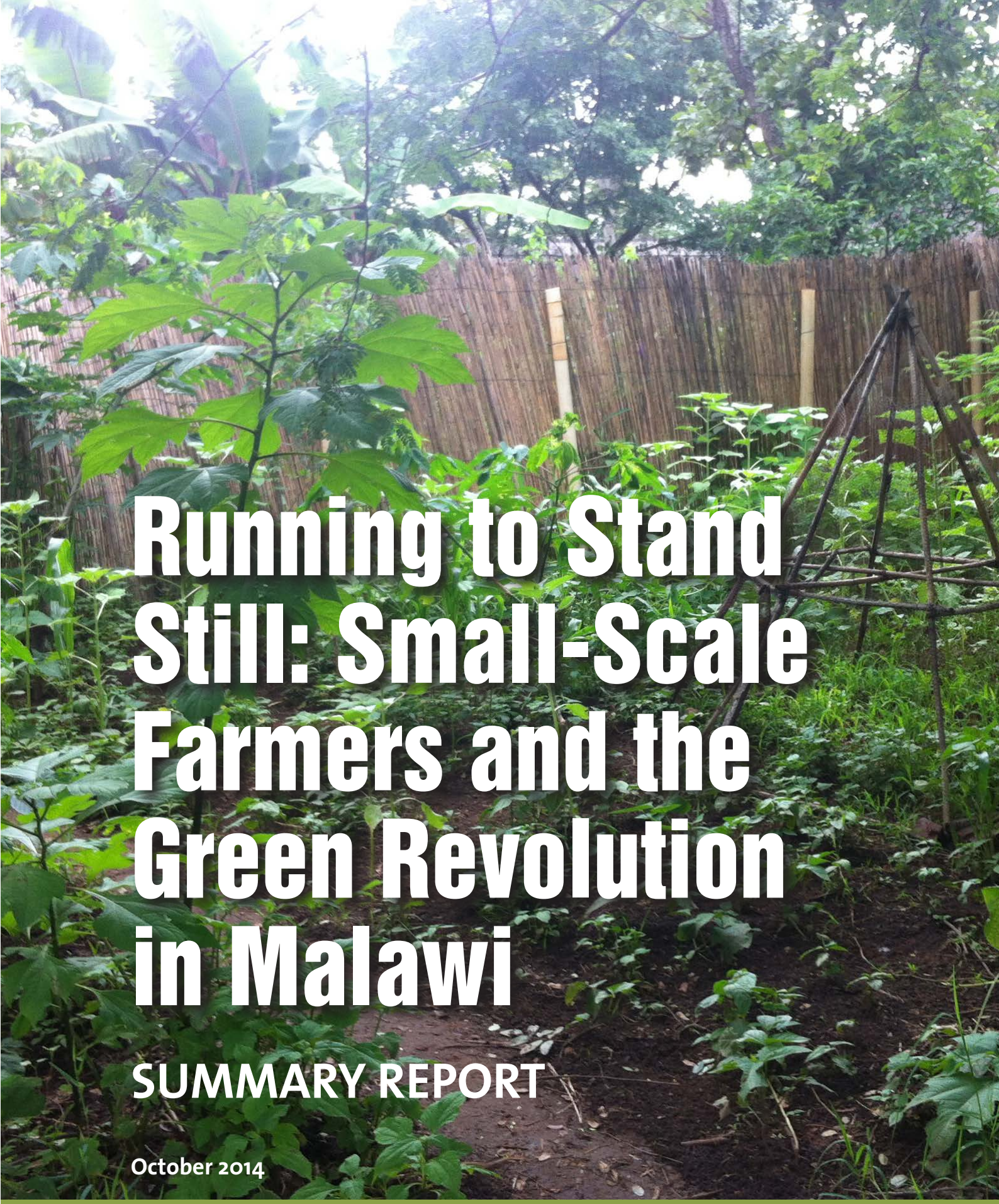

Running to Stand Still: Small-Scale Farmers and the Green Revolution in Malawi

SUMMARY REPORT

October 2014

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The African Centre for Biosafety (ACB) is a non-profit organisation, based in Johannesburg, South Africa. It was established to protect Africa's biodiversity, traditional knowledge, food production systems, culture and diversity, from the threats posed by genetic engineering in food and agriculture. It, has in addition to its work in the field of genetic engineering, also opposed biopiracy, agrofuels and the Green Revolution push in Africa, as it strongly supports social justice, equity and ecological sustainability.

The ACB has a respected record of evidence-based work and can play a vital role in the agro-ecological movement by striving towards seed sovereignty, built upon the values of equal access to and use of resources.

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Acronyms

ACB	African Centre for Biosafety
ACE	Agricultural Commodities Exchange
ADMARC	Agricultural Development and Marketing Corporation
ADP	Agro-dealer Development Programme (AGRA)
AFSA	Alliance for Food Sovereignty in Africa
AGRA	Alliance for a Green Revolution in Africa
ANOVA	Analysis of variance
ASSMAG	Association of Smallholder Seed Multiplication Action Groups
AU	African Union
Ca	Calcium
CA	Conservation Agriculture
CAADP	Comprehensive African Agricultural Development Programme
CAN	Calcium ammonium nitrate
CEC	Cation exchange capacity
CGIAR	Consultative Group for International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CISANET	Civil Society Agriculture Network
CNFA	A non-profit international development organisation based in Washington DC
CO^2	Carbon dioxide
CSO	Civil Society Organisation
DARS	Department of Agricultural Research Services
DUS	Distinct, uniform and stable
EACI	Education for African Crop Improvement
ETG	Export Trading Group
FAO	United Nations Food and Agriculture Organisation
FGD	Focus group discussion
FIAAC	Fund for the Improvement and Adoption of African Crops (AGRA)
FISP	Farm Input Subsidy Programme
FO	Farmer Organisation
FOSCA	Farmer Organisation Support Centre in Africa
FSO	Farmer Support Organisation
FtF	Feed the Future (US government)
GDP	Gross Domestic Product
GM	Genetically Modified
GR	Green Revolution
H^+	Hydrogen ions
ICRAF	World Agroforestry Centre
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IITA	International Institute for Tropical Agriculture
IMF	International Monetary Fund
ISFM	Integrated Soil Fertility Management
ISSD	Integrated Seed Sector Development
K	Potassium

LRC	Land Resources Centre
MARDEF	Malawi Revolving Development Fund
MASP	Malawi Agro-dealer Strengthening Programme
Mg	Magnesium
MK	Malawian Kwacha
MNCs	Multinational Corporations
MoAFS	Ministry of Agriculture and Food Security
MSHC	Malawi Soil Health Consortium
N	Nitrogen
NAFSN	New Alliance for Food Security and Nutrition (G8)
NASFAM	National Smallholder Farmers' Association of Malawi
NEPAD	New Economic Partnership for Africa's Development
NGO	Non-governmental Organisation
NPK	Nitrogen, phosphorous, potassium
OAU	Organisation for African Unity
OPV	Open-pollinated Variety
P	Phosphorus
PASS	Programme for Africa's Seed Systems (AGRA)
PPP	Public-private Partnership
R&D	Research and Development
Rumark	Rural Market Development Trust
S	Sulphur
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
SDC	Swiss Development Cooperation
SEPA	Seed Production for Africa (AGRA)
SFFRFM	Smallholder Farmer Fertiliser Revolving Fund of Malawi
SHP	Soil Health Programme (AGRA)
SPSS	Statistical Package for Social Sciences
SSTP	Scaling Seeds and Technologies Partnership
STAM	Seed Trade Association of Malawi
TIP	Targeted Input Programme
UPOV	Union for the Protection of New Varieties of Plants
VDC	Village Development Committee
WEF	World Economic Forum

EXECUTIVE SUMMARY

Introduction, context and methodology

Malawi has been hailed as a Green Revolution success story. But a closer look reveals farmers trapped in a cycle of debt and dependency on costly external inputs, and an eroding natural resource base. Small-scale farmers are using shockingly high levels of synthetic fertiliser at great financial cost to themselves and the government, with the additional consequence of rising soil infertility. Encouraged by government subsidies and the promise of massive yield increases farmers are increasingly adopting hybrid maize seed. However, adoption of these hybrid seeds comes at the cost of abandoning the diversity and resilience of local varieties and the ever-escalating requirement for synthetic fertiliser applications. Given structurally low product prices, the slight yield increases being realised by farmers seldom justify the added financial and ecological expense of the inputs. Indeed, findings show net transfers away from farming households to agribusinesses through the adoption of Green Revolution (GR) technologies. This report highlights the plight of small-scale farmers at the receiving end of the Green Revolution push in Malawi.

In early 2014 the African Centre for Biosafety (ACB) launched a multi-year research programme in southern and east Africa to investigate seed and soil fertility practices and the challenges facing small-scale farmers in the region. Malawi was the first country to be studied, and ACB worked with the National Smallholder Farmers' Association of Malawi (NASFAM), the Kusamala Institute of Agriculture and Ecology and Dr Blessings Chinsinga at the University of Malawi to conduct the research, and with Chitedze Research Station for the soil testing. The research programme has two broad aims: to contribute to the establishment of a regional research network on seed and soil fertility issues, and to offer an evidence-based critique of the GR agenda. The second aim includes a particular focus on the activities of the Alliance for a Green Revolution in Africa (AGRA), an institution that plays a critical coordinating role in expanding the GR on the African continent.

AGRA's work in the GR push is wide-ranging and includes support to public and private plant breeders, soil scientists, private input suppliers, agricultural credit extension and policy and advocacy. In Malawi, AGRA's largest investment to date has been the Malawi Agro-dealer Support Programme (MASP), run by US-based CNFA (a non-profit international development organisation) until 2012. There were two AGRA-sponsored projects within the study sites, the CNFA-managed MASP, falling under AGRA's Programme for Africa's Seed Systems (PASS), and support to NASFAM for pigeon pea integration as part of the Soil Health Programme (SHP). The impact of these projects to date is diffuse in the study sites. These projects have had a relatively small impact on farmers within the study sites so far, but they are only building blocks in a wider GR thrust in which AGRA's influence has been significant. AGRA is the co-ordinator of the recently established Scaling Seeds and Technologies Partnership (SSTP) under the auspices of the G8's New Alliance for Food Security and Nutrition (NAFSN). At the time this research was being conducted no practical activities were yet taking place under this partnership. Follow-up research to be conducted by ACB in 2015 will include investigation of these AGRA interventions in more detail, together with country partners where possible.

The research methodology included a short survey with 90 farmers in two NASFAM sites in Kasungu (Chamama and Chipala) and one Kusamala site in Dowa (Nambuma). The survey covered demographics, land, production and yields, agricultural practices and soil fertility and seed access and practices. Stratification was based on gender, age and production practices. A cross-section of conventional agriculture, conservation agriculture (CA) and agro-ecological practices were identified as the basis for a comparison of impacts on household nutrition, production and soil fertility. Analysis of the comparative aspects is planned as a longitudinal study, with this first survey designed as a baseline study. In addition to the baseline survey, interviews and focus groups were conducted with participating farmers, and discussions were held with a range of relevant national and local informants. The initial results reveal high levels of

hybridisation of conventional, CA and agro-ecological practices; with farmers simultaneously using purchased certified and hybrid seed and synthetic fertiliser and applying farming methods such as leaving crop residues on the field, intercropping and recycling seed. The uptake of GR technologies is uneven and the reasons for this are not as simple as lack of knowledge or access. Farmers also make choices and hedge risk by employing a range of differentiated practices. What follows is a condensed summary of the main results of this research, together with conclusions and recommendations for policy development and further work. A full report will be made available shortly, following this summary.

Farmer perceptions of agricultural challenges

Farmers identified high fertiliser prices (99%), lack of markets (82%), change in rainfall patterns (81%), and high seed prices (77%) as the most serious challenges currently facing them. These priorities were consistently high across the three sites. High input prices are a key limiting factor in the adoption of GR technologies, while low output prices are the product of structural disadvantages and adverse incorporation of small-scale farmers into liberalised global commodity markets. No significant gender differentials were identified within most of the serious challenges identified. Weak institutional support, with particular emphasis on extension and research, was identified as an issue in focus groups.

Although there was general consensus that farming had become more challenging over the past five years, some farmers felt that progress was being achieved. Many of these farmers tended to be retired workers with generally higher levels of education. The research reveals some differentiation among farmers, a trend that is inevitably accelerated by the introduction of GR technologies.

Nutrition and food security

Participants were asked questions about dietary diversity and whether their households were able to eat foods they are used to, as

proxies for household food security. Dietary diversity is a measure of the variety of foods consumed in a recent period, with three or fewer foods indicating lack of diversity. Around 8% of respondent households had consumed three or fewer categories of food in the past three days. This figure would have been higher if measured over the previous 24 hours. More than 80% of households had consumed maize, green leafy vegetables, 'other' vegetables (including tomatoes, onions, okra and others) and legumes in the past three days. But fewer than 60% of households had consumed rice, wheat products, any kind of meat, potatoes, fruit or vegetables high in Vitamin A. Sixty-nine per cent of respondents indicated they sometimes, often or always could not eat foods they are used to, while only 15% were always able to eat foods they are used to.

Results showed some differentiation between study sites regarding income being enough to cover basic needs. The majority of respondents in Chipala (77%) indicated current income was often enough to cover basic needs. By contrast, in Nambuma (89%) and Chamama (82%), the majority of respondents indicated their income was rarely or never enough to cover basic needs. This was one of many results showing some differentiation between farmers in different sites.

An early indication of a problem in the food system is flagged when households confirm they are not able to eat foods they are used to and yet they are are selling food. Although a relatively small number, 50–60% of the

households that were often or always unable to eat the foods they wanted to also sold maize, beans and groundnuts.

Most food consumed in households in the past three days was produced either by the household itself or purchased, with very little food being sourced from trade or barter, or being received as a gift or shared. The major food types produced by the household were maize (87%), pumpkin/orange sweet potato (87%), legumes (83%), eggs (69%) and potatoes (59%). Foods that were predominantly purchased include oils and fats (100%), sugar (96%), dairy (96%), fish (90%), rice and wheat (81%) and 'other' vegetables (75%). More than half the respondents had consumed fruit, which was split between own production and purchase. Banana (23%), papaya (22%) and mango (20%) were the most common food trees grown by participating households.

In rural Malawi many families run out of food well before the next harvest, meaning they are forced to abandon their own gardens in search of cash or in-kind employment in order to access food. This trend was reflected in the survey, with 56% of households running out of food between the critical farming months of October and February. Only six households, all in Chipala, said they did not run out of food, another sign of differentiation.

Land access and cultivation

Although land was not a focus area of this research, land ownership and access is an essential variable in agricultural production. The survey included questions on the size of a respondent's land holdings, cultivated areas and the distances respondents had to travel to tend their fields.

The survey showed average land holdings of around 7 acres (2.8 ha[1]) per household with a variation of 4.5 acres in Nambuma, 6.4 acres in Chamama and 9.9 acres in Chipala; the last figure is skewed by one large land holding of 99 acres. Across all sites 57% of households reported they owned between 1 and 3ha, though in Nambuma almost three-quarters owned less than 2ha. This is another indicator of differentiation between the sites, with respondents in Nambuma tending to be less well-off and respondents in Chipala tending to be slightly better off.

Cultivated land includes own land, *dimba* land (*dimbo* land translates as wetland/s in Engish; this is land bordering a river where cultivation during the dry season depends on residual moisture), rented land and borrowed land. The portion of own land cultivated averaged around 70% of total land owned by households. Just under a third of households (30%) rented some land for cultivation, with the average size of rented land being 2.26 acres or just under 1 ha. Those who were cultivating *dimba* land reported land size of close to 1ha in all three sites. Of the three sites, Nambuma is more reliant on rentals and borrowing which signifies potential land demand (i.e. people needing more land than they own).

There are some significant relationships between the size of land holding and key challenges facing farming households. Changes in rainfall patterns and lack of markets are serious issues across all land ownership sizes. High seed prices are generally more of an issue with increasing farm size, from two-thirds in the landless category to 90% in the 3–4ha category and 82% in the >4ha category. Poor quality seed tends to be more of an issue

1. Accepting that one hectare is more or less 2.5 acres, based on a NASFAM survey

for smaller farmers, from one-fifth in the <1ha category to less than one-tenth in the >4ha category, but this is not an even trend. Generally seed quality is not a major issue.

The Malawi G8 Cooperation Framework commits the Malawian government to release 200,000 ha of land in both customary and leasehold areas for large-scale commercial agriculture by 2015. We must ask where this land will come from and who will be dispossessed as a result.

Production and yields

Not surprisingly, maize (hybrid and local, combined), groundnuts, tobacco and beans were the most widely produced crops in the three sites, followed by hybrid maize (as a distinct category from local maize) and soya. Hybrid maize yields were on average 519kg more than local maize yields. At the prevailing market price of MK60/kg (US$0.14[2]) this translates into a potential additional income of MK31,140/household (US$74.14). However, this does not justify the additional average input costs of MK5,798 (US$13.80) for hybrid maize seed plus MK81,296 (US$193.54) for NPK (three-component synthetic fertilisers) and urea which are used primarily on maize. When increased input costs are taken into account, farmers adopting GR technologies realise a potential income deficit of MK55,954 (US$133.22). Even if the synthetic fertiliser is also shared amongst other crops, overall production of these crops remains low and it is highly unlikely that farmers will realise a net profit by adopting these technologies. The short-term benefit of higher yields masks this net transfer from small-scale farming households to seed and fertiliser agribusinesses.

AGRA's seed work in Malawi emphasises maize, beans, soya, peas, groundnuts, cassava and sweet potato, so a mixture of commonly cultivated crops and less cultivated crops. There was some differentiation in the type of maize produced by area. In Nambuma a high percentage of respondents (80%) produced local maize, while in Chamama hybrid maize was predominant, at 90% of respondents.

Although other crops were not as widely produced there were a large number of smaller crops that generally are neglected by formal research and development (R&D) efforts because they are seen as non-commercial crops. Yet these crops play a critical role in ensuring local nutritional diversity. In a country where the majority of households are resource-poor farming households, these crops are extremely important.

Fifty-three per cent of the participating households planted on *dimba* land. Of these, 60% planted mustard, 48% planted pumpkin and 46% planted tomatoes. Fifty-one per cent of the participating households planted around their homesteads. A quarter of these planted papaya and a fifth planted pumpkin. There is a clear gender difference regarding the cultivation of *dimba* land—64% of women-headed households had not planted on *dimba* land in the past season, while 44% of male-headed households had not cultivated *dimba* land in the same period. This indicates lower land access for women.

On average, slightly less than 1.5 tons of maize was retained for home use. Because of greater yields, more hybrid maize on average was kept for home use (1,493kg) compared with local maize (1,173kg). Just over half the respondents retained more than 1 ton of hybrid maize, and just over a third of the producers retained more than 1 ton of local maize, for home use. The vast majority of producers of beans, groundnuts, pigeon pea, cow pea, soya and sweet potato kept less than 500kg of the product for home use.

The role of tobacco

Malawi is the world's most tobacco-reliant economy, with the crop accounting for over 60% of export earnings. Since the sector was liberalised in 1992, small-scale farmers have become the majority producers. NASFAM itself was established with funding from USAID in 1994 with a primary focus on integrating smallholders into commercial tobacco production. Kasungu and Dowa are both key tobacco producing areas in Malawi, with over

2. At a rate of US$1 = MK420, the prevailing rate at the time of the research.

Table A: Tobacco cost breakdown for one club, Chamama

	Total (48 bales) (US$)	**Per bale** (US$)	**Per bale** (MK)
a. Proceeds from sales	8,445	175.9	73,878
b. Charges at auction floor (selling concession, TCC cess and class, ARET, NASFAM levies)	359.2	7.5	3,150
c. Deductions (NASFAM transport, hessian, tax)	909.56	18.95	7,959
d. Loan repayment	6,042.65	125.89	52,873
e. Baling jack	102.86 (MK43,200)	2.14	900
f. Transport to action committee	114.29 (MK48,000)	2.38	1,000
g. Profit after deductions, loan repayment etc. (but excluding labour)	916.44	19.09	8,019
h. Average per farmer[3]	114.56 (MK48,115)	2.39	1,002
i. Farmers' share of total sale (g/a x100)	10.85%		

Source: focus group discussions and receipts

MK/US$ 420:1 exchange

81% of participating farmers growing tobacco in the 2013/14 season. Table A shows the tobacco cost breakdown of a club in Chamama and indicates that the farmers' share of total value was less than 11% of dried leaf. In order to generate the MK48,115 (US$114.56) income from a season's labour, farmers bear input costs of MK181,480 (US$432.10). Although these costs are usually covered by tobacco companies through value chain financing on contract (credit to purchase inputs with deductions before payment), farmers bear the risk of production failure.

This case reveals a classic contract farming model, where farmers with no bargaining power take on loans to grow cash crops yet receive a small fraction of its final value. As the World Bank (2003:5) states, "farmers are carried away by the high gross return from tobacco instead of comparing the net returns". There are other negative impacts associated with tobacco cultivation. It is not a crop that can be kept back for consumption in times of acute hunger, nor is there any prospect of finding alternative buyers or value addition. Further, tobacco extracts large amounts of nutrients from the soil and requires the application of large quantities of pesticides. The value chain needs to be investigated further, together with farmers, to examine the real benefits for them, in the long run, of planting tobacco.

Seed access and practices

Seed is a key focus in the GR thrust. As outlined above, AGRA has a major focus on seed in Malawi and is involved in supporting R&D and the production and distribution of improved seed for all the major crops grown by survey respondents, aside from tobacco. Although germplasm in the public sphere—national agricultural research systems and the Consultative Group for International Agricultural Research (CGIAR) institutes—is the basis of much of this development, the long-term aim is to involve the private sector in production and distribution. The implications for farmer-managed seed systems and agro-biodiversity are downplayed, with farmer-

3. Total figures on the auction house receipt for the tobacco club of eight farmers in this case.

managed systems considered inferior to profit-generating private activity in seed production and distribution.

One of the objectives of the study was to investigate seed access, farmer-based seed practices, and the implications of these practices on agricultural productivity. Investigations found that certified or hybrid seed use was limited to maize (73% of respondents) and tobacco (42%). Through the FISP the government of Malawi plays a major role in creating a market for hybrid maize seed and, to a lesser extent, improved legumes, while the tobacco companies have their own closed value chains for improved tobacco seed. Despite this, respondents recycled even hybrid seed for various reasons, the most common of which were to ensure seed availability when the first rains arrive and the high prices of certified seed which limit access.

AGRA-supported seed development, production and distribution programmes cover a fairly wide range of crop types in Malawi, but farmers in the survey are still using non-certified seed. Almost half the respondents planted non-certified or local maize varieties, and the majority of farmers planted non-certified cow peas (87%, but on a low base), beans (75%) and soya (60%). Many farmers planted both hybrid and local/uncertified maize. The availability of certified seed may be an issue, but of more importance is the limited access to certified seed. This is due to high prices and various quality factors (including storage, processing, conversion rates of kernels to flour, taste, insect resistance both in the field and in storage, and drought tolerance). Respondents tended to reserve local maize for consumption, and sell a higher proportion of their hybrid maize. The availability of local and uncertified varieties offers farmers a range of options.

Seed recycling is a common practice, with 80% of local maize, 73% of cowpea, 64% of beans, 55% of groundnuts and 54% of soybean seeds being recycled. Hybrid maize is the only seed that was mostly purchased from seed dealers (59%). Bean seed was the next most purchased seed, but only 18% of respondents who used bean seed in the past season had purchased it. NASFAM and tobacco company loans are an important source of pigeon pea seed (60%) and tobacco seed (12%) respectively. NASFAM's introduction of pigeon pea was sponsored by AGRA. The programme has not had a major impact in the research sites to date, with small quantities of seed being distributed (less than 5kg per participating farming household) and limited returns for farmers. An aspect of planned follow-up research will investigate in more detail the functioning and impacts of NASFAM's pigeon pea programme, including the extent to which it has taken off in other areas of Malawi. Further investigation will also explore other improved and hybrid seed varieties sponsored by AGRA in Malawi.

The research did not uncover any systematic market in uncertified seed in the sites and confirmed that respondents tended to save seed primarily for their own use. There is no practical support from government for the saving or exchange of uncertified seed, while efforts by AGRA and government alike tend towards replacing uncertified seeds with certified varieties. This could bring improved germplasm into seed systems but may have negative impacts on seed diversity.
Survey responses indicated a bigger variation in the cost between certified and uncertified seed than in perceived quality. This poses a question about the value for money of GR technologies. The main seed costs incurred by respondents

were for hybrid maize and certified tobacco seed. However, these costs are relatively small when compared with the cost of fertiliser inputs (see below). A high percentage of respondents incurred no expense in procuring seed for local maize (85%), groundnuts (64%) and beans (59%), as well as pigeon peas (100%) and cow peas (78%). This emphasises that the practices of seed saving and exchange are very well established and vital in Malawi.

Seed quality was not a major issue for most crops. Local maize seed was assessed by respondents as being of lower quality than hybrid maize seed. The quality of their hybrid maize seed was assessed as good by 85% of the respondents, and the quality of local maize seed was assessed as good by 62% of users. While this signifies some quality issues for local or uncertified maize, farmers are not arguing to replace local seed with hybrid or certified seed. Given the high numbers of farmers still using this seed, we can deduce that it makes an important contribution to on-farm production systems. The quality of uncertified seeds were all assessed as good by the majority of a small sample of users—pigeon pea (100%), beans (81%), groundnuts (81%), cowpea (77%) and soya (72%). However, with open pollinated varieties (OPVs), even official advice is that seed can be recycled for three years before new seed should be purchased. So it is a question of how long the farmers have been recycling, and how recycling fits into the dissemination of improved OPVs. Efforts can be geared towards investigating the quality of local or uncertified seed, identifying the positive characteristics of local/uncertified seed and developing responses based on participatory methods with farmers to improve the seed.

Agricultural practices and soil fertility

A high proportion of respondents engaged in various types of agro-ecological practices, including those that fall within the definition of conservation agriculture (CA). In Malawi CA is defined as minimum soil disturbance, permanent ground cover and crop rotation or intercropping (including the use of legumes for nitrogen fixing). These practices can also be considered agro-ecological methods, although GR advocates, including AGRA, add to the definition the use of synthetic fertilisers, hybrid and certified seeds and herbicides. The research clearly shows a mix of practices encompassing both GR inputs and agro-ecological practices, although this is uneven across farming households.

More than 8 out of 10 households practised intercropping with hybrid maize/beans, and tobacco/pumpkin being the main two intercrops. Tobacco companies discourage the tobacco/pumpkin intercrop because the plants come from the same family and the intercrop increases the threat of diseases spreading. Overall nearly three-quarters (73%) of respondents practised at least two of the three CA base practices. Almost 9 out of 10 farming households applied some kind of organic content to the soil, in the form of crop residues, animal manure, compost or green manure. This indicates that agro-ecology is not something new that must be introduced but is part of existing practice. GR inputs rely on this fundamental practical base for their success. If GR inputs undermine this base over time, it could lead to the collapse of the agricultural system as a whole, including the GR. The existing base of practices offers a very strong foundation to adopt and advance agro-ecological methods, since these practices do not need to be introduced by external agents.

Given the combination of production practices it is not possible at this early stage to make any definitive comments on the relationship between the adoption of production practices and household food security. The research results are a baseline that can be measured and compared over time. Generally, the survey indicated a positive correlation between households practicing agro-ecological practices (defined for these purposes as the three CA base practices plus the addition of organic content to the soil) and household food security. However, many of these households also used various GR technologies. In any case, correlation does not imply causation and further work must be done to understand the relationship between the adoption of production practices and household nutrition. Synthetic fertilisers are widely and intensively used in the study sites and are procured from a variety of sources (Table B). Urea and NPK were the most widely used synthetic fertilisers, with 81% of respondent households using

Table B: Mean amount of fertiliser applied, costs and sources in the past year

Type of fertiliser	Mean payment (MK) by respondents using fertiliser	Mean payment in US$	Mean kg applied by respondents using fertiliser	Major sources of fertiliser
Urea base	19,204.55	45.73	75	Agro-dealer (44%), FISP (37%), tobacco company (15%)
Urea top	27,544.52	65.58	**131.7**	
NPK base	**31,780.09**	75.67	**150.2**	Agro-dealer (44%), FISP (25%), tobacco company (16%)
NPK top	2,766.67	6.59	31.7	
CAN base	32,800.00	78.10	116.7	Agro-dealer (39%), tobacco company (31%), ADMARC (8%)
CAN top	**36,077.78**	85.90	154.8	
Super D/D compound	**65,516.67**	155.99	**230.6**	Agro-dealer (28%), tobacco company (50%), and farmer/ villager (17%)
Total (synthetic)	215,726.28	513.63	**341.5**	
Animal manure	1,134.62	2.70	2,569.5	Own production (97%)
Green manure	777.78	1.85	1,456.4	Own production (100%)
How much on total fertiliser applications where breakdown between types in unknown	307,641.25	732.48		
Average expenditure on all fertiliser	95,415.70	227.18		

urea top dressing and 68% using NPK (mostly 23:21:0) basal. There was some unevenness in use across the sites—over 90% of respondents in Chamama used both NPK and urea while only 47% of respondents in Nambuma used NPK. The tobacco fertilisers, CAN and Super D or D compound, were used by one-fifth to a quarter of households. Mean application rates across all households that confirmed using any kind of synthetic fertiliser was an extremely high 341.5kg on cultivated land that, on average, was around 2ha (see above). Fertiliser use on different pieces of land was not fully investigated, but the research shows that synthetic fertiliser use is concentrated on maize and tobacco plots. This means synthetic fertiliser use is even more intensive than this measure, which divides fertiliser use by the entire land owned. The high cost of fertiliser was identified as a 'serious' problem by every respondent except one.

The average amount spent on fertilisers across all households was MK95,000 (US$226.19), more than the market value of 1.5 tons of maize at MK60/kg (US$210.00) in local markets. At

the same time, the combination of hybrid seed and synthetic fertiliser application increases yields by around 500kg, so this is a very big expense for a relatively limited reward. Forty per cent of respondents identified late fertiliser delivery as a serious problem, with another quarter of households calling it a 'moderate' problem. Purchases from agro-dealers and vouchers from FISP accounted for 70–80% of urea and NPK acquisitions, while tobacco companies and agro-dealers were the main sources of CAN and Super D or D compound.

Animal manure presents a potentially cheaper and more readily available source of soil nutrients, and 58% of farmers reported using it in the previous season. Average application rates for those using animal manure was around 2.5 tons in the past season. Ninety-seven per cent of those applying animal manure said they did so from their own sources. We did not gather survey information on livestock ownership but this will be investigated in the follow up studies. Nevertheless, in focus groups women indicated they had a few small stock (goats, pigs and chickens), but not enough to equal the amounts of manure respondents said they applied. According to the chair of one of the local farmer committees, there has been a general decline in animal ownership as government extension services have dwindled and farmers, more in need of ready access to cash since liberalisation, are often compelled to sell their livestock. We will need to investigate further the source of animal manure, given the apparently limited ownership of large livestock.

There was no statistically significant relationship between respondents indicating soil infertility as a serious issue and the amount of fertiliser used. There appears to have been little or no soil testing conducted historically in the areas surveyed, with some farmers not even aware that soil could be tested. Independent soil testing conducted by Chitedze Research Station as part of the research indicated degraded soils across the sites with limited nutrient content and relatively high acidity; the latter favours tobacco over food crops. Recommended remedies are liming to increase pH and the addition of organic content to the soil to improve nutrient content.

For soil fertility, we established the baseline relationship between use of fertiliser (synthetic, animal or green manure) and the food security proxies indicated above. There was a positive correlation between increased levels of both synthetic and organic fertiliser use and the food security proxy measures. However, consideration must be given to the relative wealth (or purchasing power) of households in the first place; households that can purchase larger amounts of fertiliser are also more likely to afford a larger and more varied food basket. We must also consider the broader effects of a net transfer of income away from farming households employing GR technologies, and the impact of this on household food security. Evidence directly contradicts the GR argument that the adoption of these technologies will generate greater incomes and hence food security for farming households.

There was an almost universal consensus among respondents that farming is impossible without fertiliser. Farming households appear to be caught in a cycle of increasing reliance on synthetic fertiliser to squeeze production from the ground on a season by season basis. Synthetic fertilisers generate major ecological problems including soil infertility and damage to water sources. Infertile soil becomes an inert carrier for temporary nutrients that must be pumped in to prop up production. The soil tests conducted by Chitedze Research Station reveal soils that are technically infertile, with very low levels of key nutrients and nutrient holding capacity, despite years of synthetic fertiliser applications. This gives the lie to the argument

that the addition of synthetic fertiliser is necessary for long-term improvements in soil fertility. Indeed, the opposite is the case. Soil renewal, based on increasing organic content to feed soil life as the basis for long-term improvements in plant quality and nutrient uptake, takes a back seat to the short-term solution of synthetic fertiliser application for immediate gain. In their analysis of the research sites, Chitedze soil scientists recommend an increase in organic matter as a key intervention to improve the quality of these soils over time.

The Farm Input Subsidy Programme (FISP)

Three major government input subsidy programmes from 1998 were combined in 2005 to form the FISP, with a focus on providing subsidised maize and legume seed and fertiliser to farmers. The subsidy was withdrawn from cotton and tobacco farmers in 2009. Households benefiting from fertiliser subsidies need pay only MK500/50kg bag (US$1.19) which has a market value of MK17,000 (US$40.48), although they often do not receive enough and purchase additional bags at the full cost. Input distribution under FISP operates on a tender system. In 2014 two parastatals, the Agricultural Development and Marketing Corporation (ADMARC) and the Smallholder Farmer Fertiliser Revolving Fund of Malawi (SFFRFM) won the tenders to distribute the inputs. The private sector benefits from increased market demand and guaranteed markets. Key beneficiaries are the major seed companies: SeedCo, Pannar, Monsanto and Demeter Seed, especially with increased demand for their maize hybrids. The major companies providing fertiliser in Malawi are Farmers World (which also owns Demeter Seed), Yara, TransGlobe, Omnia and Rab Processors (which owns the Kulima Gold agro-dealer distribution network). Forty-four per cent of respondents indicated they had access to FISP inputs in the past season. This was slightly lower in Chamama than in Chipala and Nabuma. In the latter two sites more than half the respondents had received FISP inputs in the past season. However, respondents were concerned that there was little consistency and participation may only be for a single season. Farming households tend to share the inputs with others. The result is smaller quantities of inputs from the programme per household, but a wider diffusion of the technology.
The survey results indicate that FISP in these sites provides access to fertiliser more than to seed. In the past season only 11% of farmers accessed hybrid maize through FISP. It is possible that respondents who indicated they received seed from agro-dealers used FISP vouchers as a contribution. FISP certainly has contributed to the higher use of hybrid maize seed. Prior to the introduction of FISP approximately 43% of farmers in Malawi used hybrid maize. By the 2009–2010 season this had risen to 65%. Our survey indicates that 73% of households used hybrid seed in the last season.

There is widespread recognition that FISP is not an optimal solution. Comments from farmers, farmer support organisations, extension workers and other key informants included the following statements: FISP is politically motivated; it is not good for agriculture despite increased yields; costs and outputs of FISP do not match; there are serious targeting issues; and heavy dependence of the agricultural system on rain means that input subsidies are a wasted investment if the rains do not come. In addition, FISP has been criticised for its expenditure remaining biased in favour of private goods benefiting individual farmers, such as fertiliser and seed, rather than investments in public goods, such as research, rural infrastructure and extension that can benefit farming households collectively. Despite higher yields, most Malawians remain mired in poverty which suggests that the GR package is not delivering meaningful improvements for farmers.

Market access

More than 80% of respondents cited a lack of markets as a serious challenge. This suggests that farmers are keen to increase sales. Yet, in practice, yields are relatively low and most households do not produce enough to meet even their own yearly consumption needs. Market access may mean physical access to distribution and sales points; it can also mean product prices that enable farmers to profit from selling their outputs. The research indicates that the latter is of greater

importance than the former. While transport infrastructure was not good in the sites we visited, farmers had a number of possible outlets for the sale of produce. These included local markets, vendors who came to the farm gate to buy, as well as NASFAM and other commercial enterprises who were willing and able to purchase products from farmers.

Essentially, to farmers market access means price. Vendors are widely seen as exploitative, offering low prices and cheating farmers, but because farmers are forced into distress sales to acquire some cash they accept these prices. NASFAM, ADMARC and others offered slightly better prices for some products, some of the time, but the main concern among farmers was that these market outlets were inconsistent; also, when the buyers ran out of money they closed the channel, leaving farmers with no option but to sell for cheaper elsewhere. Respondents observed that market outlets based on value chain financing are disbanded as soon as organisers have bought enough produce to recover the loans given to farmers. One farmer observed that "these markets operate as long as the farmers have not finished repaying their loans, and disappear almost immediately afterwards".

Lack of appropriate storage facilities means that farmers have to sell as soon as the product is ready for harvest. Generally this is at the same time that everyone else is selling, so there is a temporary glut in the market just when farmers are trying to sell. Opportunities for improved producer prices through quality premiums or value addition are limited at present. ADMARC is the only organisation that offers quality premiums but its marketing arm is considered not as efficient as it once was; and it currently purchases more produce from vendors than directly from farmers.

The GR depends on profitable output markets that enable farmers to purchase inputs that benefit the input suppliers, but most participating farmers were not selling significant amounts of produce at all. Tobacco is the only major cash crop in the three study sites and the terms of trade are against farmers, as indicated above. Apart from tobacco, soya was the only crop where more than half of the production quantity was sold, but these were small amounts and this applied to relatively few farming households.

Average maize sales came to just 222kg, with the vast majority selling under 1 ton of maize. Between 62% (hybrid) and 70% (local) of respondents sold 50kg of maize or less. 50kg of maize can be sold for MK3,000 (US$7.14) at local market prices. This indicates that maize is a crop primarily for own use, with distress sales of small quantities to acquire some cash. We already mentioned earlier that the average expenditure on fertiliser inputs alone, amongst the respondent households, was equivalent to the local market value of 1.5 tons of maize. Recouping these costs requires sales of an equivalent amount, aside from production retained for own consumption. The GR proposes to turn farmers into commodity producers who earn cash from the sale of their products and then buy their food needs on the market—but this is not how it is working in practice.

Conclusion and recommendations

Green Revolution interventions, of which AGRA is a leading example, are fundamentally premised on the idea that increased costs of certified seed and synthetic fertiliser can be met by increasing yields. This will allow for increased sales that can generate income for input purchase in the next year, as well as the expansion of farming as a business—to the benefit of producers. However this 'endless virtuous cycle' does not appear to have taken root in Malawi. Farming households are purchasing some GR inputs, but realising potential yields requires ideal conditions and these are present nowhere in Malawi. Whether the limiting factors are lack of rainfall, weak soils, lack of appropriate production support, chronic ill-health, lack of access to clean water or other factors, GR technologies will always perform sub-optimally. This means that yields will be lower than potential yields in ideal circumstances. In turn, this means that households must use a greater share of their produce for their own consumption. Finally, this means less available produce for sale and thus lower incomes than are anticipated in the GR theory.

This is borne out in the research: the vast majority of households appear to be caught in a relationship of dependency on GR inputs, in particular synthetic fertiliser. It is apparent that fertiliser and seed prices are very high and are a major concern for farming households. At the same time, households feel the need to use these inputs just to stay in the same place. There may be some yield increases, especially with maize, but the maintenance of these yields requires a continual reliance on and expansion of external inputs, at a long-term ecological cost. Instead of a virtuous cycle of increasing prosperity for farmers, we see a negative cycle based on short-term yield improvements, creating a dependency on these inputs while generating long-term yield stagnation and declining soil fertility. These negative outcomes all reinforce dependency on the GR technologies that contributed to the problem in the first place.

Even if maize yields are higher using GR technologies, the diversity of nutrition and the all-year production of agro-ecological systems give the latter much greater depth. Malawi still has a regular hungry season despite productivity increases in maize. This is related to the production and harvest of a single crop every year.[4] Support for crop diversification and differentiated year round production can extend the range of nutrients available to farming households.

Tobacco company value chain financing and FISP are key mechanisms for propping up this system of production. In the tobacco value chain primary producers are reliant on tobacco production as a cash crop. But producers are clearly in a weak position, relying on buyers to provide inputs while carrying the production risk and receiving only a small portion of value added. Tobacco multinationals are the primary beneficiaries of this system. The multinational corporations (MNCs) are politically very powerful and the Malawian government is reliant on the industry for a large portion of its foreign exchange earnings. However, tobacco as a crop is poisonous—it damages the soil, contributes to deforestation which in turn

leads to soil degradation and increasing CO^2 emissions, and locks farmers into production systems that are not in their long term interests. In essence, tobacco is an anti-social crop and Malawi and other producing countries in the region should consider socially and ecologically just alternative crops and production systems to replace tobacco.

FISP is an essential element in the expansion of GR technologies in Malawi. The programme has increased effective demand for hybrid maize seed and synthetic fertiliser and created a guaranteed market for MNCs in which to profit. FISP has increased the amount of money circulating in and out of the farming system, but farmers are in much the same position as they were before the advent of FISP. Mostly their gains are limited to relatively minor yield increases, with concurrent long-term negative consequences on the ecology. To make matters worse, the money comes in from public expenditure through the subsidies (development aid as well as African governments) and out through private channels (seed and fertiliser companies). Effectively this is public investment for corporate gain, with seed and fertiliser multinationals as the primary beneficiaries of the system.

Green Revolution technologies are making inroads into small-scale farming systems in

4. Interview, Kristof Nordin, Never Ending Farms, Lilongwe, 5 Feb 2014.

Malawi support from the public and from philanthropic institutions including AGRA. But farming households are engaged in a range of agro-ecological practices that form the material basis within which the GR embeds itself. Conservation Agriculture and Integrated Soil Fertility Management (ISFM) are good examples of a base of agro-ecological practice being used to advance GR technologies. The research indicates that agro-ecological practices are widespread and this offers an opportunity for systematic support to realise a more sustainable and equitable path of agricultural development.

Currently fertiliser is allocated without any knowledge of soil nutrient needs. High levels of synthetic fertiliser are being used and farmers are trapped on the treadmill of dependency. The best solution for this is a gradual weaning process, based on the evidence that other methods of maintaining and improving soil fertility can be effective. Even the proponents of GR recognise the critical importance of adding organic content to the soil, as a fundamental basis for improving fertility, yet they are unwilling to invest in enhancing and expanding these practices.

In agreement with Olivier de Schutter, we propose that input subsidies targeted at individuals should be phased out and replaced with public investment in extension, farmer-based R&D and bulk infrastructure such as water and roads with collective benefit. A key part of public investments in R&D and extension can include: identifying, prioritising and supporting work around participatory plant breeding; participatory variety selection; farmer-managed seed certification and quality assurance systems; identifying and supporting the development of locally important crops on the basis of decentralised participatory R&D; farmer to farmer exchanges; identifying and expanding the means of increasing organic content in the soil; an orientation to nurturing soil life as the basis of soil fertility, or soil health programmes: and support for agro-ecological methods of soil improvement and water retention. In addition, work on nitrogen fixing trees and food trees could advance soil fertility and food security agendas.

Thus far research has shown that while AGRA programmes are having a relatively small impact on the three study sites so far, AGRA contributes significantly to the broader GR thrust. Follow up research will focus in more detail on NASFAM's pigeon pea programme and other seed related issues, on the CNFA-supported agro-dealer networks and on monitoring and analysing the interventions of the SSTP.