the seed production costs for smallholder farmers are high, market forces dictate that they lower their selling prices in order to compete with the imported one. As the result the smallholder producers make small profits margin not adequate to improve their seed production requirements.

6.5.6 Development of code of conduct for seed movement under emergency situation

There is little question that the uncertainties of trade restrictions and delays in obtaining export or import clearances reduce the quantities of seed traded, and raise the costs. But it is difficult to determine the actual severity of these constraints, or to estimate their economic cost. Anecdotal evidence also suggests that many of these barriers are reduced in emergency situations. If seed is needed for drought or flood relief, certification requirements are reduced and imports are speeded. There is thus need to develop a code of conduct for seed movement under emergency situations.

6.5.7 Strengthening national and regional training activities

There is also a general need to strengthen national and regional training activities on the SADC/COMESA/WTO agreements. The Ministry of Agriculture and Food Security observed that the challenge for Malawi, as an exporter of mainly agricultural products and venturing into exporting more processed products, is that it lacks trained manpower and equipment to address these non-tariff barriers and to comply with WTO commitments (Kandiero, 2005). This would include training on member countries' rights and obligations under these agreements and on the workings of their Dispute Settlement Mechanisms. Such training programmes could also prove beneficial because a thorough understanding among countries is also needed in order to negotiate effectively in trade negotiations, both as individual countries and as the SADC region.

6.6 Any additional information on import and export measures necessary for the purpose of harmonization at COMESA level

6.6.1 The monitoring of informal trade

The amounts of crop seeds that move informally between countries are well below formal trade figures for most countries in the region (Minde and Nakhumwa, 1996). However, given

the high probability that these informal trade amounts are under-estimated due to the limited scope of monitoring, informal trade statistics for most agricultural commodities could far outweigh the formal trade figures. Given that negative aspects of informal cross-border trade include seed quality concerns, and that monitoring movement of varieties becomes almost impossible if crops are increasingly traded through informal channels, it still remains pertinent for the region to maintain seed quality and to establish a monitoring mechanism to capture both formal and informal crop seed trade statistics on a continuous basis.

The argument for monitoring also holds true for international seed movement that goes unmonitored by Seed Services Unit. The international (unmonitored) trade in seed has the potential to make the seed produced within the country have carry-over seed stocks from one season to the next and make the calculation of the replacement rates tricky (Ng’ambi and Maliro, 2003).

6.6.2. Searching for complementarities in seed trade

Other schools of thought have been wary of the observation that most, if not all, SADC economies are similar in nature when it comes to the products they produce, hence the export products they offer (Chipeta, 2006; Makochekanwa, 2006). The same is true when it comes to the region’s imports, they all import more or less same type of products for which none of them produce. It follows that the output of regional 17 countries does not at all complement each other. Table 6.5 below shows a list of the regions’ imports and exports.

Table 6.5: SADC’s exports and imports products

Export Products	Import Products
Crude oil, refined petroleum, ores & minerals, diamonds, gas, coffee, fish & fish products, meat & meat products, hides & skins, textiles, vehicles & parts, cobalt, zinc, copper, rubber, gecamines, food and live animals, tobacco, chemicals & by-products, tea, rice, pulses, clothing, yarn & thread, aluminum, prawns, timber, cashew nuts (raw & processed), sugar, horticulture and floriculture products, Ferro-alloys, asbestos, gold and cut flowers.	Machinery and electric equipment, vehicles and spare parts, machines, military goods, fuels, textiles & footwear, consumer goods, transport equipment, miscellaneous manufactured items and industrial raw materials.

Source: Makochekanwa (2006) citing Official SADC Trade, Industry and Investment Review 2005

It is thus argued that intra-SADC trade does not offer enough the import requirements of the member countries since none of the countries produce them, especially in right quantities that are required by the region (Chipeta, 2006; Makochekanwa, 2006). On the other hand, the trading bloc does not absorb the exports products of member states as most countries produce the same export products. While the import and export of seed is silent in Table 6.5 above, the question is whether a similar quantitative inventory of seed exports and imports has been conducted for various seed types and whether such trade will not suffer the same fate as described above. It appears that one of the cardinal pillars of harmonization should be in the numerical volumes of seed trade and some kind of convergence on chosen indicators of seed trade. There appears adequate concern for common market rules and standards expected to improve the quality, speed and timeliness of either commercial and emergency seed supply or

propensity among countries for restricting seed exports in order to protect domestic seed security (Rohrbach et al., 2003). The potential lack of numerical complementarities needs review with respect to seed trade.

7.1 International Seed Testing Association (ISTA)

The National Seed Certification and Quality Control Unit at Chitedze Agricultural Research Station is accredited to the International Seed Testing Association (ISTA), and has adopted the ISTA seed testing procedures so that there is uniformity in the results of seed analyses. This development remains a positive step towards improving the movement of seed within the region. However, being an ISTA laboratory, it is audited every three years in order to maintain the accreditation status. The laboratory pays audit fees every three years and annual membership fee. Mtambo (2004) observed that accreditation to ISTA has benefits to the entire seed industry despite being expensive. Appropriate facilities and equipment are required for timely, efficient and effective service delivery. The Department of Agricultural Research Services which houses the Seed Certification and Quality Control Unit always struggles to obtain funds for this purpose.

7.2 Organization of Economic Cooperation and Development (OECD)

The objective of the OECD seed scheme for varietal certification is to encourage the use of consistently high quality seed in countries that are members to the organization. The organization authorizes the use of labels and certificates for seed produced and processed for international trade according to agreed principles (OECD Seed Schemes 2010). The schemes are based on the following principles:

- They include varieties that are officially recognized as distinct (DUS) and having acceptable value for cultivation
- All the certified seed produced must be related directly through one or more generations to authentic basic seed of the variety.
- Post-control tests are conducted to ascertain that the schemes are operating satisfactorily

The seed certification and quality control Unit in Malawi uses the OECD standards. The Unit makes sure that all the basic principles of OECD are followed although it is not yet a member of OECD. However, plans are under way for the unit to get affiliated to the organization as this is the only way for the country (Seed industry) to participate in seed trade within the region and beyond.

7.3 The Convention on Biological Diversity (CBD)

Agricultural biodiversity is a precious inheritance from previous generations, which we have the moral obligation to pass on, intact to coming generations to help them to face unforeseen needs and problems. There is no country that is self-sufficient with respect to the genetic resources for food and agriculture. International cooperation should lead to a more fair and equitable sharing of the benefits derived from the use of genetic resources, providing an essential incentive to ensure that countries continue developing, conserving and making available to humanity their genetic diversity. There is also interdependence between generations. These principles are enshrined in the Global Plan of Action for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture (1996), the Convention on Biological Diversity (CBD) (2001), the International Treaty on Plant Genetic Resources for Food and Agriculture (2004), and lately the Global Crop Diversity Trust (2004) (Hawtin, 2004), all to which Malawi is a signatory.

These agreements need to be passed on to non-governmental organisations, farmer associations and community based organisations and enforced at national levels by different relevant government institutions. The development of national legislation for implementation of provisions in the treaties will be essential in deterring genetic erosion, protecting indigenous germplasm and Farmers' Rights, facilitating access to plant genetic resources for food and agriculture, and ensuring benefit-sharing. In this endeavour, national legislations are to ensure harmony, coordination and synergy with other international agreements in all relevant sector, especially in agriculture, the environment and trade.

7.4 The Cartagena Protocol

The Biosafety Protocol is the first international treaty governing the movement of genetically modified organisms (GMOs) across international boundaries (Freeman, 2003). It entered into force for member countries on September 11th, 2003, ninety days after the fiftieth country completed the process of ratifying it. On the basis of a 'precautionary approach' the protocol aims to ensure the safe transfer, handling, and use of GMOs that may have adverse effects on the conservation and sustainable use of biological diversity. The Protocol specifies a detailed plan for the import and export of GMOs, in which an exporter must provide the country of import with a detailed description of the GMO, including a risk assessment outlined by the protocol. The importer may then accept or refuse the GMO, or request additional time for consideration. Following this protocol, regional groupings molded their guidelines on GMOs for their members such the Africa Union GM Model law and the SADC Guidelines on GMOs (SADC Seed Security Network Update No. 5).

Perhaps what is critical is for Malawi to follow the SADC recommendations that comprehensively deal with specific areas of handling of food aid, policy and regulations, capacity building and public awareness and participation. However, the SADC Committee on Biotechnology (SADC Seed Network Update No. 12) observed that the Africa Model Law did not receive wide consultation. It was cited, for example, that the Model extends the scope

to products of genetically modified organisms, when such products have been excluded from the Cartagena Biosafety Protocol. There was therefore need for further refinement on the development and design of the Africa Biosafety Model.

7.5 The SADC Protocol on Trade

The SADC, the Protocol on Trade provided for the attainment of a Free Trade Area (FTA) (by 2008) through the elimination of tariff barriers to trade. Mmasi & Ihinga (2007) observed that whilst the process of eliminating tariff barriers within SADC is in progress and predictable, the success of the FTA hinged to a large extent on a systematic process of eliminating non-tariff barriers which hinder intra-SADC trade. The 2004 Inventory Report on Non-Trade Barriers (NTBs) in SADC countries defines NTBs as “any regulations to trade other than a tariff or other discretionary policies that restrict international trade”, and groups NTBs into three broad categories, namely:

- (a) Health, safety and environment NTBs: these barriers include exports bans, restrictive SPS requirements, standards and conformance requirements;
- (b) Trade policy NTBs: these barriers include broader policy measures including public export assistance, export taxes, import licenses, import quotas, production subsidies, state trading and import monopolies, tax concessions, trade remedy practices (such as anti-dumping, safeguard and countervailing measures);
- (c) Administrative NTBs: these barriers include customs clearance delays, lack of transparency and consistency in customs procedures, overly bureaucratic and often arbitrary processing and documentation requirements for consignments, high freight and transport charges, and generally, services that are not user-friendly.

FANRPAN (2003) reported that the major barriers to trade in the region as a whole consisted of high transportation costs, tariff, non-tariff and technical barriers and supply response constraints. With respect to seed movement, the import and export procedures have been noted to be restrictive, cumbersome and time consuming (SADC Seed Update, 2003).

Bangwe, L., Bjornstad, A. & Lundgren, B. 2006. SADC Plant Genetic Resources Centre and the network of NPGRCs. Final Report: In-depth Review of the joint SADC/Nordic programme.

Chipeta, C. 2006. Deepening Integration in SADC: Can Malawi Meet the Challenge? Regional Integration in Southern Africa Vol. 3. Friedrich Ebert Foundation, Botswana.

Cook, J.J., Bredemeijer, G.M.M., Ganai, M.W., Peeters, R., Isaac, P., Rendell, S. 2003. Assessment of the uniformity of wheat and tomato varieties at DNA microsatellite loci. *Euphytica* 132:331-341.

Cromwell, E. 2001. Incentive measures at the farmers' level to enhance use and conservation of agricultural biodiversity. In: Almekinders, C.J.M. (Comp.), 2002. Incentive measures for sustainable use and conservation of agrobiodiversity. Experiences and lessons from Southern Africa. Proceedings of a Workshop, Lusaka, Zambia, 11-14 September 2001.

DeVries, J. and Toenniessen, G. 2001 Securing the Harvest: Biotechnology, Breeding and Seed Systems for African Crops. CABI Publishing. UK and U.S.A. 208 p.

Eaton, D. 2008. Trade and Intellectual Property Rights in the Agricultural Seed Sector. Agricultural Economics Research Institute (LEI), Wageningen University and Research Centre, The Netherlands.

Food and Agriculture Organisation of the United Nations (FAO). 2009. Strengthening Seed Systems: A Contribution to the Preparation of the Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture. CGRFA-12/09/Inf.20. Rome, Italy.

FANRPAN (The Food, Agriculture and Natural Resources Policy Analysis Network). 2003. Policy Discussion Paper No. 3. Trade Policy and Agricultural Trade in the SADC Region: Challenges and Implications. Regional Synthesis report.

FANRPAN. 2010. FANRPAN Launches Pilot Seed Project in Malawi. 5 March 2010, Lilongwe, Malawi.

Freeman, L. 2003. Leveling the Field. Council for Responsible Genetics. 16: 3. Government of Malawi. 2000. Economic Report 2000, Lilongwe, Malawi.

Government of Malawi. 2004. Food and Nutrition Security Policy, Fifth Draft. Ministry of Agriculture, Lilongwe: Malawi (mimeo).

Hawtin, G. 2004. The Global Crop Diversity Trust: a foundation for food security. *Plant Genetic Resources Newsletter*. **139**, 7-10.

IFDC (International Center for Soil Fertility and Agricultural Development). 2004. An Assessment of the Requirements for Establishing a Seed Regulatory System in Malawi. Muscle Shoals, Alabama, USA. USAID/IFDC/Ministry of Agriculture & Food Security, Lilongwe, Malawi

Jere, P.M. 2010. Proceedings Report on the National Planning Workshop on the Harmonized Seed Security Project (HASSP). 4th- 6th August 2010, Lilongwe – Malawi.

Kandiero, T. 2005. Malawi in the Multilateral Trading System. <http://www.wto.org>

Law, J.R., Cooke, R.J., Reeves, J.C., Donini, P. & Smith, J.S.C. 1999. Most similar variety comparisons as a grouping tool. *Plant Varieties and Seeds* 12: 181-190.

Makochekeanwa, A. 2006. SACU (Run-Away) Trade Agenda: Challenges and Threats to the SADC Regional Integration Project. Trades & Development Studies Centre – Trust, Harare, Zimbabwe

Malawi Government. 2002. State of Environment Report for Malawi 2002. Lilongwe: Ministry of Natural Resources and Environmental Affairs

Malawi Government. 2007. Evaluation of the 2006/7 Agricultural Input Supply Programme, Malawi Interim Report. Lilongwe, Malawi.

Malawi Government. 2008. General Information on Import and Export (Rules and Procedures). Ministry of Industry & Trade. Lilongwe, Malawi.

Mgoja, M., Monyo, E., Rohrbach, D. & Maredia, M. 2004. Regional Plant Breeding and Variety Registration: A Case Study of Southern Africa. Pages 65-80. In: Rohrbach, D. & Howard, J. (eds.). Seed Trade Liberalization in Sub-Saharan Africa. Proceedings of a Workshop 5-6 Dec 2002. Matopos Research Station, Bulawayo, Zimbabwe.

Minde, I. and T.O. Nakhumwa. 1996. Unrecorded cross-border trade between Malawi and her neighbours: implications on food security. Technoserve Inc.

Mmasi, J. & Ihinga, S. 2007. A Survey of non-tariff barriers that affect Tanzanian imports and exports within EAC, SADC and COMESA countries. Final Report. <http://ntb.africonnect.com/media/tanzania.pdf>

Mugwara, R.T., Berhan, T. & Egziabher, G. 2001. Incentive measures to enhance the sustainable use of agrobiodiversity. In: Almekinders, C.J.M. (Comp.), 2002. Incentive

measures for sustainable use and conservation of agrobiodiversity. Experiences and lessons from Southern Africa. Proceedings of a Workshop, Lusaka, Zambia, 11-14 September 2001.

Mtambo, L. 2004. Challenges of seed certification process in facilitating development of the seed industry in Malawi. Paper presented at the Maize Sector Stakeholder's Workshop. 17 March 2004, Lilongwe, Malawi.

Ng'ambi, F. and Maliro, M.F.A. 2003. Seed Security in Malawi with Emphasis on Food Crops. A Draft Report Prepared for Submission to Africa Biodiversity Network (ABN) by Malawi Economic Justice Network (MEJN), Lilongwe, Malawi.

OECD Seed Scheme 2010. OECD schemes for the varietal certification or the control of seed moving in international trade. Revised by the OECD council. {C(2000)146/FINAL}.

Rohrbach, D.D., Minde, I.J., & Howard, J. 2003. Looking beyond national boundaries: regional harmonization of seed policies, laws and regulations. *Food Policy* 28, 317–333

Rohrbach, D., Minde, I. & Howard, J. 2004. Looking beyond national policies: regional harmonization of seed markets. Pages 14-36. In: Rohrbach, D. & Howard, J. (eds.). *Seed Trade Liberalization in Sub-Saharan Africa. Proceedings of a workshop 5-6 Dec 2002.* Matopos Research Station, Bulawayo, Zimbabwe.

Southern African Development Community (SADC). 1996. Southern African Development Community Protocol on Trade, Maseru. August 1996. SADC, Gaborone, Botswana.

SADC Seed Update. 2003. Seed Policies and Regulations in SADC: Update and Harmonization Initiatives. No. 3. The SADC Seed Security Network, Harare, Zimbabwe.

SADC. 2008. Simple Checklist for Importing from and Exporting to SADC Member States. SADC, Gaborone, Botswana

Santos, M. M. and Lewontin, R.C. 1997. Genetics, plant breeding and patents: conceptual contradictions and practical problems in protecting biological innovations. *Plant Genetic Resources Newsletter* 112:1-8.

Sperling, L. and Cooper, H.D. 2003. Understanding seed systems and seed security. In *Improving the effectiveness and sustainability of seed relief. Proceedings of a stakeholders' workshop, Rome, 26–28 May 2003.* Rome: Food and Agriculture Organization.

Tchale, H. 2001. Informal Cross-Border Trade: The Case of Beans in Eastern and Southern Africa - Implications on Bean Seed Multiplication, Dissemination, Entrepreneurship and Quality. *Bean/Cowpea Collaborative Research Support Program . East Africa Proceedings: Bean Seed Workshop, Arusha, Tanzania January 12-14, 2001.*

UPOV (International Union for the Protection of New Varieties of Plants). 2002. General introduction to the examination of distinctness, uniformity and stability and the development of harmonized descriptors of new varieties of plants. Document TG/I/3. UPOV, Geneva, Switzerland.

World Bank. 2003. Malawi Country Economic Memorandum: Policies for Accelerating Growth, Washington: World Bank

World Trade Organisation (WTO). 2002. Malawi: Trade Policy Review, Geneva: WTO

Table 9.1: Personnel Serving Under Plant Protection and Seed Services Commodity by Section, Post and Location in the Ministry of Agriculture & Food Security, Government of Malawi

Section	Title of Posts	Posts Filled	Department of Agriculture Research Services
Plant Protection			
	Assistant Director of Agricultural Research Services	1	Chitedze Agricultural Research Station
	Senior Agricultural Research Officer	1	Baka Agricultural Research Station
	Senior Assistant Agricultural Research Officer	1	Baka Agricultural Research Station
	Assistant Agricultural Research Officer	2	Chitedze Agricultural Research Station
	Subtotal	5	
Storage & Pest Management			
	Principal Agricultural Research Officer	1	Chitedze Agricultural Research Station
	Agricultural Research Officer	1	Chitedze Agricultural Research Station
	Senior Assistant Agricultural Research Officer	4	Chitedze Agricultural Research Station
	Assistant Agricultural Research Officer	3	Chitedze Agricultural Research Station
	Technical Assistant	2	Chitedze Agricultural Research Station
	Research Attendant	1	Chitedze Agricultural Research Station
	Subtotal	12	
Pathology/ Nematology			
	Assistant Director of Agricultural Research Services	1	Bvumbwe Agricultural Research Station
	Chief Agricultural Research Scientist	1	Bvumbwe Agricultural Research Station
	Senior Assistant Agricultural Research Officer	2	Bvumbwe Agricultural Research Station
	Assistant Agricultural Research Officer	5	Bvumbwe Agricultural Research Station
	Technical Assistant	1	Bvumbwe Agricultural Research Station
	Subtotal	10	
Storage & Plant Produce Inspection Services			
	Senior Assistant Agricultural Research Officer	2	Bvumbwe Agricultural Research Station
	Assistant Agricultural Research Officer	3	Bvumbwe Agricultural Research Station
	Technical Assistant	2	Bvumbwe Agricultural Research Station
	Subtotal	7	
Integrated Field Disease Management			
	Principal Agricultural Research Scientist	1	Lunyangwa Agricultural Research Station
	Subtotal	1	
Crop Storage			
	Assistant Agricultural Research Officer	3	Lunyangwa Agricultural Research Station
	Subtotal	3	
Cotton Entomology			
	Agricultural Research Scientist	1	Makoka Agricultural Research Station
	Assistant Agricultural Research Officer	2	Makoka Agricultural Research Station
	Subtotal	3	
Seed Certification & Quality Control			
	Principal Agricultural Research Scientist	1	Chitedze Agricultural Research Station
	Agricultural Research Scientist	1	Chitedze Agricultural Research Station
	Agricultural Research Officer	1	Chitedze Agricultural Research Station
	Senior Assistant Agricultural Research Officer	2	Chitedze Agricultural Research Station
	Assistant Agricultural Research Officer	6	Chitedze Agricultural Research Station
	Technical Assistant	1	Chitedze Agricultural Research Station
	Research Attendant	6	Chitedze Agricultural Research Station
	Casual Labourer	4	Chitedze Agricultural Research Station
	Subtotal	22	
Seed Services			
	Senior Agricultural Research Scientist	1	Bvumbwe Agricultural Research Station
	Senior Assistant Agricultural Research Officer	1	Bvumbwe Agricultural Research Station
	Assistant Agricultural Research Officer	2	Bvumbwe Agricultural Research Station
	Technical Assistant	2	Bvumbwe Agricultural Research Station
	Research Attendant	4	Bvumbwe Agricultural Research Station
	Subtotal	10	

Seed Inspection		
Senior Assistant Agricultural Research Officer	2	Lunyangwa Agricultural Research Station
Assistant Agricultural Research Officer	1	Lunyangwa Agricultural Research Station
Subtotal	3	
Seed Testing		
Assistant Agricultural Research Officer	1	Lunyangwa Agricultural Research Station
Technical Assistant	1	Lunyangwa Agricultural Research Station
Research Attendant	2	Lunyangwa Agricultural Research Station
Subtotal	4	
Seed Services: Production and Multiplication		
Principal Agriculture Officer	5	Department of Crop Development Shire Valley, Salima, Kasungu, Machinga ADDs
Agriculture Officer (I/PO)	16	District Agricultural Offices
Agriculture Officer (I/CTO)	7	District Agricultural Offices
Field Officer	1	District Agricultural Office
Subtotal	29	

Grand Total: 109

Source: Ministry of Agriculture and Food Security, 12/10/2010.

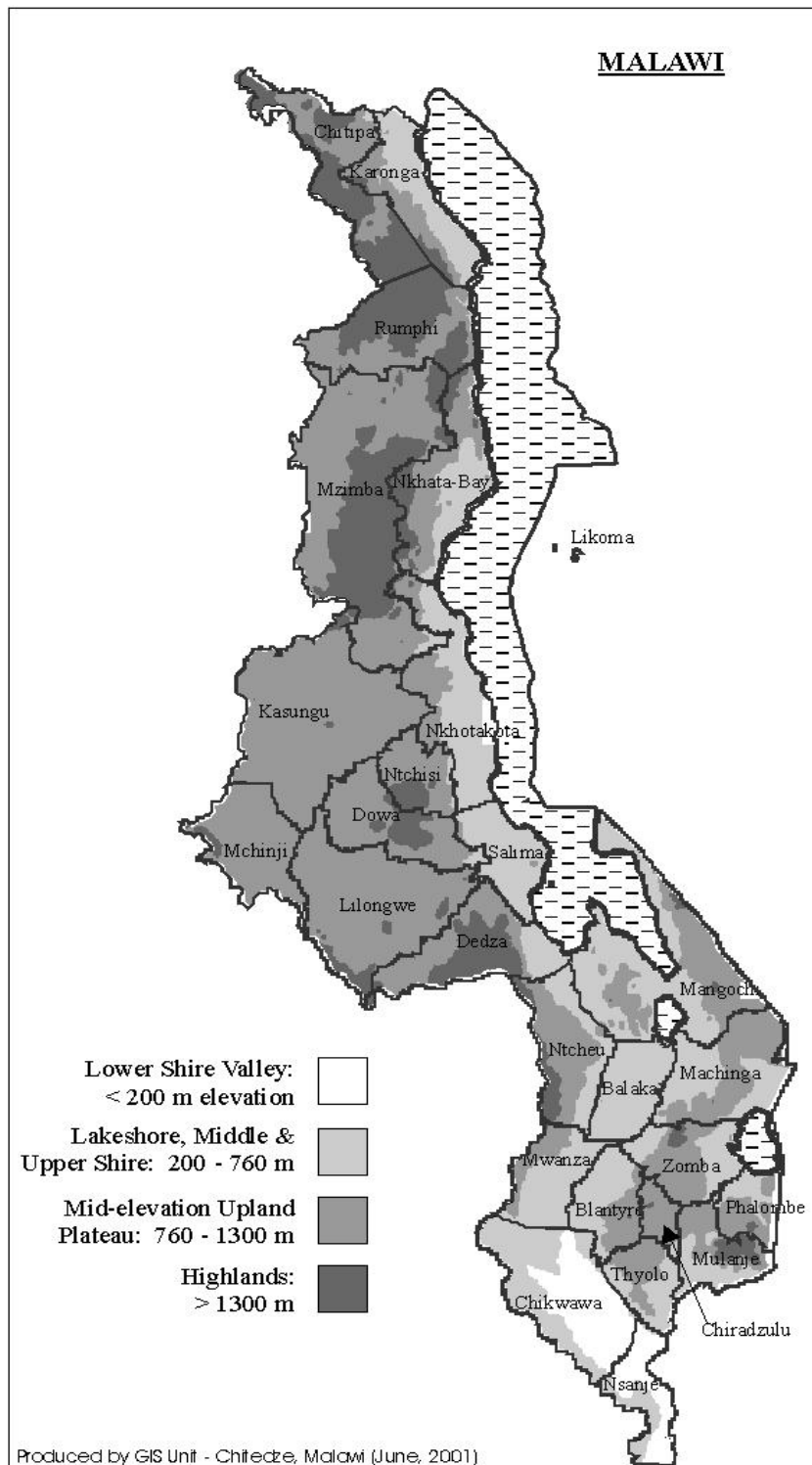


Figure 9.1 Major physiographic regions of Malawi

Table 9.2: The crop production statistics for Malawi for the period 2005/06 to 2009/10. Production in metric tones and area in hectares.

Crop	2004		2005		2006		2007		2008		2009	
	Area (Ha)	Prod. (mt)	Area (Ha)	Prod. (mt)	Area (Ha)	Prod. (mt)	Area (Ha)	Prod. (mt)	Area (Ha)	Prod. (mt)	Hect	Prod (mt)
Maize	1,478,750	1,608,349	1,513,929	1,225,234	1,624,030	2,611,486	1,686,442	3,444,655	1,647,214	2,777,438	1,712,935	3,823,696
Rice	42,554	49,693	49,154	41,270	52,461	91,450	58,091	113,166	63,130	114,905	130,197	300,791
Groundnuts	207,786	153,414	248,276	141,078	244,567	203,071	268,301	273,757	280,786	260,573	224,693	221,416
Tobacco	136,012	106,186	141,527	93,598	136,527	121,600	118,551	117,412	161,626	160,238	104,522	120,220,518
Cotton	63,447	53,581	88,535	50,363	62,233	58,569	60,673	63,290	69,826	76,761	10,870	13,463
Wheat	2,113	1,668	1,987	1,730	1,656	2,000	2,005	4,605	1,541	2,491	89,107	74,098
Sorghum	63,459	40,905	68,419	18,175	70,644	54,309	74,131	63,698	74,569	61,999	52,273	47,082
Millet	37,368	17,349	41,192	15,970	41,491	27,037	44,878	32,251	43,988	31,869	24,347	13,805
Pulses	486,602	242,364	537,863	209,492	549,561	344,586	604,846	415,551	610,112	396,868	42,745	27,146
Cashew	-	-	-	-	24,895	50	1,128	283	94,971	382	5,984	8,509
Macadamia	878	3	72,426	232	34,096	96	7,507	35	42,080	6,038	4,508	574
Sesame	714	227	546	106	719	291	1,467,512	504	2,159	909	897	644
Sunflower	6,600	3,660	7,429	2,672	7,651	5,450	4,263	5,910	7,575	5,745	3,224,033	1,385,157
Coffee	574,992	455	1,192,576	1,181	1,373,318	2,091	2,115	1,410	2,601,121	(1,122,902)	3,338	684,151
Paprika	2,862	837	4,309	1,218	4,749	2,127	174,932	1,917	4,390	2,215	4,704	2,325
Chillies	3,735	1,678	3,530	1,477	3,006	1,445	150,592	1,109	2,968	1,574	105,725	2,142,495
Cassava	154,945	2,532,079	153,687	2,197,640	163,598	2,832,141	40,202	3,285,127	185,470	3,539,660	97,275	1,638,435
S. Potato	147,519	1,762,034	128,982	1,081,463	132,461	1,781,595	150,592	2,307,354	161,718	2,362,425	519,116	3,504,793
I. Potato	33,053	420,490	35,439	404,420	40,601	527,831	40,202	594,003	45,442	673,344	533,134	1,208,271

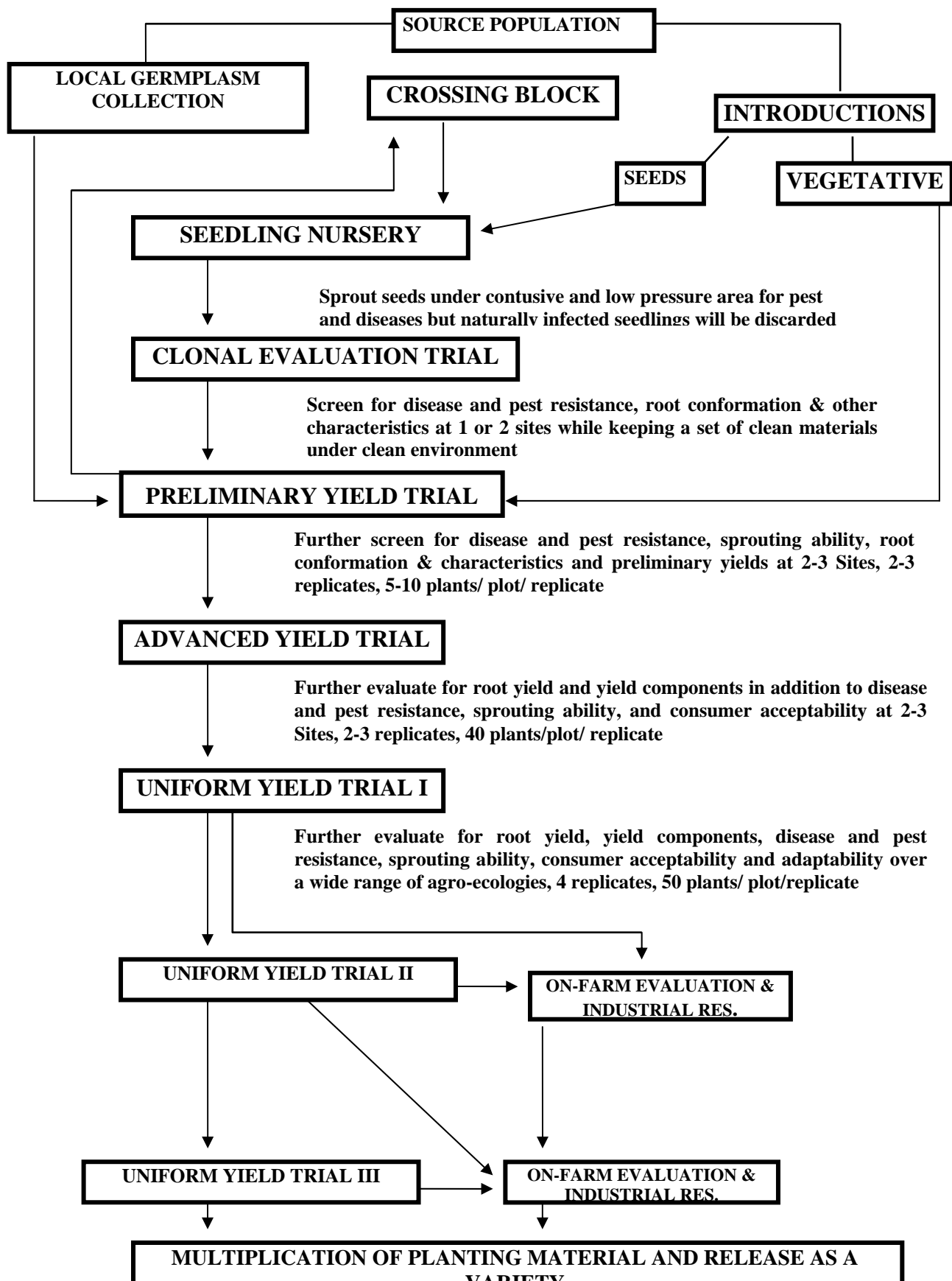


Figure 9.2: Cassava breeding scheme followed in Malawi