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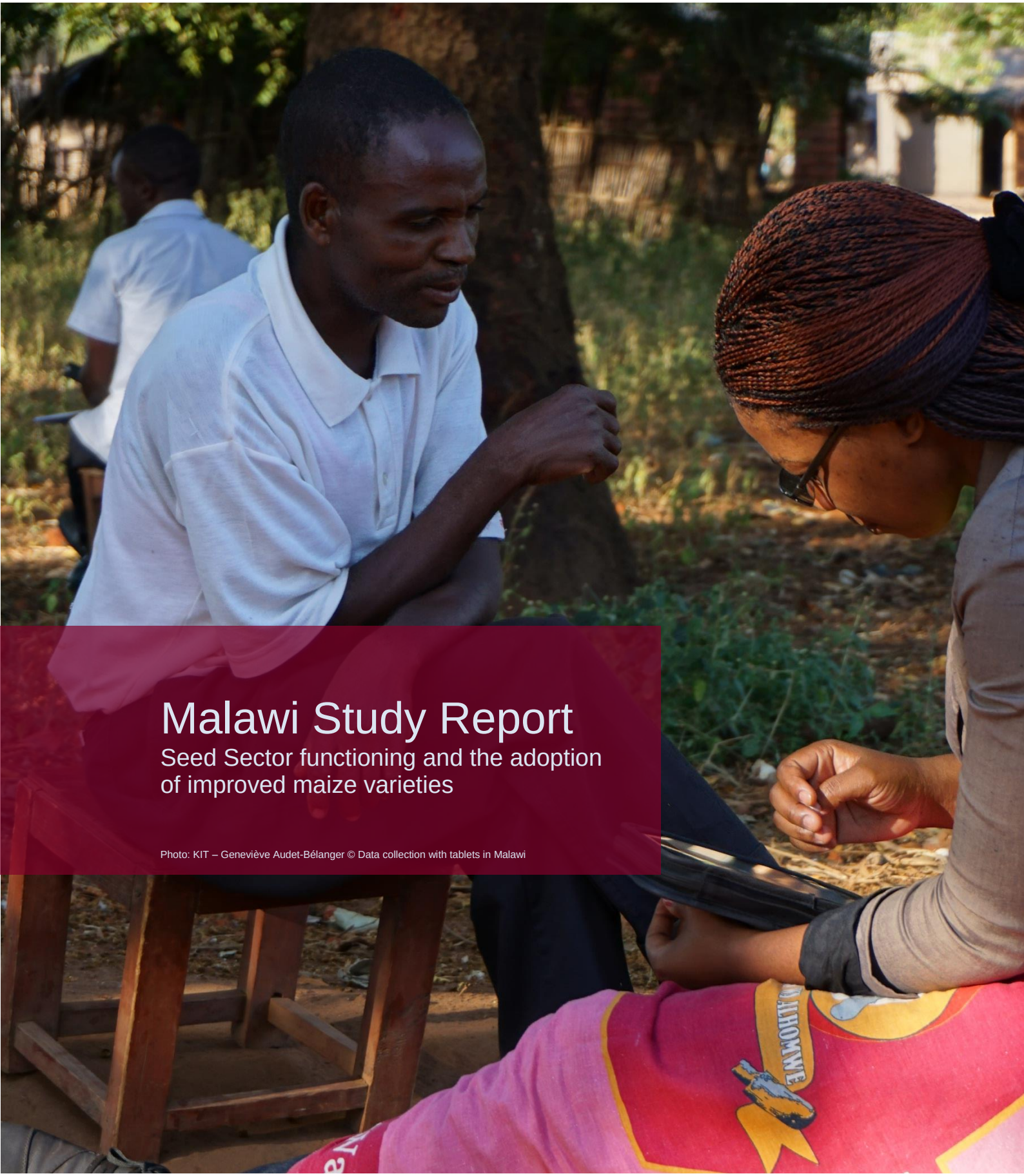

Malawi Study Report

Seed Sector functioning and the adoption of improved maize varieties

Photo: KIT – Geneviève Audet-Bélanger © Data collection with tablets in Malawi

Malawi Study Report

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Acronyms

ASSMAG	Association of Smallholder Seed Multiplication Action Group
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
DTMA	Drought Tolerant Maize for Africa
EGS	Early generation seed
FGD	Focus group discussion
FISP	Farm Input Subsidy Program
GRC	Genetic resources conservation
IOPV / OPV	(Improved) open pollinated variety
MWK	Malawian kwacha
Nxxx	Number of units (producers, harvests, etc.) surveyed contributing to data
PGRC	Plant Genetic Resources Centre
SADC	Southern African Development Community
SSA	Seed Sector Analysis
SSU	Seed Services Unit
STAM	Seed Trade Association of Malawi
SVCA	Seed Value Chain Analysis

Exchange rate at the time of the study 1 MWK = US$0.00222 (May 2015)

QR code is linked to short clip on study topic

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Executive Summary

This document describes the impact of adopting improved maize germplasm at small scale farmer level in Malawi. The objective is to understand whether smallholder farmers have access to affordable, quality maize seed, and if so, how the seed sector supports this. This study is part of a larger research project commissioned by MAIZE, with similar studies conducted in Zambia, Bihar state in India and Chiapas state in Mexico.

A seed sector stakeholder workshop, key informant interviews, focus group discussions (FGDs) with farmers and a household survey were held. The workshop provided information on general seed sector functioning, whilst the informant interviews yielded insights into the functioning of the formal seed system in Malawi. The landscape of the seed sector has changed dramatically over the past 20 years, shifting from the predominance of one parastatal company, to a diverse system of numerous national and international companies competing for the market. Hybrid maize varieties are now widely available across the country and suit the prevailing agro-ecology, as well as farmer requirements.

The public sector plays a role in variety development for both hybrid and improved open pollinated varieties (IOPVs). Such varieties are then made available to companies for multiplication. For over 10 years, Malawi's seed sector has been strongly influenced by the Farm and Input Subsidy Program (FISP), which aims to provide poor farmers with farming inputs. Through the program, IOPV and hybrid maize seed and fertilizers are made available to small scale producers via agro-dealers at subsidized rates. As well as its role in seed distribution through FISP, the public sector also regulates and certifies seed across the country. Since FISP's establishment, an increasing number of players to the market has resulted in the availability of a large number of maize varieties. However, due to limited resources, quality control within seed production and marketing remain weak links of the formal system. Extension and financial services such as loan schemes, also appear not to be responding effectively to farmers' needs.

The household survey, carried out around Lilongwe and Salima, provided valuable insights into the use of variety types, appreciated varieties, agricultural practices, producers' preferences and productivity. Complemented by key informant interviews and FGDs, the survey provided information on the functioning of both the formal and informal seed systems at farm level. Maize is primarily an important food security crop, however farmers also sell their surplus of maize. Although companies have developed well adapted hybrid maize varieties (short maturity period and high yields), producers also look for food quality related traits (poundability, flint grains, dry matter and taste), which are still mainly found in local varieties.

It is not uncommon for farmers to grow hybrid maize on their main maize plot from seed acquired through the FISP subsidy scheme, and grow local maize varieties on other fields as a buffer or risk mitigation strategy. Farmers were found to have grown hybrids on 67% of main maize plots and local varieties on 18%. Many farmers acquire their seed through agro-dealers who are responsible for distributing inputs under FISP. Farmers are first provided with coupons used to redeem inputs, and the distribution of such coupons gives an incentive for agro-dealers to move closer to the farmers to distribute their products.

Improved OPVs, although widely available, were not popular among the farmers surveyed. During FGDs, farmers reported that although it is possible to acquire IOPVs from the FISP subsidy schemes, they prefer acquiring hybrid varieties due to the greater discount. Farmers were also found to use recycled maize hybrids, even up to two generations. This practice is common when farmers do not receive subsidized hybrid seed at the discounted price.

Total yields varied depending on variety type. Local varieties were reported to yield around 1.4 t/ha while hybrids reached statistically significant higher yields at 1.6 t/ha. IOPVs (very few observations) gave 1.7 t/ha and recycled hybrids provided average yields of 1.5 t/ha. It was

found that producers who had received seed and input subsidies did not reach significantly higher yields than producers who didn't.

The maize seed sector in Malawi has developed significantly due to FISP and the incentive it provides for companies to operate in the country. Seed companies interviewed for the study reported that up to 50-60% of their revenue was acquired from FISP sales and agro-dealers mentioned FISP for 60-70% of their seed sales income.

Farmers are widely using hybrid varieties, but it remains to be seen whether this would continue in the absence of seed and fertilizer subsidies. Where farmers had not received subsidized seed, only a twelfth of plots were sown with hybrid varieties. The presence of recycled hybrids further indicates that farmers are not inclined to purchase hybrid seed every season, particularly when the reduced rate is not available to them.

In summary, the maize seed sector in Malawi has benefited from the establishment of FISP, which has encouraged the active involvement of the private sector. This has translated into the increased production of improved varieties, but more is necessary to realize the yield potential of quality seed at the smallholder farmer level. Value chain services such as certification, quality control, and financial and extension services were found to be the weak links, holding back the full development of the seed sector and constituting entry-points for future interventions.

1 Introduction

For Africa, the last decade has seen a continuous high economic growth and quickly developing food and other agricultural markets. This translates into unprecedented opportunities for agriculture-based economic development. Intensification of agriculture is sought with the double objective of improving food and nutrition security of producers and fast growing urban populations, as well as rural economic development. A highly essential input for sustainable agricultural intensification is high quality seed with a high production potential, well-adapted to both the agro-ecology and to market demand. However, improved high quality seed is often not accessible and available, especially for the poorer households (Dalberg, 2015).

Through breeding, improved varieties of crops can be developed. In addition to good crop management, the quality of seeds, both genetically and physiologically, determines to a large extent crop yield and produce quality, hence its market value and/or its potential contribution to food security. Seed characteristics determine how the crop will cope with adverse conditions and risks (Louwaars and Boef, 2012). IFAD (2011a) shows that in the 1980s and 1990s, the use of seed of improved varieties of crops accounted for half of the yield growth in China for example. When comparing regions, sub-Saharan Africa has particularly fallen behind Asia in the use of improved varieties for cereals (IFAD, 2011b).

The CGIAR Research Program 'MAIZE', takes a holistic approach to increasing the contribution of maize to food security and poverty reduction (http://maize.org/). The MAIZE flagship project 5, aims at reducing constraints to seed production and increasing the number of MAIZE derived varieties available to farmers. The project intends to do this by improving access to germplasm through working with the National Agricultural Research Systems and small-scale, as well as larger seed companies. It is expected that improved access to germplasm and the release of improved varieties should positively impact on productivity and food security, and reduce demands on land. For this, the maize seed sector needs to become more vibrant, plural, competitive and responsive to users' needs, in particular those of smallholder farmers.

The aim of this project is to document the adoption and impact of improved maize germplasm at small scale farmers' level. Furthermore, the study also sought to understand how access to affordable quality maize seed can be achieved through seed sector development. The assumption is that understanding the challenges, opportunities and implications of seed sector functioning will improve research results and support higher adoption and impact of research-derived maize germplasm. For this project four countries (Mexico/Chiapas, India/Bihar, Malawi and Zambia) were studied independently. Subsequently, an overarching analysis process will take place. This report focuses on the outcomes of the fieldwork in Malawi.

2 Methodology

The same methodology is applied for the four field studies of the research (Mexico/Chiapas, India/Bihar, Malawi and Zambia). A mixed-method approach to data collection on maize seed use by smallholder farmers was used. A quantitative survey was developed for collecting data from farmer households, taking into consideration important elements such as maize grown in different seasons, subsidy schemes, production and sales figures, variety type and variety used, input use and changes in practices over time. The survey provides quantitative information about farmers' practices and their access to, and use of, quality seed. A national level seed sector analysis workshop, key informant interviews, and focus group discussions (FGDs) with farmers form the qualitative part of the study.

These tools were designed to provide insight into relevant factors, enablers and constraints in the seed sector. Key interventions influencing the functioning of the seed value chain, perceived changes, and views of key actors on what will be needed to further optimize the seed value chain in the study areas, were also explored through these qualitative tools. By combining these different types of data, it is possible to obtain insights into seed sector functioning and the adoption of improved varieties of maize. Malawi is the first country in which fieldwork took place.

The national level seed sector analysis workshop took place in Lilongwe, the capital of Malawi. The quantitative surveys were carried out in the region around Lilongwe, one survey in the district of Ukwe and the second, close to Lake Malawi in Salima. Four sections which are divisions of the extension planning units, were selected per location.

Ukwe sections	Salima sections
Kalimpesha	Chitala
Kanong'ona	Chitala Central
Lilongwe	Chitala East
Lutu	Chitala West

Table 1 Sections per location for household survey

2.1 Data collection tools

The workshop and interviews make use of two qualitative data collection tools:

1) Seed Sector Analysis (Subedi *et al.,* 2013), a tool specially developed to understand the composition and variations within a seed sector.
2) Seed Value Chain Analysis (Audet-Bélanger *et al.,* 2013), which results in understanding of the functioning of the seed value chain, flows of seeds, services, financial resources and knowledge.

Seed Sector Analysis (SSA) (Subedi *et al.,* 2013) is a multi-stakeholder processing tool used to understand the composition, distinctness and variations within a seed sector. SSA takes a systemic perspective in analyzing the role of seed systems and their complexity. It helps to identify specific seed systems by their domain of operation (farmers, public, private, NGO, others), crops and varieties, technologies, farmers targeted, seed quality assurance mechanisms, seed dissemination mechanisms, seed supply sources, service provision and associated strengths and weaknesses. This tool enables the establishment of key factors which have been instrumental in the development process, as well as the preconditions for this development to take place within a specific environment. SSA explores the qualitative cause-effect relationship between maize seed sector development and the adoption of new germplasm.

A Seed Value Chain Analysis (Audet-Bélanger *et al.,* 2013) refers to the appraisal of the functioning of the chain; flows of the product, services, financial resources and knowledge are analyzed, to explore whether linkages between stakeholders are effective and efficient in terms of the performance of the entire value chain. It enables an understanding of the role played by various private and public actors in the development of the seed sector, and how the seed sector influences the impact of the introduction of improved germplasm.

A snowballing process was used to identify key informants to interview. Criteria for interview included relevance, diversity of stakeholders and role in the maize seed value chain. While it was not possible to meet with all the stakeholders identified as important due to time and availability constraints, in total, 17 interviews were conducted with national and international seed companies, extension agents, agro-dealers, the seed traders association, policy-makers, NGO staff and researchers. The interviews provided good in-sights into seed sector functioning

To gather quantitative information, a household survey was developed and rolled out in two locations. The first location was around Lilongwe in Ukwe district and the second, close the Lake Malawi in Salima district. Both locations were selected with the help of a local consultant. Ukwe is close to Lilongwe, while Salima is an area which is more prone to erratic water conditions (rains and inundations) and sandier soils. One day was allocated to training the enumerators and testing the tablet based data collection tool with producers around Lilongwe. Based on the training and testing, the tool was further adapted and tailored to the local context. Data collection lasted for 7 days. Sections were selected according to geographical spread from the central point (in Ukwe and Salima), and villages were selected based on a transect pathway in each of the sections. Each day, a different direction was selected on which four to five villages were selected for the study, with the support of a local extension officer.

The limited time allocated for the study did not allow for mapping or using lists for the pre-selection of districts and villages. Selection of villages was made based on local knowledge of the district. Efforts were made to get to villages which had at least 20 households, and which were representative of the zone's agricultural practices. The transect approach was also used to structure daily data gathering. On average, in each village eight to 10 interviews were conducted. Enumerators dispersed themselves in the village first, then interviewed one or two households in the area. For the second, or sometimes third household to be interviewed, enumerators were asked to perform a transect walk to the right of the household and select the 3rd house they encountered for the following interview from randomness.

Each producer was asked to provide quantitative figures on seed use and maize production for the past two completed seasons. Producers were also asked to answer, in a more qualitative manner, questions regarding maize seed use and production 10 years ago - since it is generally more difficult to remember accurately such information over a long period of time. Each survey interview lasted on average for 40 minutes.

Additional to the household survey, FGDs with producers were held in the two locations of the survey. The villages where the FGDs took place were selected with the support of two extension agents through the local consultant. Selection criteria included the general representativeness of the survey area and the village in regards to crops and agricultural practices, as well as the ability to – on short notice - organize an FGD with a mixed group of men, women and young producers. In total, 64 men and women farmers were engaged in the FGDs.

Where relevant, data have been disaggregated to highlight the differences in practices between men and women surveyed and/or interviewed.

2.2 Limitations

A general constraint observed throughout fieldwork and across data sources, was the recall period of 10 years to identify major changes and their triggers in maize seed sector functioning. Market liberalization was one major change that occurred earlier, in the 1990s. The other significant development influencing the adoption of improved maize seed, was the introduction of the Farm Input Subsidy Program (FISP), just over 10 years ago in 2005. Furthermore it was found for all approaches i.e. the surveys, FGDs, key informant interviews and the workshop that interviewees found it difficult to look back reliably that long in time. For example, many of the producers interviewed were not producing 10 years ago, or were producing in a different setting (part of the household, different geographic location, etc.), which makes data comparison with the current situation difficult. This issue with recall also introduced inconsistency into the data, even though

only a limited number of quantitative questions were integrated in the part of the survey that looked back 10 years. Hence, a recall period of 10 years should be interpreted as 'quite some time ago', and data as indicative but not necessarily absolute, rather than describing the situation of exactly 10 years ago.

With a fieldwork duration of 10 days and Malawi being the first country where the survey was implemented, there was limited time to train and pre-test the survey. However, a number of questions related to seed use, area under cultivation and production figures, had been used in various surveys and other projects before and hence were already field-tested.

A few concepts were difficult to translate into a thorough understanding by the enumerators. Difficult questions where confusion in interpretation may have influenced the responses, were those concerning the type of seed used by producers (local, IOPVs and hybrids) in relation to the immediate source of the seed (e.g. own field, agro-dealer, market, etc.). Originally, the data collection tool did not leave room for recycled hybrids, leaving space for interpretation by enumerators on how to consider the data related to such variety types. It also yielded some confusion as this practice is in clear contradiction with companies' and extension messages.

Some data cleaning was necessary to match varieties, type and source of seed. For example, a question on 'original source of the seed', meaning the source of the seed prior to any use and recycling, was not understood and the data was not used for the analysis. Data cleaning and analysis revealed inconsistencies between variety, type, source and renewal of seed, which can be difficult to explain. The data analysis also revealed misunderstanding on seed renewal (the action of renewing one's stock of seed). However, the survey allowed to identify the relatively common practice of recycling hybrid maize seed. This was taken as a major learning point for the following fieldwork periods and questionnaires were adapted consequently.

The findings of this study are not fully generalizable to country level because of the limited and purposeful, but random, sampling used for the household survey. Nevertheless, they provide good insights into the general seed sector functioning because of the diversity of stakeholders interviewed and the mixed-methodology applied to collect information. It is also important to consider that only the main maize plot (largest in size) was surveyed due to time limitations. In practice, producers are likely to use different seed sources and agricultural practices on different maize plots. Hence, the findings of the main crops do not encompass all farmer practices, but only demonstrates the practices used on the main maize plot of the farmer.

3 Seed Sector Functioning

Malawi's seed sector has changed greatly in the past 10 to 20 years. This is mostly due to the strong incentive provided by the FISP public subsidy scheme for farm inputs (mainly seeds and fertilizer), which has created an important market for quality seed and was initiated in 2005. FISP followed the Universal Starter Pack Program which was initiated in 1999, modified to the Targeted Inputs Program in 2001, and discontinued in 2005 (WorldBank, 2007). FISP's main objective is to give smallholder producers timely access to hybrid maize seed and fertilizer, with the objective of increasing food security.

FISP is one of the preconditions which supported the shift from a public seed delivery system, fueled by one public company, to a sector in which a number of national and international companies are operating. These private companies are providing farmers with seed of improved varieties of maize, largely hybrids. The country has seen a great surge in the use of hybrids, because hybrids are widely promoted by the government through the FISP program. Hybrids are also promoted by a number of programs (e.g. IFAD, World Vision) from NGOS and bilateral organizations.

In their variety development programs, seed companies have made great efforts to create hybrids which have appreciated characteristics of local varieties, paying attention to flint grains, poundability, taste, tolerance to drought and short maturing cycles. For most companies operating in Malawi, their main market is the government through the subsidy system. In addition, some have elaborated compelling marketing strategies to reach out to farmers and establish a clientele in the country, by making themselves recognizable and making their product attractive to producers. Throughout the interviews, it was acknowledged that the sector would not have been shaped the way it is functioning now, without the introduction of FISP and its strong focus on hybrid maize varieties.

3.1 The Maize Seed Value Chain

To understand the seed sector functioning, it is helpful to analyze the operations in the seed value chain. Actors making-up the seed value chains are inherent components of the seed sector. By looking more closely to their roles, functions and appreciation by the sector over the years, it is possible to draw conclusions for the maize sector as a whole. The discussion below is based on information gleaned from the workshop discussion and key informant interviews. Participants were requested to rank the functioning of operations and services in the seed value chain with a score ranking from 1 (lowest level of functioning) to 5 (highest level of functioning).

Genetic resources conservation (GRC)

Genetic resources are maintained at the Plant Genetic Resources Centre (PGRC). Ex situ conservation is done in Zambia for the Southern African Development Community (SADC) region, while national PGRCs in the SADC member states act as local satellites for ex situ conservation of materials. Prior to the creation of the national Malawi PGRC in 1992, only a limited share of the local Malawi varieties was collected and stored. While the national PGRC allows to store local material and assures easy access to the material, the SADC facility in Zambia allows for back-ups in case of critical events. In recent years, much efforts have been directed at

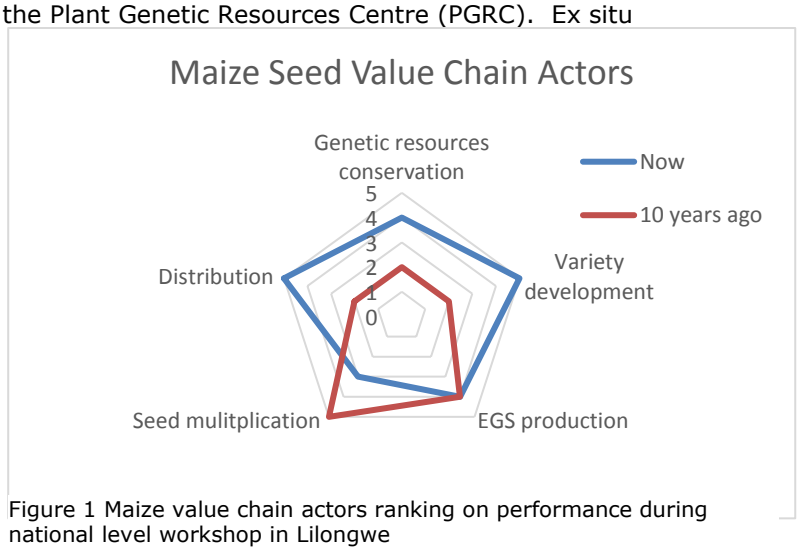

Figure 1 Maize value chain actors ranking on performance during national level workshop in Lilongwe

collecting local varieties, while in the past, farmers were the only gate-keepers of local genetic materials. Participants to the workshop affirmed that the PGRC performs according to the expectations. There is limited involvement of the private sector in GRC.

Since its creation in 1992, there has been limited change to the functioning of the PGRC. However, because in recent years special attention has been given to accessions of local varieties, stakeholders consider this part of the maize seed sector to have strengthened.

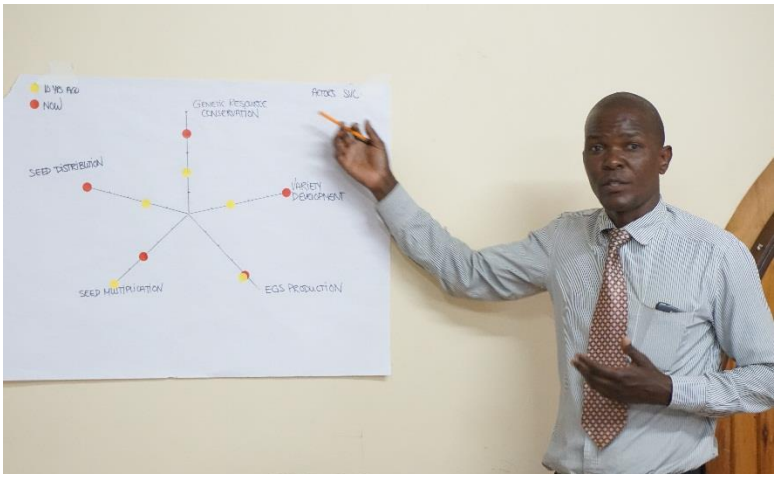

Photo 1 Workshop: presentation of SVCA in Lilongwe, may 2015

Variety development
The gene bank acts as guardian of the genetic material used for variety development. Variety development either follows the public or private pathway. The public sector breeds and tests various new varieties every year which are then made available to private companies for multiplication. In Malawi, private companies can make use of the varieties developed by the public sector, both by marketing them or using them as input in their own breeding program to generate new varieties. Companies like Monsanto (which bought MRI, a Malawi breeding company in 1998), Pannar (owned by Pioneer) and Seed Co are well established in the region. In the case of private variety development, limited information is publicly available on crosses and origin of the germplasm. Private companies sell varieties of public origin under their own brand name, but keep the public variety number – an example of this is MH18.

IOPVs mostly originate from the public sector. The private sector gives little attention to IOPVs and focuses on hybrid seed for which the business case is much stronger. IOPVs are considered by many of the key informants consulted as 'starting business material' for new seed companies, and hybrids as the 'real deal' where business is to be made. This is because IOPV seed production is less difficult, costly and labor intensive. Also, the International Maize and Wheat Improvement Center (CIMMYT) has clearly contributed to the development of a number of IOPVs and hybrid varieties through the provision of genetic material, including material with drought tolerant traits. Both the public breeding institutions and private companies use CIMMYT's material to develop varieties. However, once integrated in a private variety development program it becomes difficult to evaluate the contribution of CIMMYT germplasm as companies, particularly the large scale ones, do not disclose the pedigree of their varieties.

In the past, much variety development was in the hands of the public sector. With market liberalization and the ability of companies to effectively tap into the Malawian market, seed companies have entered the country. With the FISP subsidy, more companies have become interested in supplying hybrid maize seed in Malawi because FISP provides a secure outlet for hybrid maize seed. The presence of FISP has also led to the establishment of more local seed companies.

Early Generation Seed (EGS) production
Both the public and the private sector are responsible to produce seed for the varieties they wish to commercialize. Both produce IOPVs and hybrids, with the public sector tending to focus more on IOPVs, while the private sector focuses on hybrids. IOPV seed production requires the production of high quality EGS and subsequent seed production; hybrid seed production requires the production of adequate quantities of parental inbred lines (i.e. the equivalent of EGS), which are then combined in one field to produce hybrid seed for use by farmers. The public breeding system has limited capacity and is the provider of a limited volume of EGS seed. Interviews also revealed that early generation and inbred line seed from the public sector, is often of poor quality and in limited, untimely supply.

CIMMYT is an important supplier of EGS to both the public and private sector breeding programs in Malawi, except for large scale multinational seed companies. However, due to increasing demand, it is becoming more and more difficult for CIMMYT to provide adequate quantities of EGS to the seed businesses. As a result, models for efficient provision of EGS are being worked out by CIMMYT, including targeted sub-grants and capacity building of seed companies - to enable them to produce their own EGS like the large multinationals.

Seed production
Nowadays, the greatest share of maize seed production is out of the hands of the public sector and is mostly controlled by the private sector, accomplished on own land or via out-grower schemes. The more difficult varieties for seed production are usually multiplied on own land to guarantee quality, volumes and minimize losses. Private companies produce much more hybrids than IOPVs due to the clear financial benefits and the current policy environment, which favors the use of hybrids by farmers. FISP subsidized both IOPVs and hybrids, but promotes hybrids to a larger extent (hybrid maize seed constitutes over 80% of the market share in FISP). FISP offers important discounts on its maize seed purchase price, which has led to many companies entering Malawi's market. There are now about 24 companies as compared to one parastatal company 10 years ago – the National Seed Company of Malawi. IOPVs are produced by a handful of organizations hosted by the Association of Smallholder Seed Multiplication Action Group (ASSMAG) and a few private companies. They source their EGS from the public sector. ASSMAG is supported by donors and is not autonomous and sustainable on its own. In the past few years, ASSMAG has faced commercialization issues, even although its main buyer is FISP.

Distribution
Distribution is done through networks of agro-dealers[1]. It is often the case that an agro-dealer will sell seed of various maize types, varieties and from different seed companies. Agro-dealers are provided a license and have to be registered by the Seed Trader Association of Malawi (STAM) and often receive training from the major companies on how to use the seed and the key characteristics of the variety. While agro-dealers can be found in the main population centers throughout the year, in villages they are found only in season, or following the distribution of coupons for the seed subsidy. "We move where there are coupons" is how it is done according to an interviewee.

STAM has a key role in coordinating the exchange of coupons for seeds. First of all, the government and STAM enter into contract agreements for the supply of certified seed with companies. The government is responsible for the selection of beneficiaries of the FISP program and issues coupons to the selected farmers. STAM members (seed companies) distribute seed country wide through the agro-dealer networks and farmers can exchange their coupons for seed. Companies can later claim their dues from the government on the basis of the coupons collected. This last step is seen as problematic by the companies, who expressed that it takes a very long time to be compensated for the sales completed under the FISP program. This sometimes leads to cash flow problems for the multiplication of seed for the following season.

3.2 Services

As for services in the seed value chain i.e. certification, seed-user extension and quality control of the marketed product (viability and prevention of counterfeit seeds), they are controlled by the public sector. Financial systems, including subsidies, are also important. During the workshop and by means of the interviews with key informants, information was gathered about the perceived quality of these services, and developments during the last 10 years.

[1] Private sector companies as well as two state owned enterprises, the Agricultural Development and Marketing Corporation and Smallholder Farmers Fertiliser Revolving Fund of Malawi are involved in the tendering for inputs (Chirwa and Dorward, 2013).

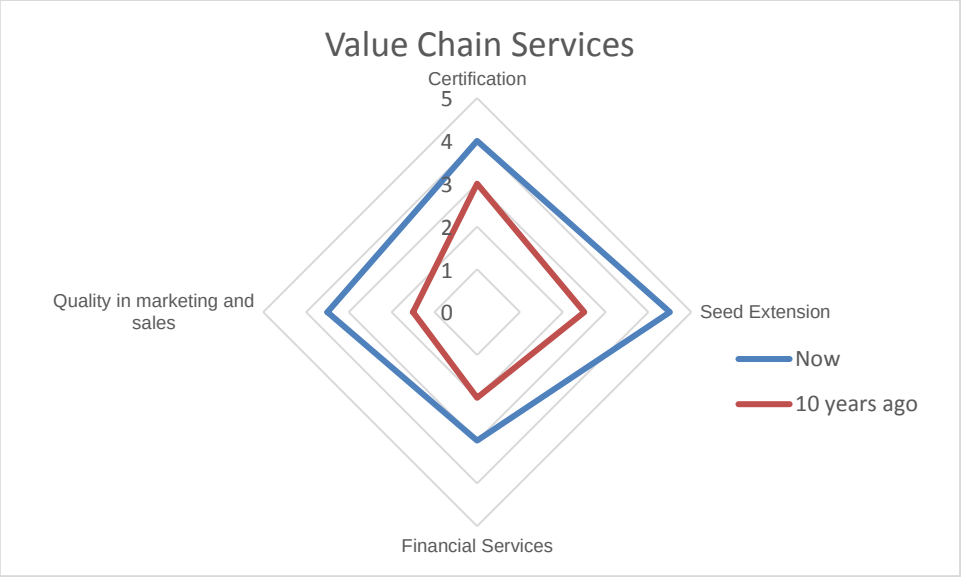

Figure 2 Services in the value chain ranking during the national level workshop

Certification
Certification is done by the Seed Services Unit (SSU) of the Department of Agricultural Research Services (DARS). The SSU seed testing laboratory is accredited to the International Seed Testing Association. SSU performs functions of training on seed production and marketing, seed trade control, and issues seed trade licenses to private companies. Prior to the start of the season, seed producers are registered and their land assessed. Inspectors are in charge of controlling the production at critical moments during production (e.g. de-tasseling in the case of hybrid seed production). To reduce the burden on the public system, some large companies like Seed Co are establishing their own laboratory to control the quality of their products with the involvement of the SSU at limited occasions - mainly for the seed certification.

While the FISP program has greatly increased maize seed production, services offered by the public sector have not grown to adapt to the changing seed sector. The SSU has not grown proportionally with the seed production sector, which results in delays and difficulties in accessing all the certification requests. In-field inspections have become a challenge as the number of inspectors is limited. To ensure services, companies or entrepreneurs allocate transport and/or fuel to ensure certification services, private companies are looking into having their own testing facilities for quality control prior to certification. Many interviewees reported that the inspection and certification services are still functioning as if they were only serving the former parastatal seed company, with limited capacity to offer services to a growing number of players. While there is no evidence that the strain exercised on the certification system and current practices (such as paying for transport/fuel of the SSU staff, in house company quality control) are influencing the quality of the seed certified, questions were raised about independency. For example, will in-house quality controllers have the capacity to reject seed lots if proven to be sub-standard? Some say yes, because it is the reputation of the company that is at stake, but others believe it will be more difficult and advocate for a stronger independent quality control and certification mechanism[2].

Quality in Marketing and Sales
Quality control in the sales and marketing process remains a challenge, according to many of the stakeholders interviewed due to issues around fake and counterfeit seeds. The current seed law is outdated and is currently being reviewed, a process supported by STAM. Under the current system there are few prosecutions, and penalties are not deterrent enough to prevent bad practices. Companies are now working on packaging systems which cannot be copied easily, and

[2] In many OECD countries, seed companies are trained and/or certified by the public certification body to carry own their own controls, with regular spot checks by the public agency to ensure that the seed companies stick to the rules.

are enforcing systems to ensure that such packages are not disappearing illegally from the seed processing factories.

CIMMYT continues to provide capacity building opportunities through training and technical backstopping, in order to enhance the skills of private (including seed companies and agro-dealers) and public sector staff in seed marketing and promotion. Additionally, targeted sub-grants are provided to seed companies to help them establish demonstration sites, hold field days and produce promotional materials for their seed. Through CIMMYT's Malawi Seed Systems and Technologies project, a number of so-called 'para-seed inspectors' from seed companies are being trained in order to boost the national capacity for quality control and assurance.

The SSU should also be assuring quality control in marketing by verifying the quality of the inputs sold by agro-dealers and monitoring selling points. Yet with limited resources, it is difficult to extensively control quality of the product sold.

Seed Extension
Public extension, backed by the subsidy system, has played an important role in promoting and showcasing the use of IOPVs and hybrid varieties. Demonstration plots are a common way to deliver extension messages. Information is also channeled through farmer groups and cooperatives. In the current system, there is little time or resources for individualized training and support, thus extension agents focus on groups. NGOs also provide extension services. Seed companies typically engage in demonstrations and farmer days to demonstrate and show-case their products, hence providing some knowledge and expertise to producers through targeted extension methods. Some extension agents are working directly with renowned agro-dealers in communities to support groups, provide advice and access to products. Many interviewees highlighted the lack of harmonization in the extension service programs, because organizations are all following their own agenda.

Financial Services
The FISP program allows access to improved maize seeds by many smallholder farmers. However, access to financial services such as loans, especially for small(er) and/or local seed companies with little capital and collateral, remains difficult. While it was noted that things have improved in the past 10 years since at the time it was virtually impossible to get a loan, the current interest rates of around 45% are still highly prohibitive. Such costs make it difficult for enterprises to finance production and acquire new seed processing materials. Cash flow and investments are often a struggle, and without the secure market offered by the FISP subsidies, it is unlikely that currently operating companies would all be able to continue their activities. There is now a push to develop the agricultural banking sector as so far, this market segment is far from well catered for and this may improve the availability of finance for the seed sector.

https://www.flickr.com/photos/131614333@N02/28678051662/in/dateposted/

3.3 The role of the public sector and the private sector in sector functioning

Over the past 10 to 20 years, Malawi has seen a great shift in task division in the maize seed sector. Moving from a parastatal company to greater market liberalization, it can now be said that the private sector is the main driving force behind the maize seed value chain. From breeding to distribution and marketing, the private sector is taking action, following the rationale that their involvement in these steps of the value chain supports their commercial activities. While the public sector also still engages in breeding and seed production, the scope and magnitude of activities is much greater for the private sector.

From the research, it emerged that with the exception of GRC, the typical public sector activities such as quality control, certification services, and IOPV development are regarded as poor quality, inefficient and insufficient. On the other hand, in Malawi, the public sector contributes much to the commercial success of the private sector through price regulations and FISP.

The seed subsidies certainly have a substantial impact on the maize seed sector, providing seed companies with a strong incentive to produce hybrid maize, and farmers to use seed of hybrid varieties. With companies reporting that the subsidy represents on average 50 to 60% of their business, there is no doubt that the seed industry would not have developed to this level in the country without FISP. Some interviewees argued that the market for hybrid maize would not be nearly as important without FISP. Smaller local companies reported having specifically engaged in hybrid maize seed production and sales because of the subsidy system, which provides a secure market. Agro-dealers also reported that on average, seed sales through the coupon system account for 60 to 70% of their seed sales income. However, with the coupon system market also comes regulated seed prices imposed by the government. Also, the maize commodity market in Malawi is not considered highly remunerative and therefore, does not act as a strong driver for adoption of hybrid maize seed.

The government's policy strongly advocating the use of hybrid maize seeds, is reflected in the curriculum and training of producers provided by extension officers. Hybrids are promoted as a way to increase productivity, reduce food insecurity and increase income. IOPVs receive far less promotion in the extension services.

4 Evidence of use of improved varieties at farmers' level

4.1 Maize and livelihood strategies

Using the Out of Poverty Index[3], it is estimated that close to 59% of the households interviewed are likely to live on less than US$2.50 per day (> 99.6 % probability). Therefore, it can be assumed that producers interviewed for the study are relatively poor, and likely to grow maize in the first place with a food security purpose (Table 2).

Likelihood of household to be living on US$2.50/day or less in percent	Percent of households interviewed in survey	Cum.% of interviewed households
100	2	2
100	3	5
100	3	8
100	13	20
99.9	8	28
99.6	16	44
99.6	**15**	**59**
99.2	13	72

Table 2 Likelihood of household to be under US$2.50/day 2005 purchasing power parity (N320 households)

Agriculture is clearly the main livelihood strategy for most of the households interviewed. Forty three percent rely entirely on agriculture for income, yet only 16% of the households rely fully on maize for income. Other crops feature more predominantly, such as cash crops like tobacco and cotton. The percentage of households relying fully on maize for agricultural income generation interestingly has not changed in the last 10 years (Table 3).

Share of income	Total agricultural activities now	Total agricultural activities 10 years ago	Share of maize in agricultural income now	Share of maize in agricultural income 10 years ago
Little (10 % or less)	0	4	22	29
A quarter (25%)	2	4	18	13
Half (50%)	9	10	13	14
Three quarters (75%)	18	15	18	15
Nearly all (90%)	28	29	13	13
Full (100%)	43	38	16	16

Table 3 Importance of agricultural activities and maize for income amongst households surveyed (%) (N 320 households)

Seventy nine percent of the producers interviewed were growing maize 10 years ago. Only 5% of producers interviewed reported being farmers 10 years ago and not producing maize as a crop, which shows the importance of maize in Malawi's production system.

Producers selling maize got on average 80 Malawian kwacha (MWK) per kg of maize sold (US$0.11 per kg) (N = 212 – 95% confidence interval: 74 – 84). This price is considered by many as an insufficiently remunerative price and does not trigger investments to boost production further. Ninety percent of sales recorded, yielded less than 50,000 MWK in total which equals approx. US$75 (Table 4). As a matter of comparison, unsubsidized seeds of hybrids are on average US$11 per 5 kg and IOPVs are sold at US$11 per 8kg. The relatively low maize production and low prices make it difficult for producers to save sufficient funds to purchase inputs for the following season, in particular if the household does not get subsidy vouchers.

[3] The Out of Poverty Index is a statistically-sound, yet simple tool that has been developed for a number of countries. The answers to 10 country-specific questions (which were included in the survey carried out in Malawi for this purpose) about a household's characteristics and asset ownership are scored to compute the likelihood that the household is living below the poverty line – or above by only a narrow margin. http://www.progressoutofpoverty.org/

Gross revenues from maize sales in MWK	Percent	Cum.%
0 to 10,000	32	32
10,001 to 20,000	28	61
20,001 to 50,000	30	90
50,001 to 100,000	8	98
100,001 and +	2	100
Total	N210	

Table 4 Gross revenues from maize sales in MWK in recent seasons

4.2 Site comparison

The preliminary data analysis revealed no significant difference between the two survey locations for yields. Although the team expected some differences in yields due to the different agro-ecology and seasons, no clear differences were observed (Table 5). Yields are low, about 500 kg less than average yields available for the recent years (2010-2013) in FAO Stats (2015). Yields for the last two seasons were similar (Table 6).

Average yields per location (kg/ha)	Mean	[95% Conf. interval]		N plots	N farmers
		low	high		
Ukwe	1547	1429	1666	305	153
Salima	1559	1452	1665	324	162

Table 5 Average yields (kg/ha) per survey location

Average yields per season (kg/ha)	Mean	[95% Conf. interval]		N plots	N farmers
		low	high		
Season 2013-2014	1548	1410	1645	365	183
Season 2012-2013	1551	1414	1689	242	121

Table 6 Average yields (kg/ha) according to seasons

The analysis of the type of seed used also demonstrated a limited variation between the two locations of the survey, with the majority of producers using hybrid varieties as the predominant variety on their main maize plot (Table 7).

Type of seed used according to location (%)	Ukwe	Salima	Mean
Local variety (open-pollinated)	24	12	18
IOPV	4	3	4
Recycled hybrid	9	15	12
Hybrid	64	70	67
Total	100	100	100
N	312	322	634

Table 7 Different types of seed used by farmers at the two survey locations

Yields and variety type are the two most central variables to the study, and because they did not show statistically significant differences between the two locations, these and other data of both locations have been aggregated for the analysis.

A statistical test was performed on to what extent yield in seasons might be contributed to the skills and resources of specific farmers. The correlation coefficient between the most recent yield of a farmer and that of her/his maize crop the previous season is 0.49. This translated into a coefficient of determination (r2) equaling 24%. While this is not insignificant, it is at a fairly modest level, and therefore it was decided to pool all recent harvests for the remainder of the analysis.

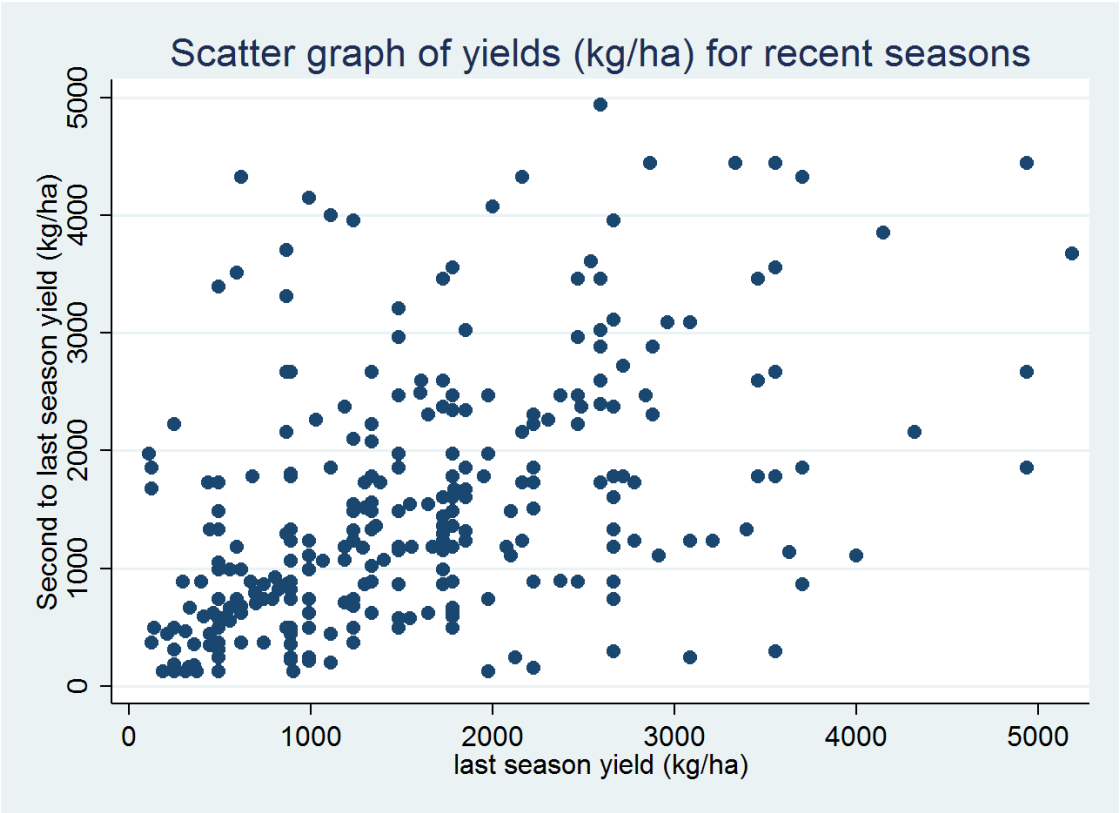

Figure 3 Scatter graph of yields (kg/ha) for recent seasons

4.3 General information

The main season for production is the rainy season (November to April). Occasionally producers having 'dambo' (garden) land or irrigated land may also produce during the drier season. Upland winter (from May to October) production of maize is virtually inexistent due to irrigation limitations. The average area of land cultivated by producers is 1.16 ha (95% confidence interval 1.01 – 1.2: N320). The main plot dedicated to maize cultivation averaged at 0.65 ha.

Over 40% of recent harvests were kept completely for consumption and not sold. Of up to 84% of the recent harvests, at least 75% of the harvested grain was kept for consumption (Table 8).

Ratio consumption to production	Freq.	Percent	Cum. %
0-25%	5	1	100
26-50%	21	3	99
51-75%	80	13	96
76-90%	134	21	84
91-99%	125	20	63
100% - consumption only	274	43	43

Table 8 Ratio of consumption to production for recent maize harvests (N640)

A large number of interviewed producers benefited from FISP for the recent harvests. Farmers interviewed received subsidies for seed in only 17% of cases, and seed and fertilizer in 47% of cases for at least one of the last two seasons during which they were producing maize. During FGDs, it was mentioned that some producers might not have benefitted directly from the subsidy, but somehow got hold of subsidized inputs by trading vouchers for example (Chirwa *et al.,* 2013). Ten years ago, when the FISP program was just starting, much of the emphasis was on fertilizer which explains the higher percentages of producers reporting access to fertilizer only (41%). Now the focus is on access to seed and fertilizer (47%) (Table 9).

	Now		10 years ago	
Subsidy	N of plots	%	N of farmers	%
Seed	107	17	74	19
Seed and fertilizer	298	47	131	23
Fertilizer	118	18	54	41
No subsidy	117	18	61	17
Total of subsidy received in the past 2 seasons	640	100	320	100

Table 9 Occurrence of input subsidy for maize crops now and 10 years ago

4.4 Maize varieties, variety selection and seed renewal

Varieties

Most producers interviewed relied on one variety of maize on their main plot in recent seasons, but around 12% of the plots were sown with more than one variety (Table 10). The most common reasons cited for such a strategy were 1) for agronomic and financial risk mitigation, having at least one successful variety when the other would fail (the more expensive hybrids are thought to carry more risk for crop failure); 2) the incapacity to access sufficient amounts of seeds from a single variety; and 3) requiring different varieties for different purposes (Table 11).

Number of varieties grown on main maize plots	N	%
1	564	88
2	69	11
3	4	1
4	1	0.2

Table 10 Number of varieties grown by producers on the main maize plot for the last two seasons (N639)

During FGDs, it appeared that many producers grew a local variety for consumption alongside the seed they acquire through the subsidy system (most likely hybrid). This method indicates that farmers tend to adopt a mixed strategy when it comes to varieties they use for different purposes. Data from the survey suggest that when farmers are asked about the variety grown on their main plot, they report the hybrid variety and tend to leave out the fact that they grow local varieties on the side, on smaller plots. Therefore, while this survey concentrated on the main maize plot, since this was most likely to be the one where new improved varieties would be planted, it should be realized that producers are likely to rely on more than one variety and experiment with seed from various sources and types on a regular basis. Furthermore, in many cases, the total quantity of subsidized inputs (the amounts needed for 0.4 ha, the average smallholder farm size in the country, K. Lweya, CIMMYT, *pers. comm*) didn't cover the total maize area under cultivation by farmers in the surveyed area. Therefore it was necessary for farmers to use additional seed sources and hence variety types and varieties, such as local varieties or recycled hybrid varieties.

Reason for using more than one variety	N answers	% of answers
Risk mitigation strategy	15	32
Unable to access enough seed of one type	20	43
I need different maize varieties for different purposes	4	9
Other	8	17
Total	47	100

Table 11 Reason for growing more than one variety on the main plot of maize in recent seasons.

Variety Selection

The variety which is most widely used on the producers' main maize plot is the Seed Co 403 maize hybrid. It has a very short maturity cycle and for this reason is highly appreciated (sown in 18% of cases on recent main maize plots). Local varieties (no specific variety names) and MH18, a hybrid produced with genetic material from CIMMYT, were both reported for 11% of the main maize plots. Overall, there is an important diversity of varieties used by producers.

Farmers recognize easily the Seed Co varieties by the animal symbol used to differentiate the maturity cycles of the varieties. The 'Monkey' varieties are most appreciated because of their early maturity (Table 12).

The following table should not be taken as an absolute representation of farmers' variety preferences since through FISP, not all hybrid maize varieties and/or in the requested quantities are made available to farmers. Hence, producers may acquire a certain seed because it's the best option available, not their preferred variety. Some of the varieties reported by producers may in fact have been recycled, and not be true-to-type as when they were originally sourced.

Variety	N plots	% of plots	Variety	N plots	% of plots
SC 403 Kanyani	114	18	ZM 309	12	2
Local varieties	67	11	DK 8073	11	2
MH18	66	11	PAN63	11	2
DK 8033	64	10	SC 407	11	2
Demeta	46	7	PAN 77	9	1
DK 8053	38	6	Dekalb Various	9	1
Pannar Various	23	4	Fumba (SC monkey)	8	1
PAN 67	16	3	DK 9080	7	1
SC 719 Njobvu	16	3	MRI Various	7	1
SC 627 Mkango	15	2	Other	27	4
SC Other	15	2	Don't know	18	3
MH Various	13	2	Total	623	100

Table 12 Main maize variety used by producers on recent main maize plots (various: unknown number or small number of observations)

Producers were requested to select the two main reasons for them to select the variety they had chosen. Table 13 represents the answers most often given as a percentage of the total number of answers given. The question was asked once per survey. Reasons for selecting the variety sown varied greatly among producers interviewed. Yields were the most important factor followed by drought tolerance and maturing period. Availability and poundability were also important factors considered when producers chose the variety to plant. Most producers selected their varieties based on the same criteria 10 years ago, but the ability to recycle the seed of a particular variety was more appreciated then than it is now.

	Now		10 years ago	
Reason for variety selection	N	%	N	%
I get better yields	113	21	82	21
Drought tolerance	77	14	44	11
Maturing characteristics	75	14	43	11
It is the variety that was available at the time	58	11	39	10
It is the variety that I recycle – field availability	55	10	67	17
Poundability	32	6	42	11
These seeds were subsidized	28	5	5	1
I got the seeds of this variety for free	21	4	9	2
Type of grain	16	3	15	4
I trust the origin of the seed	11	2	5	1
Easy to store	11	2	11	3
I like the taste and or texture for food	8	2	10	3
I can process this maize into food	4	1	1	0
I can easily sell this maize/appreciated by the market	4	1	2	1
Flood tolerant	3	1	1	0
This variety is required by my contract	2	0	0	0
Other	18	3	14	4
Total	N 536	100	N 390	100

Table 13 Main reasons for variety selection, some indicated one reason only

Fifty eight percent of the producers also reported to selecting the varieties they plant according to the final use of the maize. Although this may not be the most important criteria when making the decision. These producers were requested to select the two main reasons for them to select the

variety they had chosen when considering the final use of the maize. Table 14 represents the answers most often given.

Male and female farmers expressed similar appreciation of end-use related variety traits, poundability being the most important one, followed by taste and storability (Table 14). Comparing Table 13 and Table 14, it becomes clear that when producers select a variety, the final use of the grain is of considerable importance. Traditionally, these traits are expressed in local varieties more than in hybrid varieties of maize. This may be an indication that for consumption, local varieties remain appreciated.

Variety planted was selected because its high quality in relation to	N of answers	% of answers
Poundability	126	36
Taste	56	16
Storability	55	16
Grain type	52	15
Dry mass	43	12
Processing into flour	10	3
Other	9	3
Total	351	100

Table 14 Main reasons to select a variety in relation to final use of the maize

Hybrid varieties offer high yields, early maturing and drought tolerance - something CIMMYT has been working on specifically under the Drought Tolerant Maize for Africa program. During the FGDs, producers reported that with regards to poundability and consumption of maize for food, local varieties are much more appreciated for their texture, weight and taste than hybrids. Moreover, local varieties are perceived as keeping for longer periods, while hybrids preferably are sold shortly after harvest since the maize tends to be attacked by weevils. As shown in table 7, 67% of the fields were planted with hybrid seed, and 84% of the surveyed households are consuming at least 76% of the maize they produce at home. Therefore it would appear that the disadvantages of hybrid seed for home consumption, are not enough reason for many households to refrain from planting hybrids.

In the past, family members and social relations were the overall factor (68%) influencing producers to use specific varieties. Nowadays, family and social relations are still the main influence with 48% of producers reporting to have been convinced by these same people. Professionals i.e. agro-dealers (19%), extension agents (14%) and seed company agents (4%), uphold the bulk of the remaining influence on producers' choice. The FISP system and availability of certain varieties of maize, further impact on choices made by producers. There are no clear differences between male and female producers.

Who convinced you to use a variety?	Now Men % (N145)	Now Women % (N175)	Now Mean % (N320)	10 yrs Men % (N117)	10 yrs Women % (N142)	10yrs ago Mean % (N259)
Family, friends, neighbors	46	49	48	68	67	68
Agro-dealer	19	19	19	12	17	15
Extension officer	17	12	14	9	10	9
Producer group or association	5	3	4	4	1	2
Seed company/agent	4	5	4	2	1	2
Subsidy program	4	5	4	1	2	2
NGO	1	2	2	0	1	0
Seed demo plot from seed company	1	2	1	0	1	0
Other	4	3	3	4	1	2

Table 15 Influence on variety choice now and 10 years ago

Type of seed

Hybrid varieties have been sown on 64% of the main plots surveyed in the last two seasons. This is in line with the number of farmers having received subsidies for seed and the outcomes of the FGD discussions. Interestingly, farmers also reported using recycled hybrids. It might be that farmers recycle their hybrids if they are left without subsidy for a season, since they are unable

or unwilling to purchase hybrids at the full market price. This perspective was offered by farmers during the FGDs. When looking at variety type trends between seasons, while half of the producers using local varieties stuck to local varieties, others have shifted to recycled hybrids and hybrid seed. Out of the 23 who had used recycled hybrids in the second to last season, 10 continued to use recycled hybrids, while 8 went on to hybrids and others to local varieties and IOPVs. About two thirds of the producers who had used hybrids stuck to hybrids but others shifted to recycled hybrids, and OPVs (Table 16).

Variety type	Last season				
Second to last season	Local variety	IOPV	Recycled hybrid	Hybrid	Total N plots
Local variety	28	1	8	20	57
IOPV	0	1	2	4	7
Recycled hybrid	2	3	10	8	23
Hybrid	23	10	31	163	227
Total N plots	53	15	51	195	314

Table 16 Cross table variety type over 2 recent seasons

During the FGDs, producers reported that they tend to buy hybrid seed with the subsidies as opposed to IOPVS. The reason for this is that the total discount offered on seed is greater for hybrids than it is the case for IOPVs and hence, it is perceived to be a better bargain. This might explain to some extent the low numbers of IOPVs among recent plots (4%). Moreover, IOPVs are simply less accessible and available in lesser quantities than hybrid varieties.

When producers reported not having received subsidies, plots were sown with hyrbids in 46% of cases (lowest occurrence of hybrids), followed by local varieties at 28% and recycled hybrids at 22%. When producers reported having received seed subsidy only, 69% of the plots were reportedly sown with hybrids, while 18% were under local variety as the main variety (potentially coupons were traded and/or were not necessary to cover the largest share of the surface of the main plot), and 8% under recycled hybrids. Producers who only received a subsidy for fertilizer, sowed hybrids in 62% of cases (second lowest percentage after no subsidy at all), followed by 25% of the plots under local varieties and 12% recycled hybrids. The producers who reported having received seed and fertilizer subsidy in recent seasons sowed hybrids in the highest proportion (77%), while local varieties were sown on 11% of the plots, followed by recycled hybrids at 9%. Overall, IOPVs were sown in small proportions, between 2 and 5%. Table 17 shows that producers who do not have access to subsidies, do resort, in a higher proportion to using local varieties and recycled hybrids than when they have received seed subsidies.

	No subsidy	Seed subsidy only	Fertilizer subsidy only	Seed and Fertilizer subsidy	Total
Local variety	28	18	25	11	18
IOPV	3	5	2	4	3
Recycled hybrid	22	8	12	9	12
Hybrid	46	69	62	77	67

Table 17 Cross table variety type and subsidies, recent seasons (N634)

While farmers are aware of the push to use hybrid seeds, farmers also reported growing local varieties for food security. While yields are lower, these offer a steady production at a lower cost while hybrids are more risky – greater financial losses in cases of bad harvest. Male producers tend to use hybrid seeds in higher proportions than women, and women tend to recycle their hybrids somewhat more (Table 18). There is little variation of the type of seed used by producers over seasons. Nevertheless, producers using hybrids in the winter are much more likely to pay the full price for the seed they use, as opposed to producers in the main rains seasons. This is because subsidies are mostly for the main rains seasons (FGD data).

Type of seed used according to gender	Male (%)	Female (%)	Total (%)
Local variety, open-pollinated	15	20	18
IOPV	5	2	4
Recycled hybrid	9	14	12
Hybrid	71	64	67
N plots	288	346	634

Table 18 Type of seed used by male and female farmers

Type of seed used now and 10 years ago	Now (%)	10 yrs ago (%)
Local variety, open-pollinated	18	39
IOPV	4	6
Recycled hybrid	12	7
Hybrid	67	48
N plots	634	254

Table 19 Type of seed used now and 10 years ago by producers on their main maize plot

Source of the seed

Forty two percent of the seed sourced for recent main maize plots came from the agro-dealer; agro-dealers being the source of subsidized seed, while the rural markets are also an important source of seed for 21% of the seed sourced[4]. McGuire and Sperling (2016) also found agro-dealers and rural markets to be important sources of maize seed in Malawi. Rural markets offer a wide range of variety type from mixed provenance. In some cases, agro-dealers have small kiosks at the markets where they sell hybrid varieties and other inputs. Seed from own fields, trade and gifts from neighbors, family and friends are also important, together accounting for 25% of the seed sourced. Selecting seed from your own fields and relying on relatives, are common options for producers using local varieties or unable to purchase seed. The frequencies of this are rather similar for men and women.

Over the period of the last 10 years, the use of self-recycled seed by producers has diminished significantly, favoring agro-dealers and rural markets as source of seed. The subsidy system, with seed distributed through agro-dealers, appears to have contributed to developing the agro-dealer network, as well as improving access to improved varieties. In the past, women tended to rely more on recycling seed, as compared to men, but that difference now seems to have disappeared (Table 20).

Seed Source	Male now (%)	Female now (%)	Mean (%)	Male 10 yrs (%)	Female 10 yrs (%)	Mean (%)
Agro-dealer	44	40	42	38	30	34
Rural market	21	21	21	15	9	12
Own field - recycled seed	14	16	15	31	41	36
Neighbor, family or friend	9	12	11	11	10	10
Project or Gov't program	6	5	5	3	4	3
Local agent of a seed company	4	3	4	4	4	4
Other	3	3	4	0	2	1
N of plots	287	342	629	114	139	253

Table 20 Source of seed used by male and female farmers now and 10 years ago

Seed renewal

[4] The source of the seed has proven to be a confusing concept for enumerators and producers alike. The source of the seed refers to the actual and immediate source of the seed planted in the ground as opposed to the original source of the seed prior to recycling, gifting or exchange.

Of 33% of the recent maize harvests, some grain was kept for use as seed in the next generation. No matter what type of varieties is used, producers recycled seed. Out of the 210 plots from which seeds were kept, 88 were from local varieties and already recycled hybrids. On average, from these 210 plots, 114 (more than half of all farmers providing details on their practice in this respect) were the source of 28 kg on average 1st generation recycled hybrid seed, kept for the next season. This clearly confirms the practice of recycling hybrid maize seeds.

Volume of recycled seed by producers according to type	Mean	95% Conf. interval - low	95% Conf. interval - high	N(210)
Local variety, open-pollinated	21	16	26	48
IOPV	12	6	17	8
Recycled hybrid	22	15	28	40
Hybrid	28	24	32	114

Table 21 Volumes of recycled seed following the harvest based on variety type sown

Distance to seed

Farmers reported to have access to seed relatively close to their home, with 36% of instances where no travel was involved to source the seed (catering for most of the recycled and gifted seed), and 83% of instances where less than 10 km of travelling was required (Table 22). This is likely to be explained by the subsidy scheme, coupled with the fact that efforts of United States Agency for International Development in the 1990s supported the development of the agro-dealer network. First, vouchers are distributed to producers, then agro-dealers who are responsible to deliver subsidized inputs, move in and farmers exchange their vouchers for seed and/or fertilizer. Because agro-dealers want to cash-in on the subsidies, it creates an incentive to move to areas where vouchers have been distributed, thus reducing the distance producers have to travel to access inputs. Interviews with agro-dealers confirmed that about 70% of their business comes through the sale of subsidized inputs, with companies greatly benefiting from the subsidy scheme because of the volumes of seed they can make available on the market.

Distance to access seed (km) (N525)	Freq.	Percent	Cum.%
0 km	229	36	36
0.1 to 0.4 km	12	2	38
0.5 to 1.4 km	83	13	51
1.5 to 1.9 km	1	0	51
2.0 to 4.9 km	103	16	67
5 to 9.9 km	100	16	83
10 km +	112	18	100

Table 22 Distance travelled by producers to seed in km

Seed prices

Thirty nine percent of producers reported not having paid for the seed they used. When producers paid for the seed sown, the average price paid for seed is 354 MWK per kg. Hybrids, with the highest purchasing price of 362 MWK per kg, generally have a better reputation and are strongly advocated by extension programs and subsidized under FISP. Moreover, they are also more widely available than IOPVs – especially through FISP. Data seems to corroborate the information gathered in the FGDs, with higher prices paid for hybrids as opposed to IOPVs. In 37 instances over the past two seasons, producers reported having paid for recycled hybrids, indicating that there is a certain market for these seeds. The influx of hybrid seed created by the distribution of coupons for subsidized seeds may have translated into good quality recycled hybrids on the markets (Table 23). The average price paid for hybrid maize seed when producers received subsidies is clearly lower (273 MWK, close to the average price of IOPVs at 254 MWk) than the average price paid for hybrid maize seed which was not subsidized (563 MWk). The difference in means is statistically significant with a p value of < 1%.

Average price paid for seed when producers engaged in seed purchase	Mean	95% Conf. interval - low	95% Conf. interval - high	N (383)
Local variety	301	150	453	22

IOPV	254	65	442	13
Recycled hybrid	332	229	436	37
Hybrid (mean)	362	322	402	311
Hybrid (seed or seed & fertilizer subsidy)	273	225	321	201
Hybrid (no subsidy)	563	463	664	50

Table 23 Average price paid for seed per kg (in MWK) in recent seasons according to variety type

4.5 Inputs

Farmers interviewed did not report to using much inputs outside of NPK (80% of recent plots) and urea (76% of plots). Calcium ammonium nitrate (CAN) was only applied on 3% of plots. Manure was more common and used on 21% of plots, while compost was used on over 13% of plots (Table 24). No significant difference was found between men and women producers in regards to fertilizer use.

	NPK	Urea	CAN	Manure	Compost
Male	79	82	3	17	17
Female	74	78	2	23	9
Mean	80	76	3	21	13

Table 24 Fertilizer use percentage on recent plots (N plots 640)

Table 24 shows that producers applied an average 100 kg per ha of either NPK or urea. This is in line with the fact that through FISP, farmers are usually distributed vouchers to access 50 kg bags of NPK and urea (1 voucher = 1 bag of 50 kg). Either farmers buy the remainder of the inputs used, or they may have received or accessed more than one fertilizer voucher (e.g. other family members, trade, fertilizer intended for another crop). There were hardly any differences in fertilizer usage between variety types, although on average local varieties and recycled hybrids received 10-20% less fertilizer than for example, hybrids (Table 25).

NPK (kg/ha)	Mean	95% Conf. interval - low	95% Conf. interval - high	N harvests
Local variety	87	74	100	69
IOPV	113	77	149	17
Recycled hybrid	87	73	100	54
Hybrid	105	99	112	331
Overall	101	95	106	471
Urea (kg/ha)	Mean	95% Conf. interval - low	95% Conf. interval - high	N harvests
Local variety	93	80	107	72
IOPV	107	75	140	19
Recycled hybrids	87	77	98	64
Hybrid	105	98	111	349
Overall	101	96	106	504

Table 25 Levels of fertilizer use (NPK and urea in kg/ha) according to variety type used

4.6 Yields

When it comes to yields, IOPVs and hybrids gave the highest yields at an average of 1,677 kg/ha and 1,616 kg/ha respectively. This is followed by recycled hybrids (1,518 kg/ha) and local varieties (1349 kg/ha) which resulted in the lowest yields. Only the difference between local varieties and hybrids was found to be significant (at p-value<0.01) (Table 26 and Table 27).

Variety type used	Mean yield/ha	95% Conf. interval - low	95% Conf. interval - high	N of plots	N of farmers
Local varieties, open pollinated	1350	1170	1530	109	55
IOPV	1677	1184	2170	22	11
Recycled hybrid	1518	1323	1714	73	37
Hybrid	1617	1517	1717	419	210
Total	1561	1481	1641	623	313

Table 26 Average recent yields (kg/ha) according to type of seed

T-test for yield differences between variety type	Local	IOPVs	RHs	Hybrids
Local varieties, open-pollinated		327	168	267**
Improved open pollinated varieties			-159	-60
Recycled hybrids				99
Hybrid seeds				

Table 27 T-test for yield differences between variety type. Column minus rows, *p<=10%, **p<=5%, ***p<=1%

Yield levels do not account for intercropping which was reported to have been practiced on 56% of the recent main maize plots surveyed. It is difficult to estimate the impacts of intercropping on yields as farmers use different mixes of crops, slightly different techniques and also crop coverage varies. However, producers who reported to intercrop had on average a 300 kg/ha lower yield than producers who didn't intercrop.

In general the reported yields are low, lower than expected and lower than the data registered in FAOstats, where an average of 2.1 t/ha for pure-stand maize in Malawi can be found. However, the yields reported from the survey are similar to the findings of a studies on FISP by Chibwana *et al.,*[5] (2011) and Chibwana and Fisher (2011) on the impact of the combination of fertilizer and improved seed (local varieties: 114 kg fertilizer=1,063 yield/ha; 177 kg fertilizer=1,312 yield/ha; hybrid varieties: 139 kg fertilizer=1,389 yield/ha); 178 kg fertilizer=1,510 yield/ha). The results of Chibawa's studies show that a higher quantity of fertiliser and hybrid variety resulted in higher yields of 447 kg/ha, more than the local varieties with lower fertilisation rate (Chibawa studies).

The relatively low yields for all variety type may be attributed to a number of factors. One possible cause could be underreporting of yields by farmers to appear vulnerable in order not to affect subsidy distribution. The reported low yields could also be caused by poor crop husbandry by producers, who have a limited incentive to maximize and optimize practices around maize because of their limited market orientation (40% of the harvests were consumed entirely by the household).

The subsidy seems to have a limited impact on the yields of producers. The difference in yields for producers who benefited from the subsidy and didn't, was small and not significant when separated for local and hybrid maize varieties (Table 28).

	Average yield	95% Confidence interval for yield (low)	95% Confidence interval for yield (high)	N plots	Average yields plots with local varieties	N Plots	Average yields plots with hybrids	N Plots
No subsidy	1583	1392	1774	114	1396	32	1756	53
Seed and fertilizer Subsidy	1719	1593	1846	292	1362	30	1773	221

Table 28 Yields per ha according to variety type and subsidies

Reported yields are lower for women, in line with the fact that fewer women use hybrid seeds. However, the difference in yields for men and women is not statistically significant (Table 29).

Average recent yields	Mean	95% Conf. interval - low	95% Conf. interval - high	N harvests
Men	1590	1471	1708	285
Women	1536	1428	1643	338
Overall	1561	1561	1481	623

Table 29 Average recent yields for men and women

[5] Available at : (http://fsg.afre.msu.edu/aamp/Kigali%20Conference/Chibwana_Measuring_the_Impacts_of_Malawi%E2%80%99s_Farm_Input_Subsidy.pdf)

5 Observations and Conclusions

With the role of subsidies, the role of the public sector in the actual seed value chain has changed considerably in the last 10 to 20 years. The FISP scheme provides a favorable environment for the development of the private seed sector environment. The public sector is now mostly providing services such as GRC, certification, quality control and seed extension. However, with the limited budget available, these services are often deemed inefficient by the private sector, leading to the private sector taking up more and more roles. For example, some companies are having their own in-house testing laboratories for quality control and assessment. While some argue that such changes are for the better, with companies able to carry out certification and quality control quicker and more efficiently than the public sector, others say that it skews the quality control, with staff possibly being pressured to certify stocks which have failed inspections. While a similar system is working in many developed countries, with the public entity overseeing certification by companies, it is not clear whether such a system is likely to develop effectively in Malawi. As a result of the introduction of FISP, public breeding and variety development is very limited compared with the private sector. However, the public sector does have a role in developing IOPVs as the private sector does not show much interest in this line of work (as compared to marketing hybrids).

Maize remains a major food security staple crop for rural households in Malawi. Farmers interviewed saw little other option than to grow maize: "If I don't grow maize, what else will we eat?" is the question on everyone's lips. While producers mentioned alternatives such as groundnuts, tobacco and cotton, no other crop is considered more important for food security than maize is. While it is possible to also make a small income out of maize production, the figures resulting from this study have shown this to be limited.

The FGDs underlined that producers are not yet inclined to purchase seed of hybrid varieties at an unsubsidized rate. The survey demonstrated that a large share of producers interviewed received a seed subsidy in at least one of the past two seasons. While they may not have all been targeted directly by the program, they had managed to get hold of subsidy vouchers. The FISP seed and input subsidy is deeply entrenched in people's minds and behaviors, as well as becoming highly political. While it has supported the growth and expansion of the seed industry in Malawi by providing a secure market to the companies, and to a certain extent favored the development of varieties which are adapted to the use and to the context of producers in Malawi, it is unlikely to be sustainable. The weaknesses of FISP and the preceding starter pack program have been highlighted in a number of studies (Levy *et al.,* 2004; Chirwa *et al.,* 2013; Chirwa and Dorward, 2014), and since its early phases, it has gone through various rounds and transformation. Hence, it is doubtful that the formal seed sector would be self-sustaining without the current subsidy scheme. If FISP were to be curtailed, small companies in particular with high production costs because of the small-scale of their operations, are likely to face a hard time competing and engaging on the market.

While there has been a great push by companies, extension agents and diverse development programs to promote the use of hybrids seeds, the step from using local OPVs which can be recycled, to hybrids, is big. While this shift in practice is now supported by the subsidies, there seems to be a high level of reluctance to continue this for most producers if they are not allocated the subsidy vouchers. Some producers do buy unsubsidized seed of hybrid varieties and these producers constitute the group who has adopted these new varieties of maize. The presence of so-called 'recycled hybrids' are another indication of the reluctance to switch to hybrid seed without subsidies. This variety type seems to have taken its own place within the seed sector, including the (informal) trading of such seeds. Within the smallholder farming systems investigated, recycled hybrids appear to be accepted as providing enough yield and quality to be

grown - if farmers have no vouchers to buy hybrid seed[6]. It would be good to understand better how recycle hybrids function i.e. their recycling potential, yields, response to fertilizer and renewal of seed stocks.

Little is done to promote the use of IOPVs, which as far as yield is concerned appear to be similar to hybrids in Malawi. IOPVs could be a viable intermediary step in the process of changing to better quality seed and input practices in a context without seed subsidies. Also, the limited extension service activities mostly revolved around the use of hybrid varieties, with limited information on IOPVs. Few companies market IOVPs. While yields are good and similar to what hybrids offer (around 1.6 t/ha), they are less widely available and less promoted under FISP. While theoretically they offer the advantage that they can be recycled true-to-type for a few seasons before renewal becomes required, maybe farmers are equally satisfied with harvesting seed grain on hybrids. The popularity of recycled hybrids, as observed in the research reported here, further supports this notion.

It seems that there is little pull for higher yields (and hence higher quality inputs) from the maize grain market. The market is not extremely remunerative and therefore does not offer high incentives for commercial production and generating higher surpluses of maize. Producers don't want to store large quantities of maize harvested from hybrid varieties, as problems with weevils are reported to be very common among farmers – or at least producers perceive this as a problem of hybrid varieties.

Finally, it is important to note that producers interviewed still assess the use of hybrids as being a risky business. With erratic conditions of rains and drought, producers fear losing their harvests, preventing many to invest more financial resources than the current level, in their production. Local varieties are very much seen as a safety net by producers and are serving in particular their subsistence needs. While most producers interviewed recognized the high yielding potential of hybrids as compared to local varieties, they appreciate the stability and reliability offered by local varieties - "You will always get something with your local seed". In reality it seems that producers tend to adopt a mixed strategy, using local and hybrid varieties of maize in their field during the same season to mitigate risks. If one does not give any yield, the other may.

This study has shown that, largely due to the introduction of subsidy programs such as FISP, the maize seed system of Malawi now has strong formal private players. Most farmers have regular access to improved quality seed of hybrid varieties, and because of the available attractive subsidies, also make use of that opportunity. This subsidy-dependent use of hybrids has resulted in a new seed category, recycled hybrids, which appear to have become an accepted seed source when farmers have no access to subsidies. To what extent the current strengthened seed sector has contributed to food security as compared to a decade ago, was not part of this study. However, such an analysis may be relevant to Malawian stakeholders when considering future decisions on investments in the sector. This may include the improvement of the perceived weak links in the chain, such as certification, quality control and seed extension.

[6] We are not aware of any scholarly publications describing the performance of recycled hybrids in more detail, and would be grateful for links or references on the subject.

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7 Annex: List of interviews

The fieldwork was conducted in collaboration with a local consultant, Mthakati Alexander R. Phiri PhD, Associate Professor of Agricultural Economics, and Head of the Department of Agricultural and Applied Economics of Lilongwe University of Agriculture & Natural Resources. Key responsibilities of the consultant included organization of the workshop, hiring and coordination of enumerators, facilitation of the identification process of key informants, organization of FGDs and translation from local language to English when informants did not speak English. Locations for the household survey were also suggested by the local consultant.

Activity	Dates	Location	Participants
Stakeholder workshop	May 19th	Lilongwe	11
FGDs	May 23rd and 24th	Salima and Ukwe	64
Key interviews	May 21st – May 28th	Lilongwe, Salima and Ukwe	17
Survey	May 21st – May 28th	Salima (143) and Ukwe (177)	320

Interviews with key-informants

Mr. Auswad Zidana	World Vision
Mr. Blessing Kayenda	Farmers' World Salima
Mr. Brayton Maonga	ASSMAG
Country Director	Sustainable Agricultural Production Program – IFAD
Mr. Felix Jumbe	Peacock Seed Manager
Mr. George Chitunga	Extension worker
Mr. Grevasio Phiri	Agro-dealer
Mr. Jayaka Kipandura	Crops officer Salima
Mr. Jeffrey Luhanga	Public Servant
Mr. Kesbell Kaogan	Breeder Chitedze Research Station
Mr. Lingson Maliwa	Peacock Seed
Mrs. Lucia Mtambo	SSU
Mr. Somne Maganga	Assistant seed field production Peacock seed
Mr. Supply Chimsi	STAM
Mr. Salatiel Martin	Agro-dealer
Mr. Vernon Kabambe	Agronomist Bunda college
Seed Co.	Visit

Stakeholder Workshop

No	*Name*	*Organization*
1	Mr. Andrew Mpesi	Farmers Union of Malawi
2	Mr. K.K. Kaonga	Chitedze Research Station - DARS
3	Mr. Ernest Chilimbiro	Monsanto - Malawi
4	Mr. Samuel Mingu	FAO
5	Mr. James Gausi	Save the Children
6	Mr. Emmanuel M. Munthali	Ministry of Agriculture, Irrigation and Water Development - Extension
7	Mr Gilbert Malota	Ministry of Agriculture, Irrigation and Water Development - Crops
8	Mr. Frank Masankha	National Smallholder Farmers Association of Malawi
9	Mr. Chipiliro Juziwelo	Pannar Seed (Mw) Ltd
10	Mr. Owen Chirwa	Lilongwe ADD - Ministry of Agriculture, Irrigation and Water Development - Extension
11	Mr. Osborne Tsoka	Ministry of Agriculture, Irrigation and Water Development - FISP

FGDs

Salima

Iwewi Gainaza

Jester Pongolani

Elick Msaweya
Yohane Gawaza
Fillimone Martin
Mizeki Gawizani
Sebita Kalichero
Maleni Kalumba
Grace Mandu
Egile Neja
Sisila Mabvuto
Titanchucewji Msowoya
Labeka Banda
Chrise Chinkhuzi
Dolofe Beni
Tereza Yobe
Christina Chulu
Esinati Yohane
Felinati Kazozo
Likunesi Sawkhulani

Ukwe
Mikiwadi Kundulu
Samisoni Denesi
Dawito Ndizo
Alekisi Kashmoni
Alafurodi Kadango
Pondini Bintikoni
Miseki Makamaka
Lameki Kajentoni
Noweki Mikiwasadi
Kumbrilemi Nawrizeni
Eliasi Kendekeza
Gibisoni Kundulu
Makalami Ngoma
Kasi Namalambi
Kamadyaapa Dwesi
Samalami Mikiyele
Fodiwelo Bikisoni
Zikiyele Hadiwiki
Padyela Tomasi
Franck Matursale
Isack Kadwa
Ehiyame Mikiasi
Eda Fosiatal
Aimesi Kashmi
Jurdiki Kaytoni
Mukitano Fuxedileki
Agimesi Chiyesaji
Chaterini Johanne
Dolesi Falisoni
Linile Hesitoni
Lawuresi Johanne
Enelesi Jolofami
Agimesi Windimani
Ayida Kumbileni
Lemita Kamafyaapa
Lejesi Kambaye
Malita Kamgoma

Agriesi Nthambala
Magaleti Mphandauyo
Zelesi Layisoni
Limesi Zingamu
Joyisi Hesitoni
Kmlisita Musale
Matilida Nowa