End of Phase 1 Evaluation

AGRA's Soil Health Program

FINAL REPORT

Submitted to

The Alliance for a Green Revolution in Africa

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Acknowledgements

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Acronyms

ACT	Africa Conservation Tillage Network
AFAP	Africa Fertilizer Agribusiness Partnership
AFAAS	African Forum for Agricultural Advisory Services
AFFM	Africa Fertilizer Financing Mechanism
AfDB	African Development Bank
AfNET	African Network for Soil Biology and Fertility
AfSIS	African Soil Information Service
AGMARK	Agricultural Market Development Trust Africa
AGRA	Alliance for a Green Revolution in Africa
AICAD	Africa Institute for Capacity Development
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASHC	African Soil Health Consortium
AWARD	African Women in Agricultural Research and Development
BMGF	Bill and Melinda Gates Foundation
CAADP	Comprehensive Africa Agriculture Development Program
CABI	CAB International
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
CGIAR	Consultative Group of International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Centre
CORAF/WECARD	Conseil Ouest et Centre Africain pour la Recherche et la Developpement Agricoles/ West and Central African Council for Agricultural Research and Development
CROPNUT	Crop Nutrition Laboratory Services
EAC	East African Community
EAAFF	Eastern Africa Farmers Federation
ECOWAS	Economic Community of West African States
ESF	Extension Support Function
FAC	Future Agricultures Consortium
FANRPAN	Food, Agriculture and Natural Resources Policy Network
FARA	Forum for Agricultural Research in Africa
FGD	Focus Group Discussion
FIPS	Farm Input Promotions
FO	Farmer Organisation
FOSCA	Farmer Organisation Support Centre in Africa
GFRAS	Global Forum for Rural Advisory Services
GIS	Geographic Information Systems
HU	Haramaya University - Ethiopia
ICRAF	World Agroforestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technologies
IFDC	International Fertilizer Development Centre
IFPRI	International Food Policy Research Institute
IIRR	International Institute for Rural Reconstruction

IPNI	International Plant Nutrition Institute
ISFM	Integrated Soil Fertility Management
KII	Key Informant Interview
KNUST	Kwame Nkrumah University of Science and Technology
KU	Kenyatta University - Kenya
LUANAR	Lilongwe University of Agriculture and Natural Resources - Malawi
MAP	Market Access Program
MC	Management Committee
MIS	Management Information System
MTP	Mid Term Plan
MU	Makerere University - Uganda
M&E	Monitoring and Evaluation
NARES	National Agricultural Research and Extension Services
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation
NSHC	National Soil Health Consortium
OM	Organic Matter
PASS	Program for African Seed Systems
PIP	Project Implementation Plan
PO	Program Officer
PPP	Public-Private Partnership
PSU	Program Support Unit
P&P	Policy and Partnerships Program
RIU	Research Into Use
RMF	Results Monitoring Framework
ROP	Rural Outreach Program - Kenya
ROPPA	Network of Farmers' and Agricultural Producers' Organisations of West Africa
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
R&D	Research and Development
SACCO	Savings and Credit Cooperative
SHE	Soil Health Extension
SHF	Soil Health Fertilizer Supply
SHP	Soil Health Program
SHR	Soil Health Research
SHT	Soil Health Training
SIDA	Swedish International Development Cooperation Agency
SIMLESA-ACIAR	Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa – Australian Centre for International Agricultural Research
SUA	Sokoine University of Agriculture
TSBF-CIAT	Tropical Soil Biology and Fertility Institute – International Centre for Tropical Agriculture
UZ	University of Zambia

Executive Summary

Introduction and background

This report presents an end of phase one evaluation of the Alliance for a Green Revolution in Africa's (AGRA) Soil Health Program (SHP). SHP is one of the four core Programs of AGRA. Its mission is to increase incomes, improve food security and reduce household poverty by promoting the use and adoption of integrated soil fertility management (ISFM) practices among smallholder farmers and creating an enabling environment for farmers to adopt the practices in an efficient, equitable and sustainable manner across sub Saharan Africa.

The SHP was established in August 2008, and its first phase will come to an end in November 2015. AGRA therefore commissioned an independent end-of-program evaluation of the Soil Health Program by the Natural Resources Institute, University of Greenwich, in collaboration with the Department of Extension, Lilongwe University of Agricultural and Natural Resources. The aim was to assess the overall program performance in relation to its objectives, and to provide input into the new strategic directions or implementation designs/strategies of another phase. The evaluation was to assess what has worked, what did not work so well, key lessons learned and what should be emphasized or adjusted, in the second phase.

Methodology and approach

The evaluation used mixed quantitative and qualitative methods for systematic data collection and analysis.

An evaluation framework was drawn up to guide the evaluation, covering evaluation questions, indicators, data sources and methods for data collection. Evaluation questions were grouped under themes: Quality and relevance of Program design, Program impact, efficacy of models used under the program, integration with other AGRA Programs, Program efficiency, management issues and challenges and lessons. The framework formed the basis of the evaluation design.

The evaluation exercise covered the thirteen SHP program countries of Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Rwanda, Niger, Nigeria, Tanzania, Uganda and Zambia. In-depth fieldwork including household surveys was focused on seven countries: AGRA P1 countries (Ghana, Mali, Mozambique, Tanzania), one P1+2 country (Nigeria), and two P2 countries (Malawi and Kenya). The justification for choice of these countries was based on the revised strategy prioritized and focused SHP investments and specifically the Breadbasket regions within P1 countries (agreed with SHP and M&E staff). In addition to these seven countries, field interviews were carried out in Ethiopia, Rwanda, Uganda and Zambia with key stakeholders and beneficiaries.

Field data was collected from a sample of key informants of the Soil Health Program including: farmer organizations, agro-dealer networks, private sector input producers and traders, project administrative and technical personnel, program partners, AGRA program staff and management. Focus Group Discussions (FGDs) were also carried out with communities and other groups targeted by the program. These included: Government officials, University and research staff, Agro-dealers, postgraduate students and laboratory technicians. Focus Group Discussions and Key Informant interviews were carried out using focused checklists.

Following actor mapping, representatives of the actor category were purposively selected on the basis of level of influence, gender and social difference for key informant interviews including: Government officials, national and international agricultural

research Programs and capacity building partners. The evaluation involved a household survey with the use of questionnaires administered to a representative sample size of farmer households and small-scale processors. To enhance likelihood of achieving the evaluation objectives stated above, the selection of grants was made using a sampling frame of SHP-funded projects which were clustered into: projects that have ended; projects half-way into implementation; and projects that are in the early stages of implementation. In agreement with SHP, and to enable assessment of project impact, the focus was on completed projects and those which have been implemented for 2 years or more.

Challenges

The main challenges faced included: locating some beneficiaries in the field and unavailability of project staff, particularly where projects had ended. Nevertheless, the team was able to meet targets on household interviews and also conducted focus group discussions and key informant interviews with around 30 percent of projects across the sub-Programs.

Key findings

ISFM Scale out

Context of ISFM scale out and models under ISFM scale out

The goal of the Integrated Soil Fertility Management Scale-Out (ISFM Scaling-Out) was to extend ISFM technology packages to 4.1 million smallholder households in an efficient, equitable and sustainable manner by 2018. This was refocused during the SHP strategy refresh and development of the Medium Term Strategy and Plan leading to: increased investments that facilitate an integrated approach to ISFM scale-out in breadbasket areas of six prioritized “P1 (+2)” countries, prioritized SHP investments in areas where non-core intervention areas are in place with these interventions carried out via partnerships, creation of a new Extension Support Function (ESF) that works across AGRA programs, and increased capacity for intervention area in diagnosis and strategic choice prioritization.

The Strategy also prioritized integrated interventions targeting barriers across the entire agricultural value-chain, including access to inputs via innovative financing mechanisms.

Several models were used in operationalising the ISFM concept. These include:

- Fertilizer Microdosing (Mali, Burkina Faso and Niger) with ‘warrantage’ or inventory storage systems that allowed farmers gain access to input and output markets
- Legume-Maize Rotation: Doubled up legumes (SHP countries including: Malawi, Mozambique, Rwanda, Zambia) and Scaling up ISFM systems (Western Kenya)
- Anchor Farmer (CDI Malawi)
- Contract arrangements between farmers and companies providing inputs and buying produce (Zambia)
- Micro-finance institutions providing input (fertilizers and inputs) credit (cashless) to farmers

The review mission noted that though the project embraced a broad and holistic ISFM concept - “A set of soil fertility management practices that necessarily include the use of fertilizer, organic inputs and improved germplasm combined with the knowledge on how

to adopt these practices to local conditions" (Africa Soil Health Consortium 2012) most of the SHP projects have focused on improved fertilizer application (e.g. microdosing) and a combination of fertilizer and legumes as well as a little bit of manure application to help farmers address their soil fertility problems. The application of a wide range of high quality organic materials has been minimal, particularly when crop residues are removed from the field to feed livestock. The evaluation mission noted that generally interventions on soil organic matter management and micronutrients, and to reduce top soil losses (e.g. Conservation Agriculture practices, soil & water conservation) tend to be few and isolated.

It also appears that the focus has been on increasing awareness of inorganic fertilizer and legume technologies, with less attention to helping farmers to understand the soil science underlying the ISFM concept. For example there appears to be limited internalisation of the role of soil testing by farmers.

Partnerships for delivery: Beyond demos = beyond awareness raising

The ISFM scale up approach evolved from increasing awareness through demonstrations to linkages with inputs, markets, financial institutions etc. in what has become known as: Going Beyond Demos.

SHP ISFM Scale out projects have aimed to involve a range of stakeholders including researchers (testing ISFM technologies), extension (demonstrating ISFM technology), input suppliers (to provide fertilizer and improved seeds), farmer organisations (to mobilize farmers into groups) and buyers of agricultural produce (for output markets). Examples of partnership/linkages were seen in Mozambique and Zambia. Such arrangements where different stakeholders come together to diagnose problems, identify opportunities and find ways to achieve their goals in a space for learning and change is known as an Innovation Platform (IP). Though the principles of Innovation Platforms – including expert facilitation - are generally well documented, the SHP does not appear to have guidelines for grantees on how to facilitate innovation platforms. As a result, projects that have put in place such platforms for promoting ISFM are facing challenges on how to continue to facilitate and sustain the arrangements (for example in Mozambique).

Research and extension approaches under SHP

The SHP has promoted research on ISFM through various models. Interesting examples include the establishment of Research-Extension-Farmer Linkage committee (RELC) in Ethiopia where farmers' production constraints are identified at the local level by extension staff. These constraints are categorized into researchable and extension constraints and prioritized within each group. Researchers develop the technology which is transferred to farmers by the extension staff. However, the central research question in some of the experiments was not always clear.

The review mission noted that the research approach under SHP tends to be conventional empirical research approach or a variation of the Farming Systems research approach. This research approach has fixed questions and methods, designed to fill information gaps perceived to be constraining positive change. The strength of this research approach is its legitimacy in rigor of knowledge acquisition. The experimental design makes it possible for the experiment to be repeated. However a major weakness of the approach is that it only characterizes the situations and does not in itself address problems or identify "workable" solutions for target groups. At best, it generates hypotheses about what works.

It is the view of the review mission that the SHP ISFM extension approach is dominantly

conventional transfer of technology (ToT) whereby researchers develop the technologies which extension workers then transfer to lead farmers (early adopters), who eventually have to transfer these technologies to other smallholder 'follower' farmers. Many projects supported by AGRA follow this model. Typical of this model is support for on-farm demonstrations. Farmers have participated as managers of demonstration plots: however farmer participation in the design and evaluation of experiments has been limited. This approach works well with large-scale commercial farmers but has failed with smallholder farmers worldwide due to poor public extension services and unavailability of extension staff on the ground. While radio and phone messages appear to be a way to ensure that messages reach farmers, but these were limited by a shortage of extension workers to reinforce the messages. The effectiveness of demonstrations is questionable as previous evaluations on AGRA programs have indicated that farmers rarely learn from demonstrations but rather from extension workers and fellow farmers.

Extension support function

The Extension Support Function (ESF) of SHP has tested and piloted extension tools and methods with some promising results. These include radio listening clubs, mass sms, innovation platforms, cooperative services, convergence of radio and sms, voice mail and the Digital Green (DG) approach, Women and youth participation in District Agents empowerment, Mobile video on tri-cycles, radio listening clubs, cell-phones and Innovation platforms, ICT platforms, cell-phones, private extension and Community Extension workers and youth approach.

There have been a wide range of experiences from these pilots and experiments. However lessons from the different extension tools are not yet fully documented and analysed for the Extension Support Function to able to put together advice to ISFM projects on appropriate learning and dissemination approaches for different contexts.

Awareness of ISFM technologies by smallholder farmers in SHP

Findings from the survey show that levels of awareness of various technologies, including inorganic Fertilizer and growing legumes in 2014 were high, particularly amongst beneficiary households. Awareness of use of improved legume seeds as an ISFM technology was high (over 80%) amongst surveyed beneficiaries in Mali, Kenya and Malawi. In all countries, except Mali, awareness of improved legume technologies was significantly higher for beneficiaries than non-beneficiaries: significant in Ghana, Kenya, Tanzania, Malawi and Mozambique. For other soil fertility technologies, such as use of farmyard manure and composting, levels of awareness among beneficiaries were high in Mali, Malawi and Kenya (both technologies) and for manure in Nigeria, Tanzania and Mozambique. Awareness of composting was low (below 50 percent) in Ghana, Nigeria, Tanzania and Mozambique. The differences between beneficiaries and non-beneficiaries were significant in Ghana, Nigeria, Tanzania, Malawi and Mozambique (both technologies) and Mali for composting. Although ISFM technologies such as composting and use of farmyard manure are not the main focus of most SHP projects, project beneficiaries were found to be more aware of these options – though they are not necessarily practising them. Variations in awareness of ISFM technologies and practices are influenced by a number of factors, including degree of ISFM technologies dissemination.

Source of Knowledge on ISFM technologies

Various channels have been used by SHP projects to provide information and

knowledge about ISFM technologies including: demonstrations, radio, phone messages, field days, extension workers and lead farmers. The Evaluation Survey across found that on average extension workers were the most important source of information for fertilizer (37 percent for beneficiaries and 30 percent for non-beneficiaries) and second most important source for legume technologies (15-20 percent of respondents). Family members or fellow farmers were a leading source of knowledge on fertilizer, legumes and composting technologies for beneficiaries and non-beneficiaries. For beneficiaries, fellow SHP beneficiaries were the third most important source of information on both technologies and were particularly important for Fertilizer.

The role of farmers as community extension agents is highlighted by the Evaluation survey. Over 50% of SHP beneficiaries in Kenya, Tanzania, Ghana and Malawi shared knowledge about ISFM with other farmers. The most important ISFM technologies and management practices shared with non-beneficiary households across the seven countries were: composting, inorganic fertilizer and crop rotation. Legume technologies, microdosing and mulching were the least shared technologies.

Farmers using ISFM technologies

The evaluation survey revealed inorganic fertilizers were used by over 70 percent of beneficiary households in Ghana, Mali, Nigeria, Malawi and Mozambique, and by 63 percent in Kenya in 2014. Use of Fertilizer by non-beneficiary households was significantly lower in all countries except Mali (no significant difference).

Grain legume cultivation was practised by over 70 percent of beneficiary households in Kenya, Mali and Malawi; and over 60 percent in Mozambique and Mali. This is not a new technology for all countries, however, beneficiary cultivation of improved legumes is significantly higher than non-beneficiaries for all countries except Mali. Again in Mali it appears that spill over effects from the project have been high, with 70 percent of non-beneficiary households also taking up legumes.

Use of farmyard manure as a soil fertility technology is most common in Mali and Kenya, followed by Malawi, Mozambique and Nigeria. The lowest use is in Ghana. Beneficiary households are significantly more likely than non-beneficiary households to be applying farmyard manure to their fields in all countries except Mali (where it is widely practised). Composting is a less widely practised technology, not having been widely promoted under SHP projects, and generally requiring significant labour inputs and a source of water. Nevertheless, a high proportion of beneficiaries in Mali (76 percent), followed by Kenya (53 percent) and Nigeria (45 percent) were found to be using composting. In the other countries less than 30 percent of beneficiaries were using composts (none in Tanzania and Malawi).

Crop Yields

Mean yields of key crops, maize, rice groundnuts, and soya, have increased for most crops over the project period for beneficiaries in all countries surveyed except for Kenya, where maize was hit by leaf rust in 2013/14, and Nigeria where there were problems of rainfall. Mean yields of maize have increased from around 1 tonne per hectare in Ghana, Mozambique and Mali to between 1.1 and 1.4 t/ha; and from 1.5 t/ha in Tanzania and Malawi to 1.9 and 2.2 tonnes per hectare respectively. In all countries except Ghana and Mali, maize yields for beneficiaries were higher than for non-beneficiaries. Rice production for surveyed beneficiaries has increased in Ghana (by 20 percent) and Nigeria (28 percent). No significant increase was found Mali where yields were highly variable between farms. Overall yields are lower than those recorded by the projects on research plots. High variability in yields was seen amongst farmers surveyed.

Harmonized ISFM messages through Soil Health Consortia

The ISFM scaling-up sub-program is supporting National Soil Health Consortia and all countries have made some progress towards the establishment and initial functioning of the National Soil Health Consortium. Progress is varied in different countries but generally positive across the region. Websites are up and running in Kenya, Malawi and Zambia. Seventy consortia members have been trained in data synthesis and development of communication products. Thirty communication products have been developed (policy briefs, extension guidelines, technical reports, radio messages). Malawi has developed harmonized ISFM messages and packaged them for radio.

The Soil Health Consortia were intended to provide a one-stop shop to information on soil health and fertilisers. This is clearly a medium- to long-term goal and both the approach to harmonisation of ISFM messages and rate of progress has varied across countries. In Malawi, SHC are making progress in synthesising data and developing ISFM guidelines to provide a set of options that farmers can choose from depending on their context. In Kenya, SHC are collating the huge amount of data available on fertilizer recommendations and coming up with a single best-bet recommendation for key commodities.

Fertilizer Supply and Policy

AGRA SHP support focused on building technical and institutional capacity of fertilizer regulatory divisions for the effective implementation of fertilizer regulation and quality control in the target countries. By the end of 2014, SHP exceeded the target of six countries and has since covered all the 13 countries. In some countries (Ghana, Mali and Tanzania), regulations are in place and implementation is underway, others (Uganda, Mozambique, Zambia, Burkina-Faso, Malawi and Rwanda) are at advanced stages and the rest (Niger, Nigeria, Kenya and Ethiopia) are still in the initial stages.

Fertilizer supply projects supported the purchase of office supplies and equipment for fertilizer regulatory agencies and trained 2,863 fertilizer inspectors and fertilizer analysts/ technicians. The intervention has contributed to notable success in fertilizer inspection throughout the market chain. There is also increased uptake of the fertilizer analysis services offered by technicians and more samples are being taken for analysis. These outcomes were particularly emphasized during evaluation survey in Ghana and Tanzania. In addition, the on-going Fertilizer policy harmonisation activities in EAC and ECOWAS are drawing from achievements from member countries – especially in ECOWAS (Mali, Ghana, Burkina Faso, Niger and Nigeria).

Despite the existence of regulatory systems, there is weak compliance to laws and regulations in fertilizer supply in many countries under review. This problem is attributed to implementation bottlenecks, problem of mobility among fertilizer inspectors and budgetary limitations.

The fertilizer blends and lime projects have made commendable progress towards development and implementation. The achievements in the agricultural lime projects in Kenya and Rwanda are likely to be sustainable given that they piloted a public-private partnership (PPP) approach --with lessons drawn from the previous projects built into the new ones. However, the problem analysis appears to be incomplete for several reasons: i) micronutrients are not being given adequate attention in the problem analysis; ii) lack of clarity on partnership with international researchers, iii) emerging challenges in the value chain (e.g. seeds) when addressing the lime problem, iv) issues of sustainability, method of application given its powder form, and v) how to integrate lime with inorganic

fertilizer.

A total of 9074 agro-dealers were trained in 12 target countries. However, key informants asked for more support to agro-dealers in remote areas especially on input sourcing and use as well as use of IT in record-keeping.

AGRA's Innovative Finance Program has facilitated provision of individual loans and group loans. Different approaches of innovative finance were adopted in the SHP. The approaches include projects: providing credit guarantee for the farmers, advancing funds to farmers through farm input suppliers, brokering arrangements between farmers and buyers, and supplier credit. Most projects under SHP adopted credit guarantee for the farmers.

These approaches had mixed performances in delivering input credit to smallholder farmers. For instance, the project advancing funds to farmers through farm input suppliers implemented by Instituto de Investigação Agrária de Moçambique (IIAM) achieved over 80% success rate of repayment and farmers doubled their yields. The partnership with financial institutions to facilitate credit entailed: farmers' financial access to inputs, and farmers' physical access to available inputs through agro-dealers. The input credit guarantee approach through a lending institution such as a bank or a Savings and Credit Co-operatives (SACCO) adopted in Kenya by ARDAP did not have defaulting farmers because the defaulted payments were recovered from individual savings or shares. Similarly, the cashless financing involving a financial institution scheme such C*entre for Agricultural Rural Development (CARD) in Ghana* achieved a recovery rate of 100% of the cashless credit. The inventory credit under a warehouse receipt system in countries such Kenya and Nigeria, or French warrantage system in francophone West Africa aimed at building a network of win-win business relationships among the different stakeholders. In the project procuring inputs and distributing through government officials being implemented by Clinton Hunter Development Initiative (CHDI) in Malawi reported that 2200 farmers were accessing loans and loan repayment for 2011/2012 season was 88%.

Key challenges are: (i) repayments when production is affected by climatic conditions and farmers are unable to repay seed, ii) for rapid scale up, a proportionate increase in the volume of funds needs to be set aside in revolving funds for cash collateral – this means that a large credit guarantee level is required as collateral which is unaffordable for many SACCOs and cooperative societies, iii) credit available is limited to a few farmers, iv) the credit provider has limited capacity to offer services, v) market oriented credit systems such warehouse receipt system and warrantage system face management and operational challenges. As a result, SHP should work with financial institutions with a track record of managing loans and credit to farmers. In so doing, SHP's focus should be on providing technical advice on how finance institutions and governments can design products that meet needs of farmers; building capacity of farmers; and facilitating farmer linkages to such services.

Soil Health Training and Education sub-program

Since the inception of the AGRA SHP training sub-program 177 post-graduate students from 13 countries have been enrolled in MSc or PhD programs and the first 69 MScs and 9 doctorates have been awarded. The introduction of course work into PhDs, an innovation of the Soil science/ISFM PhDs at SUA and KNUST, is now being adopted across other departments and subjects. The trained graduates are returning to strengthen their organizations with knowledge of soil science, ISFM or in some cases soil and water management. The training program has made a particular contribution to increasing the participation of women in ISFM related work: female students now comprise 51% of total SHP-supported enrolment. Progress has been made in awarding PhD studentships to women (currently 33 percent) with support provided by the program, but reaching 50 percent will require a concerted effort by universities and the program.

The AGRA training program made significant investment in support to curriculum review by the participating universities with contributions from national and regional stakeholders. The taught courses and research projects have emphasized effects of soil fertility on crop production and soil chemistry, rather than looking at the functioning of the rhizosphere and contribution of soil micro-organisms and invertebrates to nutrient cycling and maintenance of soil health.

Course work prior to the research project at some universities e.g. SUA, LUANAR and Makerere includes discussion of national issues on soil fertility. Makerere takes students on a field trip early in the course to help them identify ISFM topics.

Impact of SHP at Household level

Soil Health Program was found to have contributed to positive impacts at the household level on incomes, food security, poverty alleviation and enhancing households' overall wellbeing.

Income from crops

Survey results show that beneficiary households have seen significant increases in the value of maize production over the project period in Nigeria, Kenya and Ghana (50-100 percent increases). Farmers in Nigeria and Kenya have increased their groundnut, sorghum and millet output value. In Mali and Ghana, farmers have increased rice, sorghum and millet production values from 50 percent to over 100 percent.

Markets

In terms of marketing, it was found that informal markets remain the most important outlet for farmers involved in SHP-supported projects. Farmer organisations were important for farmers in Mali (25 percent) and Malawi. In Tanzania, non-beneficiaries were more likely to market through farmer organisations. Tanzania has a history of well-organized farmers' organization which seems to influence marketing of commodities than the other countries. Only in Nigeria were farmers (both beneficiaries and non-beneficiaries) marketing through formal markets on a significant scale (80 percent of households).

Household food security

Households interviewed reported improvements in their food security situation in all

countries visited except Malawi. Improvements ranged from 6 percent to 41 percent in Kenya. On average over 75 percent of beneficiary households were able to meet their food requirements throughout the year. In Mali, Nigeria, Kenya and Mozambique project beneficiaries were more likely to be meeting their household food needs than non-beneficiary households. In Ghana and Malawi the difference between non-beneficiary household food security situations was not significant

Overall impact

The proportion of SHP beneficiary households assessing themselves as poor or very poor has fallen all across the countries – notably Ghana (by 36 percent), Kenya (44 percent) and Tanzania (52 percent) while the proportion of between moderately better off and better off increased in all countries. Non-beneficiary households have also improved their economic status. However, in Kenya and Tanzania beneficiaries were considerably more likely to have moved out of poverty than non-beneficiary households.

SHP project beneficiary households reported on changes occurring on the farms and in their households as a result of taking up ISFM technologies. Farmers perceived improvements in soil texture in countries except Mozambique, as well as improved water holding capacity of the soils. High proportion of farmers, ranging from 67% in Mali to 86% in Kenya, reported they are now using improved seed varieties and agronomic practices, including fertilizer. Households have also increased the diversity of crops grown for both household food security and the market.

SHP project beneficiary households were asked about the overall impact of participation in the project. Responses on the overall impact of participation in the project were overwhelmingly positive and included: increased variety of crops grown for the market in Malawi (71% of respondents), Kenya (63%) and Nigeria (61%); improved crop yields (Ghana, Kenya and Tanzania), improved skills in value addition (Mozambique) and food self-sufficiency (Malawi and Mozambique).

SHP Programming issues

SHP Theory of Change

The review mission noted that the SHP theory of change (ToC) provides a useful visualization of the interventions required to bring about Program outcomes and wider development goals. The review mission noted that progress towards achieving the Program goals looks positive, although exact numbers of farmers reached are difficult to verify.

Equity and inclusion

Findings from the evaluation showed that, farmers participating in the Program across the surveyed countries were mainly in the poor groupings of their communities at the start of the Program with some, particularly in Tanzania, considering themselves very poor. There were few cases of well off smallholders being targeted. This implies that the program has targeted mainly vulnerable but viable households as well as some highly vulnerable and a few market-ready smallholders. There appears to have been some transformation over the 5 years since the start of the Program. Many beneficiary households have become moderately poor or moderately better off in their communities: 12 percent in Mali and Nigeria, 36 percent in Ghana, 44 percent in Kenya and 52 percent in Tanzania.

AGRA projects deliberately target women farmers and students. Around one-third to half of project participants were reported to be women. Women also made up 50 percent of

trainees under the Training and Education sub-Program, though the number of PhD candidates has been low (33 percent).

Landscaping and Partnerships

The launch of AGRA was a major contribution to the effort of improving Africa's soils. A large number of actors are addressing soil fertility at different levels. SHP has made considerable efforts to network and link with many of these organisations at different levels. These include international organisations, CGIAR institutions, and dissemination agencies. However, the level of interaction and degree of convergence with these Programs is variable. Also the division in responsibilities seems to be hazy and communication sometimes poor, so that SHP and other organisations are sometimes funding the same partner.

Strategic partnerships have been made with a number of national, regional and international organisations who are providing a range of backstopping and advisory services to the Program. The impact of these inputs can be seen in areas such as communications, where the project has linked with IIRR to produce high quality outputs, in a facilitation and value-addition role.

Grant management

SHP has achieved a very high rate of project commissioning: an average of 19 grants per Program Officer (PO); ranging from 12 (new PO) to 36 for Senior PO. By January 2015, 94 percent of available funds had been awarded as grants. SHP aimed to target the 'hard to reach' grantees – NGOs and national institutions – rather than large international NGOs and international research centres. SHP often started out with a small grant whilst supporting the capacity of target grantees. Some of these have now graduated to large grants, particularly in the ISFM-scale out and Fertiliser supply sub-programs. However, in some cases it is not evident how the small projects will graduate into larger projects (for example in the Extension support sub-program).

Overall there had been a successful conclusion of 12 grants up to December 2014, with active grants at 102. Three grants were cancelled: two were not taken up by the national government and one organisation changed strategy (2.5 percent of total grants).

The number of no-cost extensions is almost 40 percent and is across all sub-Programs. Reasons given by the Program and grantees include: delays in sending/receiving grants due to administrative issues by either party; insufficient time period for the grant to implement activities (three years was perceived to be too short by many grantees and some program staff); grant received after the start of the academic year (SHT); and staff capacity or changes at project level.

Audit recommendations on SHP projects have been 82 percent partly satisfactory; 9 percent satisfactory; and 9 percent unsatisfactory. The Grants Unit has made a concerted effort to address this by providing capacity building to grantees through orientation workshops and one-to-one review and coaching. These have been a useful way of improving performance and reaching out to difficult to reach grantees.

Conclusions and Key Recommendations

The review mission concluded that the SHP appears on track to reach its targets by end of 2015. There are issues of the extent of attribution of impacts noticed to SHP, difficulties of estimating number of farmers practising ISFM technologies and sustainability of project outcomes: not all farmers practising technologies or agrodealers operating during the life of a project may continue their activities after support is phased

out. However, even with a large margin of error, the achievements are significant.

To develop and sustain the Program the following recommendations are made:

ISFM Scale-out

1. The Program should critically look at how to support arrangements put in place by the project to ensure they continue after phase-out. Options are to facilitate a further funded phase; mainstreaming into Government Soil fertility Programs; and also tapping into Private sector initiatives.
2. The Soil Health Program needs to develop a model and guidelines for developing sustainable innovation platforms for the promotion of ISFM with strong links to SH Consortia. Farmers groups such as the GACs need to operate as Agricultural Innovation Platforms (AIP), interacting and engaging with different actors, for example researchers on developing/adapting the technologies, private buyers to market their crops and extension workers for skills and information on the technologies.
3. ISFM under the program should include: organic matter, micronutrients management and Conservation Agricultural practices such as minimum disturbance of soil, maintaining permanent soil cover and promoting crop associations (intercropping/rotation of cereals with N –fixing legumes)
4. Soil science principles underlying ISFM need to be communicated with farmers.
5. Participatory Action Research approaches should be generally adopted as the appropriate approach. There needs to be clarity on the research questions, and in whether the project is mounting demonstrations or experiments. A participatory extension demand driven service delivery is required for farmers to secure sustained benefits.

Extension support function

1. The extension support function should promote the operationalisation of Participatory extension approaches, Participatory Learning and Action Research, Participatory Technology Development, Farmer Field Schools and Farmer Field Fora and the Participatory Development Approach that strengthen the demand side of extension, strengthen the supply side and strengthen the Organising the Response – Policies to support Services.
2. National Soil Health Consortium should identify a range of ISFM options for smallholders for different socioeconomic and agro-ecological contexts. IPNI should review and provide appropriate levels of capacity support to SHC members. Where necessary, harmonisation of ISFM data across regions and the continent might best be handled by regional research organisations mandated with coordination and harmonisation

Fertilizer supply and policy

1. Develop stronger partnerships with (inter)national researchers and governments to respectively conduct research on micronutrients and integrate the distribution of lime into government fertilizer policy and programs.
2. Match existing institutional mandate and competence in providing grants to build

their capacities.

3. Review successful Agro-dealer Development Project to provide useful lessons for strengthening national agro-dealer associations and aligning their functions with the national goals and priorities;
4. Support agro-dealers through agribusiness advisory services, to improve their profitability and professionalism by: i) linking them to extension providers, especially by tapping into lead farmers; ii) encouraging agro-dealers to carry out more ISFM research through demos by providing them more extension services from the Ministry of agriculture; iii) including agro-dealers in stakeholder decision-making meetings; iv) accessing credit facility at a lower interest rates.
5. Engage governments to promote agro-dealer participation in the input subsidy programs, where farmers access inputs through the E-voucher system;
6. Work directly with financial institutions (i.e., banks and micro-finance institutions) that are better-suited to manage loans and credit to farmers. In so doing, SHP should focus on providing technical advice on how finance institutions and governments can design products that meet needs of farmers --and also build capacity (awareness and training) of farmers and facilitate their linkages to such services.

Training and Education Sub-Program

1. Now that graduates are returning to their posts it will be important to conduct a follow-up to determine how they are using the skills learnt and the extent they are contributing to transformation of their organizations. A thorough review of the impact of the Wageningen support should be undertaken to ensure lesson learning.
2. Universities need to be facilitated to re-examine their curricula with expert assistance to identify gaps in teaching particularly to move courses towards a more holistic understanding of soil rhizosphere processes and how ISFM practice contributes to long term soil health. Selected centers of excellence should be established with long-term trials at benchmark sites representative of key farming systems to provide field laboratories for student experimentation. Curricula should include a unit that establishes a linkage between national priorities, ISFM and context at farmer level and provides students with the analytical tools to understand how ISFM options can be adapted at a local level. This will need greater attention to economic issues and spatial analysis.
3. Students should be encouraged to investigate and analyse ISFM in relationship to existing farming systems, ensuring appropriate site characterization to understand the extent of extrapolation. Research must be based on a thorough understanding of previous work to identify gaps in knowledge so that new research questions are addressed.
4. AGRA should work with universities and other partners, such as USAID iAgri in Tanzania and RUFORUM to review Research Methods provision and develop plans to upgrade this and ensure sufficient staff are trained and appointed.
5. Universities should be engaged in a discussion on the appropriate standards for publication prior to graduation. It may be better to require students to have

presented papers at a conference, which should be included in the thesis and for PhDs include draft journal manuscripts.

6. To sustain improvement in laboratory facilities provided by the project, AGRA SHP needs to consider how to address maintenance of lab equipment which is largely associated with the "project-cycle" of donor support. It is also suggested that the laboratories assisted by the AGRA SHP should be facilitated to form a network to share knowledge on best practice. Such networking activity would need co-ordination and a modest budget but would consolidate gains made by the investment AGRA SHP has made to improve laboratory capacity.
7. The potential of the leadership to deliver quality training in a timely manner should be a key criterion in selecting grantees training institutions in future. There needs to be clear communication and agreement about budgets which should be related to university scales prior to contracts for training grants being signed.

SHP Programming

1. It is recommended to revisit the Theory of Change to unpack the assumptions behind it, identifying where SHP's comparative advantage lies and how it should use this to leverage change. SHP should focus on identifying, supporting and facilitating appropriate partners to implement the SHP Theory of Change – rather than trying to include all these activities within projects. At field level this could best be done through supporting Innovation Platforms.
2. To ensure Program outcomes are equitably distributed, there is need to develop an inclusion strategy examining constraints and opportunities for women, young people and vulnerable groups to participate effectively in project activities and decision-making and take control over resources and benefits.
3. It is recommended that all projects include an Inception phase for training in project systems, recruitment (e.g. of students) and procurement. It is also recommended that project period and scheduling should be tailored to the activities of the project, rather than a one-size fits all approach. A Post-Implementation phase should also be added for finalisation of reports and publications and completion of activities where these could not reasonably be completed during the Implementation phase of the project.
4. It is recommended that specialised regional project management support institutions provide capacity building to the grantees to free up Program staff to focus on project technical oversight.
5. It is recommended that a small number of medium-sized ISFM scale-out projects (one per P1 country) are piloted to reach larger numbers of smallholders in a sustainable way. These should be professionally facilitated to ensure active participation of all appropriate stakeholders, and based on innovation platform and participatory approaches to effectively integrate ISFM into inputs, output and credit markets.

1. Background to SHP and Evaluation Objectives

1.1 Introduction

The Alliance for a Green Revolution in Africa (AGRA) has a mission to trigger a uniquely African Green Revolution that transforms agriculture into a highly productive, efficient, competitive and sustainable system to assure food security and lift millions out of poverty. Its vision is a food secure and prosperous Africa achieved through rapid, sustainable agricultural growth based on smallholder farmers who are primarily engaged in production of staple food crops in Africa. The main goals are, by 2020, to: i) Reduce food insecurity by 50 percent in at least 20 countries, ii) Double the incomes of 20 million smallholder families, and iii) Put at least 15 countries on track for attaining and sustaining a uniquely African Green Revolution. The mission, vision and goals of AGRA are pursued through four programmatic areas of Soil Health (SHP), Program for Africa's Seed Systems, Market Access and Policy and Partnerships. Other areas such as agricultural water management, Support to Farmer organizations, Innovative Agricultural finance, extension, and gender have been incorporated into AGRA's implementation strategy.

1.2 Soil Health Program

The SHP is one of the four core Programs of AGRA, and was established and largely funded by the Bill and Melinda Gates Foundation (BMGF). The mission of the SHP is to increase incomes, improve food security and reduce household poverty by promoting the use and adoption of integrated soil fertility management (ISFM) practices among smallholder farmers and creating an enabling environment for farmers to adopt the practices in an efficient, equitable and sustainable manner across sub Saharan Africa.

Established in August 2008, the SHP had the following medium-term objectives that were expected to be achieved by 2015:

(i) Increase farmers' financial and physical access to locally appropriate soil nutrients and fertilizers
(ii) To improve access to locally appropriate ISFM knowledge, agronomic practices and technology packages, for around 4.1 m smallholder farmers in an efficient, equitable and sustainable manner;
(iii) To support development of a national policy environment for investment in fertilizer and ISFM.
(iv) Strengthen capacity of national institutions to deliver on their mandate

SHP is implemented through four thematic sub-programs that focus on each of the program objectives highlighted above. These include: (i) ISFM Technology scale-out; (ii) Extension Support Function (iii) Fertilizer supply and policy, and (iv) Training and Education.

The first phase of the SHP will come to an end on November 2015. Grant-making is expected to end by November 2014. In view of the above background, AGRA commissioned an independent end-of-program evaluation of its Soil Health Program by the Natural Resources Institute, University of Greenwich, in collaboration with the Department of Extension, Lilongwe University of Agricultural and Natural Resources.

1.3 Objectives of the End of Phase 1 Evaluation

The main objective of this end-of-program evaluation was to assess the overall program performance in relation to its objectives, and to provide input into the new strategic directions or implementation designs/strategies of another phase. The evaluation was to assess what has worked, what did not work so well, key lessons learned and what should be emphasized or adjusted, in the second phase. The evaluation covered the following three components of the Soil Health investment portfolio:

(i) *Programmatic impacts* – what outputs have been delivered, what changes (outcomes, both intended and unintended) have occurred among the beneficiaries, relevance of program interventions, return on investments and sustainability of achievements to-date.

(ii) *Program delivery mechanisms* – the approach adopted by the program to achieve the results highlighted above, e.g., models/best practices employed by the program; e.g. Agro-dealer network; "going beyond demos"; partnerships developed (e.g. Country Soil Health Consortia); fertilizer business; legume seed production; micro-dosing technology, cropping systems etc. How successful these models have been, lessons learned and whether these results are likely to be sustainable.

(iii) *Program management for results*- This looked at the internal program management processes to assess their adequacy, efficiency and effectiveness. This included the program structure; staffing; grant-making processes; quality of grants funded; level of integration and alignment with other AGRA programs.

1.3.1 Specific Objectives

Specifically, the end of program evaluation was to:

(i) Determine the relevance or appropriateness of the Program theory of change, design, strategies, management structure and delivery mechanisms and determine whether or not they are adequate to realize the intended program objectives;

(ii) Critically assess to what extent, if any, the program achieved its intended objectives; outputs, and whether these are beginning to yield into outcomes, both intended and unintended;

(iii) Ascertain to what extent the program was effective and efficient in achieving its intended objectives;

(iv) Assess whether the program has been cost effective in achieving the desired outcomes and the likelihood that those results will be sustained over the medium to long term;

(v) Identify to what extent SHP integrates and aligns with other AGRA programs, the quality of partnerships built, if any, with national and international researchers; soil scientists and other stakeholders in supporting program delivery and whether these are sustainable over time;

(vi) Assess the efficacy of the different models utilized by the program, for instance, in scaling-up ISFM practices, financing mechanisms for farmers to access inputs (particularly improved legume seeds and fertilizers), and the produce marketing support initiatives;

(vii) Identify challenges and document lessons learned and best practices that will inform future strategic program decisions. The evaluation will provide recommendations on practical strategic actions that need to be taken to improve future implementation and ensure sustainability of outcomes and institutionalization of key lessons learnt. Suggestions on how to build stronger governance systems, gender integration, and how future program initiatives should feed into ongoing and planned national-level agricultural strategies to enhance synergy, complementarity and value addition will be expected.

1.4 Scope of the evaluation

The SHP end of program evaluation assessed the program performance since its inception in August, 2008 to August, 2014. The evaluation entailed an in-depth review of selected grants in target countries to determine whether SHP has made progress towards achieving its stated goal and objectives.

Thematically, the end of program evaluation was to focus on the following areas:

- Quality and relevance of program design
- Program performance
- Efficiency in resource utilization
- Management issues
- Lessons learned

1.5 Outline of the report

This end of Phase 1 Evaluation report has three main components. The introductory chapters (Chapters 1 and 2) cover the background to the evaluation, Evaluation Approach and Methodology. Chapters 3 to 8 present findings from the evaluation on: the overall Program and each of the subprograms; Impact at smallholder level and programming issues. Chapter 9 provides evaluation recommendations.

2 Evaluation approach and methodology

2.1 Evaluation scope

The Evaluation used mixed quantitative and qualitative methods for systematic data collection and analysis.

An evaluation framework was drawn up to guide the evaluation, covering evaluation questions, indicators, data sources and methods for data collection. Evaluation questions were grouped under Themes: Quality and relevance of Program design, Program impact, efficacy of models used under the program, integration with other AGRA Programs, Program efficiency, management issues and challenges and lessons. The framework formed the basis of the evaluation design (see Appendix).

The evaluation exercise covered the thirteen SHP program countries of Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Rwanda, Niger, Nigeria, Tanzania, Uganda and Zambia. In-depth fieldwork including household surveys was focused on seven countries: AGRA P1 countries (Ghana, Mali, Mozambique, Tanzania), one P1+2 country (Nigeria), and two P2 countries (Malawi and Kenya). The justification for choice of these countries was based on the revised strategy prioritized and focused SHP investments and specifically the Breadbasket regions within P1 countries (agreed with SHP and M&E staff). In addition to these seven countries, field interviews were carried out in Ethiopia, Rwanda, Uganda and Zambia with key stakeholders and beneficiaries (See Appendix).

2.2 Methodology

Field data was collected from a sample of key informants of the Soil Health Program including: farmer organizations, agro-dealer networks, private sector input producers and traders, project administrative and technical personnel, program partners, AGRA program staff and management. Focus Group Discussions (FGDs) were also carried out with communities and other groups targeted by the program. These included: Agro-dealers, postgraduate students and laboratory technicians. Focus Group Discussions and Key Informant interviews were carried out using focused checklists.

Following actor mapping, representatives of the actor category were purposively selected on the basis of level of influence, gender and social difference for key informant interviews (see checklists on institutions/organisations). In addition to actors in the project, the evaluation also conducted key informant interviews with other important stakeholders including: national and local government researchers and policy makers; international agricultural research Programs (International Institute of Tropical Agriculture (IITA), International Maize and Wheat Improvement Centre, Southern Africa (CIMMYT) SIMLESA, International Crops Research Institute for Semi-Arid Tropics (ICRISAT), Soil Fertility Consortium of Southern Africa (SOFESCA); International Plant Nutrition Institute (IPNI) and Wageningen University and Research Center), and capacity building partners (Universities, Soils-testing laboratories, NARS, etc). The evaluation involved a household survey with the use of questionnaires administered to a representative sample size of farmer households and small-scale processors. To enhance likelihood of achieving the evaluation objectives stated above, the selection of grants was made using a sampling frame of SHP- funded projects which were clustered into: projects that have ended;

projects half-way into implementation; and projects that are in the early stages of implementation. In agreement with SHP, and to enable assessment of project impact, the focus was on completed projects and those which have been implemented for 2 years or more.

Detailed activities included:

i. Document review

The document review involved a desk review of key program documents and program implementation progress reports from grantees, program officers and other partners. Documents reviewed include the background program documents; grant proposals; progress reports; projects' rapid assessment reports, and other key documents related to the program.

ii. Sampling framework

A list of SHP Grantees from AGRA Grants Unit was used to construct a sampling frame presented to the M&E Unit and SHP staff at the Inception meeting (Appendix 3). This was stratified by size of grant, country and type of SHP Sub-program and crop. Projects selected for in-depth household survey evaluation were agreed with the SHP and M&E unit and comprised: 3 projects for each of the P1 countries (Tanzania, Mozambique, Ghana, Mali), 2 projects for the +2 countries (Nigeria), 2 innovative projects for P2 countries (Malawi and Kenya).

The evaluation followed standard statistical procedures to ensure adequate samples reflecting important characteristics of the population under study. Random sampling and non-random sampling methods were used to select our samples. For the household survey, this generated sufficient samples to allow statistically robust analyses with a high level of precision for a confidence interval and to ensure inferences to the population of interest.

Household surveys of farmers were undertaken in each of the selected 20 SHP projects, covering 7 countries. In each country, two groups were purposively selected for interview (i); the beneficiaries of the project and (ii) non-beneficiaries for counter-factual (identified in consultation with project and extension staff as not having been targeted by the project or other projects and located approximately 10 kilometres from target villages). Within the selected areas, a random sample of approximately 60 beneficiary households and 60 non-beneficiary households per project was carried out. This gave a total of 2,154 households surveyed across the seven countries (Table 1). This included 38 percent female respondents.

Table 1 Beneficiary and non-beneficiary households surveyed

Country	SHP Beneficiary households	Non-beneficiary households	Total households surveyed
Mali	180	180	360
Ghana	184	155	339
Nigeria	122	118	240
Kenya	123	121	244
Tanzania	152	188	340
Malawi	302	104	406
Mozambique	170	55	225
TOTAL			**2154**

Source: End of Program Evaluation survey

Focus Group Discussions (FGD) were held with representatives of local level actors in selected project areas and non-project areas. An average of two to four FGDs with between 6 and 15 male and female participants were held in each country. These representatives were purposively selected based on their knowledge and experience of project activities.

iii. *Field surveys*

Questionnaires were developed to address the Evaluation tasks and the specific indicators of the SHP program. The field surveys included: Institutions/organisations survey and farmer surveys.

a) Institutions/organisations survey

Key Informant Interviews: A list of AGRA partners and other stakeholders was obtained from the selected countries for Key Informant Interviews. The aim of these interviews was to elicit further qualitative and quantitative information on the current status of and trends in fertilizer supply and demand and ISFM technology availability and uptake and constraints and opportunities in each country.

Focus group discussions: Participatory discussions including rapid outcome mapping were conducted with small groups of people (6-15) with specialist knowledge or interest in SHP activities, including beneficiary communities, processors, traders and agro dealers. The FGDs and KIIs were conducted using checklists.

SHP Staff Retreat. As part of the Evaluation inception process, 3 members from the evaluation team attended the SHP staff retreat (October, 6-8) in Nairobi, Kenya. This enabled the evaluators and SHP team to develop a common understanding on expectations of the evaluation. It also enabled the evaluators to observe SHP in action and conduct interviews with team members and members of the Technical Advisory Committee.

b) Household surveys

The farmer household surveys investigated both socio-economic and technical factors. This included soil fertility technologies tried and practiced, training received on the technologies, types and sources of inputs used, factors determining choice of

technology; crops grown, yield estimates, income and profitability, and the main constraints faced; changes (outcomes) arising from participation in the project. A structured questionnaire was designed for the household survey and administered by trained enumerators and supervisors.

iv. Survey management

The Evaluation team was divided into 3 regional teams: Southern, Eastern and West Africa, with a soils specialist, extension specialist and evaluation survey specialist in each regional team. The Training and Development specialist covered all regions.

Teams of experienced interviewers were recruited in each country (composed of a balance of male and female enumerators) and carefully trained in the use of the survey tools. Interviews were conducted with farmers in local languages. A quality control program was developed to ensure robust and valid data. This included supervision of teams in the field by trained supervisors, who checked questionnaires for errors and inconsistencies. Survey instruments were field tested and adjusted after piloting for errors and inconsistencies.

v. Data Processing

Data entry was carried out by qualified data teams in the three regions. Data entry templates were created in SPSS with related tables and queries. Data cleaning rules such as removing outliers were developed to ensure consistency of data. Data analysis was carried out by the consultants primarily using SPSS. Data collected by the evaluation will be part of the materials to be made available to the SHP/M&E team.

2.3 Challenges

The evaluation team was supported during the evaluation process by the SHP and M&E teams. This included provision of reports and access to the project database through Basecamp, letters of introduction to project grantees, and feedback on selection of projects for the evaluation and evaluation tools. Challenges faced included: locating some projects in the field and unavailability of project staff, particularly for closed projects. This increased the time required in the field to complete interviews. Nevertheless, the team was able to meet targets on household interviews and also conducted focus group discussions and key informant interviews with around 30 percent of projects across the sub-Programs.

3 Soil Health Program Overview

3.1 Evolution of SHP

The development of the Soil Health Program was informed by the Soil Health Strategy Paper (2007) which provided the rationale for the Program. The Strategy is a detailed document which was drawn up by a high level group of experts on soil fertility. It identified the critical issues to be addressed as:

- severe constraints to fertilizer demand and supply;
- diverse agro-ecologies and crop systems demanding local adaptation;
- inappropriate technologies for farmer needs;
- smallholder incentives for soil fertility management;
- increasing fertilizer use efficiency – organic matter management and fertilizer (but neither one alone);
- environmental degradation;
- need for a clear policy agenda, and information gaps for decision-making.

It identified the strongest point for entry of interventions to improve soil health to be around ***fertilizer supply and use, provided that it is rooted in ISFM that is appropriate to local knowledge, practice and agro-ecology***. The Strategy proposed investments of $74m in Fertilizer supply chain and Policy; $91m in large-scale extension of ISFM Programs, including training and development; and $33 for Program management.

The SHP Business plan adopted the basic components of the Strategy proposal: Extension support, Policy Advocacy, Financial guarantees and grants for Fertilizer suppliers, Education and Research. To operationalise these activities, four sub-programs were developed:

(i) The Soil Health Fertilizer sub-program (SHFP): focused on the production and distribution elements of the fertilizer supply chain. SHFP includes policy advocacy activities; investment to support 6,125 agro-dealers through the existing PASS agrodealer program; and targeted support for local fertilizer blending, production, importing and wholesaling.

(ii) The Soil Health Extension sub-program (SHEP): designed to extend ISFM technology packages to 4.1m farm households by 2018, through facilitating adoption of improved technology and practises to achieve greater yields and output. SHEP was to focus on the extension of ISFM technology packages that, to the extent possible, use inorganic fertilizer and contain conservation agriculture agronomic practices.

(iii) The Soil Health Training sub-program (SHTP): aimed to work with national governments to invest in African extension workers, technicians and scientists. SHTP sought to achieve: (i) in service training for 3,000 extension workers; (ii) in service training for 100 laboratory technicians; (iii) 100 additional, diploma trained laboratory technicians; (iv) 100 MScs and 15 PhDs in soil science and agronomy.

(iv) The Soil Health Research sub-program (SHRP): focused on supporting the development, adaptation and fine-tuning of ISFM technologies. SHRP envisaged supporting 50 research projects to deliver new or improved ISFM recommendations.

There were some slight changes in emphasis compared to the Strategy – stemming from analysis of available opportunities and judgments on where SHP believed it had greatest potential to achieve impact: an increase in the allocation to fertilizer supply chain activities and a decrease to policy. Within the sub-Programs there have been some divergences from the Strategy e.g. the strong emphasis on promotion of practices combining organic matter management and fertilizer (discussed in Chapter 4). The Program was to invest in the 13 PASS countries, chosen in order to leverage existing AGRA activities.

The Mid-Term Plan for the period 2011-2015 (2010) reviewed SHP progress, analysed lessons and developed a revised plan to achieve SHP targets. These lessons covered: Systemic problems requiring integrated engagements in fewer countries; limitations requiring new or innovative approaches to grant making; and complex engagements requiring additional capacity.

Key lessons learnt during the course of implementation produced strategic implications including:

- Increased investments that facilitate an integrated approach to ISFM scale-out in breadbasket areas of six prioritized “P1 (+2)” countries
- Prioritize SHP investments in areas where non-core intervention areas are in place with these interventions carried out via partnerships
- Engage additional capacity to support program staff
- Create a new Extension Support Function (ESF) that works across AGRA programs
- Invest in improved knowledge management and communication strategy
- Increase capacity for intervention area diagnosis and strategic choice prioritization.

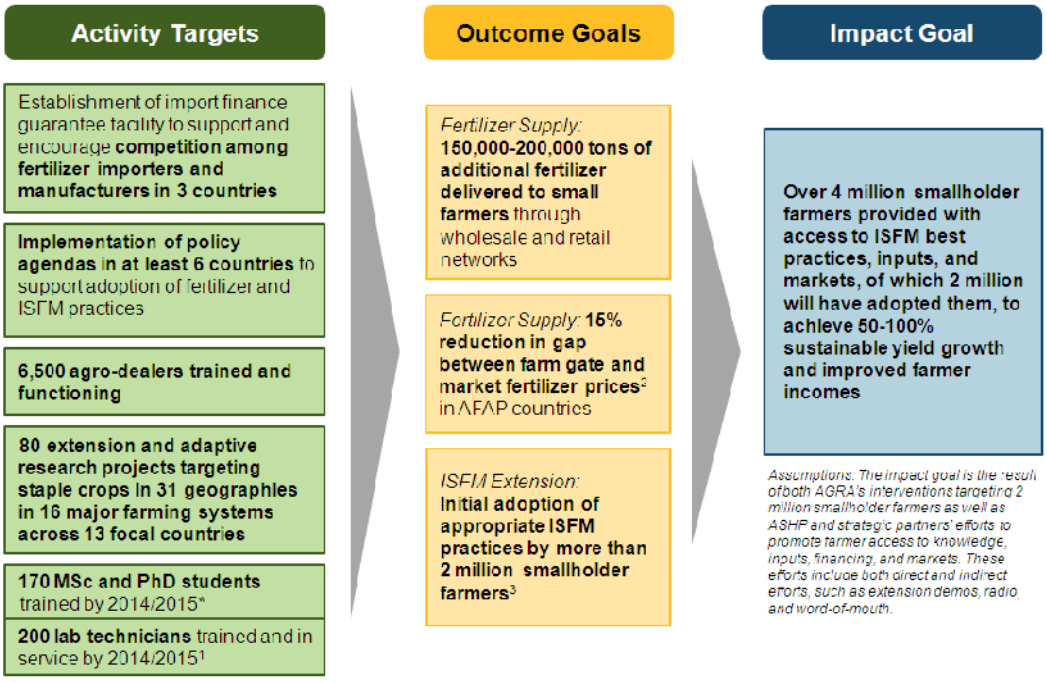
The lessons from the Mid-term strategy refresh were internalized within the Program and resulted in changes in programming across the sub-Programs. These are discussed in chapters 4 and 8 below.

3.2 Overall SHP performance

According to the SHP Business Plan, Program success should be measured by progress towards: **Impact Goal**: over 4 million smallholder farmers provided with access to ISFM practices, inputs and markets, with 2 million adopting them and achieving 50-100% sustainable yields growth and incomes; **Outcome goals** on Fertilizer Supply and ISFM Extension; and **Activity Targets** on Import finance guarantees established, supportive ISFM policy agendas, agrodealers trained and functioning, extension and adaptive research Programs implemented, and postgraduate students and lab technicians trained by 2015 (Figure 1). Overall Impact was expected to come about as the result of both AGRA’s interventions and strategic partners’ efforts to promote farmer access to

knowledge, inputs, financing and markets.

Figure 1: SHP Program Goals



According to M&E reports, progress towards achieving these goals as at January 2015 was as follows:

- 3.6 million farmers are aware of ISFM technologies
- 1.5 million smallholders are using ISFM: out of the targeted 2 million.
- 74 percent of direct beneficiaries have increased cereal grain yields from 1 t/ha to over 3 t/ha (from improved seeds and ISFM practices): the target was 50-100% of adopters.
- 205,000 MT of fertilizers have been delivered to smallholder famers through wholesale and retail networks: achieving the target of 200,000 MT.
- 9400 agro-dealers have been trained: exceeds the 6500 target (no data on the number functioning).
- Nine students have achieved PhDs and 79 MScs as at January 2015: 52 percent of target. In total 188 students have been enrolled in 11 universities (exceeding target of 177). Fifty per cent of these are women.
- 229 lab technicians have been trained: 92 per cent of target.

Evaluation observations

From SHP M&E reports, all targets are expected to be 90 to 100 percent achieved by the end of the project, and in some cases targets may be exceeded. Detailed findings on farmer uptake of ISFM technologies; agrodealers trained; Fertilizer distribution; students and lab technicians trained; and farmer yields are given in Chapters 4-6. However, several general observations can be made. The first, as noted in the Impact Goal Assumptions, is that these achievements are not attributable solely to SHP: other AGRA

Programs and partners have contributed to efforts to increase farmer access to extension, input and markets. A second issue is verification of data. The data used in SHP M&E reports is derived from quarterly reports submitted by grantees and based on project activities. In most cases, projects estimate number of farmers using ISFM from their records on project beneficiaries and numbers of farmers trained. Similarly, agrodealer data shows number of farmers trained rather than agrodealers functioning. There have been only a limited number of impact studies: data available is mainly at output rather than outcome level. Sustainability is also an issue: not all farmers practising technologies or agrodealers operating during the life of a project continue their activities after support is phased out. At the same time, other farmers are taking up the technologies where knowledge, inputs and markets are available. It is therefore difficult to confirm precise figures but even with a large margin of error, program achievements appear considerable.

3.3 SHP Sub-Programs

To-date 136 grants have been awarded under SHP with a value of$123.8 million (Table 2). Two-thirds are under ISFM Scale-out and Extension Support Function (60 percent of total amount committed). Fertilizer supply and policy is 21 percent of total grants, but includes two large grants through AFAP. Training and education stands at 10 percent of total commitments. Average grant sizes vary between sub Programs from US$620,000 and US$828,500 for Training and ISFM Scale-out/ESF to US$1.367 million for the Fertilizer Supply and Policy sub-Program. Grants range tremendously from $50,000 for strengthening capacity of NGOs to deliver services to farmers (e.g. UCAMA in Mozambique) under ISFM Scale-out to $22 million for AFAP to increase Fertilizer availability in Ghana, Tanzania and Mozambique. This demonstrates the range of projects under SHP meeting different objectives in different environmental, socioeconomic and institutional contexts.

The commitments are generally in line with the overall Program concept, with the focus on providing smallholders with knowledge on technologies, and improving access to and supply of inputs, plus increasing research capacity. However, the challenge of effective management of such a large number of grants is discussed in Chapter 9.

Table 2 Share of Sub program investments in SHP

Sub-program	No. of grants	%	Amount committed (US$)	%	Average grant size (US$)	Minimum grant size (US$)	Maximum grant size (US$)
Fertilizer Supply & Policy	28	21	38,283,370	31	1,367,263	200,000	22,258,672
ISFM Scale out & Extension Support Function	89	65	73,738,113	60	828,518	50,000	2,930,000
Training & Education	19	14	11,780,278	10	620,015	161,964	2,194,693
Total	**136**		**123,801,761**		**910,307**	-	-

Source: SHP Program data

3.4 Geographical focus

Since the initial conceptualization of SHP, following lessons from the Mid-term review on the need to increase focus for greater impact, there have been considerable efforts to shift the geographical focus from the 13 countries to the 6 P1+2 countries. This has resulted in changes in the pattern of grant awarding (Figure 2).

The largest number of grants under SHP has been awarded to Ghana, Tanzania and Mozambique (P1 countries) and Kenya (due to historical grant-making). Of the '+2' countries Nigeria has 7 grants but Ethiopia only 3, partly due to what program staff stated as challenges of grant-making in Ethiopia. In terms of spending, the Program has successfully awarded grants of over $15 million to 3 of the P1 countries: Ghana, Tanzania and Mozambique (Figure 3). This includes a $25 million grant to AFAP to the 3 countries. However, Mali, a P-1 country, lags in both number of grants and amount awarded due to civil strife in 2012 resulting SHP repurposing its investments due to the adverse political environment.

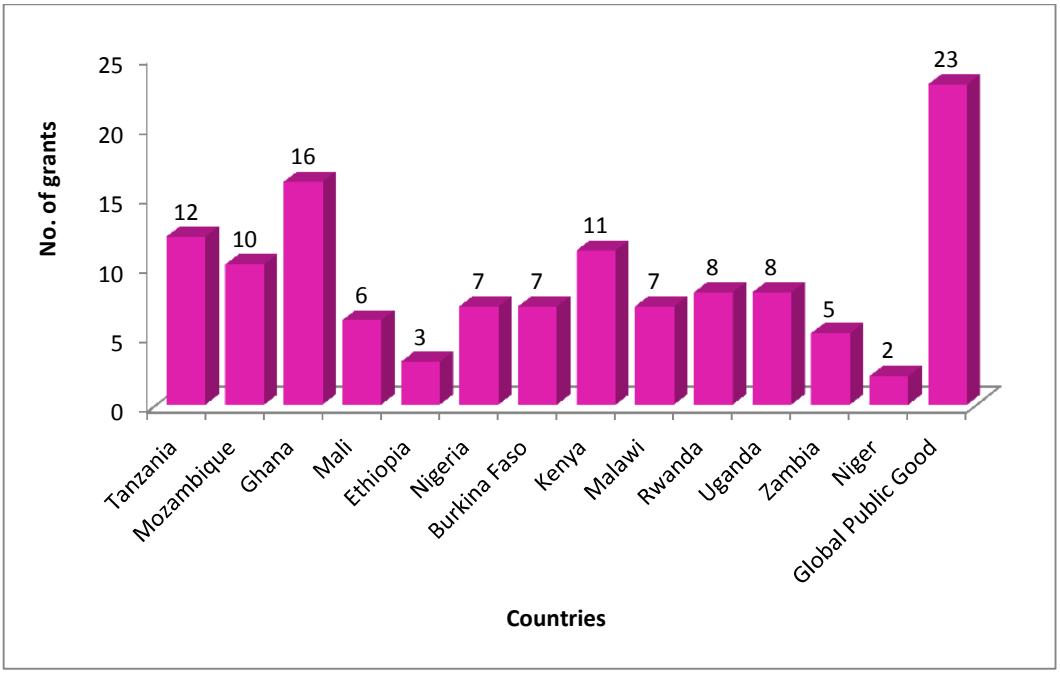


Figure 2 SHP grants awarded by country

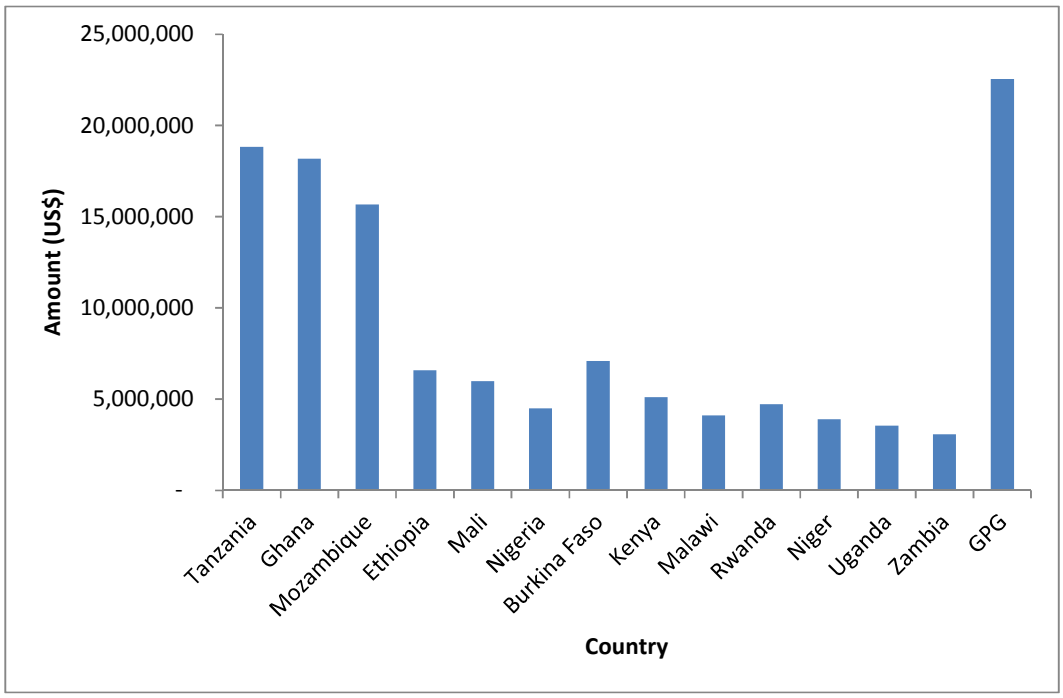


Figure 3 Value of SHP grant-making by country

3.5 Overall SHP Achievements

The Program set ambitious targets to increase awareness of ISFM technologies to over 4 million smallholder farmers and to ensure that 2 million are using ISFM technologies by 2015. Indications are that these targets as well as training sub-Program targets are likely to be reached or surpassed, in terms of outputs achieved by the project. Fertilizer supply was primarily addressed through AFAP which was not covered by this evaluation.

However, there are particular challenges of operationalising ISFM concepts, approaches to programming and sustainability which need to be addressed to achieve and maintain outcome goals - improving and maintain farmer livelihoods, including their incomes, yields and soils. These are discussed in the following chapters.

4. ISFM Technology Scale-out and Extension Support Function

4.1 Context of ISFM Scale out

The Integrated Soil Fertility Management Scale-Out (ISFM Scaling-Out) sub-Program contributes to Objective 2 of the Soil Health Program (SHP) which is to achieve large-scale adoption of locally effective integrated soil fertility management practices. The goal of objective two is the adoption of more sustainable soil management practices that maximize returns on fertilizer investment, labour, and land by 4.1m smallholder households. Initially ISFM scale-out sub-Program was made up of two closely related sub-programs:

(i) The Soil Health Extension sub-program (SHEP)

(ii) The Soil Health Research sub-program (SHRP)

The Soil Health Extension sub-program (SHEP) was designed to extend ISFM technology packages to 4.1 million smallholder households in an efficient, equitable and sustainable manner by 2018. The aim was to increase the knowledge and facilitate adoption of improved technologies and appropriate agronomic practices to improve the quality of soil and sustain smallholder food production. SHEP focused on the extension of ISFM technology packages. Planned Extension activities, included: (i) demonstrating ISFM technology packages to farmers, including facilitating farmer experimentation with organic and inorganic fertilizers, seed and other inputs; (ii) coordinating a sustainable supply of inputs both during extension activities and once farmers have adopted the ISFM technology package; and (iii) working to ensure farmers have access to output markets and efficiently capturing and managing water resources. The Soil Health Research sub-program (SHRP) was focused on supporting the development, adaptation and fine-tuning of ISFM technologies. The SHRP envisaged supporting 50 research projects to deliver new or improved ISFM recommendations.

While initial outputs and some outcomes were recorded in the first two years of the Program, key lessons learnt during the course of implementation led to strategic implications during SHP strategy refresh and development of the Medium Term Strategy and Plan including:

- The need for increased investments that facilitate an integrated approach to ISFM scale-out in breadbasket areas of six prioritized “P1 (+2)” countries
- Prioritize SHP investments in areas where non-core intervention areas are in place with these interventions carried out via partnerships
- Create a new Extension Support Function (ESF) that works across AGRA programs
- Increase capacity for intervention area in diagnosis and strategic choice prioritization

The Strategy also prioritized integrated interventions targeting barriers across the entire agricultural value-chain, including access to inputs via innovative financing mechanisms.

4.2 ISFM models under SHP

Low organic matter is a major problem for most African soils (Zingore et al. 2011). Poor soil status is due to losses from erosion and management factors such as inappropriate land use systems, mono-cropping and nutrient mining. The situation is aggravated by inadequate supply of nutrients. The concept of ISFM is thus highly relevant as it aims to improve both the chemical fertility of the soil through fertilizer, and physical and biological fertility through application of organic resources.

Within the ISFM concept, SHP projects have focused on improved fertilizer application (e.g. microdosing) and a combination of fertilizer and legumes as well as manure application to help farmers address their soil fertility problems. SHP initiatives use several models in operationalising the ISFM concept. These include:

- Fertilizer Microdosing (Mali)
- Legume-Maize Rotation: Doubled up legumes (SHP countries including: Malawi, Mozambique, Rwanda, Zambia) and Scaling up ISFM systems (Western Kenya)
- Anchor Farmer (CDI Malawi)

a) Fertilizer Microdosing

Microdosing involves using small amounts of inorganic fertilizers efficiently. According to ICRISAT (2012): microdosing is a practice involving the application of small, affordable quantities of inorganic fertilizers with the seed at planting time, or as a top dressing 3 to 4 weeks after emergence. Farmers apply 2 to 6 grams of fertilizer in or near the seed hole at the time of planting. When the technology is combined with manure yields can be doubled. AGRA has implemented three projects to promote the technology in Mali. This technology works well when farmers can access cheap or subsidised fertilizers. However, even where farmers can get subsidised fertilizer, this will only be sufficient for 0.5ha. A farmer owning 10 ha of millet or sorghum will need to buy fertilizer for the remaining acreage at the market price.

Farmers and other actors in Mali recognise the advantages of microdosing in terms of increasing both yields and the areas to which farmer can afford to apply fertilizers. However, they unanimously find the microdosing technology labour intensive and affordable only by households with sufficient labour – generally the better-off who can afford to hire. Focus group discussants explained that the application of micro dose of fertilizers requires 3 persons per ha per day: the first makes the hole, the second put the micro dose in the hole and the third closes the hole containing the micro dose of fertilizer. Thus, many said they cannot afford to sow the seed and fertilizer however productive the technology. Many farmers said they had used the microdose technology only once - in the demonstration fields. If they managed to continue with microdosing it is not necessarily in the recommended way - they just throw fertilizer under crop without sowing. The recommended treatment of soaking the seed before sowing adds a further constraint, given availability of labour. Though this is known to speed up germination time - the day following sowing, confirmed several farmers - it means the farmer needs to know the exact amount of seed they can sow in one day to avoid losing rest of the seed, since it cannot be stored. These are critical constraints that may limit uptake of the technology, particularly when technical support from research and extension is not

available. SHP research is developing an animal-drawn application which could help relieve the labour constraint, if it can be manufactured and sold at a price affordable to farmers and other constraints addressed (including gender issues).

In villages not exposed to the technology by the project, a number of farmers were found to have heard about microdosing but were not applying the technology. In one village around 3km from the intervention, farmers were aware of the good cereal production there compared to their own village but were unconvinced on whether this was the result of microdosing. In this case there was no mechanism for enabling exchange of information between the two villages. In other non-intervention villages, several farmers were selected to visit demonstration fields in neighbouring villages: however there was no feedback to the rest of the village. Thus the technology is known only to those who visited the demonstration and they don't necessary apply it in their own field due to labour and other constraints. Some non-beneficiaries requested to join the project training pointing out they need to understand the technology themselves before trying out something they have no idea about.

b) Maize Legume Rotation

Growing legumes is another technology promoted widely by the project to supply nitrogen to crops through N-fixation. Grain legumes have been introduced over the years into sole cereal crop system in several countries including Rwanda (climbing beans), Uganda (soybeans), Ghana (soybeans), Mozambique (pigeon pea, groundnuts, cowpea and soybeans) and Malawi (groundnuts, soybeans, Tephrosia). Two examples are the Malawi doubled up grain legume technology and the western Kenya Rural Outreach Africa soybean project:

i) Doubled up grain legume system in Malawi

The doubled up technology involves rotating maize in a 'doubled up grain legume' system, where pigeon peas are intercropped with groundnuts or soybeans in year one, whilst in the second year maize is grown and benefits from the incorporation of the dual legume residues into the soil (Snapp *et al*., 2002),. With support from AGRA, the National Smallholder Farmers Association of Malawi (NASFAM) has promoted the doubled up grain legume technology in Malawi, now known as the 'new farming method'. Under the project farmers received training on how to mix pigeon peas, ground nuts and Tephrosia with maize to improve soil fertility. Lead farmers mount demonstrations where they plant 2 lines of legumes alternating with 2 lines of maize.

Farmers reported tangible benefits in terms of cash earned from selling pigeon peas, groundnuts and soya; good stands of maize in the rotation; and changes in soil texture on demonstration plots from hard to soft. In an area visited during the evaluation, the number of farmers participating in the doubled up technology has increased from 50 when the project started in 2010 to 500 by the end of 2014. Farmers have increased land allocated to pigeon peas as a result of the cash incomes.

However, there is uncertainty over continuing use of the technology, which has become dependent on the availability of markets for the legumes. It is evident that farmers have focused on crops as a means to generate cash rather than soil fertility improvement. Farmers have formed Group Action Committees (GAC) to facilitate access to seed and

marketing of the crops. Members of GAC get seed on credit and pay back seed or grain 100 percent. The members sell in bulk. The main buyer has been NASFAM but the organization is not a reliable market, either buying late or not at all, at times offering lower than expected prices. For crops such as Tephrosia farmers have been disappointed and stopped growing it because there is no market. In 2014 farmers dumped bags of Tephrosia seed at NASFAM offices, frustrated at lack of sales.

ii) Scaling up Integrated Soil Fertility Management (ISFM) systems in western Kenya

The Scaling up integrated soil fertility management project in western Kenya, led by Rural Outreach Africa aims to improve the low soil fertility by promoting incorporation of legumes, including soya, in maize based farming systems. The organization is a woman-led NGO working in the area since 1992. The project has set up demonstration plots in six clusters in the two counties of Kakamega and Vihiga (Butere, Lurambi, Emuhaya, Vihiga, Sabatia and Hamisi subcounties) and organizes field days on demonstration sites so farmers can compare various combinations of crops and fertilizers. Farmers are trained in integrated soil fertility management technologies such as proper soil preparation, use of improved seeds, use of rhizobium inoculant, and fertilizer applications.

The project has worked with 539 farmers' groups, consisting mostly of women (70%). These farmers are registered with the government Ministry of Social Services. The extension work is done by existing youth and farmers within the communities who have been trained in extension approaches and practices. The farmers are trained on quality seed selection, and the project helps them with timely procurement buy inputs in bulk and on time. Apart from soybeans, the project also promotes climbing beans, bush beans, maize, improved varieties of bananas, and indigenous vegetables.

The project initiatives have yielded results. Farmers who have adopted the technologies have seen their soils have improved and yields increased: legume (soybeans, climbing beans and bush beans) yields from 0.65 to 0.95 t/ha, and maize from under 2 to nearly 5t/ha. These farmers are able to save more, and invest in quality inputs. The groups are more cohesive, and they purchase inputs collectively. Out of the 30,000 farmers targeted, 34,678 were reached with 11,760 (33.9%) fully adopting the recommended technologies; the rest are aware of these techniques (Project reports and Focus Group Discussions).

c) The Anchor Farm

SHP has supported the 'anchor farm' model in Malawi, led by the Clinton Development Initiative (CDI), to promote improved soybean cultivation among smallholder farmers in maize and tobacco based systems. The farms are commercial, belonging to CDI, and were existing growers of groundnuts, maize and soybeans. The anchor farms train government extension workers and lead farmers to train smallholder farmers on agronomic practices and farmer organizational development. Farmers are organized into clubs of 10 to 20 members and receive loans from the banks for inputs, with CDI as broker. The farmers sell their produce through CDI farms which have contracts to supply soybeans to large buyers in Malawi: thus farmers have a readily available market. Reports and key informant interviews indicate that the anchor farm initiative has

increased yields of maize and soybeans in the project area.

Our analysis

Through the use of different ISFM models SHP has promoted the application of inorganic fertilizer and the inclusion of legumes in traditional sole maize or sorghum cropping systems. While cultivation of legumes has helped with the supply of nitrogen through N fixation, it appears this is secondary to farmers' main interest in growing legumes to generate cash. In some cases the application of organic material has been minimal, particularly when crop residues are removed from the field to feed livestock. The evaluation mission also noted that interventions on soil organic matter management and micronutrients, and to reduce top soil losses (e.g. Conservation Agriculture practices, soil & water conservation) tend to be few and isolated.

Generally, it seems there has been a limited focus on helping farmers to understand the soil science underlying the ISFM concept. If farmers are to internalize ISFM practices, they will need to understand the underlying principles. For example the farmers need to understand what soil testing is all about and the benefits of testing their soils. It seems that while soil samples were collected from farmers' fields and analysed, the results were not well communicated to farmers (some farmers said; "the researchers took our soils and brought seeds"!). The results of the soil test need to be communicated to the farmers to enable them to understand the interventions available. They need to know the benefits of soil testing to determine what type and quantity of fertilizer to apply to their crops. There appears to be limited internalisation of the role of soil testing.

For farmers to achieve a win-win of improved soils and income, reliable markets also need to be in place. The example of NASFAM, where the farmer organization itself is the main buyer, is a self-defeating strategy, and farmers have discontinued the technologies once the market is not available. Since the market is the main driver of technology adoption, there is need for viable marketing arrangements, linking farmers to several buyers.

RECOMMENDATIONS:

1. *Given microdosing is still being researched, there is need to incorporate farmer concerns on labour demands and cost implications of the technology.*
2. *Coordinated efforts with local extension services is needed to promote awareness of new technologies such as microdosing in areas where farmers have not been reached by the project*
3. *ISFM should adopt collaborative, integrated agricultural systems research involving scientists, farmers, and policy makers aimed at constructing a range of flexible, responsive solutions to soil fertility management challenges.*
4. *Farmers groups such as the GACs need to operate as Agricultural Innovation Platforms (AIP), interacting and engaging with different actors, for example researchers on developing/adapting the technologies, private buyers to market their crops and extension workers for skills and information on the technologies.*
5. *Different demonstration methods are needed to communicate skills and knowledge to farmers on underlying principles of soil fertility management.*
6. *Farmer understanding of ISFM technologies needs to be broadened so they are*

able to realize twin objectives of cash generation and rebuilding soil fertility.

4.3 Partnerships for delivery: Beyond demos = beyond awareness raising

The use of extension methods such as demonstrations alone does not stimulate high levels of adoption of technologies. This was confirmed through the experience of SHP in the early years of the program. The ISFM scale up approach has therefore evolved from increasing awareness through demonstrations to linkages with inputs, markets etc. in what has become known as: Going Beyond Demos. The beyond demos approach has focused on:

- Scaling up of promising integrated soil fertility management technologies
- Improvement of access to and affordability of fertilizers
- Engagement and empowerment of local institutions to deliver
- Forging of strategic partnerships for greater impact

SHP ISFM Scale out projects have aimed to involve a range of stakeholders including researchers (testing ISFM technologies), extension (demonstrating ISFM technology), input suppliers (to provide fertilizer and other inputs), farmer organisations (to mobilize farmers into groups) and buyers of agricultural produce (for output markets). Examples of partnership/linkages were seen in Mozambique and Zambia.

1. Improving soil fertility, productivity and livelihoods of smallholder farmers in Mozambique through fertilizer use and integration of grain legumes project (Box 1). The project involved bringing together researchers, extension staff, agrodealers, financial institutions and buyers - all supporting farmers and farmers' associations – and facilitated by the national research organisation, IIAM. IIAM was also tasked with providing research inputs, technical assistance, facilitation of access to inputs and markets and capacity building. Although these linkages were functioning during the project, by the time the review mission visited the project had ended and these arrangements had collapsed as researchers from IIAM who were holding the partnership together with help of project resources had gone back to their research activities.

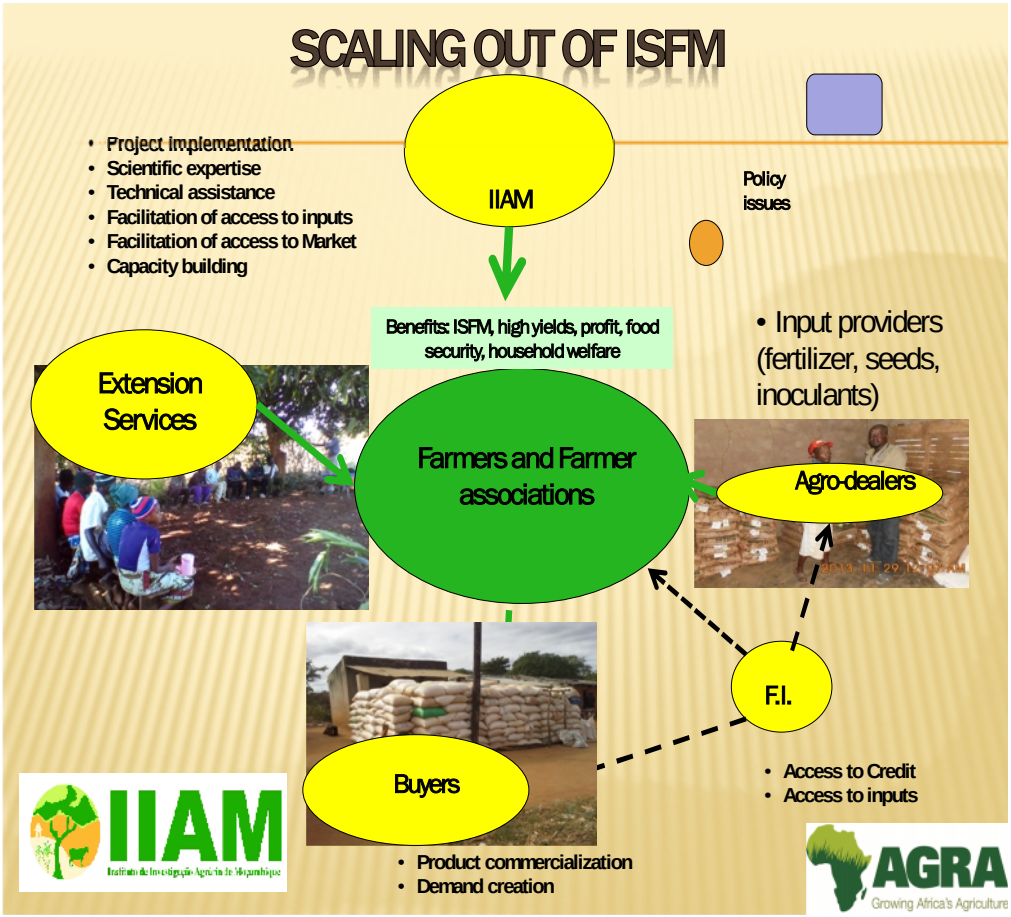
2. Improved soybean production and marketing in Zambia (Box 2). The second initiative is the creation of a soybean promotion platform in Zambia. This was developed mainly through the Increasing food legume crop production for improvement of soil fertility, food security, nutrition and income by smallholder farmers in Zambia project led by the Zambia Agricultural Research Institute (ZARI). ZARI are the secretariat to the Soya plus platform and though they have done very well so far, they seem to be facing challenges of capacity to facilitate the platform and how to sustain it after the end of the project. Development and facilitation of innovation platforms is not seen as part of a researcher's day to day work.

SHP has invested in developing linkages between key actors in the innovation chain in a number of countries, but these linkages seem to be weak - largely because of the project timeframe and availability of facilitation capacity. It was observed that there was still no clear shared vision among the actors: many did not fully appreciate the relevance of the arrangements or see tangible benefits for their institution. The general perception was that the partnership arrangements were for the benefit of the "project" and they expected the lead institutions to pay for their participation in the partnership. Trust between actors

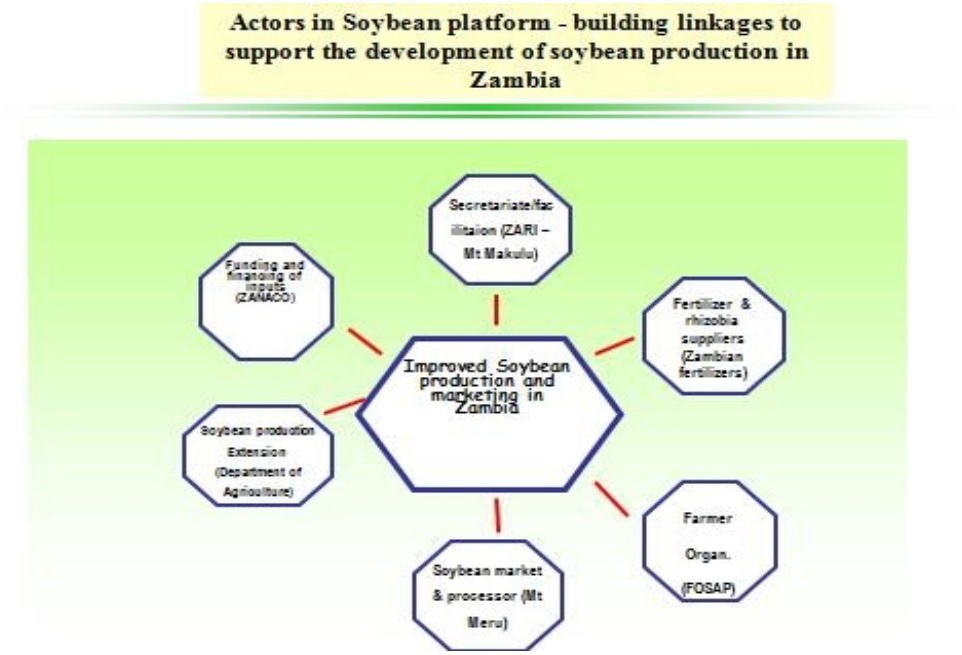
was very weak and the commitment of most key players was not yet strong. Linkages among key actors need to be strengthened and continue to be supported to deliver sustained results.

Different stakeholders coming together to diagnose problems, identify opportunities and find ways to achieve their goals in a space for learning and change is known as an Innovation Platform (IP). The principles of Innovation Platforms – including expert facilitation - are generally well documented (Makini et al (2013), Adekunle A.A and Fatunbi A.O (2012), Hounkonnou, D. et al (2012) and ,Adekunle A.A, A.O Fatunbi and M.P Jones (2010)). However, SHP does not appear to have guidelines for grantees on how to facilitate platforms. As a result, projects that have put in place such platforms for promoting ISFM are facing challenges on how to continue to facilitate and sustain the arrangements.

***RECOMMENDATION**: The Soil Health Program needs to develop a model and guidelines for developing sustainable partnership arrangements that are self-sustaining after the project period: develop innovation platforms for the promotion of ISFM with appropriate local facilitation.*



Box 1 – ISFM platform for legume promotion in Mozambique The innovation platform was hosted by IIAM which had multiple and overburdening responsibilities. An effective and sustainable innovation platform needs to be hosted by a local organisation and supported with professional facilitation (such as Farmer Associations).



Box 2 – Zambia Soybean Platform: Project Increasing food legume crop production for improvement of soil fertility, food security, nutrition and income by smallholder farmers in Zambia led by the Zambia Agricultural Research Institute (ZARI).

4.4 Research and extension approaches under SHP

4.4.1 Research approach

The SHP has promoted research on ISFM through various models. In Ghana, for example, the Research-Extension-Farmer Linkage committee (RELC) is in place where farmers' production constraints are identified at the local level by extension staff. These constraints are categorized into researchable and extension constraints and prioritized within each group. Researchers develop the technology which is transferred to farmers by the extension staff. However, the central research question in some of the experiments carried out was sometimes not clear. An example was an experiment carried out to determine if common beans benefit from inoculation. It is widely documented that there are no significant yield benefits from the inoculation of common beans. Demonstrations and research experiments were also not clearly distinguished. It is important for projects to be clear on whether they are establishing a demonstration or an experiment because the objectives, design and management are different.

Our analysis

The research approach under SHP tends to be conventional empirical research approach or a variation of the Farming Systems research approach. This research approach has fixed questions and methods, designed to fill information gaps perceived to be constraining positive change. It is operationalized through a standard research protocol (made up of: Introduction & Justification; Objectives; Research Questions/ Hypotheses; Methodology, Activities & Implementation; Outputs)

The strength of this research approach is its legitimacy in rigor of knowledge acquisition. The experimental design makes it possible for the experiment to be repeated. However a major weakness of the approach is that it just characterizes the situations and does not in itself address problems or identify "workable" solutions for target groups. At best, it generates hypotheses about what works.

RECOMMENDATION: *Participatory Action Research (PAR) approaches should be adopted (Annex 5). In other words researchers, farmers and other actors have to work together right away from defining the problems to be solved as well as implementing the identified solutions. Farmers and other actors should also be part and parcel in evaluating the results of the technologies.*

4.4.2 Extension approach

Extension is central to scaling up of technologies. In most countries in the 1980s and 1990s, extension services were vibrant and contributed to the development of the agricultural sector. But this is not the case now. It is commendable that AGRA has made efforts to revitalize extension.

The SHP ISFM extension approach was found to be dominantly conventional transfer of technology (ToT) whereby researchers develop the technologies which extension workers then transfer to lead farmers (early adopters), who eventually have to transfer these technologies to other smallholder 'follower' farmers. Many projects supported by AGRA follow this model. For example, the CDI anchor farm in Malawi encourages farmers surrounding its commercial farmers to work in clubs of 10 -20 people. Each club elects a leader as a contact person for the anchor farm's services (leader farmer). CDI staff train these lead farmers in recommended agronomic practices for soybeans, who in turn train the members of their clubs. They use demonstration plots and field days to show the effect of crop, good cultivation practices, the use of fertilizer, and improved varieties of soybeans and maize.

In Mozambique, the MANICA Polytechnic has an AGRA supported project that has organized farmers in groups or clubs to receive extension messages through radio or short messages on the phone. The messages are on recommended practices for various crops. The farmers and extension workers receive the messages together. Once received, extension workers help the farmers to understand the messages. Lead farmers mount demonstration plots to show their follower farmers recommended practices.

Our analysis

The ISFM scale-out dissemination approach overall is not based on demand-led extension but on the transfer of technology (ToT) model (Figure 5) which assumes modern technologies will be adopted by farmers if they are aware of the benefits. This approach works well with large-scale commercial farmers but has failed with smallholder farmers worldwide due to poor public extension services and unavailability of extension staff on the ground. Where extension staff were found to be available, their interaction with researchers appeared to be one-directional with minimal feedback on the technologies from farmers to researchers. While radio and phone messages appear to be a way to ensure that messages reach farmers but these were limited by a shortage of extension workers to reinforce the messages. In Tanzania, for example, extension

workers had gone back to their day to day activities after the project and had limited time and no resources to work with the listening clubs or continue the farmer field schools. District Agricultural Offices had not mainstreamed the activity into extension work-plans. While lead farmers have emerged as community extension workers, they are not a replacement for well-trained extension workers because they need back-stopping.

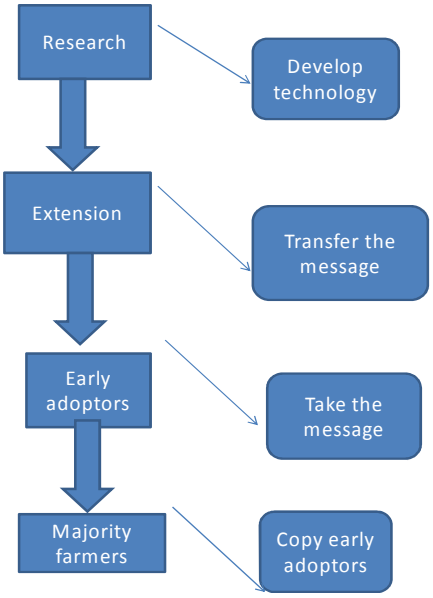


Figure 4 Conventional Transfer of Technology approach

ToT tends to be operated through conventional service delivery, where weak policies plus poorly developed support for implementation have resulted in production packages being pushed onto an undifferentiated clientele for years without any changes (Figure 5).

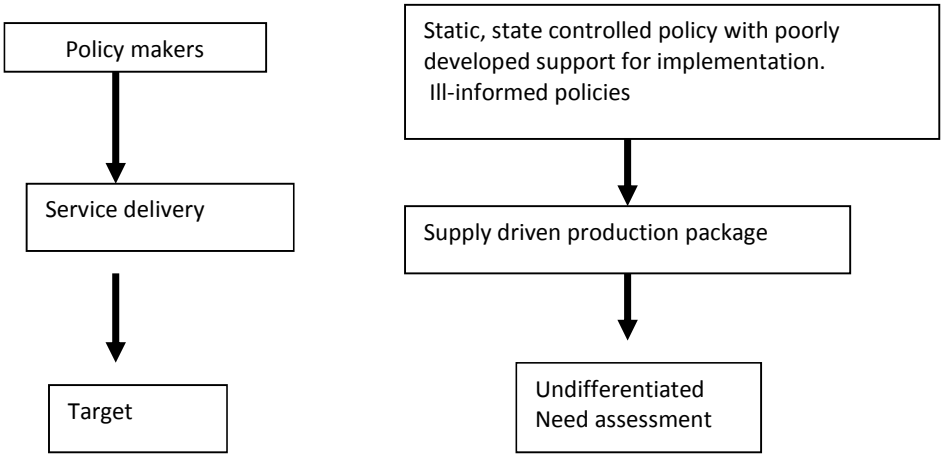


Figure 5 Conventional service delivery system

RECOMMENDATION: *If AGRA is to sustain and scale out its technologies there is need to move from a technology transfer to demand-led extension model. This extension*

model will build the capacity of farmers by imparting knowledge and skills on the various technologies with the farmers being active in identifying problems, generating and using technologies. Currently, the farmers are passive recipients of technologies. It is recommended that AGRA, through the Education and Training subprogram, should target extension workers for training to support technology scale-out.

4.5 Extension support function

The Extension Support Function (ESF) of SHP has tested and piloted extension tools and methods with some promising results. In Tanzania, radio listening clubs were established and in Burkina Faso Radio, mass sms and innovation platforms were piloted. In Mozambique Community Extension Workers (CEWs) were the focus in the cooperative services, convergence of radio and sms, voice mail and the Digital Green (DG) approach. In Ethiopia, Women and youth participation in District Agents empowerment was tried out through the Digital Green approach. In Ghana, Mobile video on tri-cycles, radio listening clubs, cell-phones and Innovation platforms were tried. In Nigeria ICT platforms, cell-phones, private extension and Community Extension workers and youth approach were the focus.

There have been a wide range of experiences from these pilots and experiments. Some were positive – for example, in Tanzania, the community radio station was looking for support to develop new Programs on sustainable agriculture. In Mozambique, however, it was found that although the project was sending out SMS messages to farmers, most of the cell-phone numbers were not attainable. The messages were in Portuguese but most farmers could not understand because they did not speak the language.

Our analysis

Lessons from the different extension tools need to be carefully documented and analysed. The Extension Support Function should use these lessons to advise ISFM projects on appropriate learning and dissemination approaches for different contexts. In its current form, the Extension Support Function has been reduced to use of or research on tools for extension without a system supporting their use. The challenge is that this approach lacks continuity once the project is finished. This requires that ESF embeds the tools in existing or new community-based structures such as ISFM platforms. ESF would then focus on addressing the central question of how to facilitate ISFM platforms to ensure they become sustainable. This requires strengthening the Demand side of extension; the Supply side; and the Organising the Response – Policies for Services.

Strengthening the demand side of extension entails:

- Strengthening Local Producer Organisation development for improved self-governance, representation and quality control of service provision.
- Facilitating the articulation of inclusive demand based on well-analysed and prioritized problems and potential opportunities.
- Supporting creative farmers and communities who seek and experiment with innovative solutions and adapt change to their local situation.
- Organising sustainable financing of the demand side of extension.

Strengthening the responding to Demand – the Service Providers - means

- Developing efficient pluralistic, decentralised service management and service delivery.
- Facilitating capable service providers responding to diverse demands by clientele.
- Organising sustainable financing of rural service systems.

Strengthening the Organising the Response – the Policies for Services will entail:

- Facilitating a paradigm shift in policy and strategy development towards an enabling environment in pluralistic, demand-oriented service provision.
- Developing high performing and adaptive rural service organisations, including management.

The development and application of participatory extension approaches (PEA) or participatory development approaches (PDA) provides a practical way to achieve the above mentioned objectives. These approaches involve transformation in the way extension workers interact with farmers. They facilitate the organisation of farmers, farm women and rural young people into different groups of farmer-based organizations (FBOs) to improve rural livelihoods, achieve food security at the household level and transform rural communities in the development process (Abaru, Nyakuni and Shone (2006), de Zutter, Cabero and Wiener (2006) Wennink and Heemsker (2007) and Swanson, B and Rajahalahti, R (2010)). They integrate principles of participatory training and development (PTD), social development action learning and training for transformation. These principles can be operationalized through methods such as Participatory Learning and Action Research, Participatory Technology Development, Farmer Field Schools and Farmer Field Fora and the Participatory Development Approach (Ngwenya and Hagmann, 2009, Friis-Hansen E. and Duveskog D (2008) Davis K., Nkonya E. Et.al (2010). Some of these approaches are described in annex.

RECOMMENDATION*: SHP supports the establishment of farmer based organizations such as Farmer Field Schools to strengthen the demand side of extension, strengthen the supply side and strengthen the Organising the Response – the Policies for Services.*

4.6 Findings on awareness, knowledge and Use of ISFM technologies by smallholder farmers in SHP

In the adoption process of a new technology or practice, farmers must first be aware of the innovation, including its advantages and limitations before they accept it, become knowledgeable and adopt and adapt it to their farming systems. In this section we present findings from the Independent Evaluation household survey on whether the methods SHP has been using have made farmers aware about the ISFM technologies being promoted. We also look at the extent to which farmers are knowledgeable about the technologies and have made the decision to use them on their farms.

4.6.1 Awareness on ISFM technologies

An objective of many ISFM Scale-Out and Extension Support Function projects was to increase farmers' awareness of different ISFM technologies. Findings from the Independent Evaluation survey show that levels of awareness of various technologies, including inorganic fertilizer and growing legumes in 2014 were high, particularly amongst beneficiary households (Figure 6). In Mali, Nigeria, Kenya, Tanzania, Ghana and Mozambique beneficiaries' awareness of inorganic fertilizer use was over 85 percent, with slightly lower levels in Malawi (74 percent) and Mozambique (40 percent). In all countries except Kenya, SHP beneficiaries' awareness of fertilizers was higher than non-beneficiaries: this was highly significant in Nigeria and Tanzania.

Awareness of use of legumes as an ISFM technology was also high (almost 80 percent and above) amongst surveyed beneficiaries in Mali, Kenya and Malawi. In Ghana awareness was relatively low (55 percent). In all countries except Mali, awareness of legume technologies was higher for beneficiaries than non-beneficiaries: significant in Ghana, Kenya, Tanzania, Malawi and Mozambique.

For other soil fertility technologies, such as use of farmyard manure and composting, levels of awareness among beneficiaries were high in Mali, Malawi and Kenya (both technologies) and for manure in Nigeria, Tanzania and Mozambique (Figure 7). Awareness of composting was low (below 50 percent) in Ghana, Nigeria, Tanzania and Mozambique. The differences between beneficiaries and non-beneficiaries were significant in Ghana, Nigeria, Tanzania, Malawi and Mozambique (both technologies) and Mali for composting. Although ISFM technologies such as composting and use of farmyard manure are not the main focus of most SHP projects, project beneficiaries were nevertheless found to be more aware of these options – though they are not necessarily practising these (see below).

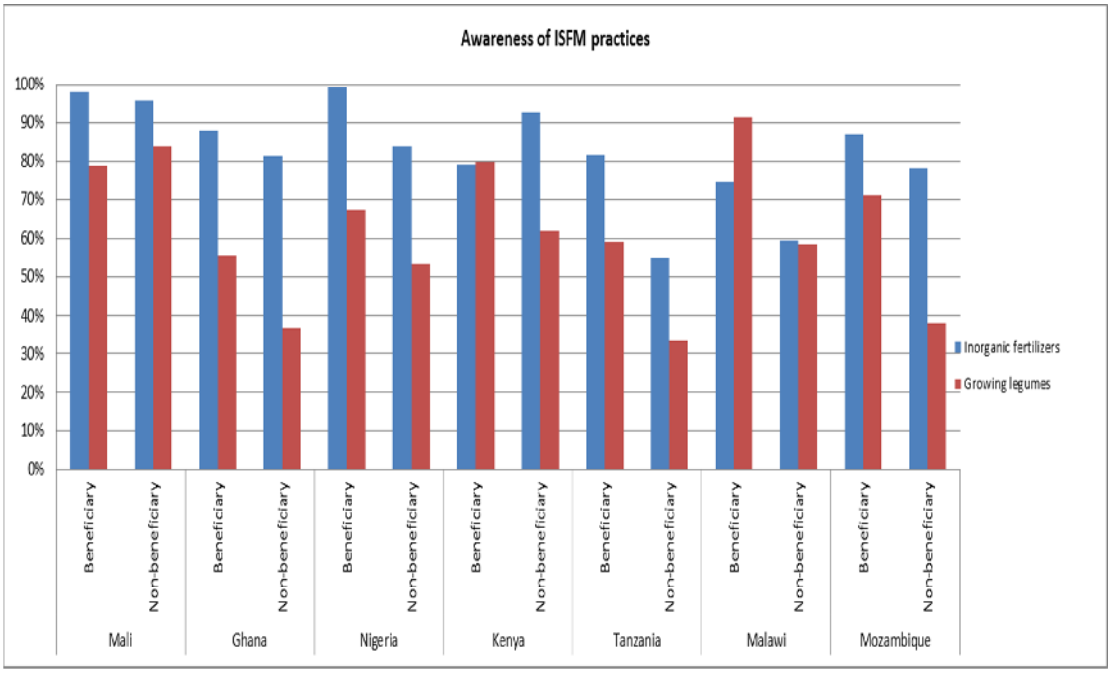


Figure 6 Awareness of fertilizer and legumes as ISFM technologies among SHP beneficiaries and non-beneficiaries households (Percentage of surveyed households)

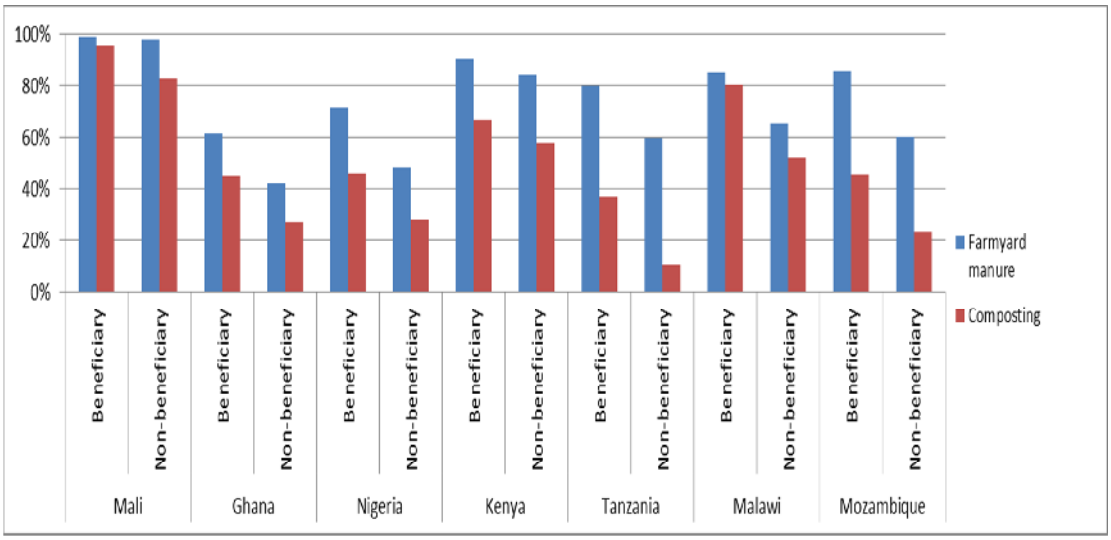


Figure 7 Awareness of use of composting and farmyard manure as ISFM technologies among SHP beneficiaries and non-beneficiaries (Percentage of surveyed households)

4.6.2 Knowledge on ISFM technologies

Various channels have been used by SHP projects to provide information and knowledge about ISFM technologies including: demonstrations, radio, phone messages, field days, extension workers and lead farmers (Table 3). The Evaluation Survey asked about respondents' main sources of information on different ISFM technologies. Extension workers were the most important source of knowledge for fertilizer (37 per cent for beneficiaries and 30 percent for non-beneficiaries) and second most important

source for legume technologies (15-20 percent of respondents). This points to a continuing need for SHP to support extension workers in the ISFM technology dissemination and adoption process. Family members or fellow farmers (not SHP group members) were a leading source of knowledge on fertilizer, legumes and composing technologies for beneficiaries and non-beneficiaries (and particularly for non-beneficiaries). This reflects wider experiences in the region: farmers are more likely to take up a technology that has been validated by a member of their social network (see number of farmers passing on technologies to other farmers below). For beneficiaries SHP fellow beneficiaries were the third most important source of knowledge on both technologies and were particularly important for fertilizer. These are primarily lead farmers who were trained under the project or by other agencies to provide information to other farmers. This finding supports the Lead Farmer approach and Farmer Groups adopted by many SHP ISFM scaling-out projects. However, with only 19 percent of beneficiaries reporting SHP members/Lead Farmers as their source of knowledge on fertilizer, and 11 percent for legumes, the approach does not appear to be working as envisaged. Possible reasons could be that Lead Farmers are working with rather a narrow group of follower farmers, and that they are not adequately trained and backstopped by the projects and extension services.

Nineteen percent of beneficiaries reported radio as a source of knowledge on fertilizer, and 18 per cent non-beneficiaries. Although this is still a relatively small share, it indicates the potential of radio for scaling-out technologies to non-beneficiaries. Evaluation survey findings confirm that demonstration plots and field days are an insignificant source of knowledge on ISFM technologies for farmers. Only 2 per cent of beneficiary farmers cited demos as a source for fertilizer knowledge and legume technologies and three percent on legumes. Only one percent of non-beneficiaries gained useable knowledge on ISFM technologies from demos.

Field demonstrations of ISFM technologies by SHP projects were intended to bring knowledge and skills to farmers: rather it appears they have been a means to create awareness. Over 70 percent of SHP beneficiary farmers interviewed had seen ISFM demos across the countries (Figure 8). The conclusion here is that merely seeing a demo does not equate with increasing farmer knowledge and understanding of the technology being demonstrated.

The fact that a high number of project participants have seen demos and yet only 2 percent report this as their source of knowledge on ISFM technologies means that demos have mostly been used to show results of technologies and not to impart skills and knowledge. This finding suggests SHP is focusing more on the awareness stage and little is being done to help farmers gain knowledge. This underlines the need for SHP to shift from result demonstrations to more participatory learning approaches to develop farmer knowledge and skills (as discussed in Extension Support Function above).

Around 20 to 40 percent of non-beneficiary farmers had seen the demonstration plots – which were around 5-10 km from their homes – indicating that this approach is not reaching the majority of farmers in the area. The exception was Mozambique where 60 percent of non-beneficiaries had seen a demonstration plot.

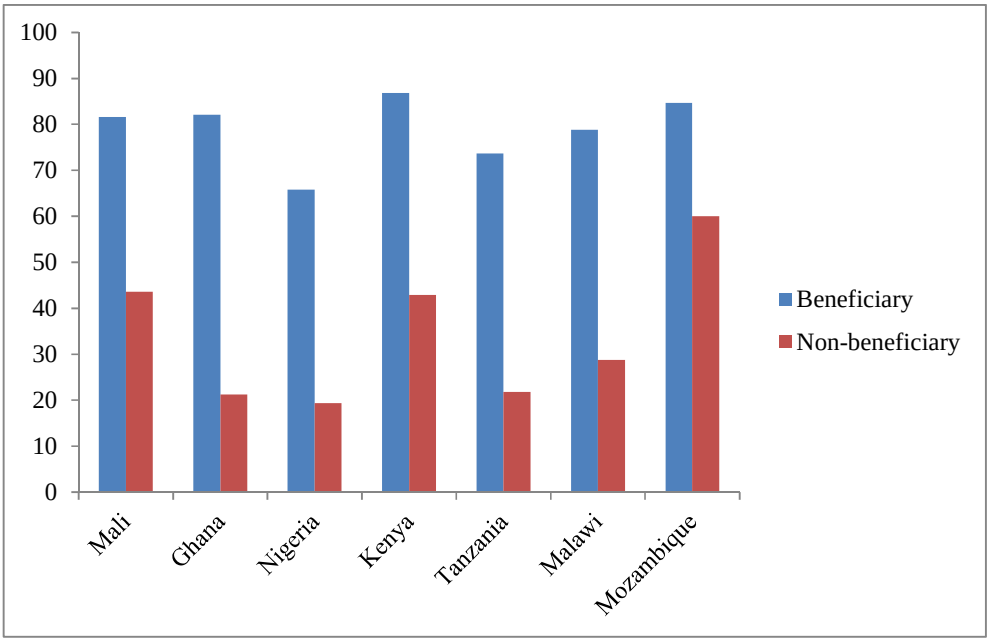
Table 3 Farmers' sources of knowledge on ISFM practices (percent of beneficiaries and non-beneficiaries reporting)

Source of ISFM Knowledge	Inorganic Fertilizer		Legume crops		Compost	
	Beneficiary (N=761)	Non-beneficiary (N=762)	Beneficiary (N=761)	Non-beneficiary (N=762)	Beneficiary (N=761)	Non-beneficiary (N=762)
Family member, other farmer (not SHP group member)	33%	43%**	32%	37%	20%	23%
SHP group member/ Lead Farmer	19%**	8%	11%**	6%	14%**	7%
Extension worker	38%	30%	20%	18%	20%	15%
Radio	19%	18%	9%	8%	9%	9%
Field day	3%	1%	2%	1%	3%**	1%
Researcher	2%	2%	1%	2%	2%	1%
Demo	2%	1%	2%	1%	3%	1%
CBOs/Farmer groups	13%	11%	7%	8%	8%	7%

Source: End of Program Evaluation survey

** Significant at 1% level; * at 5% level. Computed for 5 countries: Kenya, Tanzania, Ghana, Mali and Nigeria. Comparable data not available for Malawi and Mozambique

Figure 8 SHP project beneficiary and non-beneficiary households who saw demonstrations of ISFM technologies (percent)

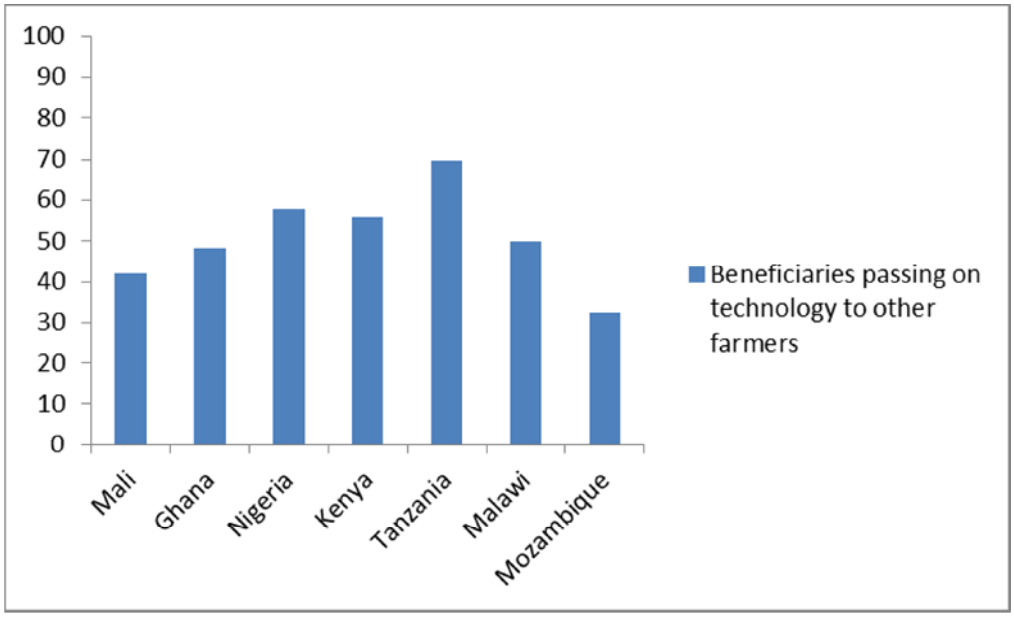


Source: End of Program Evaluation survey

The role of farmers as community extension agents is highlighted by the Evaluation survey. Findings on SHP sampled beneficiary households who shared knowledge about ISFM technologies with non-beneficiary households are presented in Figure 9. Over 50% of SHP beneficiary members in Kenya, Tanzania, Ghana and Malawi shared knowledge about ISFM with other farmers. This farmer-to-farmer knowledge sharing or extension is

an informal system whereby an individual farmer in a community assists other farmers by sharing information or knowledge on improved technologies with other farmers (Gwary 2008). Such knowledge sharing is critical to uptake and facilitates the use and subsequent adoption of technologies.

Figure 9 Beneficiary farmers passing on knowledge on ISFM to other farmers (percent)

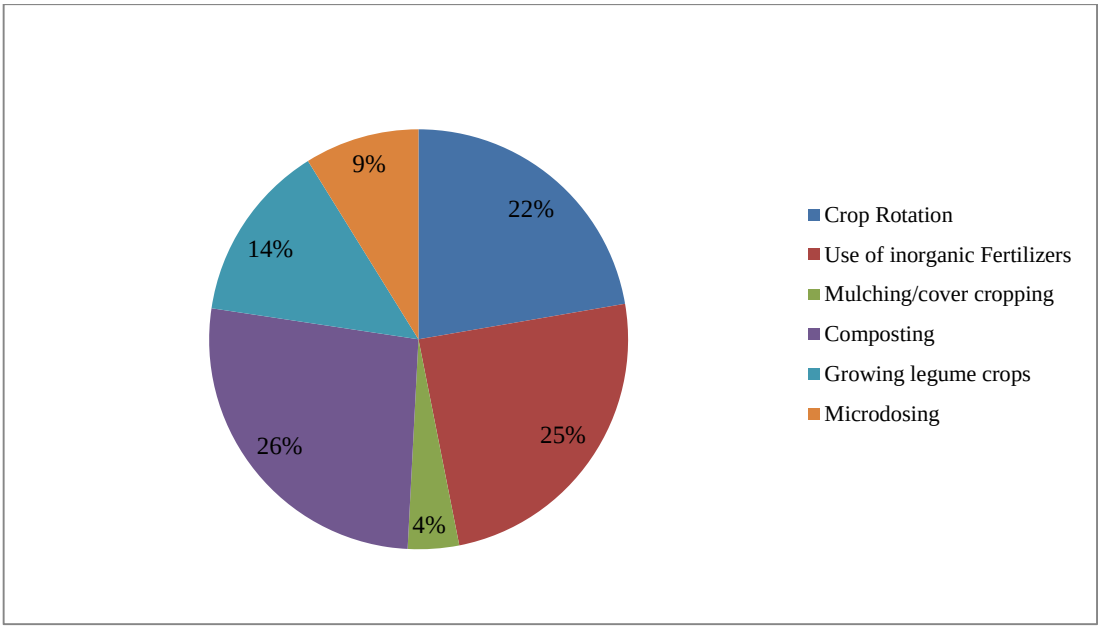


Source: End of Program Evaluation survey

As a result of passing on knowledge and information about ISFM technologies, SHP beneficiaries estimate that an average of 9 non-beneficiaries are now practising the technologies. Although difficult to verify precisely this indicates a high scaling-out factor of 1:9.

The most important ISFM technologies and management practices shared with non-beneficiary households across the seven countries were: composting, use of fertilizer and crop rotation (Figure 10). Growing legumes technologies, microdosing and mulching were the least widely shared technologies. These findings provide an indication of technologies that are most popular and can be passed on from farmer to farmer.

Figure 10 ISFM technologies learnt from SHP beneficiaries



Source: End of Program Evaluation survey

4.6.3 Farmers using ISFM technologies

The overall aim of making farmers aware of ISFM technologies and giving them knowledge and skills is to enable them to try out, and eventually take up those with potential to improve their livelihoods and soils. The 2014 End of Program Evaluation survey looked at different ISFM technologies practised by SHP project beneficiaries and non-beneficiaries and when they took up the practice.

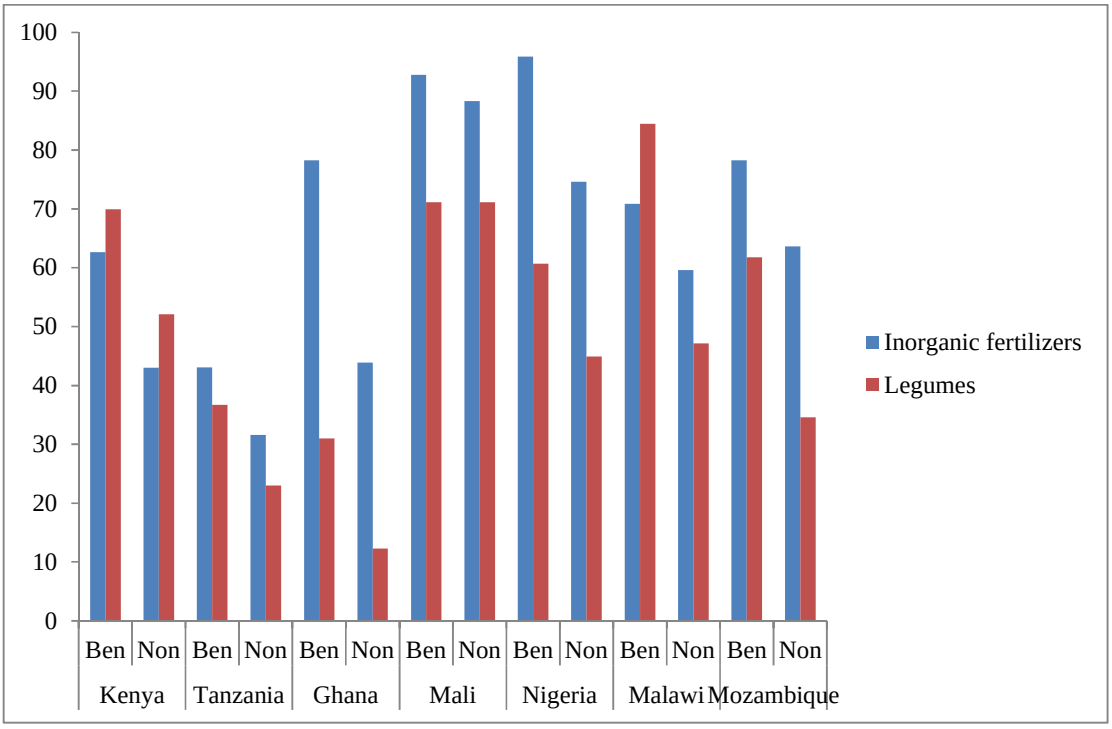
Inorganic Fertilizers were found to be in use by over 70 percent of beneficiary households in Ghana, Mali, Nigeria, Malawi and Mozambique, and by 63 percent in Kenya in 2014 (Figure 11). Only Tanzania recorded less than 50 percent of beneficiary households using Fertilizer. Use of Fertilizer by non-beneficiary households was significantly lower in all countries except Mali (no significant difference).

Table 4 shows the period during which households started using inorganic Fertilizer technologies: designated as before or after the start of the SHP Program (2009). In Nigeria and Kenya the majority of beneficiaries had started using Fertilizers before the inception of the project, indicating that this was a longstanding technology in the project sites. In Mali and Ghana, 100 percent and 71 percent of beneficiaries respectively started using Fertilizer after 2009. In Mali almost all beneficiaries and non-beneficiaries had started using them during the past 5 years. This indicates that both knowledge and availability of Fertilizers has increased in the project areas. It is likely that these are at least partially the result of SHP activities such as introduction of the agrodealer Program.

Grain legumes cultivation was practised by over 70 percent of beneficiary households in Kenya, Mali and Malawi; and over 60 percent in Mozambique and Mali. Only

beneficiaries in Tanzania and Ghana had low rates of use of legumes (37 and 31 percent of beneficiaries). Beneficiary cultivation of legumes is significantly higher than non-beneficiaries for all countries except Mali. Again in Mali it appears that spill-over effects from the project have been high, with 70 percent of non-beneficiary households also taking up legumes.

Figure 11 Use of inorganic Fertilizers and legume technologies by beneficiary and non-beneficiary households (percent)



Source: End of Program Evaluation survey

Table 4 Period beneficiaries and non-beneficiaries started using inorganic Fertilizers and legumes (percent)

	Mali		Ghana		Nigeria		Kenya	
	Before 2009	2009 onwards	Before 2009	2009 onwards	Before 2009	2009 onwards	Before 2009	2009 onwards
Started using inorganic Fertilizer								
Beneficiary	1	99	58.3	41.7	62	38	42.9	57.1
Non-beneficiary	0	100	28.9	71.1	82.4	17.6	63.4	36.6
Started using legumes								
Beneficiary	0	100	15.4	84.6	27.1	72.9	71.7	28.3
Non-beneficiary	0	100	23.5	76.5	48.3	51.7	48.3	51.7

Source: End of Program Evaluation survey

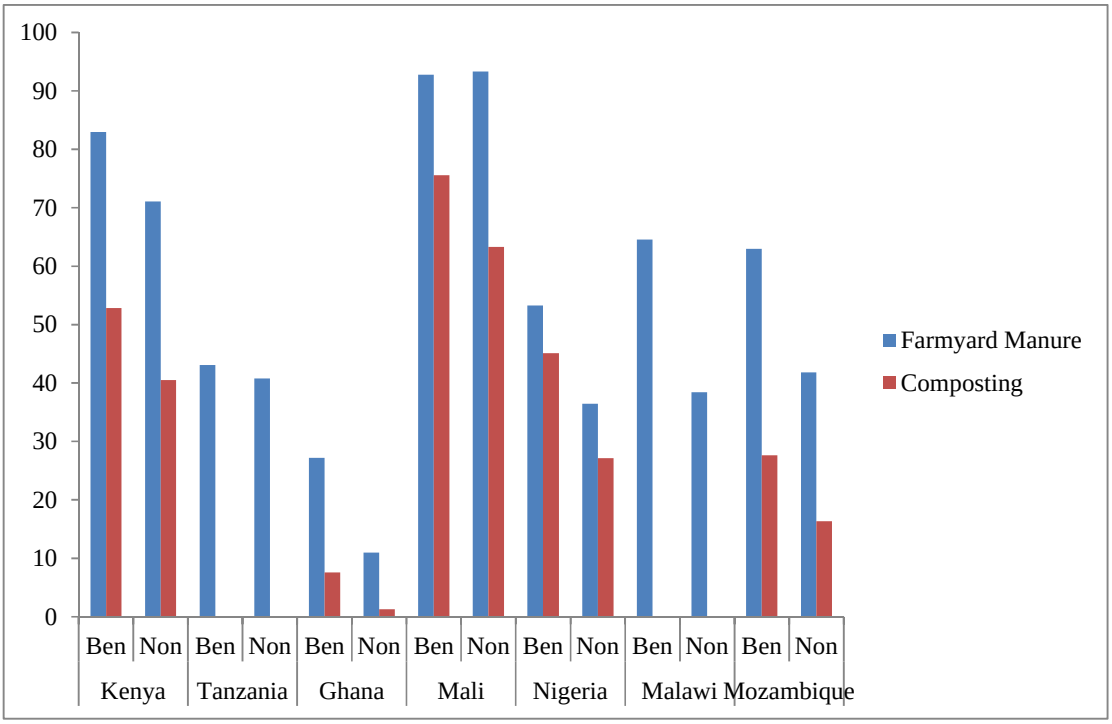
Households practising farmyard manure and composting technologies are shown in Figure 12. Use of farmyard manure as a soil fertility technology is most common in Mali

and Kenya, followed by Malawi, Mozambique and Nigeria. The lowest use is in Ghana. Beneficiary households are significantly more likely than non-beneficiary households to be applying farmyard manure to their fields in all countries except Mali (where it is widely practised).

Composting is a less widely practised technology, not having been widely promoted under SHP projects, and generally requiring significant labour inputs and a source of water. Nevertheless, a high proportion of beneficiaries in Mali (76 percent), followed by Kenya (53 percent) and Nigeria (45 percent) were found to be using composting. Beneficiaries were significantly more likely to be making composts than non-beneficiaries). In the other countries less than 30 percent of beneficiaries were using composts (none in Tanzania and Malawi).

Although farmyard manure and composting were not key technologies under SHP projects, beneficiary households appear to be taking up the technologies – albeit at a slower rate than Fertilizer and legumes. This suggests they have been exposed to and appreciate the benefits of these ISFM technologies and are willing to try them out and take them up.

Figure 12 Use of farmyard manure and composting by beneficiary and non-beneficiary households (percent)



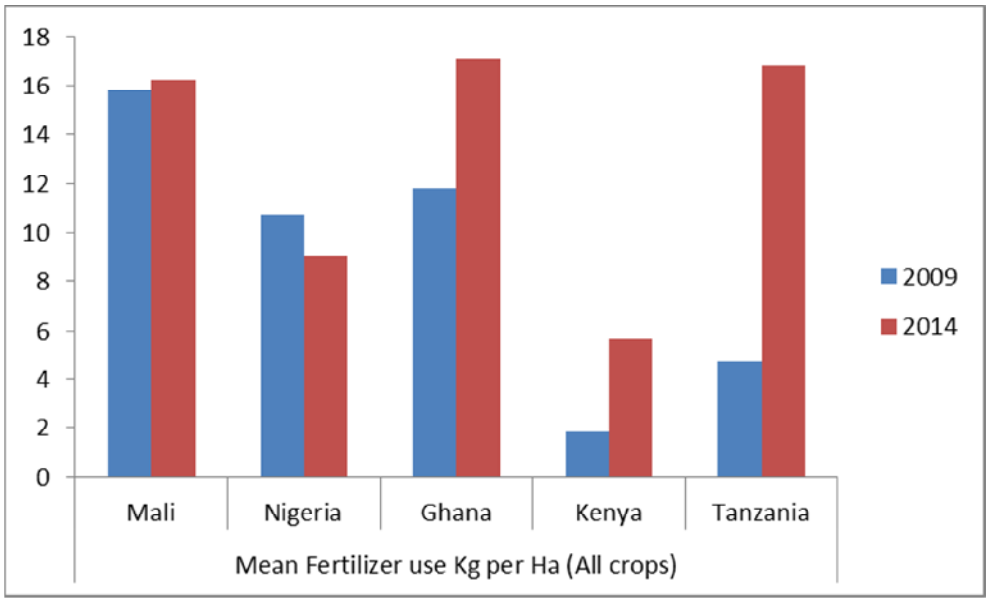
Source: End of Program Evaluation survey

4.6.4 Rates of Fertilizer use

Increased Fertilizer use by farmers is one of the expected outcomes of SHP. Findings from the Evaluation show that Fertilizer use per hectare has increased amongst farmers surveyed in four of the countries surveyed – Mali, Ghana, Kenya and Tanzania. In

Tanzania the increase is highly significant (Figure 13). In Nigeria, there was a marginal fall in Fertilizer, but this was not significant. Rates of Fertilizer use were found to be over 15 kg per hectare in Mali, Ghana and Tanzania. In Kenya, rates amongst surveyed farmers were low at 6 kg per hectare. It was noted that some farmers in project areas had tended to adopt grain legume technologies as a substitute for or complement to inorganic Fertilizers, while some in Mali were using microdosing to improve Fertilizer use efficiency, which impacted on Fertilizer usage rates.

Figure 13 Mean Fertilizer use per Kg/ha



Source: End of Program Evaluation survey

4.6.5 Crop Yields

Agricultural output and yields are dependent on a combination of production factors, including technology (see Tables 5 and 6). Mean yields of key crops, maize, rice groundnuts, and soya, have increased for most crops over the project period for beneficiaries in all countries surveyed except for Kenya, where maize was hit by leaf rust in 2013/14, and Nigeria where there were problems of rainfall. Mean yields of maize have increased from around 1 tonne per hectare in Ghana, Mozambique and Mali to between 1100 and 1400 t/ha; and from 1.5 t/ha in Tanzania and Malawi to 1.9 and 2.2 tonnes per hectare respectively. In all countries except Ghana and Mali, maize yields for beneficiaries were higher than for non-beneficiaries; in Kenya and Tanzania the differences were significant. Rice production has increased in Ghana and Nigeria, but not in Mali where yields were highly variable between farms. Soya yields were recorded in Malawi and Mai: both have increased.

Overall yields are lower than those recorded by the projects on research plots. There are a number of possible reasons for this, including management, timeliness of securing and applying inputs, as well as climatic and pest factors. It is also noted that the Evaluation used farmer recall estimates, which reduces accuracy, although there was no indication

of systematic bias. Fertilizer use was plotted against maize yields per hectare (Figure 14 and 15). Correlation was found to be positive but low, indicating that this is not the binding constraint in increasing yields.

High variability in yields was seen amongst farmers surveyed (Figure 16). There This indicates that a key project focus should be on understanding variability and addressing this in future research and learning activities. Participatory Technology Development and other approaches described above, conducted in partnership between researchers, extension/development agents and farmers/farmer organisations are ideal for this.

Table 5 Yields of key crops by Surveyed households in 2009 (Kg/ha)

Yields in 2009 - Kg/Ha	Ghana		Nigeria		Kenya		Tanzania		Malawi		Mozambique		Mali	
	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben
Maize	869	1013	2893	3958	1238	782	1,531	1,704	1,560	1,741	1,248	1,114	1,094	1,506
Rice	1134	694	1324	1663	X	x	x	x	x	x	x	x	1,288	1,288
Groundnut	435	x	1125	1727	X	x	1,736	1,715	1,752	1,687	515	364	1,366	1,726
Soya	x	308	447	1590	X	x	x	x	898	887	613	x	x	x

Table 6 Yields of key crops by Surveyed households in 2014 (Kg/ha)

Yields in 2014- Kg/Ha	Ghana		Nigeria		Kenya		Tanzania		Malawi		Mozambique		Mali	
	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben	Ben	Non-ben
Maize	1109	1269	1467	X	675	399	2,231	1,774	1,982	1,872	1,439	1,245	1,337	1,547
Rice	1399	1089	1718	2148	x	x	x	x	x	x	x	x	927	1,467
Groundnut	x	x	x	X	x	x	1,608	2,152	2,079	2,552	498	495	1,421	1,904
Soya	x	x	x	X	376	x	x	x	1100	828	720	498	x	x

Source: End of Program Evaluation survey

Figure 14 Correlation of Maize yield and Fertilizer use by beneficiaries 2014

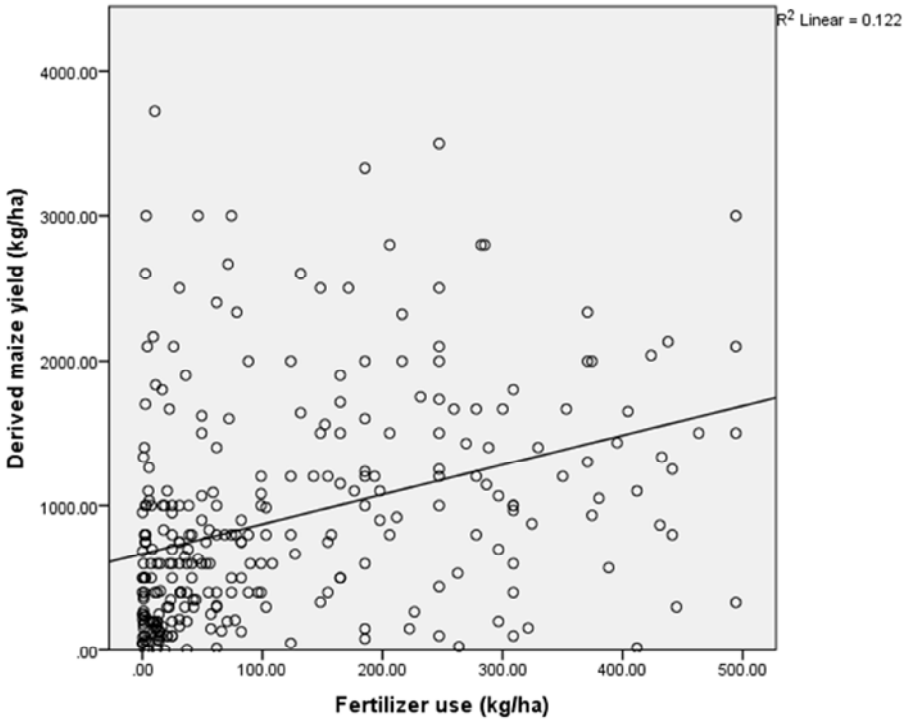
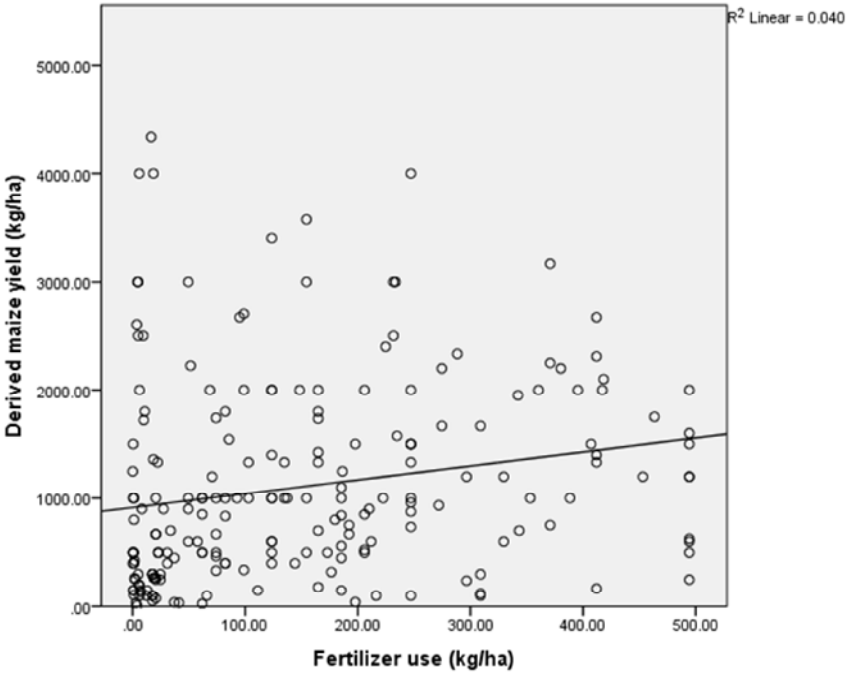


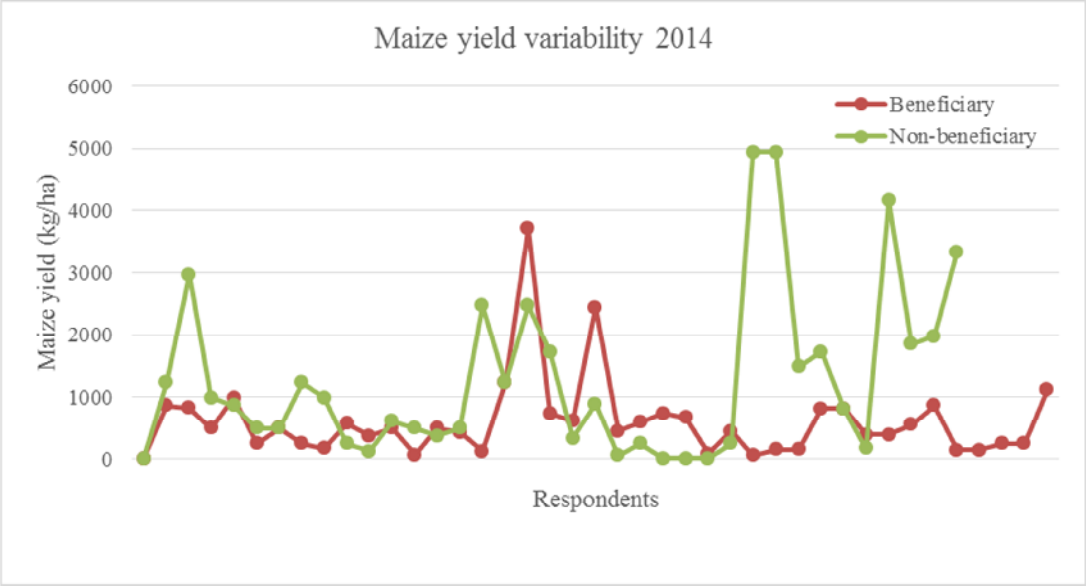
Figure 15 Correlation of Maize yield and Fertilizer use by non-beneficiaries 2014

Source: End of Program Evaluation survey



Source: End of Program Evaluation survey

Figure 16 Illustration of variability of yields by respondents (n=75)



Source: End of Program Evaluation survey

4.7 Harmonized ISFM messages through Soil Health Consortia

The ISFM scaling up sub-program is supporting National Soil Health Consortia. The objectives of National Soil Health Consortium are:

- To work towards minimized duplication of efforts and improve the use of limited resources in the country
- To enhance collaboration with and increase prospects of developing joint communication within stakeholders/clients who are often the same for all the projects
- To develop joint protocols for demonstrations and trials that the stakeholders will conduct in different locations
- To bring and build transparency, trust and a clear understanding of programs and projects on soil and land management related issues in the country that are funded by various donors, and thus build synergy and leverage each other's resources
- To help collect and collate legacy data needed to develop fertilizer recommendations
- To develop/strengthen the technical and delivery capacity of the members.

All countries have made some progress towards the establishment and initial functioning of the National Soil Health Consortium. Soil Health Consortia are functioning in 8 countries in East and Southern Africa (Kenya, Uganda, Malawi, Ethiopia, Mozambique, Rwanda, Zambia and Rwanda) though at different levels of development.

Membership of National Soil Health Consortia is free and open to all members of the public and private sectors who share an interest in promotion of ISFM. Potential stakeholders include members from research institutions; extension services; universities; policy makers, Non-government Organizations (NGOs); Community-based Organizations (CBOs); farmers' organizations; seed and fertilizer companies, agro-dealers; natural resource management networks and funding partners. Operationalization of the consortia is through a secretariat office for coordination and four sub-committees made of representatives of different stakeholder institutions (focal persons) to address the four key output deliverables of the consortium. The four sub-committees are Research, communication and marketing, policy and resource mobilization.

The importance of learning from the past has been recognized by all countries. With the support of the International Plant Nutrition Institute (IPNI), all countries have initially focused on collection of data and establishment of databases for storage of the data, development of communication products using the data collected, establishment of website to create a means of sharing the information.

Progress is varied in different countries but is generally positive across the region. Websites are up and running in Kenya (www.kari.org/kshc/), Malawi (www.sohcom.org) and Zambia (www.zamshc.org). Seventy consortia members have been trained in data synthesis and development of communication products. Thirty communication products have been developed (policy briefs, extension guidelines, technical reports, radio messages). Malawi

has developed harmonized ISFM messages and packaged for radio.

The approach to harmonisation of ISFM messages has varied across countries. In some countries (e.g. Malawi), SHC members are synthesising data and developing ISFM guidelines that can be regarded as options that farmers can choose from depending on their context. In other countries (e.g. Kenya) the approach has been collating the different research on fertilizer recommendations and evaluating the best responses based on the agronomic and economic responses.
These efforts will contribute towards more targeted fertilizer application recommendations. To benefit from existing data, National Soil Fertility Consortia have established linkages with data rich networks/initiatives like the Soil Fertility Consortium of Southern Africa (SOFECSA) and Agroforestry Network (AFNET). There is need for formalised data and information sharing arrangements with these and other natural resource management networks. It is also necessary to learn from previous networks like the Soil Fertility Management and Policy Network for Southern Africa and Conservation Agriculture task forces and working groups. Closer linkage with these other initiatives will also help concerns of the sustainability of National Soil Health Consortia as that will help secure the buy-in of a wide range of stakeholders including Government.

In East and Southern Africa IPNI has been supporting the National Consortia while in West Africa IITA provided the support. While some countries view the level of support as adequate, some countries with limited capacity would require more support. Support of IPNI and IITA has focused on the collection and collation of data at national level to facilitate production of dissemination products. It also envisaged that data will be collated across all countries and analyzed at continental level. However, since there will be issues of harmonization, the function of collecting and collating data across all countries should best be carried through sub-regional organizations (ASARECA, CARDESA etc.) and continental organizations (e.g. FARA) that already have the mandate for coordination and harmonization.

RECOMMENDATION*: National Soil Health Consortia should identify a range of ISFM options for smallholders for different socio-economic and agro-ecological contexts. Operationally National Soil Health Consortium should be a self-sustaining partnership platform for the mobilisation of ISFM services for farmers. The SHP should aim at developing a shared common vision and internal facilitation capacity of the platforms. IPNI (and IITA) should review and provide appropriate levels of support to different SHC members depending on their capacity. Harmonisation of ISFM data across regions and the continent might best be handled by regional research organisations mandated with coordination and harmonisation*

5. Fertilizer Supply and Policy

5.1 Overview

It is well recognized that Africa is the continent with the lowest fertilizer use per hectare of land under crop, while much of its soils are highly degraded and infertile (Bationo et al., 2012). Recognizing this challenge, the first objective of AGRA SHP targets increasing financial and physical access to appropriate fertilizers by (i) boosting local availability of appropriate fertilizers through specific blends, small packaging, and quality certification; (ii) increasing the distribution of appropriate fertilizers to smallholder farmers by supporting efficient wholesale, retail, and cooperative networks; (iii) establishing a fertilizer market information and trading system at country level; and (iv) financing for improved procurement, production capacity and policy implementation (AGRA, 2007). SHP target is to increase fertilizer supplies by 150,000 to 200,000 MT by 2014.

The specific interventions within SHP were (i) promoting African Fertilizer and Agribusiness Partnership (AFAP), (ii) supporting the establishment or strengthening of companies to produce required fertilizer blending capacity, (iii) supporting the establishment of lime crushing facilities to boost domestic lime availability, (iv) engaging for improvement of soil fertility related policy issues, v) supporting creation of effective distribution mechanism mainly through strengthening and widening agro-dealer network, and (vi) facilitating access to finance. These interrelated interventions are expected to boost the availability of chemical fertilizers and of relevant types of fertilizers mainly in the form of local blending for micro-nutrients and enhancing local production of lime in the target countries. Table 7 below presents the different AGRA grants within the fertilizer supply sub-program that were approved at August 2014. The two AFAP grants to Ghana, Mozambique and Tanzania account for 67% of total grants in the sub-program whereas the grants to each of the other countries are below 6%.

Many of the grants are embedded in several SHP projects while in a few cases they are stand-alone projects. The evaluation focuses on the latter but also draws material from the former given the inter-related nature of SHP activities. The evaluation of this sub-program used different sources of information including review of secondary literature (including program and project documents) and key informant interviews.

Table 7 Fertilizer AGRA grants (2009-2014)[1]

Country	Number of grants	Amount (in US$)	Share of total
Burkina Faso	2	1,455,114	4%
Ethiopia	1	526,425	1%
Ghana	1	466,669	1%
Kenya	1	499,790	1%
Malawi	1	495,870	1%
Mali	3	1,147,415	3%
Mozambique	2	1,656,338	4%
Mozambique, Tanzania & Ghana	2	25,000,000	67%
Niger	2	604,723	2%
Nigeria	1	244,366	1%
Rwanda	4	2,248,417	6%
Tanzania	2	1,895,647	5%
Uganda	1	485,365	1%
Zambia	1	398,925	1%
Total	24	37,125,064	100%

Source: AGRA Grant Database, 2014

5.2 African Fertilizer and Agribusiness Partnership

Although this end-of-program evaluation does not specifically cover the AGRA grants made under AFAP, we draw important lessons on the implementation of the agro-dealer 'hub' concept to reflect on criteria for developing a strong network of agro-dealers that is sustainable and scalable (see 5.4 below).

A review of documents and interviews with key informants shows AFAP's mandate is to increase supply of fertilizer along the supply value chain. It mobilises private sector actors from major suppliers through manufacturing, blending, granulation, importation to distributors/distribution, to retailers - who are the last mile to the farmers. In so doing, AFAP has promoted linkages in the form of contracts among eligible international, regional or local agribusinesses. The contracts target enhancing domestic availability of fertilizer. When AFAP was established in 2011 the founding partners were AGRA, NEPAD, IFDC, USAID, the Africa Development Bank, and AGMARK. In terms of achievements, the program has improved private sector participation through agribusiness partnerships often through matching grants and credit grantees. The credit facilities established with four banks in Mozambique, Ghana, Tanzania, and South Africa have played key role is this regard. Accordingly, 2 grants amounting to US$25 million were provided to Ghana, Mozambique and Tanzania.

This partnership arrangement has been augmented with investment in fertilizer warehousing to enhance efficient distribution. According to AGRA (2014), fertilizer storage facilities targeting 150,000 MT are being established in three countries (Mozambique, Ghana and

[1] Most of these projects (except AFAP) were meant to improve fertilizer value in terms of both supply/delivery and demand creation at the farmer level and quality enhancement.

Tanzania). In Mozambique, four fertilizer warehouses with capacity of 23,000 MT have been constructed and six more are under construction. In Ghana, four warehouses with capacity of 23,000 MT are constructed while in Tanzania, 10 warehouses with capacity of 50,000 MT are constructed.

AFAP has supported companies to engage in fertilizer supply: as a result, the number of fertilizer companies has increased in target countries (viz. Mozambique, Ghana and Tanzania). Compared to 2009, the number of fertilizer companies in Mozambique has increased from 2 to 11, in Ghana from 12 to 45, and Tanzania from 15 to 51 companies (AGRA, 2014). In summary, AFAP is working on the supply side of fertilizer. Demand creation activities are carried out with farmers under the ISFM sub-program, including field days and demos conducted by fertilizer suppliers and distributors (AFAP key informant March 2015).

5.3 Fertilizer Policy, Regulations and Quality Control

This section brings together components of fertilizer policy, regulations and quality control. Key elements of this review are: a) Policy formulation and review, b) Awareness and Advocacy, and c) Capacity building (infrastructure development and training).

Quality control is a central piece here because it is critical to the proper development of the fertilizer industry. It involves strengthening regulations and building capacity in awareness, institutions and training. AGRA support was designed to build fertilizer regulatory divisions' technical and institutional capacity for the effective implementation of fertilizer regulation and quality. Major components included (i) Policy formulation and review, (ii) Creating awareness and advocacy, (iii) Building institutional capacity, (iv) Training to develop and strengthen human capacity, and (v) Fertilizer policy harmonization.

5.3.1 Policy formulation and review

At the end of 2014, a total of 12 grants to 12 countries in (Tanzania, Mozambique, Mali, Ghana, Rwanda, Burkina Faso, Uganda, Malawi, Zambia, Niger, Nigeria, and Kenya) were provided towards improvement of fertilizer regulation systems and quality control. The Ethiopia grant was defended and also got underway before the end of 2014. It is important to note that SHP has exceeded its initial target of six countries (i.e., six P1+ 2 countries) and has since covered all the 13 countries. SHP realised that all the 13 AGRA-focal countries were lacking policies to support the implementation of fertilizer regulatory systems and the adoption of inorganic fertilizer and ISFM practices by smallholder farmers. As a result, some countries (Ghana, Mali and Tanzania) undertook to address the entire process. Hence, regulations are in place and implementation is underway in these countries. Other countries (Uganda, Mozambique, Zambia, Burkina-Faso, Malawi and Rwanda) are at advanced stage while the rest (Niger, Nigeria, Kenya and Ethiopia) are still at an early stage.

Although fertilizer market had been liberalized in Ghana, there was no functional regulatory system in place before the AGRA intervention. AGRA funded the Ministry of Food and Agriculture project implemented by the Plant Protection and Regulatory Services Directorate through its Pesticide and Fertilizer Regulatory division. It helped to develop, review and publish manuals on analysis and specification and many forms.

In Tanzania the government enacted the national fertilizer Act No. 9 of 2009; the project funded by AGRA was started in 2010 to provide the foundation for the Tanzania Fertilizer Regulatory Authority (TFRA) which was finally established in 2012. So far, 721 fertilizer companies and dealers have contacted TFRA for registration. Moreover, the existence of TRFA has increased sensitization and awareness on fertilizer quality and control.

In Uganda the National Fertilizer Policy (NFP) was developed under the leadership of the Economic Policy Research Centre (EPRC), Makerere University. The project aims to develop fertilizer policy, strategies, regulations and quality control in Uganda. Among key stakeholders is Uganda National Agro-input Dealers Association (UNADA) which works closely with Ministry of Agriculture, Animal Industries and Fisheries (MAAIF) to ensure all Fertilizer importers registered and licenced. The impact of this activity will likely be realised by 2018.

In Nigeria, a national fertilizer bill was prepared and sent to the parliament. The bill has passed the second reading. In addition, four draft regulations on inspection, analysis, specification and labelling have been produced.

Despite the existence of fertilizer regulatory systems in countries which now cover the entire process, product adulteration and contamination persist. For example, in Ghana, there are reported cases of smuggling and sale of fertilizers in vans during market days. This necessitates policing and enforcement of the regulation in fertilizer supply.

5.3.2 Awareness and advocacy

In all the countries under review, stakeholder meetings and workshops were organized to sensitize and create awareness on regulation and fertilizer quality and control. Print material such as factsheets and manuals were developed and distributed. Public awareness education was intensified by electronic media. This has resulted in increased researcher knowledge on major gaps to be addressed in fertilizer quality control and increased awareness among stakeholders on fertilizer policy and regulations.

5.3.3 Capacity building

The project supported the purchase of office supplies and equipment for fertilizer regulatory activities including equipment for laboratories. It also trained 2,863 fertilizer inspectors and fertilizer analysts/technicians in the AGRA target countries. This includes 82 inspectors trained from Training and Education sub-program (see Table 8 below). The two AFAP grants to Ghana, Mozambique and Tanzania account for 23% of total inspectors trained. This is followed by Burkina Faso (17%), Ghana (15%), Mozambique (12%). Each of the remaining countries accounted for less than 10%. Overall, there was a substantial improvement in the number of inspectors and analysts trained and their skills improved.

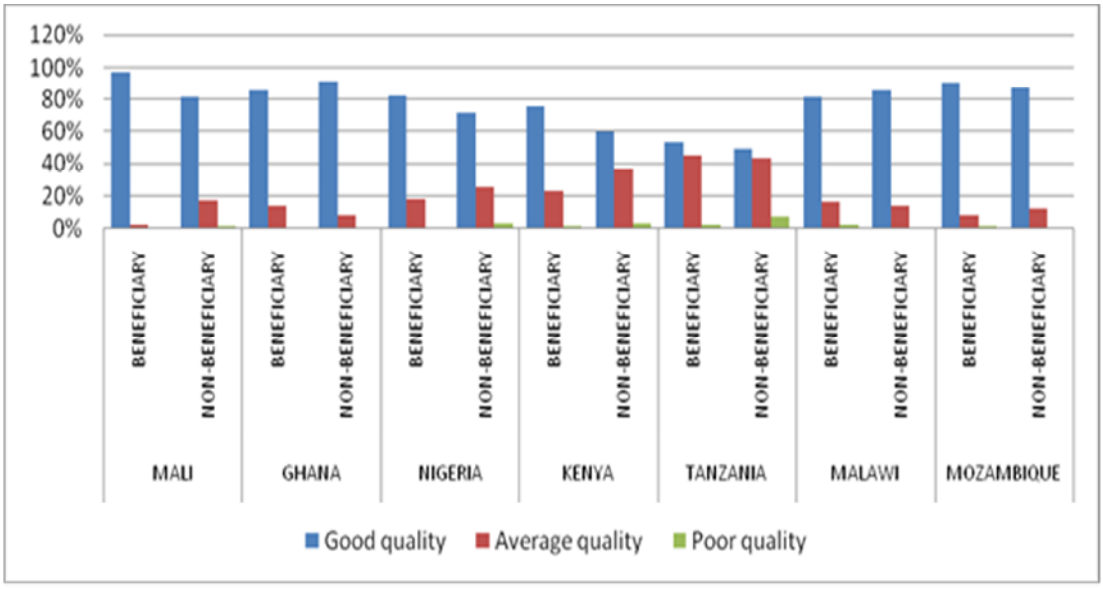
Table 8 Inspectors trained on Fertilizer Supply

Country	No. of Inspectors	Percentage
Burkina Faso	447	16
Ghana	430	15
Mali	210	8
Mozambique	337	12
AFAP (Mozambique, Tanzania, Ghana)	635	23
Niger	165	6
Rwanda	77	4
Tanzania	255	9
Zambia	225	8
Total	2781	100

Source: AGRA Grant Database, 2014
Note: Other than the Fertilizer Supply program, 82 Fertilizer inspectors received training and learning program

This intervention has contributed to great success in fertilizer inspection throughout the market chain in many countries under review. In Ghana, there were reports of increased uptake of the fertilizer analysis services offered by technicians and more samples are being taken for analysis. The Evaluation Household survey (2014) reported that quality of fertilizer available at their nearest agro-dealers had improved. This result was highly significant in Mali (90%) and significant in Nigeria (80%), Kenya (60%) and Tanzania (55%) (10% level of significance) (Figure 17).

Figure 17 Quality of fertilizer available at nearest agro-dealer (Farmer responses)



Source: Evaluation household survey, 2014

5.3.4 Fertilizer policy harmonisation

The use of fertilizer by African farmers on crops is faced by challenges such as restricted markets for fertilizer, high transaction costs and uncertain quality of fertilizer. Fertilizer

markets in Africa are highly fragmented (World Bank (2012). Poor access and use of fertilizers in the East Africa (EAC) Community has been partly attributed to weak, unsupportive and fragmented policy frameworks and standards governing fertilizer supply chain. The EAC Policy body in the Agricultural Sector recognizes the need for appropriate regional policies and efficient markets for sustainable agricultural development and is committed to ensuring that agricultural development is achieved through appropriate policies and regulatory frameworks. The proposed Regional Fertilizer Policy in EAC aims at providing the necessary guidance towards improvement of farmers access to improved fertilizers of a wide variety, high quality, affordable prices, and which are better suited to the soil and climatic conditions of the region by promoting inter and intra-regional trade of agricultural inputs as well as improving technology transfer.

AGRA has been supporting EAC harmonization of farm inputs agenda (fertilizer and seeds). Work on development of fertilizer policy has been initiated.

The West Africa Fertilizer Policy (WAFP) harmonization work has been slowed due to concerns of poor quality of fertilizer in countries within the ECOWAS region. Here locally manufactured fertilizer has been reported to be adulterated in terms of the chemical component as well as the weight of the fertilizer (Sanabria et.al, 2013; Ayoola, 2014; Eilittä, 2014). As a result, many countries are seeking to address this market failure through effective regulatory policies at the country and regional levels. This is seen as new opportunities that will increase the use of fertilizer among food crops producers.

The West Africa governments, for example, who are the main target in the current policy harmonization process by ECOWAS, are receptive in promoting the use of fertilizer by smallholder farmers in specific countries. Increasingly, countries supported by AGRA - Ghana, Nigeria, Mali and Burkina Faso - are embracing the private sector approach in distribution of subsidized fertilizer.

Overall, AGRA SHP had a total of 13 grants awarded in 13 countries by the end of 2014 to improve fertilizer regulation systems and quality control. This support to the 13 AGRA-focal countries was made upon SHP realising that at all countries did not have policies in place to support the implementation of fertilizer regulatory systems. As mentioned above, some countries undertook the entire process and regulations are in place and implementation is underway in these countries. Other countries are at advanced stage while the rest are still at the starting stage. Therefore, SHP has funded EAC while the on-going Fertilizer policy harmonisation in ECOWAS is drawing from achievements from member countries (Mali, Ghana, Burkina Faso, Niger and Nigeria).

Challenges and lessons

- Mass media is an effective mechanism in creating awareness in fertilizer quality and regulations. Apart from technical training, more exposure on fertilizer analysis, sample exchange programs and accreditation of laboratories is needed to gain trust from clients and to strengthen the regional laboratories.

- Despite the existence of a regulatory system there still persist a challenge of non-compliance of laws and regulations in fertilizer supply. For instance, several cases of smuggling, adulteration and contamination of fertilizers are reported in many countries. This challenge is attributed to implementation bottlenecks, problem of mobility among fertilizer inspectors and budgetary limitations.

- Further, policy implementation process takes a long-time beyond the 3-year duration of the SHP projects under review. This situation leaves the farmer who is the end user of fertilizer and other inputs suffering from the existing malpractices, thus the need to raise the voice of farmers and involve civil society groups in policy advocacy.

Recommendations

- There is need to raise voices of farmers to communicate their demands through a meaningful engagement. A coherent communication strategy needs to be developed to enable farmers to articulate themselves. Farmers also need to organize themselves in strong social groups that will enable them to have bargaining power to engage appropriately and be engaged with the policy process.

- Sustaining policy change requires linking the process to civil society groups in order to promote farmer activism in policy dialogue, drum up support for policy implementation and demand accountability from the leaders.

5.4 Fertilizer blending and small packs

Given the small-scale nature of production systems in many African countries and the diversity of soil types in terms of nutrient requirement, SHP has assisted Mali, Ethiopia, and Nigeria to consider fertilizer blending and promotion of smaller fertilizer packs.

In Ethiopia, fertilizer blending is highly associated with high level policy makers' direction in promoting blended fertilizer, as there is a belief that Ethiopian soils are deficient of micronutrients. The two fertilizer types that have been in use in Ethiopia are Urea and DAP. There are five types of blended fertilizer formulation approved in Ethiopia and all of them have the basic content of NPKS (nitrogen, phosphorus, potassium and sulphur) with different composition depending up on the micronutrient added (like zinc, manganese, etc).

Currently, five blending facilities are under construction. All of them are managed by farmers' cooperative unions and their distribution considers regional equity. Facilities are therefore located at: at Mekele in Tigray region; Bahir Dar and Dessie in Amhara region; Tulu Bolo in Oromia and Hawassa in SNNPR. All of them are under construction except the one in Oromiya that is already operational, blending two formulations of blended fertilizer.

The efficacy of the five formulations have been tested by research (EIAR), AGRA SHP funded MSc research and the MoA at the farmers' training centers (FTCs) with ATA assistance. However, the results obtained from these three independently run verifications were not consistent. Thus, it was agreed in 2014 to undertake nationally designed verification of five-seven blended fertilizers with a link with EthioSIS (Ethiopia soil mapping project). Accordingly, a study was launched targeting 173 woredas (districts) in the four major regions (Amhra, Oromia, SNNPR and Tirgay), taking 51 sample sites with full-fledge soil analysis. First year data has been collected and second year data will be collected in the coming production season. In areas where there was visible performance of the blended fertilizers, there is already promotion of the application of the verified blended fertilizers.

In key informant interviews, soil scientists mentioned that there are challenges in application of blended fertilizers based on the EthioSIS which was developed on the basis of administrative boundaries. Generally fertilizer recommendations are based on agro-ecology

and soil type. Administrative boundaries may not accurately reflect agro-ecology and soil type. There is also a recommendation by soil scientists that the five formulations need further validations as the benefits may not be higher than the additional costs for some of the formulations. So far, no cost-benefit analysis has been done and much of the promotion is based on the unverified assumption that Ethiopian soils are deficient of micronutrients.

Recommendation

- **It will be important to wait until the results of the comprehensive verification of the different blended fertilizers to decide the approach to be followed in scaling up the blended fertilizers.**

5.5 Support to lime industries

Recognizing the soil acidity problems especially in areas of high rainfall, this sub-program has supported target countries to establish and/or strengthen domestic lime production through supporting farmers' cooperatives and private entities to install lime crushers.

In Ethiopia, huge surface areas of highlands in all regional states of the country are affected by soil acidity. Available estimates on the extent of the soil acidity problem indicate that about 40.9 % of the Ethiopian total land is affected by soil acidity (Schlede, 1989). However, due to the continued traditional mismanagement of soils, it is expected that actual the figure is much higher. Some of the well-known areas severely affected by soil acidity in Ethiopia are Ghimbi and Nedjo areas of Oromia, Hossana, Sodo, Chencha, and Hagere-Mariam of SNNPR and Awi Zone of the Amhara regional state.

In addressing the challenges of acidic soil, the Ministry of Agriculture with partners has been promoting the application of lime in those severely affected areas of the country. In this effort, the following activities are supported: (i) the establishment of three lime crushers in Amhara, Oromia and SNNP regions, (ii) demonstration, popularization, and its scaling up of lime application, (iii) creating accessibility through improved access to finance (credit) for farmers participating in the rehabilitation of acid soil.

These interventions have resulted in huge demand for lime in almost all intervention areas where soil acidity is a major problem and now the issue is related with limited supply. The amount of lime supplied from the installed three crushers is reported to be very small compared to the demand. The annual performance report of the MoA indicates that the total affected land treated with lime in 2013 was about 6,000 ha though the plan was to treat 22,010 ha, which is only 27% of the plan (MoA, 2013). The main reasons stated are (i) limited capacity of the crushers installed and (ii) challenges of maintenance of the crushers as they are often out of operation. The crushers are managed by farmers' cooperative unions in the three regions.

Recommendation

- **It will be important to boost the domestic production of lime through: installation of additional crushers, human capacity building in managing and maintaining the crushers, and further strengthening soil testing for appropriate lime application.**

Kenya and Rwanda are the only two countries where agricultural lime was promoted: the project in Kenya aimed at promotion and upscaling of lime while the one in Rwanda the SHP supported the establishment of lime crushing facilities to boost domestic lime availability.

In Kenya, KARI Kakamega received SHP grant titled: ''The upscaling the use of agricultural lime to enhance soil health and for increased crop production in acidic soils of Western Kenya''. The baseline survey carried out in Kakamega North and Ugenya on crop yields and soils showed that acidity was a limiting factor. Through a PPP initiative, farmers became aware and are accessing lime from agro-dealers way after the project ended (see Box 1 below).

Box 1: PPP initiative in promoting agricultural lime in Kenya

The KARI-Kakamega project initiated a PPP involving the Ministry of Agriculture and private companies in the promotion of lime. The former mobilized and trained farmers while the latter supplied the following fertilizers: Homalime Company Ltd (lime), Athi River Mining Company (Mavuno fertilizer) and MEA (Rhizobium inocula, etc). Through the leadership of SHP program, the project negotiated with Homalime Company Ltd (lime), one of the leading producers of agricultural lime in Kenya, to supply lime to agro-dealers at reduced price of Ksh200 per 50 kg instead of its regular price of Ksh300 per 50kg bag. At the beginning of the project, there were no agro-dealers stocking lime in the area; but at the of evaluation survey 12 agro-dealers were stocking it. The agro-dealers are buying a 50kg bag and selling the same bag to farmers at Ksh275. With increased awareness by 40 project-mediated extension workers, many farmers are increasingly demanding lime through their over 20 farmer groups. Also agro-dealers were making new orders of lime after the project ended.

Source: Key informant interview with Dr. David Mbakaya of KARI, February 2015

In Rwanda, the project titled ''Improving crop productivity through wide scale promotion of lime and other ISFM technologies in the acidic soils of Rwanda'', is appropriate and relevant to national priorities and the soil fertility issue of smallholder farmers in high rainfall areas of the country.

The SHP project addressed issues of lime which are not generally mainstreamed in Government Soil Fertility programs. The project is a key innovation because it is fully integrated into the fertilizer sub-Program and within the on-going discussion on how lime could be included on the Government fertilizer subsidy Program. The project(s) is expected to achieve household targets by producing 80,000 MT per annum to correct the prevailing soil acidity in the country –upon installation of machines.

The development and implementation of the lime project is highly commendable because it provides a means of scaling up lessons from the first lime project through the new project. The project achievements are likely to be sustainable because they are already built into the new project. However, in all countries with projects on lime (including Kenya) the problem analysis appears incomplete for several reasons: (i) the issue of micronutrients is not being given adequate attention in the problem analysis; ii) it is not clear how partnerships have been built with international researchers, iii) emerging key challenges on the value chain (e.g. seeds) when addressing the lime problem iv) issues of sustainability (frequent use), method of application given its powder form, and v) how to integrate lime with inorganic Fertilizer. These set of issues require 'going beyond lime'.

Access to finance for farmers to pay for lime is a major constraint limiting increased use of lime in the target. Local production could reduce the cost of lime. The AGRA SHP grant in Rwanda is trying to address the issue of access to finance for farmers by providing a small amount of credit guarantee in the grant. Also, the grantee has planned to use the machines

as a guarantee to facilitate access to credit by farmers.

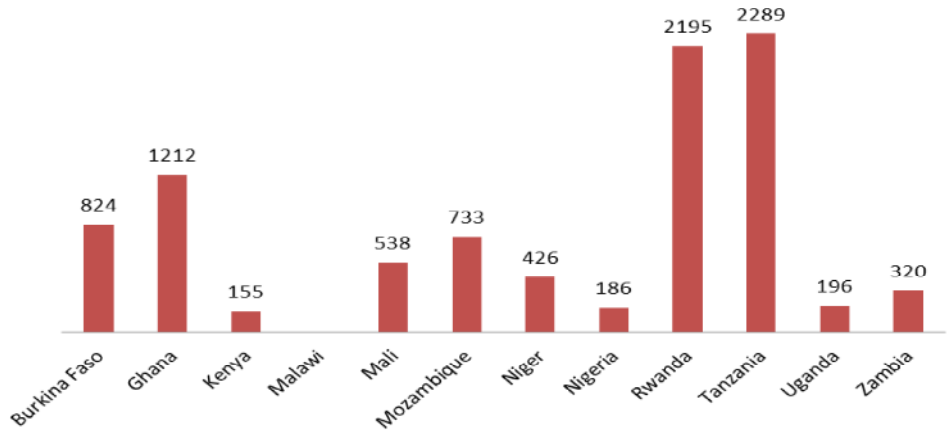
Recommendations

- **Stronger partnerships should be developed with (inter)national researchers to look at the issue of micronutrients, sustainable use, methods of application and integration inorganic Fertilizer. These set of recommendations entails going 'beyond liming'.**

5.6 Support to agro-dealers

This activity was targeted at building the capacity of agro-dealers through training on how to deal with fertilizers and better serve farmers. The objective of the agro-dealer training programs was to provide the right extension information to farmers plus better management of their businesses. A total of 9074 agro-dealers were trained in12 target countries (Figure 18).

Figure 18 Number of agro-dealers trained by country under SHP 2009-2014



Source: AGRA SHP

The total number of agro-dealers trained and volume of Fertilizer supply (including AFAP interventions) rose from almost zero to 178,700 MT for the period 2009 to 2014 showing impressive results.

Training received on ISFM

AGRA has built skills of agro-dealers in the areas of: general management skills, book keeping, budgeting, business plans, marketing and advertising. Management trainings have been useful and all the skills acquired have resulted into more profits.

AGRA SHP is already supporting agro-dealers to build a knowledgeable and skilled agro-dealer network in many countries. This includes agro-input market information intelligence.

For instance, agro-dealers in Rwanda are uploading local input prices and downloading regional prices on the mFarms/AMITSA platform using the Internet or mobile phones where stakeholders can access national and regional inputs prices through their mobile phones.

However, key informants generally reported that there is little improvement in support to agro-dealers in remote areas especially on digital record keeping. This would require that projects include IT in the agro-dealer training curriculum. It is important to train farmers in remote areas on input sourcing and use. Further, it requires helping agro-dealers learn about new technologies 'beyond hoes' – including tractors, equipment, greenhouses. These technologies are now being demanded by farmers and made available by distributors.

Recommendation

- **The emerging technological information requirements necessitate revisiting the scope and quality of training agro-dealers receive. For instance agro-dealers should be trained on entrepreneurship especially with respect to business alertness to identify opportunities and exploit these.**

Support to Agro-dealer associations

The SHP Business Plan (2009) envisaged an expanded PASS ADP to strengthen networks of certified agro-dealer associations, ''each dealer being a legally recognised seed and farm input retailer operating from a permanent address, who had received technical and business training and successfully completed an approved agro-dealer certification course''.

But there are few well-functioning agro-dealers associations in SHP target countries and projects. In West Africa, there are: AGRODIA in Burkina Faso, Agro-dealer associations in Mali supported by Mission Sahel, Agro-dealer associations supported by ADOC in Niger. In East Africa, there are: UNADA in Uganda AGRA-RADD in Rwanda.

Like AGRODIA in Burkina Faso, the Rwanda Agro-dealer Development Project exemplifies nascent good quality and relevance of AGRA SHP project design. In particular, RADD II is designed to strengthen sustainable and profitable business transactions within the agro-dealer network established under RADD I by providing advanced training and reinforcing the capacity of Hub agro-dealers to support the accessibility and affordability of agro-inputs for nearby smallholder farmers. As summarised Table 9, the project has seen several achievements.

Table 9 Achievements of Rwanda Agro dealer development Project

ACHIEVEMENT – NUMBER RECORDED	
Agro-dealers trained in Technical Product Knowledge and Business Management in 30 districts	1,062
Agro-dealers trained in agro-input market information intelligence	22
Stakeholders who access national and regional inputs prices through their own mobile phones	1,500
Trainers trained to conduct training programs for agro-dealers on Agro-Inputs Technical Product Knowledge and Business Management	16
Agro-dealers shops available as the project baseline (geo-referenced)	885
Agro-dealer cooperatives created at district level plus five unions with the purpose to build a National Agro-Dealers Federation (NADF)	31
Agro-dealer unions created to build a National Agro-Dealers Federation (NADF)	5
Inspectors trained from MINAGRI and private sector to conduct agro-dealers' accreditation	32
Agro-dealers surveyed during the accreditation survey are in the database	158
Agro-dealers study tours in Kenya and Tanzania to learn and share experiences	6
National business meetings organized to discuss business, legal and financial arrangements	4
Agro-dealers trained in entrepreneurship and business plan development	354

Source: CEO and AGRA-RADD II Project Manager (2014)

However, agro-dealer associations tend to be beset by governance and leadership problems. The leadership of such organization is frequently dominated by technical people with vested interests and little or no interest in their members. A chronic challenge is fake seed, fertilizers and agro-chemicals which agro-dealers have not been able to prevent because of the industry-wide problem of poor enforcement of laws/regulations and corruption. Farmers also face high input prices, especially with respect to fertilizer which affects the profitability of the business.

Drawing lessons from the AFAP (5.2 above), associations could have solved the problem if they encouraged agro-dealers to 'collaborate to compete'. This idea has not gained prominence and yet it can encourage farm input suppliers to adopt more value-based business models that enable agro-dealers to adopt auction house-type input procurement in regional centres. This is contrary to having parallel competition with government subsidized inputs in the markets as seen in many AGRA target countries.

To promote agro-dealer participation in such programs, governments should use voucher systems which enable farmers to purchase inputs from agro-dealers and facilitate agro-dealers to import inputs at subsidized rates. The government should also support farm input companies to use government auction centres to reduce the costs agro-dealers incur in procurement and transportation.

Recommendation

- **AGRA SHP has so far trained over 9000 agro-dealers in urban and rural areas**

but it is yet to effectively address the issue of how agro-dealers source inputs and the prices they face from input suppliers. The latter are also constrained to reach thousands of dispersed agro-dealers in rural areas. Therefore, agro-dealers should be encouraged to grow their businesses by becoming 'hub agro-dealers'. Like the AFAP model, hub agro-dealers would become distributors to retail agro-dealers in countries and regions where agro-dealers are not well established.

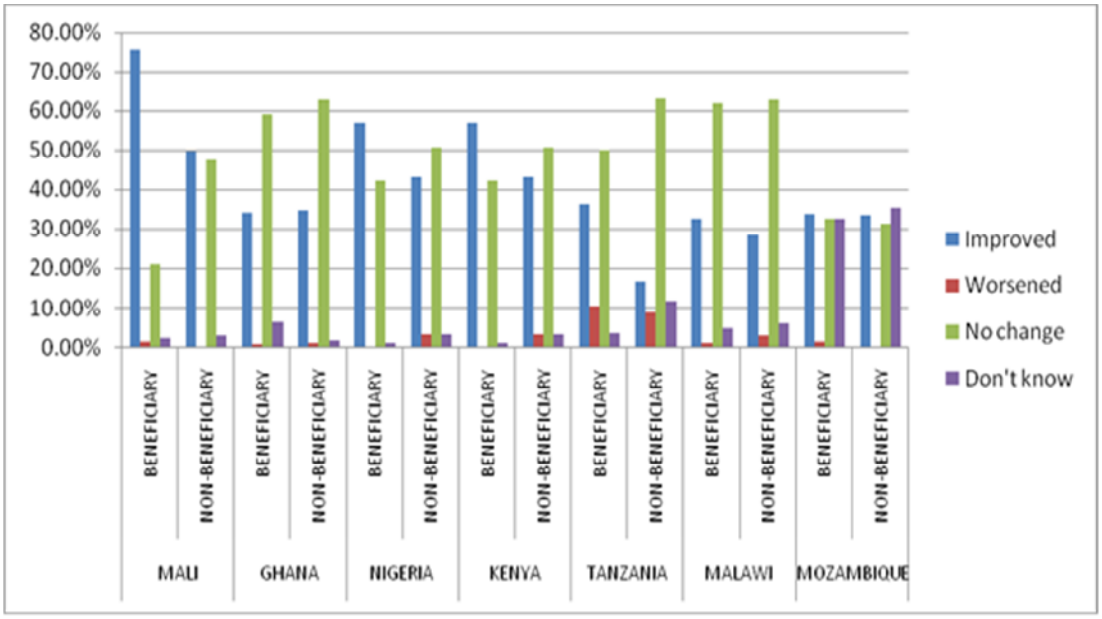
- **AGRA SHP should engage and encourage governments to promote agro-dealer participation in the input subsidy programs, where farmers access inputs through the E-voucher system. Experience gained from the ADAPT project in Zambia shows that the E-voucher system saves agro-dealers time and money, increases smallholders' choice of market, improves efficiency and transparency. It also presents the agro-dealers with the opportunity to build customer relationships with new smallholders.**

Supporting farmer access to inputs

Agro-dealers as individuals are entrepreneurs who want to do business accessing inputs to smallholder farmers. The challenge is that most lack skills on demand prediction and financial planning. As a result, many agro-dealers are unable to meet farmers' demand at the peak of planting season. Agro-dealers are poorly prepared to serve a sector with seasonal fluctuations in demand for inputs and interference from government and NGO subsidies. Many farmers opt to buy small quantities of seed they can afford and use non-certified seed to top up their seed demand. Consequently, movement of seed stock is slow and sales are low, limiting business profitability and growth (see also Odame and Muange, 2010).

AGRA SHP (2014) report indicates that in Burkina Faso the distance from an agro-dealer to a smallholder farmer was on average reduced from 27 to 20 km and from 10-20 km to 8-10 km in Rwanda. The Evaluation household survey (2014) reported that the distance to agro-dealers has improved for around 50 percent of beneficiary households in the last five years (2009-2014). This result was highly significant for beneficiaries in Mali and Nigeria, with Kenya reporting non-significant improvements. However, in Tanzania and Ghana, households indicated there had been no change in distance to agro-dealers (significant). Changes in Malawi and Mozambique were not significant (Figure 19).

Figure 19 Change in distance from household to agro-dealers over the past five years (2009-2014) (percent of households)



Source: Farmer survey Data, 2014

A detailed interview with Dr. Isaac Luvumbazi of Serem Agro-veterinary in western Kenya provides a fascinating story on successful agro-dealership (**see** Box **).**

Box 2: The Success of Serem Agro-veterinary

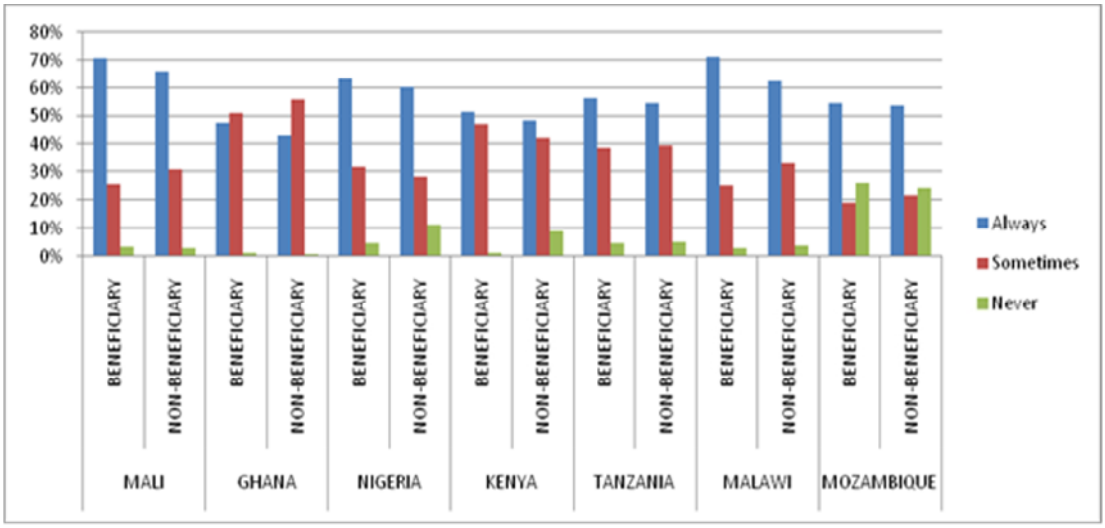
Dr Livumbazi Isaac is one of the most successful agro-dealers in Western Kenya. He established the business, Serem Agroveterinary, in 1999 and started collaborating with AGRA's Soil Health Program in 2012, who trained him on business management. The quantity of farm inputs purchased by customers has been increasing in the last 5 years by 30% largely due to increased farm productivity. The value of farm inputs stocked by Serem is Ksh1.3 million.

The business' competitiveness lies in providing a strong customer proposition (proximity, fair price, high quality and efficient service) compared to mobile traders and manufacturers' agents. He is committed to the business and says ''I have taken it as my chosen duty/career''.

Source: Dr Isaac Livumbazi Manager, Serem Agroveterinary (15.01.2015)

Successful agro-dealer businesses such as Serem provide after sales service to customers by explaining how each product is used and follow up on performance. Thus, most farmers prefer to buy inputs from Serem because it offers quality and genuine products at the right time. This confirms findings of the household survey (2014) in (Figure 20). Respondents reported that agro-dealers were generally stocking fertilizers at the time farmers require them. This result was highly significant for beneficiaries in Mali (70%) and Nigeria (65%); and significant in Kenya (50%) and Tanzania (58%.

Figure 20 Agro-dealers stocking fertilizers at the time farmers' required them (percent of households)



Source: Evaluation household survey, 2014

It is recognized that agro-dealers are profit-oriented - and there is strong incentive for them to consolidate businesses. Most lucrative businesses are usually dominated by a few well established market players.

It would therefore be important to support agribusiness advisory services to carry out enterprise business planning to provide information on client/farmer analytics – profile farmers on the basis of enterprises, revenue, lifetime customer value and profitability. These services could be provided largely by national agro-dealers associations that are effectively linked to agribusiness units of ministries of agriculture. This would entail developing key metrics that alert agro-dealers to changing farmer/client production patterns to increase their responsiveness and agility in serving farming communities. To ensure sustainability, agro-dealers would have to pay for this service through fees to their associations so that even if they transform into oligopolies (or hub agro-dealers), this would not impact on farmer ability to access improved varieties and other farm inputs at low cost.

Recommendation

- **There is need to support agro-dealers with agribusiness advisory services for enterprise business planning to provide information on client/farmer analytics – profile farmers on the basis of enterprises, revenue, lifetime customer value and profitability. The services could be provided largely by national agro-dealers associations - that are effectively linked to agribusiness units of ministries of agriculture.**

Links to input suppliers and output markets

Agro-dealers are supplied directly by different manufacturers/suppliers of fertilizer, agro-chemicals and seed companies. The price differential with competitors' products is small.

Most of the suppliers give an allowance of one week between delivery of products and full payment. In cases where the business has urgent need for cash to stock or expand to other regions agro-dealers borrow money from banks where they run overdrafts.

According to key informants in Kenya and Uganda, agro-dealers' strongest competitors in the market are large Fertilizer agro-chemicals companies that import and distribute farm input from Europe. The volume and value of imported farm inputs is large. In the two countries, the market share of agro-dealers, itinerant (mobile) traders and manufacturers' agents was estimated at: 50%, 25% and 25% respectively.

Key informants also noted there is little difference in price(s) of farm-inputs between urban and rural agro-dealer shops/manufacturers' outlets/importers' agents as prices are controlled by the manufacturers. They also observed that business flow has fluctuated with seasons and the business has experienced change in supply/demand of ISFM inputs over the past five years: the market for farm inputs is growing in volume and expanding to other areas. Section 5.7 on improving credit access highlights agro-dealers' links to output markets.

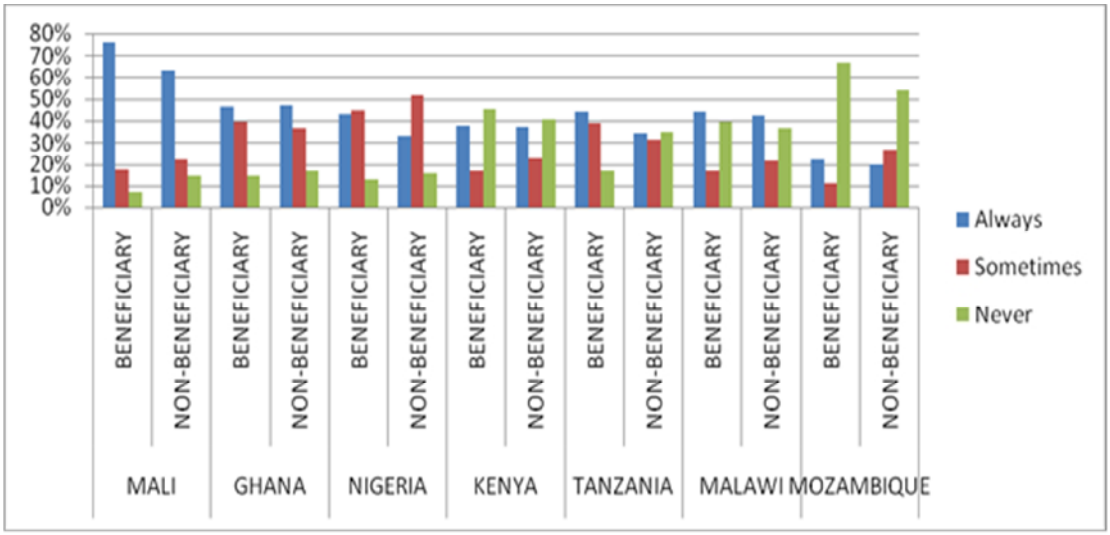
Agro-dealers as extension providers

Although the objective of agro-dealer training programs was to provide the right extension information to farmers, plus better management of their businesses, agro-dealers are primarily sales agents. They are focused on moving volumes of inputs. At the same time, agro-dealers can act as frontline extension workers and hence they need to possess basic information on inputs and communicate this information to their client farmers. However, in so doing, they cannot replace formal extension agents in the delivery of reliable information.

Evaluation household survey respondents (2014) gave mixed reports on whether agro-dealers were providing them with reliable advice on fertilizers (Figure 21). In Mali and Ghana 78% and 48% of beneficiaries respectively reported that agro-dealers always provide reliable advice (this was significantly higher than non-beneficiaries). In Ghana, Nigeria, Tanzania and Malawi, the majority of beneficiary farmers reported receiving reliable advice always or sometimes. In Mozambique, almost two-thirds of respondents reported that agro-dealers never provide farmers with reliable advice on fertilizers.

Government extension services seem better-placed to reach smallholder farmers in remote areas, linking them to agri-input suppliers. Unfortunately links between agro-dealers and local extension remain weak in many cases (Odame and Muange, 2011). In this context, SHP has potential to build strong linkages between agro-dealers and extension providers including many of their collaborating lead farmers.

Figure 21 Agro-dealers providing farmers with reliable advice on fertilizer (% households)

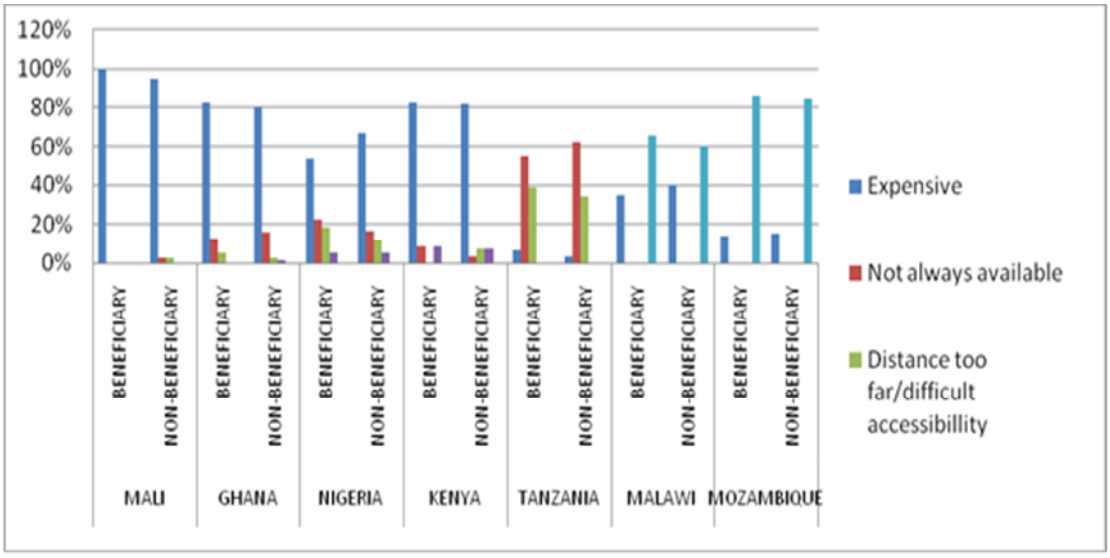


Source: Evaluation households survey, 2014

Sustainability and scalability of agro-dealer model

The evaluation was concerned with the sustainability and scalability of SHP agro-dealer model as currently conceived and delivered. Thus it also sought respondents' reasons why they were not sourcing seed and fertilizer from agro-dealers. A majority of the respondents in the farmer survey (2014) reported that getting seed and Fertilizers from agro-dealers was expensive. Respondents in Tanzania reported that seed and Fertilizer were 'not always available' at agro-dealers. Other reasons cited were: distance and/or difficult accessibility (Figure 22).

Figure 22 Reasons for not sourcing seed and fertilizer from agro-dealers (% households)



Source: Evaluation household Survey, 2014

The ADAPT Project in Zambia highlights successes and lessons learned in building a scalable network of rural agro-dealers (Box 3). The project, funded by AGRA PASS, was set up in 2007 by CARE Zambia focusing on scaling of maize production using the ADAPT model. This was a market-based approach aimed at sustaining interventions well beyond the end of a project.

Using criteria that included sustainability, scalability, CARE prioritized two areas for intervention: i) improving access to agri-inputs especially high yielding varieties (HYVs) by smallholder farmers with the potential to triple productivity from an average of 1.4 t/ha to nearly 5 t/ha; and ii) identification of the input supply model that would enable agro-dealers to get closer to smallholders. The project partners set up their own trained agro-dealers while farmers accessed improved inputs through the E-voucher platform. The one year approach saw CARE provide over 35,000 smallholders with vouchers worth more than $30 each of which was redeemed by one of 60 participating agro-dealers.

Box 3: Principles for Sustainable and Scalable Rural Agro-Dealer Network

The project partners in the ADAPT Project in Zambia adopted six core values in building a sustainable and scalable network of rural agro-dealers.

- Recruit agro-dealers based on distance from town, financial management, past experience of business viability and have them trained -- to increase access to HYVs by smallholder farmers
- Conduct demand creation activities among smallholder farmers through field days, seed fair and direct seed marketing by supply chain actors with CARE's intervention — as a facilitator
- Facilitate linkages between supply chain actors and output markets
- Use innovation fund to mitigate agro-dealers' risks of rapid expansion into smallholder market
- Develop agro-dealer associations in targeted districts to support the needs (such as access of credit facilities) of individual agro-dealers and to advocate on their behalf
- Conduct Monitoring and Evaluation (M&E)

Source: Adapted from: http://indiamicrofinance.com/wp-content/uploads/2011/06/Rural-Agro-Dealers-case-study.pdf, accessed on 26th March 2015

Recommendations

- **AGRA should continue building innovative capacity of agro-dealers and work with governments to engage agro-dealers in their input subsidy provisioning. This is the model of operation in Rwanda - which subsidises seed at 70% and Fertilizer at 30%. Agro-dealers are encouraged to give inputs to farmers on credit guaranteed by Government - the Government of Rwanda acts as facilitator/broker.**

5.7 Improving access to finance

AGRA's Innovative Finance Program has facilitated funds as individual loans and group loans. Approaches adopted in SHP include: (i) Project providing credit guarantee for the farmers (ii) Project advancing funds to farmers through farm input suppliers (iii) Brokering arrangements between farmers and buyers (iv) Supplier Credit.

Most projects under the Soil Health Program adopted credit guarantee for the farmers. However, there were different typologies in this approach.

Project advancing funds to farmers through farm input suppliers

In this approach, the project identifies farm input dealers including seed and fertilizer companies and agro-dealers to supply to the target farmers. The project makes either a full or half payment to the input dealers and the inputs are delivered to the farmers. The project pays 50% while farmers pay the other half and repay the project the remaining 50% at the end of the harvest. The repayment funds are collected through farmer groups or associations with legal binding rules. The funds continue serving the next crop of farmers as a revolving fund.

A project in Mozambique implemented by Instituto de Investigação Agrária de Moçambique (IIAM) used this approach. Input credit was administered through a network of agro-dealers whose responsibility was to distribute inputs (fertilizer and seed) and to collect seed and money. Repayment of seed was double the amount which farmers received, while fertilizer was repaid through 2 or 3 cash instalments at an interest rate of 4%.

Collateral is required to access the loan in all the countries. There were no partnerships between financial institutions and project or farmer associations since financial institutions were charging high interest rates (20-30%). Agro dealers earn a commission (10%) per bag to cover transaction costs.

This approach achieved above 80% success rate of repayment and farmers doubled their yield. The main challenges included problems in seed repayment when production is affected by climatic conditions and farmers were unable to repay seed in quantities agreed. This situation resulted in postponement of recovery to the subsequent years. Another challenge is that for the rapid scale up, there is a proportionate increase in the volume of funds that need to be set aside in revolving funds for cash collateral.

Partnership with financial institutions to facilitate credit

This approach has two typologies: i) farmers' financial access to inputs, and ii) farmers' physical access to available inputs through agro-dealers - as in Burkina, Mali and Niger with credit Guarantee and Rwanda without credit guarantee.

In Kenya, Appropriate Rural Development Agriculture Program (ARDAP), and Ghana, Centre for Agricultural Rural Development (CARD –FNGO), projects used the input credit guarantee approach which was facilitated through farmer associations. The AGRA SHP projects formed partnerships with financial institutions and linked the farmer associations to the respective banks (Equity Bank-Kenya and CARD-FNGO-Ghana).

In the case of ARDAP, the project funds are advanced to the farmers through a lending institution such as a bank or a Savings and Credit Co-operatives (SACCO). Farmers can then borrow the amount that they require for the inputs with re-payment expected to be made after selling the harvest. Farmers are also expected to pay all the interest rates. Farmer associations managed the allocation of credit to their members by allocating input credit in relation to the shares and savings a member had in group. Thus defaulted

payments would be recovered from individual savings or shares. Collateral was not required for farmers to access credit, but farmers were required to have a minimum land size of about 0.5 to 0.8 acres and the level of credit for inputs was pegged on land size. Prepayment of 50% of the input worth was done in advance and the rest paid within the cropping season after harvest. A major challenge is defaulted payments which can result from poor harvest due to climatic factors. Also, as in the previous approach, if farmers wanted to scale up their productivity, there is need to raise credits to purchase more inputs. This means that a large credit guarantee level is required as collateral which many SACCOs and cooperative societies may be unable to afford.

Cashless financing is another innovative financing approach which involves a financial institution scheme to give farmers credit inputs. CARD is one of the AGRA-funded projects that used this approach (Box 4). CARD is a cashless financial NGO regulated by the Bank of Ghana and established in 2012 which collaborates with Savanna Agricultural Research Institute (SARI) in implementing this SHP project in Northern Ghana.

Box 4: **Cashless financing: Centre for Agricultural Rural Development (CARD), Ghana**

CARD provides value chain services in the form of production inputs (seed, fertilizer and agrochemicals), ploughing, harvesting, aggregation, warehousing (owned by CARD) and marketing outputs on behalf of farmers. The inputs and services provided to the farmers are facilitated by dealing with fertilizer companies, seed suppliers and with equipment hirers directly on behalf of the farmers, creating a kind of market place of exchange. Payments for inputs and services provided by CARD are repaid by the farmers in the form of outputs after harvest. CARD charges an interest of 18% per annum (not fixed) but 1.5% per month depending on the number of months before collecting the produce from farmers.

Source: Key informant interviews, website: http://agra-alliance.org

CARD has enhanced farmers' access to inputs and outputs markets, increased demand for financial services and achieved a recovery rate of 100% of the cashless credit. However, the credit available is limited to farmers who have 2 acres or less since CARD has a limited capacity to offer services. There is need for loan guarantee funds to leverage much larger loans to reach more farmers. There are also chances of farmers engaging in side sales before the organization harvests; hence the financial organization may face challenges of low credit recovery after the sale of outputs.

SHP grants have also supported Inventory credit under a **warehouse receipt system** in countries such Kenya and Nigeria, or French **warrantage** system in francophone West Africa (viz. Mali, Burkina Faso and Niger.

In Kenya the approach is similar to CARD except that farmers access the credit directly from the financial institution using a warehouse receipt as collateral (Box). In Mali, the warrantage system, implemented by the NGO Mission-Sahel in the seven prefectures of the breadbasket region of Sikasso, aimed at building a network of input supply among companies, agro-dealers, financial institutions and farmers' organisations sustained by win-win business relationships among the different stakeholders (Box 6).

Box 5: Inventory Credit: Warehouse Receipt system in Kenya

After delivering a product such as maize to an accredited warehouse, a farmer obtains a warehouse receipt that can be used as collateral for short-term borrowing at Equity Bank to obtain working capital for buying inputs for the next season's crop. The farmers then wait for prices to rise then request the warehouse to release the produce. They use the proceeds to repay the loan and still make more money than if they had sold immediately after harvest.

Box 6: Fertilizer micro dosing and the warrantage system in Mali

Fertilizer micro dosing and the warrantage system was implemented by IER in partnership with a host of development agencies including FAO, USAID, CORAF/WECARD, ICRISAT, IFAD, Sasakawa Global 2000 and collaborating national and international NGOs (EUCORD, KALIBO and ADAF/GALLE). Building upon this existing experience, a synergetic partnership between different actors including public, private sectors and producer's organizations the AGRA SHP supported projects aimed to establish and strengthen a credit system and inputs supply schemes (warrantage, small packs of seeds and fertilizers through retail shops and microcredit).

What makes the input warehouse system or warrantage system work?

- **The farmer is assured of more income when the produce is sold at peak time thus enabling them to pay off the loan and remain with a proportion of income.**
- **The system allows farmers to extend the sales period of modestly perishable products beyond the harvesting season.**
- **Collaboration between farmers, growers, agribusiness associations, and agro-dealers, ultimately reducing the role of government agencies in agricultural commercialization.**
- **The private sector agency is responsible for purchasing, storing, disposing of the physical stocks as well as potentially providing receipt and the credit for the producers.**

However, warehouse receipt system and warrantage system face several challenges if the systems are not well managed and linked to the financial institutions. In Mali, the warrantage system was linked to the government Fertilizer subsidy program and hence achieved a lot in terms of building partnership between several actors and availing inputs and Fertilizers in remote areas of the country. But the system experienced many operational challenges including: long queues, shortage of books, 'clientelism' between extension services and certain agro-dealers – with farmers having no choice on agro-dealers, and difficulties in accessing credit for agro-dealers.

Project procures inputs and distributes through government officials

This is an approach where lending institutions partner with implementing organizations to lend to smallholder farmers with a guarantee for selling the produce. The approach links farmer groups with prospective buyers. The grantees collect information on the estimated production and share with the prospective buyers. The project together with the potential buyer then guarantee the credit advanced to farmers with recovery after the sale of the outputs.

This approach is being implemented by Clinton Hunter Development Initiative (CHDI) in Malawi operating as an anchor farm and currently partnering with NBS bank. Borrowers are required to deposit a cash collateral equivalent to 15% of the loan amount and charging about 26% (2011/2012 season). Key informants reported that so far 2200 farmers are accessing loans and loan repayment for 2011/2012 season is 88%. However, some farmers are tempted to default because someone is there to cover up defaults: when farmer default is high, the revolving fund gets mopped up to cover for the defaulted payment. The approach suffers a sustainability challenge: when the project closes farmers will be left without revolving fund, unless it is turned over to them as part of the exit strategy. Furthermore, like the other two previous approaches, rapid scale-up requires a proportionate increase in the volume of funds needed to be set aside in revolving funds for cash collateral and credit guarantee.

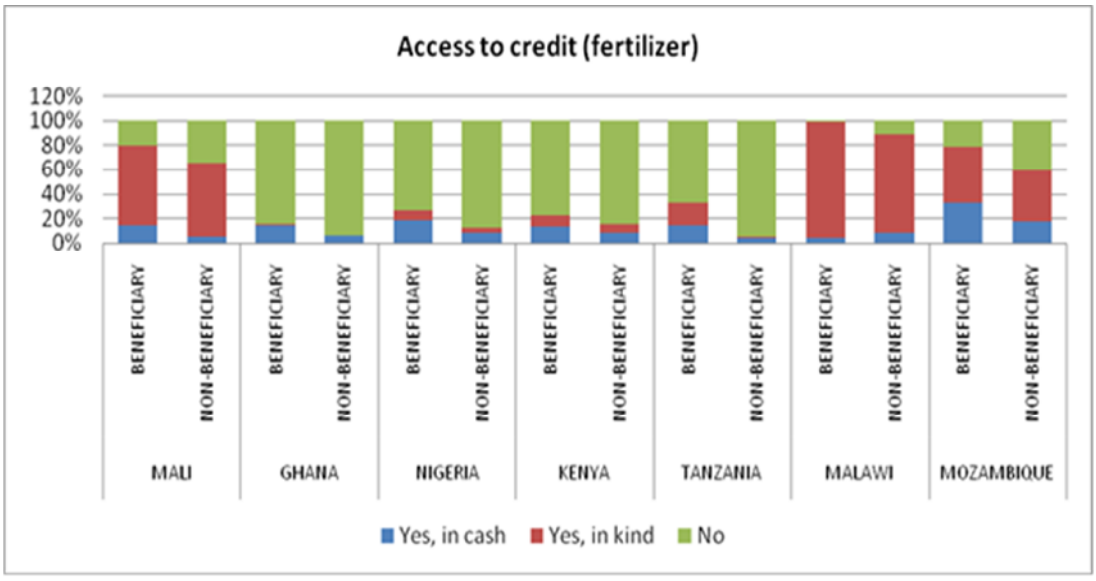
Supplier Credit

In some cases, input suppliers have extended credit to farmers by supplying inputs on credit. In Mozambique agro-dealers have a close relationship with farmers who they have known for a long time and are confident that farmers will pay back. Agro dealers are also well established and financially strong enabling to sell on credit.

Farmers' access to credit for fertilizers

Findings from the Evaluation Household survey (2014) show high levels of access to credit for fertilizers by beneficiaries in Malawi (close to 100 percent), Mali (71 percent) and Mozambique (80 percent) (Figure 23). Most of this credit is received in kind. Non-beneficiaries in the three countries also secured credit in-kind: in Malawi this may from the government Farm Input Subsidy Program. By contrast, in Ghana, Nigeria, Kenya and Tanzania less than 30% of beneficiaries interviewed had access to credit for fertilizers. Access to credit for Fertilizers was significantly higher for beneficiaries compared to non-beneficiaries in Mali, Ghana, Nigeria and Tanzania.

Figure 23 Access to credit



Source: Evaluation Household Survey, 2014

Sources of credit

Evaluation survey findings show that farmers receive input credit from a range of formal and informal sources (Table 10). Formal sources include NGOs, private companies, agro-dealers and government and input subsidy. Banks providing input credit are cooperative banks, commercial banks, agricultural finance banks and village banks. Informal sources include neighbours, farmer groups, friends, relatives as well as informal money lenders.

Commercial banks and agricultural finance banks were the main sources of credit for households surveyed in Mali, accounting for 56% of total input credit received, but informal sources were also commonly used. NGOs were the main sources of income in Malawi (60%) and Mozambique (32%). Households in Ghana, Nigeria, Kenya and Tanzania sourced input credit from informal sources: farmer groups and neighbours.

Table 10 Average credit amount by source (local currency)

	Mali (n=33)	Ghana (n=35)	Nigeria (n=18)	Kenya (n=34)	Tanzania (n=53)	Malawi (n=406)	Mozam-bique (n=225)
Neighbour	83,409	1,713	55,388	16,869	366,726	9	44
Farmer group	88,500	366	60,000	4,525	-	1,269	111
Cooperative bank	108,625	-	-	-	-	133	148
Commercial bank	419,000	-	-	-	-	539	-
Friend/Relative	30,000	-	-	-	-	214	-
Agricultural Finance/bank	400,000	-	-	-	-	2,964	-
Village Bank	146,667	-	-	-	-	272	22
Informal Money Lender	137,500	-	-	-	-	78	-
Input subsidy	58,902	-	-	-	-	-	-
NGO	-	-	-	-	-	11,491	255
Private company/Agro-dealer	-	-	-	-	-	1,098	197

Source: Evaluation household survey, 2014

Sustainability and scalability

- **With assured inputs supply, farmers see market opportunities and returns from the investment, and are willing to invest in inputs (seed and fertilizers) and use the ISFM technologies being disseminated by the project**

- **Farmers are likely to continue using improved inputs after training on financial management in addition to capacity building on ISFM methods, having seen benefits from the input credit system.**

- **Input credit system approaches rely on the repaid credit to procure inputs for the subsequent cropping seasons. This is only possible when there is a high success rate of repayment. Delays in repayment of input credit may affect procurement of inputs the following season, stalling adoption rates of improved ISFM technologies.**

Recommendations

- **Innovative financing has had a mixed performance. This is partly attributed to weak design and implementation capacity of the grantees. This calls for AGRA SHP to consider directly working with financial institutions (i.e., banks and micro-finance institutions) with a track record of managing loans and credit to farmers**

- **AGRA should also engage governments to support innovative financing, given the high levels of resources they can mobilise --as is currently the case in Nigeria.**

- **AGRA should focus on: providing technical advice on how finance institutions and governments can design products that meet needs of farmers; building capacity (awareness and training) of farmers; and facilitating farmer linkages to such services (includes mobile money approaches).**

5.8 Conclusions on Fertilizer Supply and Policy sub-program

AGRA SHP support was designed to build the fertilizer regulatory division's technical and institutional capacity for the effective implementation of fertilizer regulation and quality control in fertilizer. By end of 2014, SHP exceeded the target because it initially targeted six countries but has since covered all the 13 countries. In some countries which addressed the entire regulatory process, regulations are in place and implementation is underway. Others are at an advanced stage. The rest are still in the initial stages.

Fertilizer supply projects supported the purchase of office supplies and equipment for fertilizer regulatory activities and trained 2,863 fertilizer inspectors and fertilizer analysts/technicians. The intervention has contributed to notable success in fertilizer inspection throughout the market chain. There is also increased uptake of the fertilizer analysis services offered by technicians and more samples are being taken for analysis. In addition, the on-going Fertilizer policy harmonisation activities in EAC and ECOWAS are drawing from achievements from member countries.

Despite the existence of a regulatory system problems of non-compliance of laws and regulations in fertilizer supply persist: smuggling, adulteration and contamination of fertilizers. This is attributed to implementation bottlenecks, problem of mobility among fertilizer inspectors and budgetary limitations. Moreover, the policy implementation process takes a long time beyond the 3-year duration of the SHP projects. This leaves the farmer, the end user of Fertilizer and other inputs, continuing to suffer from the malpractices. This point to a need to raise the voice of farmers and involve civil society groups in policy advocacy.

The development and implementation of Fertilizer blends and lime project is highly commendable as project achievements are likely to be sustainable given that this is already built into the new projects. However, the problem analysis appears incomplete for several reason: i) micronutrients are not being given adequate attention in the problem analysis; ii) lack of clarity on partnership with international researchers, iii) emerging challenges in the

value chain (e.g. seeds) when addressing the lime problem, iv) issues of sustainability (frequent use), method of application given its powder form, and v) how to integrate lime with inorganic Fertilizer. This calls for 'going beyond lime'.

AGRA SHP support to agro-dealers was targeted at building capacity through training on how to deal with fertilizers and better serve farmers. The objective of the agro-dealer training programs was to provide the right extension information to farmers besides better management of their businesses. A total of 9074 agro-dealers were trained in 12 target countries. However, there is little improvement in support to agro-dealers in remote areas especially on digital record keeping. This would require projects to include IT in the agro-dealer training curriculum. It is important to train farmers in remote areas on input sourcing and use. Further, it requires helping agro-dealers to learn about new technologies 'beyond hoes'.

AGRA's Innovative Finance Program has facilitated the funds as individual loans and group loans. Different approaches of innovative finance were adopted in the SHP. These approaches had mixed performances in delivering input credit to smallholder farmers. Key challenges are: (i) repayments when production is affected by climatic conditions and farmers are unable to repay seed, ii) for rapid scale up, a proportionate increase in the volume of funds needs to be set aside in revolving funds for cash collateral – this means that a large credit guarantee level is required as collateral which is unaffordable for many SACCOs and cooperative societies, iii) credit available is limited to a few farmers, iv) the credit provider has limited capacity to offer services, v) market oriented credit systems such warehouse receipt system and warrantage system face management and operational challenges. This situation calls for AGRA SHP to rethink the design and delivery systems of these models.

5.9 Recommendations

Fertilizer supply and policy

The sub-program is promoting an integrated approach to enhance the supply of different fertilizers, support improvement of fertilizer related policies and regulations, fertilizer quality control along the value chain and fertilizer blending and small packaging to ensure appropriate fertilizers in type and size are available to farmers. But there are different levels of integration of the different components of the fertilizer supply sub-program in different countries.

- *There is need to match existing institutional mandate and competence in providing grants to build their capacities.;*
- *Stronger partnerships should be developed with (inter)national researchers to look at the issue of micronutrients. Lime distribution should be integrated in government fertilizer policy.*
- *More successful Agro-dealer Development Project need to be reviewed to provide useful lessons for strengthening national agro-dealer associations and aligning their functions with the national goals and priorities;*
- *Agro-dealers should be supported, through agribusiness advisory services, to*

improve their profitability through improved marketing and record keeping skills. AGRA/SHP should link agro-dealers to extension providers, especially by tapping into lead farmers. Government policy and programs should encourage agro-dealers to carry out more ISFM research through demos by providing them more extension services from the Ministry of agriculture. Such Programs should also include agro-dealers in stakeholder decision-making meetings. Government should encourage access to credit facility by agro-dealers and at a lower interest rate:

- *AGRA should engage governments to promote agro-dealer participation in the input subsidy programs, where farmers access inputs through the E-voucher system;*
- *AGRA work directly with financial institutions (i.e., banks and micro-finance institutions) that are better-suited to manage loans and credit to farmers. It should also engage governments to support innovative financing mainly because of their capacity to mobilise vast resources. AGRA SHP should focus on providing technical advice on how finance institutions and governments can design products that meet needs of farmers --and also build capacity (awareness and training) of farmers and facilitate their linkages to such services. This includes resource mobilization approaches that would facilitate such linkages.*

6. Soil Health Training and Education Sub-Program

6.1 Introduction

The overall objective of the training sub-program of AGRA SHP has been "to produce and maintain a pool of top-quality Africa soil scientists and technicians that will sustainably provide research and extension support to smallholder farmers". Sub-objectives were to:

1. Improved human capacity for research and development of ISFM packages through training of post-graduate students and technicians;
2. Strengthen institutional capacity of the universities through improved training facilities (i.e laboratories and students supplied with laptop computers) and curricula that is relevant to the needs of stakeholders;
3. Establish strong partnership that enhances the quality and sustainability of the training provided by universities.

Post-graduate Training

Since 2010 the program has been supporting the training of a new generation of young professionals to take the lead in Integrated Soil Fertility Management approaches (ISFM) across 13 countries in Africa (Tanzania, Mozambique, Ghana, Mali, Malawi, Rwanda, Zambia, Kenya, Uganda, Niger, Nigeria, Ethiopia and Burkina Faso). The program targets both post-graduate (MSc and PhD) training and vocational training of laboratory technicians that work in the University laboratories and national agricultural research institutions. Funding was deployed to achieve by 2018 training of 130 MSc and 40 PhDs in soil science and agronomy, of which 50% will be women. Grant support has been provided to 11 African universities in 10 countries. The students are drawn predominantly from the national and international agricultural research systems (NARS), the Ministry of Agriculture, NGOs and universities.

In addition to being experts in soil fertility management, AGRA has been keen to equip graduates with a wide range of skills from research, communication, strategic and analytical. This depth of knowledge and breadth of 'soft-skills' is referred to in the program as 'T-Shaped Skills'. The development of these skills is embedded on breadth of knowledge (cross-disciplinary) and depth of knowledge—deep understanding of the discipline. T-shaped professionals are people who are deep problem solvers in their own discipline but also capable of interacting with and understanding specialists from a wide range of disciplines and functional areas. This approach, championed within the sub-contract through a grant to Wageningen University, is consistent with the rise of knowledge-based practical professionals operating in communities of practice.

Delivery of the training program has focused on four areas:

1. Quality assurance: The program focuses attention on improving service delivery – in particular the teaching and research component through short term support in curricula development; retooling of faculty staff through partnership and staff

exchanges with the United States (US) and European universities, facilitated by Wageningen University; training of laboratory technicians.

2. Regional coverage: The training program is adopting a regional approach to achieving its training objectives. At doctoral level, Kwame Nkrumah University of Sciences and Technology (KNUST) was been targeted as focal point for training the new soil scientist for West Africa and Sokoine University of Agriculture (SUA) as the hub for the East and Southern Africa region. The program intended to strengthen regional networks through promoting cross learning initiatives, attracting visiting professors from the local and regional universities to support teaching and learning at the delivery universities, through initiatives such as student mentorship; competence and skill training and biometrics.
3. Incentive to attract and retain women: The design of the program recognized the critical role played by women in environmental and natural resource management as well as poverty reduction. Concerted efforts were planned to enrol 50% female candidate at all the AGRA's SHP delivery universities. The program set in place a financial incentive for nursing mothers and their families.
4. Partnerships for sustainability: From the outset program mangers considered the key to the success of the program would rest with developing effective networks and strong partnerships. The program has had technical input from Wageningen University Resource (WUR) Centre, the Netherlands and the University of Maryland in partnership with Columbia University, New York, USA. These partnerships were intended to improve the quality of training programs in Africa and help ensure students received the knowledge they need.

Building laboratory capacity

The sub-program recognised the critical importance of well equipped, efficiently run soil and plant analysis laboratories to the development and promotion of ISFM packages. Young professionals need access to these laboratories during training for support to their research so they need to be equipped with appropriate up to date analytical equipment and well trained technicians. Budget lines were therefore included in training grants for purchase of key items of laboratory equipment and grants were agreed with service providers in each region to provide refresher training in laboratory analysis techniques and lab management. The sub-program target was to provide in-service training of 200 laboratory technicians by 2018.

Review Questions

Based on the objectives and design of the sub-program the review considered the following questions:

- To what extent have partner universities succeeded in timely delivery of degree courses;
- To what extent has the supply of MSc. and PhD level graduates with knowledge of ISFM issues been increased in target countries;
- Has support from the program led to relevant curricula that equip graduates with a wide range of skills from research, communication, strategic and analytical;
- Has support from the sub-program led to increased quality of training of graduates

and cross-learning initiatives in each region;

- To what extent has mechanisms put in place by the sub-program led to recruitment of women into post-graduate training;
- Are the partnerships that were put in place to improve the quality of ISFM graduate training programs in Africa sustainable;
- To what extent has donation of equipment to laboratories and training of technicians improved the capacity of target institutions to deliver quality analytical services.

Approach taken to review the sub-program

Briefing on the program was provided to the lead consultant by the Program Officer, Education and Training Soil Health Program who also made relevant documents and reports available. The lead consultant attended the International Conference on "Building A New Generation of Agricultural Scientists" at Kenyatta University, Nairobi (1 to 5th December 2014) at which a number of students supported by the sub-program made presentations or exhibited posters. Members of the review team visited the following universities to interview staff and students on their experiences with post-graduate course delivery: Sokoine University of Agriculture, Tanzania (MSc. and PhD); Kwame Nkrumah University of Science and Technology (MSc. and PhD); Haramaya University, Ethiopia (MSc.); Kenyatta University, Kenya (MSC.); Makerere University, Uganda (MSc.); Lilongwe University of Agriculture and Natural Resources, Malawi (MSc.) and University of Zambia (MSc.). The MSc course at the University of Bobo-Dioulasso in Burkina Faso was unfortunately not included in the review despite repeated attempts to meet the coordinator by the evaluation team. For each course a checklist of questions was followed during interviews (Appendix 1).

Laboratories were also visited at each university and interviews were conducted with supervising staff and lab technicians. In addition technicians who had benefited from AGRA SHP funded training were followed-up at Savannah Research Institute and at the University of Development studies in Ghana. At each lab discussions covered: Equipment donated by AGRA; Skills learnt on technician training course; Local-level follow-up training; Impact of training for institutional capacity strengthening; Challenges and future opportunities.

6.3 Post-graduate training

6.3.1 To what extent has the supply of MSc. and PhD level graduates with knowledge of ISFM issues been increased in target countries?

Out-turn of Post-graduate Training Courses

Data provided by AGRA indicate that the sub-program is on-track to deliver target numbers of graduates in each partner university. It is understood that the number of students recruited to courses from each country was based on a series of country-level assessments conducted in 2008. These formed the basis of a business plan for investment by AGRA SHP in post-graduate training, having shown 50 to 100% short falls in the needs in experts in integrated soil fertility management, both for research and extension in 13 AGRA target countries (information supplied by Dr M. Rarieya). Table 11 indicates that there has been, with the exception of Nigeria, a fairly even spread of students registered from target countries. In addition to the numbers shown KNUST has agreed to train two additional Ghanaians at PhD level. This has been made possible by cost savings in the grant made to KNUST. The candidates are both graduates from cohort 1 of the MSc course.

Table 11 Distribution of SHP sponsored students by home country

Home country	MSC	PhD	Total
Burkina Faso	12	3	**15**
Ethiopia	11	3	**14**
Ghana	5	5[1]	**10**
Kenya	9	4	**13**
Malawi	12	3	**15**
Mali	12	4	**16**
Mozambique	20	0	**20**
Niger	9	3	**12**
Nigeria	2	5	**7**
Rwanda	14	1	**15**
Tanzania	12	3	**15**
Uganda	9	2	**11**
Zambia	10	4	**14**
Total	**137**	**40**	**177**

Focus of Thesis Research

The AGRA SHP Theory of Change is that by adopting integrated soil fertility management practices (ISFM) in an economically viable way smallholder farmers will increase soil productivity to achieve sustainable yield increases. Explicit in the objectives of the AGRA SHP has been the support to training of a new generation of young professionals to take the lead in championing Integrated Soil Fertility Management approaches. The program views ISFM as a range of agricultural practices that improve availability and use of plant nutrients

and soil water (see: AGRA and IIRR, 2014. *Investing in soil: Cases and lessons from AGRA's Soil Health Program*. AGRA Nairobi). These comprise:

- Combined use of mineral fertilizer, soil amendments (lime and rock phosphate) **AND** organic matter (crop residues, compost and manures);
- Agroforestry;
- Crop rotation and intercropping with legumes;
- Conservation agriculture (no-til farming using a combination of mulch, direct planting and crop rotation to maintain fertility, prevent erosion and to suppress weeds).

Clearly it is important for well qualified research and extension staff who work on soil fertility management to graduate with a good understanding of how to apply this range of approaches in different contexts. The PhD and MSc courses funded by the training grants all had taught course and research components. The taught courses are discussed in the following section. The thesis research project provides an opportunity within the degree courses for students to build-upon course work and examine how ISFM and its components can contribute to improved soil health in particular contexts. The agricultural landscape and farming community is heterogeneous in terms of agro ecologies and the resources available to growers; blanket recommendations are unlikely to be valid on a wide geographic scale. Despite this spatial variation and the increasing understanding of the value of integrating methods for maintaining soil health **nearly 40% of PhD and MSc thesis studies have focused solely on fertilizer**, studying doses, methods of application and effects on soil nutrient content (Tables 12 and 13). This analysis is based on thesis topics in the AGRA SHP data base, abstracts of student presentations made at the December 2014 Kenyatta University conference and discussions with students. There has been considerable regional variation in the topics. MSc students at **Haramaya University in Ethiopia for example all conducted field work that contributed to recommendations for the use of blended fertilizers** to support Ethiopian government policy to roll these out to farmers. Students were directed to work on blended fertilizers by the Ministry of Agriculture **rather than choosing to research topics that would have built their understanding of ISFM.** However they did not test the fertilizer formulas that have previously been the subject of studies at research stations and farmer training centres but 9 new formulations donated by fertilizer companies. According to interviews with Ethiopian soil scientists conducted by this review there has been little cost-benefit analysis done and much of the promotion is based on the assumption that Ethiopian soils are deficient of micronutrients. If there were to be further support to students in Ethiopia there appears to be a critical gap in knowledge that could from the basis of a thesis study.

Table 12 PhD studies at KNUST and SUA by topic area

Topic area	Number of studies (n=23)
Fertilizer doses, application method and uptake (includes use of lime as soil amendment)	9
Integration of legumes into cropping system	2
N fixation and rhizobia	1
Soil characterization & Mapping	2
Tillage & soil fertility management interactions	1
Conservation tillage, nutrients and water	1
Integration of inorganic fertilizer and organic manures	4
Soil carbon and plant nutrient dynamics	1
Modelling crop responses to fertilizer and use of remote sensing in fertilizer management	2

Table 13 MSc studies at partner universities by topic area

Topic area	Number of studies (n= 84)
Fertilizer doses, application method and uptake (includes use of rock phosphate and lime as soil amendment)	31
Integration of inorganic and organic fertilizers/manures	20
Integration of legumes into cropping system (rotation and intercropping)	4
N fixation and rhizobia	9
Soil characterization & Mapping	3
Tillage & soil fertility management interactions	4
Conservation tillage, nutrients and water	2
Fertilizer and *Striga* management	2
Modelling nutrient dynamics	1
Crop spacing	1
Variety x fertilizer interactions	1
Soil amendments to mitigate erosion	2
Plastic degrading soil organisms	1
Composting methods	1
Mycorrhiza	1
Fertilizer policy	1

Some 24% of MSc studies investigated application of combinations of inorganic fertilizers and organic manures. This approach is central to the definition of ISFM outlined in chapter 4. However despite the need to increase organic carbon content of soils **there have been surprisingly few studies of integrating legumes into cereal-based systems, either in inter-crops or rotations, despite the multi-functionality of these crops for addressing both soil fertility and human nutrition issues.** Legumes have however featured quite widely as test crops in fertilizer studies, for combined applications of fertilizer with manure or in work on nitrogen fixation, appearing in 34% of PhDs and 30% of MSc. projects.

Overall less than 25% of all research projects have investigated ISFM, the majority of studies have focused on individual components. AGRA SHP has classified thesis topics by the five thematic areas of the program – Fertilizer recommendations, Fertilizer efficacy, water interaction, decision support or policy. Individual student projects may address more

than one of these so it has been difficult to classify completed work definitively into these themes. However using the classification above it is clear that there has been a concentration of work on the Fertilizer recommendations and Fertilizer efficacy. Fertilizer efficacy and ISFM combinations contribute to recommendations but there has been little emphasis on decision support such as farmer decision trees or for site specific nutrient management. With the wealth of information generated by students and AGRA SHP projects there is the opportunity for future thesis work to focus more directly on decision support. Only one MSc project studied policy issues and only one appears to have had a socio-economic focus. These are both areas of which it is critical for research and extension services to have a good understanding with policy providing the enabling environment for access to legume seed, finance, fertilizer subsidies, ISFM extension, output markets etc. that facilitates adoption. Understanding the socio-economic dimensions of farmer decision making and the context under which particular options may be adopted should also be essential to the skill set of a new generation of ISFM professionals and **yet this area was almost completely ignored in the design of student research.**

Selection of research topic. With the exception of the MSc course at Haramaya in Ethiopia students appear to have had a free hand in selection of their thesis research topic. Commonly, part of the university application process was to provide a short description of the research the student wanted to do and in many cases students proposed an in-depth study of a topic they were already working on in their home institutions. However the idea came up it was discussed with their university departments and students were matched to the most appropriate staff member as a major advisor. An alternative approach would be for students to be attracted to work with university staff who have developed a track record in a particular area of soils research and to develop research questions that build on-previous studies. This would have the advantage of providing context and baseline information to identify knowledge gaps. However discussion with faculty at the universities visited indicated that this approach which is common in Europe and USA, with a group of students working towards a common goal, is rare in African universities. Publication records of faculty who have been supervising AGRA funded students tend not to demonstrate staff developing research themes over time – funding is a constraint to this in many cases. The situation at Haramaya in Ethiopia was unique among partner universities with students all working on blended fertilizers. This topic was a response to national policy with the Ministry of Agriculture using the opportunity of MSc training to develop fertilizer recommendations for a number of crops and districts of the country.

AGRA SHP program officers were keen for student research to be aligned with on-going projects funded by the program. There are examples where this influenced choice of research topic – in Malawi for example two MSc students addressed the issue of improving productivity of acid soils which were constraining yield of legume seed producers working with the Clinton-Hunter Foundation. Discussions with faculty at the universities visited by the consultant indicated considerable skepticism with attaching students to AGRA projects. Apart from budget issues which were a particular problem in Malawi where NASFAM for example could not assist students as they had not budget to do so, there are questions of relevance and academic rigor. Faculty at some universities e.g. KNUST and LUANAR observed that AGRA projects do not necessarily have a core focus on ISFM. Faculty opinion is also that project managers can be more interested in having students to test a set of pre-determined crop management treatments rather than allowing for the

development of a hypothesis and associated research questions. This is an important discipline in research and essential training for post-graduates, particularly for those developing a career as independent researchers as well as those who are extension managers. Course work prior to the research project at some universities e.g. SUA, LUANAR and Makerere includes discussion of national issues and priorities in soil fertility; Makerere takes students on a field trip to help them identify ISFM topics. However it was pointed out by faculty that there has not been systematic identification of national priorities. One way of doing this could be to invite national extension managers and leaders of ISFM initiatives to seminars with students to discuss national priorities and current responses. This it is felt would help to focus students to contextualize their work and identify on-going initiatives to work with. Such an approach could resolve the apparent tension between trying to find answers to national questions while developing students as independent thinkers. In any further phase of post-graduate training AGRA should encourage partner universities to proactively engage with national stakeholders during grant writing to identify opportunities for attaching students to on-going ISFM research or promotion initiatives (not only AGRA funded) and estimate contributions to field costs from either side to ensure mutual benefit.

Short-term soil fertility or long-term soil health? As discussed in Chapter 4, Integrated Soil Fertility Management (ISFM) is: "A set of soil fertility management practices that necessarily include the use of fertilizer, organic inputs and improved germplasm combined with the knowledge on how to adopt these practices to local conditions". Therefore ISFM aims to improve both the chemical fertility of the soil through fertilizer, and the physical and biological fertility of the soil. This review has recommended that ISFM should deliberately include the application of high quantities of high quality organic resources and ways of reducing losses to counter widespread low organic C status of soils. AGRA SHP initiatives have demonstrated the importance of combining manure use with fertilizer micro-dosing while recognizing that manure availability is often limited.

The focus of post-graduate research that has been supported through AGRA SHP training grants has been almost exclusively on crop responses by monitoring yields and examining soil nutrient content or water availability as influenced by soil fertility management and tillage practices. Studies of effects on soil carbon are the exception, despite the critical role of C in determining soil quality and as a reservoir for sequestration of CO_2 from the atmosphere. Although there has been some attention to opportunities for optimizing nitrogen fixation with studies on rhizobia and one MSc has studied mycorrhiza/root interactions there has been no in-depth work on rhizosphere interactions. Building and maintaining a healthy soil to be productive in the long-term is about more than just applying nutrients from inorganic fertilizers or manure. Indeed, this is the logic behind AGRA SHP emphasis on ISFM. In order to develop ISFM packages that will maintain health soils rather that just top-up key nutrients from year to year African institutions need soil science graduates who are skilled in methods for understanding the role of soil micro-organisms and invertebrates in nutrient cycling. Discussions with faculty during this review indicated that the skills and methods for such work are not widely available in AGRA partner universities. There are soil microbiologists and limited microbiology lab facilities but equipment will be need for studying soil respiration, particularly gas exchanges. While developing work on nutrient cycling in the rhizosphere is challenging it is an area that a Soil Health program should seriously consider facilitating in centers of excellence for ISFM training. This will need partnerships with international experts to contribute to teaching and mentoring of faculty. The opportunity

should be taken to establish long-term field trials at bench-mark sites representative of key farming systems and agroecologies that could provide field laboratories for students to sample and develop thesis research at to understand how soil biota respond to ISFM practices in the long-term so that sustainable practices are recommended to farmers.

6.3.2 Has support from the program led to relevant curricula that equip graduates with a wide range of skills from research, communication, strategic and analytical?

Curriculum review

Prior to receiving AGRA training grants the partner universities had been offering post-graduate training in soil science for a number of years but with few students, due mainly to a lack of local funds. The situation at SUA is typical - there had been an MSc course since the 1970's with up to 4 students per year. A single cohort of 15 students had been funded through a SADC grant in the 1990s and NORAD had supported staff through their on-going funding to research projects at SUA. At the University of Zambia on the other hand soil science was taught as a specialization within the MSc in Agronomy. From the outset of the post-graduate training grants AGRA SHP encouraged universities to review soil science curricula with stakeholders to identify modifications that would result in courses to equip students with an understanding of the principles of soil and water processes that contribute to soil fertility. The aim is for courses that lay a foundation of understanding of ISFM in the context of farming systems. As the taught courses lead into research projects it is also critical that students learn basic methods for research design and analysis. Furthermore AGRA has emphasized the value of a broader training to equip graduates with an understanding of GIS, Agribusiness and "soft skills" including communication skills (presentation and scientific writing), and leadership. The process of curriculum review and reform varied from university to university. AGRA support to the process included commissioning a consultant to review curricula one year into the delivery of courses funded by the program (S. Keya, 2011. Curriculum analysis: A Case Study of AGRA Supported Delivery Universities. AGRA, Nairobi). He visited 7 of the partner universities and through a questionnaire and interviews undertook a SWOT analysis and drew-up topics to be considered as core units and electives for the taught component of both MSc and PhDs. Course co-ordinators and selected staff met in August 2011 in Nairobi to review progress on curriculum reform and exchange lessons. The consultant also presented his findings and recommendations. Participants included staff from RUFORUM and Wageningen University.

Work on curriculum review at each university is summarized in the Appendix 2. The PhD courses at both KNUST and SUA were innovative in introducing taught courses rather than awarding degrees on the basis of research only. These were the first doctorate degrees with this structure at both universities and the experience has had a major influence with the practice since being adopted in all departments, a major and perhaps unexpected "value-add" from the AGRA SHP training grants. Curricula for the PhD courses built on existing MSc units. Initially consultations were held through regional workshops with key stakeholders and representatives of other universities. In East Africa RUFORUM member universities had already noted, prior to the establishment of the AGRA SHP, that most of the existing PhD Programs in the E&SA region, which were conducted by research only, lacked a broad perspective and had relatively limited analytical rigor compared to similar programs

with coursework. It was therefore agreed to develop and launch joint client-oriented regional PhD training programs with SUA taking the lead in soil and water management. At SUA the curriculum review process was funded by RUFORUM. In 2009 SUA presented a draft to a stakeholder workshop involving AGRA, ASERECA, RUFORUM and national universities in E&SA. Inputs were also made by 2 universities in Europe, facilitated by the AGRiNatura partnership and also Ohio University with support from the USAID iAgri project at SUA. There was an existing Soil Science MSc. at SUA so this formed the basis of the units included for the PhD. Units were added on leadership, entrepreneurship, and communication skills.

A similar process took place at KNUST were ISFM PhD training for West Africa was to be located. As part of the AGRA SHP training grant proposal development a stakeholder workshop was organised with participants from universities and NARS in the region. This considered what the course should cover. The core soil science courses were available from MSc level but the curriculum development workshop identified the need for scientists to have better communication skills to talk at farmer level. Subjects added were communication skills and Agribusiness taught by staff from Extension, Agribusiness and Agricultural Economics departments.

At MSc level similar work on curriculum was undertaken. At SUA MSc studentships funded by AGRA came on stream after the PhD program at SUA had started. The taught courses in soil science had been reviewed for the PhD program so were used in the MSc. Core courses include research methods and statistics with elective options on Land Management, soil and water and plant nutrition. Topics in Agribusiness, project management GIS, communication in Agriculture and academic writing were added to the MSc syllabus for the AGRA intake. Students also receive a course on computer applications such as Power Point and how to make presentations. At Kenyatta University the curriculum has had input from national and regional stakeholders. Initially the issue of ISFM was raised, found to be weak and additional material was added as were units in GIS and Agribusiness. At Makerere University, the MSc in Soil Science has been running for many years pre-AGRA. The process of curriculum change is lengthy and bureaucratic so additional courses were added in from within the department plus value chain analysis, water and fertilizer use interactions, gender, research proposal/thesis writing. When AGRA came in they looked at existing courses and supported updating of the material towards ISFM. At LUANAR on the other hand the process lacked wide consultation. A group of staff in the department reviewed the existing curriculum and framed revisions to orientate the MSc towards an ISFM focus and units were included on GIS, Agribusiness and communications. There was little involvement of outside experts; some comments on the proposed course were received from research staff at Chitedze Research Station. No additional training was offered on soft skills such as scientific writing.

The course offered to PhD students at KNUST includes the following units: Soil Biology and Biochemistry, Climate, Agriculture and Environment, Soil Resources for Agriculture, Crop Husbandry and Farming Systems, Integrated Soil Fertility Management, Soil and Water Management and Conservation, Research Methodology, GIS and Remote Sensing Applications, Participatory Research and Technology Development, Communication in Agriculture. With additional short courses in soft skills including publication and scientific writing, the overall course includes the essential elements for ISFM practitioners and

provides a good model.

It is clearly good practice to schedule on-going review of the fitness and content of courses and to consult with students on how the teaching is received – this is standard practice now in universities in Europe. Kenyatta University has adopted periodic curriculum review; this should be discussed by AGRA with other universities. SUA is currently engaged in a review of BSc curricula and will then tackle all MSc courses by April 2015. This is part of move to align courses across East Africa. It will be useful to share the outcome of this process with all AGRA partner universities. At Makerere University the curriculum is being reviewed as part of a university wide Curriculum review 2014/5. This is a result of the challenge from the President to make universities more innovative.

Discussions with students indicated considerable satisfaction with the course content and teaching. There is however some frustration over choices of elective courses. This was emphasised at SUA where PhD students follow either a course in land and water management or plant nutrition. When enrolling they had expected to graduate with a broad knowledge of ISFM.

Research methods. **Across AGRA partner universities there continues to be a lack of experienced research methods specialists and biometricians in Soil Science and Crop Science Departments.** Research methods should be a critical core course for all Soil Health students and they also need access to biometricians during the design, data collection, analysis and reporting stages of their thesis research. Various arrangements are in place for delivery of RM/biometrics as described in Appendix 2. In most cases these rely on staff from other departments, or in the case of KNUST from another university. Students comment that the teaching can be too focused on mathematical procedures rather than practical aspects of field experiment design and they need more support to use a statistics package. It was clear from listening to student presentations at the Nairobi Conference, co-sponsored by AGRA in December 2014, that student research relies on a few standard designs that are not necessarily the most appropriate and statistical analysis is presented in a routine way, rather than asking more interesting questions of the data to answer well designed research questions. Indeed many students showed the same slide to describe their design and analysis – a randomised complete block design, ANOVA and LSD! Students largely rely on university supervisors for advice on research project design while the more curious seek help from external project and institute staff. At SUA there are plans to establish a Statistics Unit with support from the USAID iAgri program and this should help future PhD trainees, provided the staff have adequate grounding in methods for agricultural research.

In response to the difficulties experience by students in accessing statistics packages, the Wageningen support project discussed below introduced the use of the free to use inter-net based “R” statistics package. There are two important imperatives for this. GENSTAT has until recently been considered the “gold standard” for statistical analysis in agricultural science and has been the main tool used by students at AGRA partner universities. This has been the program learnt by many faculty members, particularly those undertaking higher degree scholarships in European universities, so they should be able to provide some support to their students. However licences for the program are expensive and it was noted that at LUANAR at least cost was a constraint to keeping current versions for students to

use. Furthermore following a recent change in policy the company that distributes GENSTAT has cancelled the free supply of a basic GENSTAT "Discovery version" to students and researchers working in the developing world. "R" on the other hand is available free on the inter-net and is supported by a world-wide community of developers and users. It is increasingly being adopted by universities and institutes in the "north". Wageningen staff provided an introduction to "R" for staff and students at KNUST and SUA and follow-up training. Some faculty and students who travelled to Wageningen for other short courses were able to consult with specialists on use of "R". However, students have had mixed experiences and few that were interviewed for this review had mastered the methods available through "R". They comment that it takes considerable commitment and time to learn the basics. Although there are comprehensive sets of on-line training notes, examples and videos many students have either not found the time or been able to make progress on their own to become proficient uses. Instead they continue to use out of date, "borrowed" copies of GENSTAT. Individual students have shown that with perseverance it is possible to master routine analysis and also use "R" for geospatial statistics, which are particularly important for multi-site trails. Others are only using "R" for graphics.

AGRA should work with the universities and other partners, such as USAID iAgri in Tanzania to review Research Methods provision and develop plans to upgrade this and ensure sufficient staff are trained and can be appointed**.** A component of this will be reliable access to a statistics package and training on use. **Upgrading the capacity of partner universities to deliver relevant Research Methods and biometrics support will undoubtedly drive improvements in soil health research quality in African universities.**

Access to up to date literature is also critical to the delivery of a modern curriculum. Although in theory the university libraries have on-line resources or provide TEAL, in reality students struggle to find anything other than open access journals or abstracts of peer reviewed papers in high impact factor journals. There are increasing numbers of "predatory" open access journals that take fees to publish without a proper review process – see http://scholarlyoa.com/publishers/ for a description and discussion of these. It would be unfortunate if a new generation of ISFM professionals were to rely on these sources of knowledge when experts in the field only publish in reputable journals. At SUA and LUANAR students admitted that they mostly rely on abstracts for their literature reviews rather than being able to read who papers. This is another impediment to producing a quality thesis. The restrictions to access are various but include suspension of journal subscriptions (LUANAR), poor internet facilities (SUA and KNUST) and TEAL not being kept up to date (LUANAR). At KNUST students complained that they are not allowed to do internet searches themselves in the library and requests to librarians go unfulfilled or take a long time due to staff shortages. **AGRA should review arrangements for access to literature with the universities and seek ways of relieving this constraint.**

Support for Wageningen University. AGRA SHP has been concerned to ensure the quality, relevance and focus of post graduate training in ISFM. It became clear that there was a need to strengthen and secure the continuity of the knowledge base in ISFM, particularly given the decline in this over recent years due to the retirement of experience staff. In a number of situations including SUA LUANAR and KNUST MSc courses the co-ordinators were retired faculty hired back by the universities on contract. In order to support quality

development in the university curricula, support teaching skills of young staff and broaden the syllabus with "soft skills", AGRA contracted Wageningen University in September 2012 with objectives to:

1. Strengthen teaching and training skills of (young) soil scientists at KNUST and SUA in the context of advancements in soil science research, training and education;
2. Support the delivery of new/young high quality scientists and professionals at KNUST and SUA who have both knowledge and soft shills to move the field of soil science forward;
3. Strengthen linkages between the delivery universities and Wageningen.

Following workshops with staff at both universities in November/December 2012 to identify the main issues, a tailor-made program was designed and a series of visits by Wageningen specialists planned to support innovation in the PhD curricula, staff and PhD training. These inputs began in early 2013. This was following completion of course work for both cohorts of students at KNUST and towards the end of the teaching component of the course for the second cohort at SUA. Following the needs assessment with the universities it was agreed that staff training would focus on:

- aspects related to working in a higher academic environment and supervision of PhD's (project and time management, communication (scientific writing and with peers), and networking;
- training for PhD candidates on the PhD process and how to become an independent scientist with the required competences and skills (Topics: scientific communication, personal efficiency, project and time management, scientific writing and presentation).

Over the past two years Wageningen staff have delivered short courses on the above topics to both staff and PhD students in line with the "T-shaped skills" approach, described in the introduction. These have been enthusiastically received by young staff and students. Wageningen has also identified the need to improve spatial awareness of ISFM issues, particularly methods to analysis the heterogeneity of farming systems and farming communities. It was striking when listening to student presentations at the Nairobi conference in December and when talking with students how in many cases there has been little attention in research projects to spatial issues including criteria for selection of research sites and adequate baseline data collection to characterise sites so that results can be related to the wider community. This spatial awareness will be critical to scaling out ISFM options which needs to be based on an understanding of local adaptation and context.

During 2013 and 2014 Wagening support included:

- Visits by Prof Smaling to KNUST and SUA to evaluate soil science curricula and research – during the visit he spent time with PhD students to advise research methods, plans and progress. Cohort 2 students at SUA indicated how they benefitted from his input to their research proposals;
- Evaluation of the soils program at KNUST by Prof Kuyper;
- Course on Competence and skills training for PhD students: "Rise to the challenge" at KNUST. This was repeated at University of Nairobi and Kenyatta University;

- Participation of selected students in post-graduate courses under the auspices of Wageningen including “Plant Nutrients in Terrestrial Environments (at University of Copenhagen) and “Farming systems and Rural Livelihoods” a field school in Ethiopia to encourage spatial thinking. Current students have the opportunity to apply to attend a simian field course in Embu, Kenya in 2015. However places are limited with only four available to KNUST.
- Geo-statistics and GIS at Wageningen.
- Hands-on training on “Writing a Scientific Paper” at both universities
- Hands-on training on Career Development and Assessment at both universities.

Discussions with Dr van de Vijver the co-ordinator of Wageningen inputs revealed the following challenges:

- Involving university staff in the program has been difficult. High workloads are a major constraint but also some appear to lack the motivation to be involved. Commitment from SUA has been particularly disappointing - Is this due to the high numbers of “retired” faculty delivering the courses at SUA?
- A lack of funds in the university training grants at SUA for these additional courses, particularly travel costs for students, has put pressure on the Wageningen budget. This problem was eased by allocation of addition funds from AGRA SHP.
- For PhD students to be actively involved in the “soft skills” training, it is essential that supervisors are committed, particularly to allowing students to sit in ion courses at their home universities. Students, particularly at SUA indicated to the consultant that there were times when their supervisors indicated that they should be concentrating in their research rather than taking more courses.
- To maximise the output of the investment in student support from Wageningen and the soft skills training it is essential to have committed participants. Prior screening is therefore needed; letters of motivation from students help.
- The mechanism by which Wageningen professors support individual PhD projects is an issue. Quality and progress is an issue for the university supervisors and miscommunication and conflict has occurred when students have contacted Wageningen staff directly.

Wageningen support to the AGRA SHP PhD training grants was designed once these projects had been running for over 2 years. **Prior to any future training grants being awarded a thorough review of the impact of the Wageningen support should be undertaken to ensure the lessons listed above are taken into consideration. Timing of short courses, particularly when these are in Europe or field trips in Africa needs to be carefully considered in an already busy timetable.** Students have been very appreciative and maintaining the mentoring provided will be very important to maintaining the quality and breadth of the ISFM curricula at African partner universities. To date the Wageningen project has not supported the MSc courses directly. Similar arrangements for supporting the MSc courses, particularly for mentoring junior staff involved in teaching and supervision should also be considered in order to raise quality of provision across the universities. This may need the development of partnerships with other universities elsewhere in the world.

Other Visiting professors. AGRA SHP encouraged the partner universities to make use of visiting professors to fill gaps in expertise for teaching on the soil science/ISFM courses. SUA had the support of Dr Weil (University of Maryland) who spent 6 months in Tanzania. Cohort 1 students were very pleased to benefit from this experienced soil scientist, particularly in the development of their research proposals. **Ways of expanding this type of mentorship to other universities should be investigated. Local supervisors are not always up to date with global developments in soil science and do not appear to be current with the literature, particularly when constrained by inadequate library services.**

Elsewhere there has been limited staff exchange or use of visiting professors. It is understood that University of Bobo-Dioulasso in Burkina Faso and University of Nairobi did use professors from other national universities while KNUST has used a statistician from University of Ghana to deliver a course; **otherwise course co-ordinators have indicated that there was no budget for bringing in visiting professors.** There could have been discussion with AGRA about this to determine budget flexibility. When developing grant proposals for future post-graduate training AGRA should encourage universities to identify contributions to courses from potential visiting professors and include appropriate budget lines.

Faculty members expressed an interest in working with visiting professors, particularly where this would bring new skills and methods to their departments. The mechanism to make this happen should be considered in any future training grants. Staff would like greater links with other universities in the AGRA SHP post-graduate training partnership to learn lessons from each other, develop joint research and organise teaching exchanges. **One way of achieving this would be to establish a Community of Practice among faculty members focused on the issues of curriculum delivery and student research quality.** This is suggested as a way of providing more motivation for staff to engage in initiatives such as the Wageningen support; there will be costs as initially at least someone will need to take the lead to organise communications, to broker opportunities for staff exchange and an annual meeting to review progress, discuss key issues and plan solutions.

6.3.3 To what extent have mechanisms put in place by the sub-program led to recruitment of women into post-graduate training?

According to the student data base maintained by AGRA the overall gender target have been achieved with 51% of the 177 students registered with universities being female. However, the proportion of females undertaking PhD training has been below target at just 33% of students enrolled. Discussions with course leaders at the universities visited revealed the challenges that were encountered with recruitment of women and the efforts made with the support of Dr Rarieya to work through institutional and regional networks to identify qualified female candidates. In West Africa KNUST experienced resistance from families in some communities, for example in Niger, to allow their daughters to travel for training. This was partly addressed by using local professionals who had benefited from further training to discuss issues with families. KNUST achieved some cost savings within the grant for PhD training and this has been allocated to enrol two additional females, both

graduates from the first cohort of MSc students. Studentships at SUA were advertised widely in East Africa but it proved difficult to find qualified female PhD candidates across target countries. Many women applied from Kenya but not from other countries. Despite re-advertising and circulating the opportunities via RUFORM and ASERECA networks only 5 of the 20 PhD students studying at SUA have been female. The university has therefore pursued a strategy of targeting women for the MSc course in Soil Science with the expectation that a larger group of female MSc graduates will provide a future pool of individuals who are qualified to take up PhD training. By taking this longer-term view AGRA SHP has made significant contribution to training women in soil science and IPM issues – the training grants will have produced 8 female doctorate and 20 MSc graduates in West Africa and 5 female PhDs with 58 female MSc in East and Southern Africa. Progress at MSc has been particularly impressive in Ethiopia and Tanzania, for reasons discussed above, with 9 and 14 female MSc students respectively.

Some of the training grants provided extra support to female students including allowances and housing for families, nannies and payment of medical bills for children – it is understood that this facility was not in place when support to the SUA PhD course was agreed. Although advertisements emphasised that female candidates would be given priority for scholarship awards at KNUST the availability of additional financial support was not indicated. This was provided once a student had accepted. Such support would be impossible within the usual fee structure of the universities and relied on the grant funding. According to course co-ordinator at KNUST assisting female applicants to find accommodation and providing assistance with child care has been a major and very positive innovation that should be continued in the future. Including this aspect of the awards in the advertisements may help to encourage more female applicants, particularly those in employment who have young families.

6.3.4 To what extent have partner universities succeeded in timely delivery of degree courses?

There has been considerable variation in the timeliness of student completion and graduation. As shown in Table 6 some 69 new MSc. graduates have been produced so far. Although this is just 50% of enrolled candidates, many of the remainder are in later cohorts or are at universities where grants were agreed later than others, particularly in Maputo, Mozambique and at SUA, Tanzania. According to staff at the universities visited by the consultant they expect to graduate the remaining MSc candidates by mid-2016. Degree programs will be completed earlier but at some institutions there is only one graduation ceremony per year so graduation is some months after students have completed thesis examination. Time from enrollment to graduation of the majority of students in a cohort has varied from 2 years at KNUST, University of Nairobi and University of Zambia to 4 years at LUANAR. The latter is something of an outlier.

To date just fewer than 30% of PhD students have completed their studies and had thesis examined (Table 14). At KNUST students who enrolled in August 2010 graduated in November 2014. AT SUA only 3 of cohort 1 enrolled in October 2010 have completed but 6 are expected to graduate by November 2015. Completion is a better measure than graduation as the latter can be delayed when there is only one ceremony per year.

Table 14 Overall Progress of PhD Students

Institution	Phds in progress	Completed	Total
KNUST	11	9	20
SUA	20	3	20
Total	**31**	**9**	**40**

Note: based on information available at time of writing the report. Data for SUA to be updated

A number of factors contribute to timely delivery of courses by the universities. Of critical importance is strong leadership driving the delivery of teaching and quality assurance of thesis research supervisors. This starts with an organized Dean of the faculty in which the delivery department resides or Dean of Graduate Studies and continues down to course co-ordinator level who needs the support of his/her Head of Department. Elements of good practice were observed at Kenyatta University and Makerere University. When the MSc training grant was approved for Kenyatta University the VC appointed an implementation committee including the Dean, Department Head, Grants office and Agribusiness Department. The Dean School of Agriculture and Enterprise Development then took a close interest in ensuring implementation of the course went according to plan. MSc students are expected to complete their degrees in 2 years and tracking of progress is co-ordinated by the Office of the Dean. Departments report progress up to the School Board of Post Graduate Studies based on reports from supervisors and six monthly student seminars. A separate committee was also established at Makerere University to administer the grant. This reports to the college principal and is comprised of the Head of Department, Lab manager, Chair of the Graduate Committee and a senior researcher. The committee has met regularly to track student progress. This "AGRA committee" is helpful for the course director as it enables collective responsibility. Elsewhere the universities have used existing university administrative structures to plan and implement course delivery. Most have grants offices or leave it up to finance directives to administer the grant. Using existing university administration means there is less of a personal stake and pride for teaching staff in overall coursed delivery. At KNUST there had previously been problems with post-graduate students running way over the time expected for submission pf their thesis and preparation for examination. To counter this Dean of Post graduate Studies has brought in a system requiring students to pay an addition fee for re-registration if they run over time without a reasonable explanation.

It is also critical to have committed supervisors for thesis research. With many of the AGRA funded students working away from their university base the supervision teams have usually consisted of a main advisor from the university and an external advisor located either in the institution where the student conducts research or nearby. At KNUST PhD students also had a second university advisor. This was a junior lecturer who needs to shadow a more senior member of staff to gain experience of supervision before being appointed as a lead supervisor. This is clearly a good way of mentoring junior staff. One of the reasons for slow MSc completion rates at LUARNAR compared to other universities has been related to commitment of supervisors. According to the course co-ordinator there were many flaws in the budget for the training grant. It was difficult for the consultant to fully understand what had occurred in negotiations between LUANAR and AGRA. However the course co-

ordinator explained many difficulties, partly related to inadequate budgets compared to LUANAR norms for student research, supervisor's honoraria and examiners fees. The university scales provide $1,200 per student as an honorarium for the supervisory team but under the AGRA grant supervisors have received $100 to $200, if they have been paid at all. This has led to considerable dissatisfaction among staff. Students indicated to the consultant that they were very aware of the issue and they felt that supervisors took far too long to look at their work and provide comments on thesis drafts because they could be doing work on other projects for which they would be better rewarded. Honorariums are also paid to staff, at low rates, at some other universities but are not the divisive issue they have become at LUANAR. Budget issues has also delayed two of the second cohort students at LUANAR as there were insufficient funds for them to stay in university accommodation for more than 18 of the 24 month course. This led to them moving off campus and being less accessible to their supervisors. Some LUANAR students returned to work before completing their thesis because periods of study leave had ended. This makes it hard for them to concentrate on writing up.

Table 15 Overall Progress of MSc. Students (Source: AGRA SHP student database)

	Cohort 1			Cohort 2			Cohort 3		
University	**Enrolled (Date)**	**In Progress**	**Graduated (date)**	**Enrolled (Date)**	**In Progress**	**Graduated (date)**	**Enrolled (Date)**	**In Progress**	**Graduated (date)**
Bobo-Burkina	03/11	0	8 (03/14)	11/11	0	7 (03/14)	-	-	-
HU-Ethiopia	10/10	0	11	-	-	-	-	-	-
Katibougou	01/14	5	0	01/15	5	0	-	-	-
KNUST	09/12	1	8 (11/14)	09/13	6	0	-	-	-
KU-Kenya	08/10	0	7 (12/13)	09/11	0	4 (12/14)	1/12	1	2 (12/14)
LUANAR	1/11	3[1]	1 (11/13)	1/11	3	0	08/12	2	0
MU-Uganda	09/10	1	5 (1/15)	11/11	6	2 (1/15)	-	-	-
U. Nairobi	03/11	2[2]	8 (08/13)	-	-	-	-	-	-
SUA	11/13	15	0	-	-	-	-	-	-
UNZA	3/11	0	5 (10/14)	10/12	5	0	-	-	-
EMU Maputo		12	0	-	-	-	-	-	-

[1] All three students remaining from Cohort 1 at LUANAR have defended their thesis and expect to graduate 02/15.

2 One of remaining students at University of Nairobi has submitted a thesis.

The total cost of training grants includes variable amounts of funding for laboratory equipment. However the cost per MSc student, even allowing for equipment ranged from $33 thousand at KNUST to $39 k at Haramaya University and was $36.5 k at LUANAR. This indicates that cost per student as a value for money measure is not closely related to time taken to complete.

Good practice in PhD and MSc supervision has been observed at KNUST where external advisors are brought to the university once a year to sit in on student presentations so they can contribute to planning and to ensure there is good communication with the university advisors. However visits by university advisors have not been consistent. The second cohort of students did not get a visit in their first season in the field. According to some junior staff this was because the department decided to concentrate efforts on assisting the first cohort to complete their theses and prepare for examination. Elsewhere most students have received one visit during their field work but this has often come late in the season after trials have been established and it is too late to make changes.

Completion can also be delayed when external examiners delay submitting reports. This has been done exclusively by correspondence with examiners asked to respond in 6 weeks to 2 months but in some cases it has taken up to 6 months at LUANAR and 3 months at SUA. External examiners are paid a fee of £100 to $200 depending on the institution. Elsewhere Deans of Graduate studies make timely follow-up and may even terminate an examiner without them receiving their fee. Following examination, students face defence of the thesis, either in public or in front of a committee. Corrections follow in the usual way, and bound copies of the thesis are submitted to complete the process. At LUANAR students have not been provided with funding to print and bind the thesis – this has also delayed final submission and graduation.

As can be seen from this commentary the poor performance at LUANAR with students taking longer than elsewhere to complete is due to a combination of factors. However, leadership is a key issue to make sure there is a satisfactory “student experience” of course work and support for research from planning to submission. The course co-ordinator at LUANAR has been re-employed after retirement from key government positions and does not appear to focus on building a strong dynamic course for the future as has been seen elsewhere, e.g. at Kenyatta University and KNUST. This has resulted in a difficult situation for AGRA SHP staff to manage. There are however, other examples where retired at working on contract or late career academics have made strong contributions to the AGRA funded courses. Indeed this has worked well for the MSc course at KNUST where there are sufficient young staff members who are provided with adequate oversight by management. Careful consideration should be given in appraisal of future training grant applications of the motivation of the proposed university course co-ordinators and the processes that operate manage budgets and support students.

Each university has rules concerning the need to publish prior to graduation but it is not clear that these are rigorously enforced. Publication is difficult for MSc students who have one season of field work unless this can be linked to associated pot studied and lab results. International peer reviewed journals will not generally accept manuscripts based on a single site or single season. In order to achieve the number of qualifying papers students are observed to publish in “pay to publish” on-line journals which have no

impact factor and are often not abstracted. This does no good to the author's careers and needs to be discouraged. It would be useful to engage the universities in a discussion on the appropriate standards for publication prior to graduation. It may be better to require students to have presented papers at a conference, which should be included in the thesis and for PhDs include draft journal manuscripts. These will demonstrate capability at organising data from presentation and writing skills.

6.4 Strengthening laboratory capacity

6.4.1 To what extent has donation of equipment to laboratories and training of technicians improved the capacity of target institutions to deliver quality analytical services?

Prior to investing in laboratory equipment or in-service training of technicians, AGRA SHP commissioned consultants in 2010 to review the condition and capability of soils/plant analysis laboratory services at universities and research institutes in target countries (Management of Soil and Plant Laboratories in Eastern, Western and Southern Africa, prepared by Mercy Nyambur; Assessment of research and/or teaching and training laboratories in Niger, Burkina Faso and Mali prepared by M.P.Cescas, Université Laval, Canada). The problem these consultants addressed was summarised as "*In general, the national soil and plant testing laboratories lack the capacity to offer quality laboratory analytical services to farmers. There are hardly any private labs to fall back on. Most of the national labs lack the basic equipment and consumables as well as trained personnel to carry out basic of analyses. A lot of equipment is often abandoned because the lab staff has little knowledge of how to trouble shoot and carry out minor repairs. The lack of functional laboratory services is, indeed, a major factor limiting the conduct of quality research and training of soil scientists in sub-Sahara Africa. It also seriously affects the quality of advice farmers get on how best to manage their soils"*. Following visits to each lab recommendations were made on the type of equipment that each type of lab should be equipped with and an outline curriculum was proposed for in-service training of technicians. It is understood from university staff who were visited during the current review that they were invited to propose a list of equipment for funding within the post-graduate training grants. Generally the funds provided to purchase equipment were considerably less than requested.

AGRA SHP agreed grants to three service providers to undertake in-service training of laboratory technicians covering good laboratory practice, basic soil and plant analysis methods and laboratory management. According to the AGRA grants database for East and Southern Africa training of 47 technicians was undertaken by Crop Nutrition based in Nairobi. For Ghana and Nigeria 37 technicians were trained through IITA while for Francophone countries courses were provided for 42 technicians by ICRISAT. Brief reports on visits to selected labs are in Appendix 3.

Strengthening laboratory capacity - Key issues

Equipment donated to the university laboratories **has improved their capacity to provide analysis** of pH, N, P, K and important micro-nutrients most commonly by using atomic absorption spectrophotometer, UV visible spectrophotometer and N distillation

methods following donation of this equipment. Sample through-put has also improved. Other equipment including centrifuges and furnaces will facilitate sample preparation. Key items are still needed at some locations – KNUST and LUANAR labs have to borrow a pH meter from other departments and this can delay processing of samples.

Health and safety **remains an issue at some locations despite the training for facility managers on laboratory management**. A common problem is the proximity of gas cylinders to equipment and work benches when these should be placed safely outside the lab away from users. Non-functioning or inefficient fume cupboards is another issue. This problem has been resolved at SUA by the installation of a new fume chamber funded by AGRA. The situation at the SARI lab is of particular concern. There is no properly working fume cupboard so the technicians do not have a safe working environment. Indeed they are forced to vacate the lab when the block digester is running.

Power outages are common for example at LUANAR and SUA. **Provision of a generator to power the Soil Science Department laboratory at SUA has been very beneficial**, although it is currently out of action.

Maintenance, repair and calibration of equipment are major issues. There is general lack of recurrent budget to provide for equipment maintenance. The University of Development Studies in Tamale, Ghana was the only location visited which has a maintenance contract for lab equipment with a specialist company**. The lack of maintenance has negative impact on the longevity of equipment and the lack of regular calibration compromises the reliability of data. AGRA SHP needs to consider how to address this issue which is largely associated with the "project-cycle" of donor support.** This is epitomised by the SARI lab at Tamale, Ghana. The lab was built and equipped with German funding in the early 1980s. Over the years the fabric of the lab declined, the water system and much of the equipment ceased to function and has been abandoned. Technicians have no choice but to continue using a faulty water de-ioniser even though they have no idea of the quality of the water or the effect this has in the reliability of test results. New equipment was installed under a AGRA SHP grant just over four years ago but already key items have broken down. According to the technicians the institute lacks a budget to carry out essential maintenance. They now hope that the situation can be improved by a USAID Feed the Future grant.

In-service training for technicians **has been highly appreciated by the trainees, university staff and students who use the labs**. The curriculum, standard of teaching and follow-up from all service providers are all considered to be excellent. Technicians would however have appreciated more guidance on maintenance of equipment and in some cases it would have been better to have held the training earlier in the AGRA program in which case different equipment may have been ordered. **The training has led to greater confidence on the part of technicians who are now able to pass on skills to others**. This includes junior staff in their own institutions as has happened at SARI or students from other universities wishing to learn new methods as is happening at SUA. The training has also led to improved quality/reliability of analysis e.g. by the adoption of standard samples or standard curves for comparison of results. Trainees have been retained in post at most locations. An exception has been at Kenyatta

University. Due to high demand for qualified technicians in universities and county governments in Kenya technicians are relatively mobile. **This suggests the need for a regular cycle of in-service training, or at least continued support to lab managers to train-up junior staff**.

Sustainability of lab services depends in no small measure on stable budgets. One suggestion has been for labs to become more commercially orientated by generating income from soil and plant analysis for other departments, external organizations and farmers. About 10 to 20% of samples handled by the labs visited are considered "commercial". **However the potential is limited** by staff shortages; at KNUST for example there is only one lab technician who is assisted from time to time by National Service personnel. Income is also limited by governments wishing to keep down the cost of soil samples as in Tanzania. A major sticking point is that income from analysis of external samples often goes into the central accounts rather than being kept in a lab budget for supporting running costs. At SUA there is a proposal under consideration to build a new lab, to be run on a commercial basis, with funding through the USAID iAgri program. It is not clear how this will impact on the existing Soil Science Department lab.

A collaborative arrangement between labs both within and across institutions has the potential for ensuring research students and projects achieve a full range of analysis. Equipment sharing already takes place between departments in some universities. Kenyatta University has a policy not to duplicate facilities and in a future phase of AGRA support it would be worth while investigating if a more co-ordinated approach to equipping and running laboratories is feasible. Students have in any case been taking samples to external labs when equipment has broken down or a particular analysis in not available. KNUST students use the Soil Research Institute in Kumasi and in Tamale the University of Development Studies and SARI pays for analysis of samples at the Water Research Institute.

Networking. Staff suspect that the lab technician training provided by AGRA has been a "one off". Technicians emphasised the need for a mechanism for on-going networking with colleagues in other labs so that there can be mutual support for exchange of knowledge on equipment, servicing, methods and problem solving. A possible model is the now defunct *Network of Equipment Users in East and Southern Africa*. According to the Chief Technician at SUA this SADC network facilitated the sharing of information by correspondence and a biannual meeting. **It is suggested that the labs under the AGRA SHP could form a network to share knowledge on best practice. Such networking activity would need co-ordination and a modest budget but would consolidate gains made by the investment AGRA SHP has made to improve laboratory capacity.**

6.5 Overall comments and recommendations on Soil Health Training and Education sub-program

Relevance and contribution to regional capacity building

Since the inception of the AGRA SHP training sub-program 177 post-graduate students from 13 countries have been enrolled in MSc or PhD programs and the first 69 MScs and 9 doctorates have been awarded. The introduction of course work into PhDs, an innovation of the Soil science/ISFM PhDs at SUA and KNUST, is now being adopted across other departments and subjects. As the majority of the candidates were granted study leave by their employers, a condition of enrollment, the graduates are returning to strengthen their organizations with knowledge of soil science, ISFM or in some case soil and water management. The training program has made a particular contribution to increasing the participation of women in ISFM related work with 51% of enrolment of female students. However it has proved difficult to award PhD studentships to women despite significant efforts to advertise the opportunities. Just 33% of the PhD students have been women.

Recommendation 1: Now that graduates are returning to their posts it will be timely to conduct a follow-up to determine how they are using the skills learnt and the extent they are contributing to transformation of their organizations – what impact are they having on approaches to ISFM research and promotion and what challenges are they facing? Country quotas of students were determined on the basis of a needs assessment undertaken in 2008; this should be updated to inform planning of any future training grants.

Recommendation 2: Additional allowances were provided to female students to assist with housing for families and child care. The initiative was appreciated by students so the universities should now document how this innovation worked to share best practice. In any future phase of the training grants consideration should be given to include these incentives in studentship adverts in an attempt to encourage more female applicants, particularly for PhD training.

The AGRA training program made significant investment in support to curriculum review by the participating universities with contributions from national and regional stakeholders. More recently experienced professors of soil science from Wageningen University have reviewed the PhD curricula at SUA and KNUST. The taught courses and research projects have emphasized effects of soil fertility on crop production and soil chemistry, rather than looking at the functioning of the rhizosphere and contribution of soil micro-organisms and invertebrates to nutrient cycling and maintenance of soil health.

Recommendation 3: In the light of experience with two cohorts of students the universities need to be facilitated re-examine their curricula with expert assistance to identify gaps in teaching particularly to move courses towards a more holistic understanding of soil rhizosphere processes and how ISFM practice contributes to long term soil health. To facilitate this selected centers of excellence should be established with long-term trials at benchmark sites representative of key farming systems to provide field laboratories for student experimentation.

Course work prior to the research project at some universities e.g. SUA, LUANAR and Makerere includes discussion of national issues on soil fertility. Makerere takes students on a field trip early in the course to help them identify ISFM topics. It is important for ISFM practitioners to be able to analyze these within the context of farming systems, diverse farming communities, the value chain and policy.

Recommendation 4: Curricula should include a unit that establishes a linkage between national priorities, ISFM and context at farmer level and provides students with the analytical tools to understand how ISFM options can be adapted at a local level. This will need greater attention to economic issues and spatial analysis that has been the case to date. One way of doing this could be to invite national extension managers and leaders of ISFM initiatives to seminars with students to discuss national priorities and current responses. This it is felt would help to focus students to contextualize their work and identify on-going initiatives to work with. Such an approach could resolve the apparent tension between trying to find answers to national questions while developing students as independent thinkers.

Despite the heterogeneity of farming systems, of farming communities and the increasing understanding of the value of integrating methods for maintaining soil health nearly 40% of PhD and MSc thesis studies have focused solely on fertilizer. There have been few studies of integrating legumes into cereal-based systems and overall less than 25% of all research projects have investigated ISFM, the majority of studies have focused on individual components. There is a concern that some of the student research that has been completed lacks originality or is of insufficient quality to be publishable.

Recommendation 5: Students should be encouraged to investigate and analyse ISFM in relationship to existing farming systems, ensuring appropriate site characterization to understand the extent of extrapolation. Students should be discouraged from working on single management practices unless there is in-depth investigation of effects on nutrient flows, crop responses or economics at multiple sites in the landscape. Fertilizer “rates and dates” trials add little to the knowledge base that is not already known or can be predicted and should not be a part of post-graduate research.

Across AGRA partner universities there continues to be a lack of experienced research methods specialists and biometricians in Soil Science and Crop Science Departments. Research methods, both in soil/crop science and social science is a critical core course for all Soil Health students who also need access to biometricians during the design, data collection, analysis and reporting stages of their thesis research. Students also struggle to obtain up to date statistical analysis packages

Recommendation 6: AGRA should work with the universities and other partners, such as USAID iAgri in Tanzania and RUFORUM to review Research Methods provision and develop plans to upgrade this and ensure sufficient staff are trained and can be appointed. A component of this will be reliable access and training on a statistics package, probably ”R” as it is free and now widely supported in the research community. Upgrading the capacity to deliver relevant Research Methods and biometrics support will undoubtedly drive improvements in soil health research quality in African universities with knock on effects to organisations employing their graduates.

PhD and MSc curricula have been broadened by the inclusion of soft skills – time management, publication, scientific writing, leadership etc. This is an innovation that has been well received by students. The support of Wageningen University staff has been critical to this, mentoring faculty in delivery of a PhD program and provision of additional courses for selected students in Europe and a field course on systems orientation in Africa. However the input from Wageningen came once the courses were under way; high workloads of faculty are a major constraint but also some appear to lack the motivation to be involved. Commitment from SUA has been particularly disappointing - Is this due to the high numbers of "retired" faculty delivering the courses at SUA?

Recommendation 7: Prior to any future training grants being awarded a thorough review of the impact of the Wageningen support should be undertaken to ensure lessons are taken into consideration. Timing of short courses, particularly when these are in Europe or field trips in Africa needs to be carefully considered in an already busy timetable. However mentoring of young faculty members where there is a high proportion of less motivated "retired" staff on contract is highly desirable.

An important question for AGRA SHP to address is: *Are the partnerships that were put in place to improve the quality of ISFM graduate training programs in Africa sustainable*? Significant inputs from experts in overseas universities like Wageningen and University of Maryland are only possible with continued donor funding. Despite encouragement from AGRA the partner universities have struggled to make significant use of visiting professors from within their regions, generally citing a lack of funds as a major issue. However faculty members are interested in making use of the range of skills available in other universities to complement their own staff.

Recommendation 8: Future funding of "visiting professors" from Wageningen and other centers of excellence is highly desirable but should focus on curriculum development and mentoring of local staff for delivery. This may involve short courses at overseas universities and institutes.

Recommendation 9: Staff would like greater links with other universities in the AGRA SHP post-graduate training partnership to learn lessons from each other, develop joint research and organise teaching exchanges. One way of achieving this would be to establish a Community of Practice among faculty members focused on the issues of curriculum delivery for ISFM and student research quality. This is suggested as a way of providing more motivation for staff to engage in initiatives such as the Wageningen support.

Program issues

Language training for Francophone students studying in Ghana has been a constraint. English lessons were provided in parallel to course work but a number of students took private tuition to help them cope.

Recommendation 9: Students needing language training should be provided with a three month course prior to the start of post-graduate teaching.

Differences in completion rates between universities is in-part due to leadership and organisation grant implementation. Best practices noted include setting up an oversight committee to implement the grant and having strong, functioning systems for tracking student progress and project supervision.

Recommendation 10: The potential of the leadership to deliver quality training in a timely manner should be a key criterion in selecting grantees training institutions in future.

There have been some misunderstandings and local issues with funding levels for student research, supervision stipends and external examiners fees. These all influence the working environment for students and can delay progress.

Recommendation 11: There needs to be clear communication and agreement about budgets which should be related to university scales prior to contracts for training grafts being signed.

A condition of graduation at most universities is submission of journal publications. Publication is difficult for MSc students who have one season of field work as international peer reviewed journals will not generally accept manuscripts based on a single site or single season. In order to achieve the number of qualifying papers students are observed to publish in "pay to publish" on-line journals which have no impact factor and are often not abstracted. This does no good to the authors careers and needs to be discouraged.

Recommendation 12: Partner universities should be engaged in a discussion on the appropriate standards for publication prior to graduation. It may be better to require students to have presented papers at a conference, which should be included in the thesis and for PhDs include draft journal manuscripts.

AGRA has encouraged universities to place students with on-going AGRA funded country projects. There are examples where this has worked to the mutual benefit of students and the project. However not all AGRA projects have an ISFM orientation as their focus or are not prepared to share resources. The academic rigour of this approach may also be a problem if project managers see the student as an opportunity to test pre-determined treatments rather than develop a hypothesis and research questions.

Recommendation 13: AGRA country projects can provide sites for student research and valuable context. However it will be advisable to identify these opportunities ahead of students choosing projects so project managers are aware of any resource considerations. In any further phase of post-graduate training AGRA should encourage partner universities to proactively engage with national stakeholders during grant writing to identify opportunities for attaching students to on-going ISFM research or promotion initiatives (not only AGRA funded) and estimate contributions to field costs from either side to ensure mutual benefit.

Strengthening laboratory capacity

Donation of equipment to university labs has increased capacity to provide reliable analysis of ph, N, P, K and important micro-nutrients. However**,** the lack of maintenance

has negative impact on the longevity of equipment and the lack of regular calibration compromises the reliability of data.

Recommendation 14: AGRA SHP needs to consider how to address this issue which is largely associated with the "project-cycle" of donor support. Supporting equipment maintenance contracts is one possibility.

In-service training for technicians has been highly appreciated by the trainees, university staff and students who use the labs. The curriculum, standard of teaching and follow-up from all service providers are all considered to be excellent. Technicians would however have appreciated more guidance on maintenance of equipment. The training has led to greater confidence on the part of technicians who are now able to pass on skills to others. Technicians emphasised the need for a mechanism for on-going networking with colleagues in other labs so that there can be mutual support for exchange of knowledge on equipment, servicing, methods and problem solving.

Recommendation 15: It is suggested that the labs assisted by the AGRA SHP should be facilitated to form a network to share knowledge on best practice. Such networking activity would need co-ordination and a modest budget but would consolidate gains made by the investment AGRA SHP has made to improve laboratory capacity.

7. Impact of SHP at Household level

7.1 Introduction

This chapter evaluates the impact of Soil Health Program at the household level. It looks at how changes in SHP project outputs such as changes in yields of crops and market access are contributing to project outcome. It examines impact at household level in terms of household incomes, food security, poverty and households' wellbeing.

To assess the extent to which the ISFM project interventions have contributed to these outputs and outcomes, a two-stage comparison was carried out. First, was to compare changes in relevant parameters achieved by SHP beneficiary against paired non-beneficiary households. The second was to compare relevant parameters achieved by SHP beneficiary households before the SHP project (i.e. 2009) and 'after the project' (i.e. 2014). The differences from these comparisons were used to indicate the outcome of the SHP project at the household level. Since projects were frequently located in areas where other development interventions (AGRA and non-AGRA) have taken place, attribution of changes to SHP is very difficult. Therefore, where statistically differences are observed, SHP project interventions may be seen as positive contributory factors.

7.2 Income from crops

The mean value of key agricultural crop production in 2009 and 2014 was calculated using 2014 prices (marketed and non-marked output) (Table 16). This shows that beneficiary households have seen significant increases in the value of maize production over the project period in Nigeria, Kenya and Ghana (50-100 percent increases). Farmers in Nigeria and Kenya have increased their groundnut, sorghum and millet output value. In Mali and Ghana, farmers have increased rice, sorghum and millet production values.

Table 16 Mean Value of agricultural crops for beneficiary households in 2009 and 2014 (USD 2014 constant prices)

	NIGERIA		KENYA		MALI		GHANA	
	2009	2014	2009	2014	2009	2014	2009	2014
Maize	973	1494	845	1422			721	1562
Groundnuts	908	1621	1053	1421			546	483
Rice	1929	1375	1421	1021	485	493	659	787
Sorghum	876	899	946	1184	285	712	732	
Millet	3184	3990	863	5916	1716	2727	461	1650

Source: Evaluation survey

Smallholder farming households generated income from sale of a variety of crops. The most important crops as a source of income were maize, rice, millet (Mali) and Plantain (Table 17). Pigeonpea was important for farmers in Tanzania, and cowpea in Kenya. Beneficiary farmers were more significantly more likely than non-beneficiaries to derive income from maize (except Nigeria), rice (Tanzania and Ghana), pigeon pea (Tanzania)

and cowpeas (Kenya and Nigeria). This indicates the importance attached to the crops as a source of income for beneficiary households.

Table 17 Importance of crops as a source of income for households (percent)

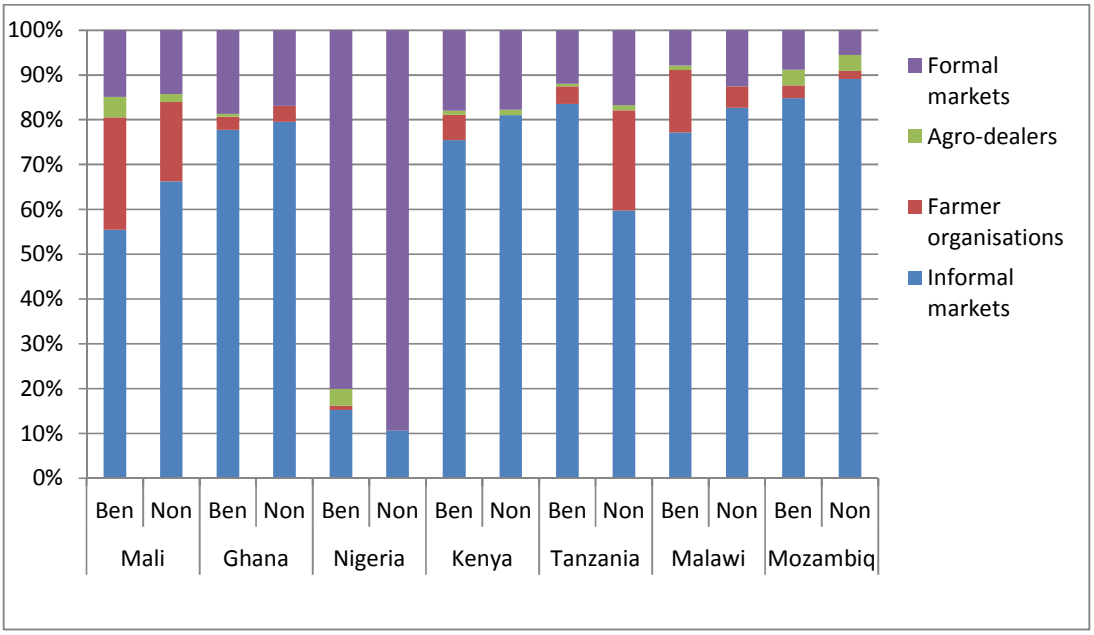
	Kenya		Tanzania		Ghana		Mali		Nigeria	
Crops	BN (n=123)	N-BN (n=121)	BN (n=183)	N-BN N=(209)	BN (n=184)	N-BN (n=155)	BN (n=180)	N-BN (n=180)	BN (n=120)	N-BN (n=120)
Maize	34%**	25%	45%**	24%	41%*	38%	24%*	19%	27%	35%
Rice	1%	2%	23%**	11%	11%**	6%	0%	3%	6%	15%
Soybeans	3%	2%	1%	0%	8%	4%	0%	1%	18%	25%
Groundnuts	0%	2%	0%	1%	5%	5%	13%	12%	5%	9%
Pigeon pea	5%	3%	34%**	13%	0%	0%	0%	2%	0%	0%
Cowpea	19%**	13%	2%	1%	1%	0%	0%	0%	8%**	2%
Beans	2%	1%	9%	7%	0%	1%	1%	3%	1%	0%
Sorghum	2%	0%	1%	0%	1%	0%	6%	6%	3%	2%
Millet	2%	0%	0%	0%	0%	0%	23%	24%	4%	3%
Plantain	22%**	36%	15%**	9%	13%	16%	31%	29%	5%	6%

** Significant at 1% level; * at 5% level

7.3 Markets

In terms of marketing, Figure 14 shows that informal markets remain the most important outlet for farmers involved in SHP projects. Farmer organisations were important for farmers in Mali (25 percent) and Malawi. In Tanzania, non-beneficiaries were more likely to market through farmer organisations. Only in Nigeria were farmers (both beneficiaries and non-beneficiaries) marketing through formal markets on a significant scale (80 percent of households). This indicates that in most SHP countries surveyed farmers are not yet engaged actively with formal markets. Increased linkages with the Markets Program should be a priority of the next phase of the Program.

Figure 24 Types of markets used by SHP beneficiaries and non-beneficiaries, 2014 (% of households)



7.4 Household food security

Food security is a key indicator of household wellbeing and includes food sources from own production and cash purchases (Table 18). Households interviewed reported improvements in their food security situation in all countries visited except Malawi where there was a fall of 3 percent (not significant). In Mali, Nigeria, Kenya and Mozambique project beneficiaries were more likely to be meeting their household food needs than non-beneficiary households. In Ghana and Malawi the difference between non-beneficiary household food security situations was not significant. Findings indicate that there has been an improvement in most countries but that this appears to be part of a general improvement in household food security. The project is likely to have been a contributory factor, particularly in Mali, Kenya and Mozambique where improvements over the project period and compared to non-beneficiaries are more significant.

Table 18 Households meeting own food requirements in 2014 and 2009 (percent)

Met household food requirement	MALI		GHANA		NIGERIA		KENYA		Malawi		Mozambique	
	Ben	Non	Ben	Non	Ben	Non	Ben	Non	Ben	Non	Ben	Non
2014	77%	67%	86%	92%	100%	96%	75%	53%	75%	78%	94%	78%
2009	59%	62%	80%	90%	89%	83%	65%	55%	78%	77%	92%	77%

7.5 Economic status

Poverty self-assessment was used to gauge household perceptions of their wealth status within the community and over time. This is a relative measure useful in capturing overall economic wellbeing. The proportion of beneficiary households assessing themselves as poor and very poor fell for all countries, while the proportion of between of moderately better off and better off increased (Table 19). The largest movements out of poverty (poor and very poor groups) were seen in Ghana, Kenya and Tanzania (36 percent, 44 percent and 55 percent respectively). Non-beneficiary households also saw improvements in their economic status. In Kenya and Tanzania beneficiaries saw a significantly greater improvement in their economic status compared to non-beneficiaries.

Table 20 shows poverty/economic status as a score (1-6: 1 being low and 6 high). This indicates that households in all countries consider their economic status to have improved between 2009 and 2014. Beneficiary households in Mali, Ghana and Malawi perceive themselves to be significantly better off in 2014 compared to 2009.

Table 19 Household self-assessment of economic status in 2009 and 2014 (percent)

PERCENTAGES 2009										
	MALI		GHANA		NIGERIA		KENYA		TANZANIA	
	Beneficiar	Non-Bene	Beneficiar	Non-Bene	Beneficiar	Non-Bene	Beneficiar	Non-Bene	Beneficiar	Non-Bene
Very Poor	11%	6%	18%	14%	0%	9%	17%	15%	92%	46%
Poor	27%	27%	36%	38%	29%	34%	30%	23%	0%	10%
Moderatel	30%	35%	37%	28%	53%	35%	39%	38%	8%	44%
Moderatel	26%	26%	8%	13%	17%	19%	11%	15%	0%	0%
Better off	4%	3%	1%	3%	1%	2%	2%	7%	0%	0%
Well-off	1%	3%	1%	3%	0%	1%	1%	3%	0%	0%

PERCENTAGES 2014										
	MALI		GHANA		NIGERIA		KENYA		TANZANIA	
	Beneficiar	Non-Bene	Beneficiar	Non-Bene	Beneficiar	Non-Bene	Beneficiar	Non-Bene	Beneficiar	Non-Bene
Very Poor	2%	2%	5%	3%	1%	9%	0%	3%	40%	33%
Poor	14%	13%	13%	12%	16%	28%	3%	13%	3%	11%
Moderatel	33%	29%	31%	39%	44%	42%	20%	28%	6%	4%
Moderatel	42%	46%	43%	34%	29%	21%	52%	36%	31%	33%
Better off	8%	7%	8%	10%	10%	1%	23%	16%	20%	19%
Well-off	1%	4%	1%	2%	0%	0%	2%	4%	0%	0%

Table 20 Poverty scores by households in 2009 and 2014 (percent of households)

	Mali		Ghana		Nigeria		Kenya		Tanzania		Malawi		Mozambique	
	Ben	Non	Ben	Non	Ben	Non	Ben	Non	Ben	Non	Ben	Non	Ben	Non
2009	2.88	3.03	2.39	2.64	2.89	2.74	2.53	3.19	1.12	0	2.37	2.15	2.17	2.04
2014	3.44	3.54	3.39	3.37	4.3	3.78	4.02	3.64	2.9	0	3.02	2.84	3.06	2.55
p-value	0.03		0.09		0.11		0.16		0.65		0.05		0.21	

7.6 SHP farm level impacts

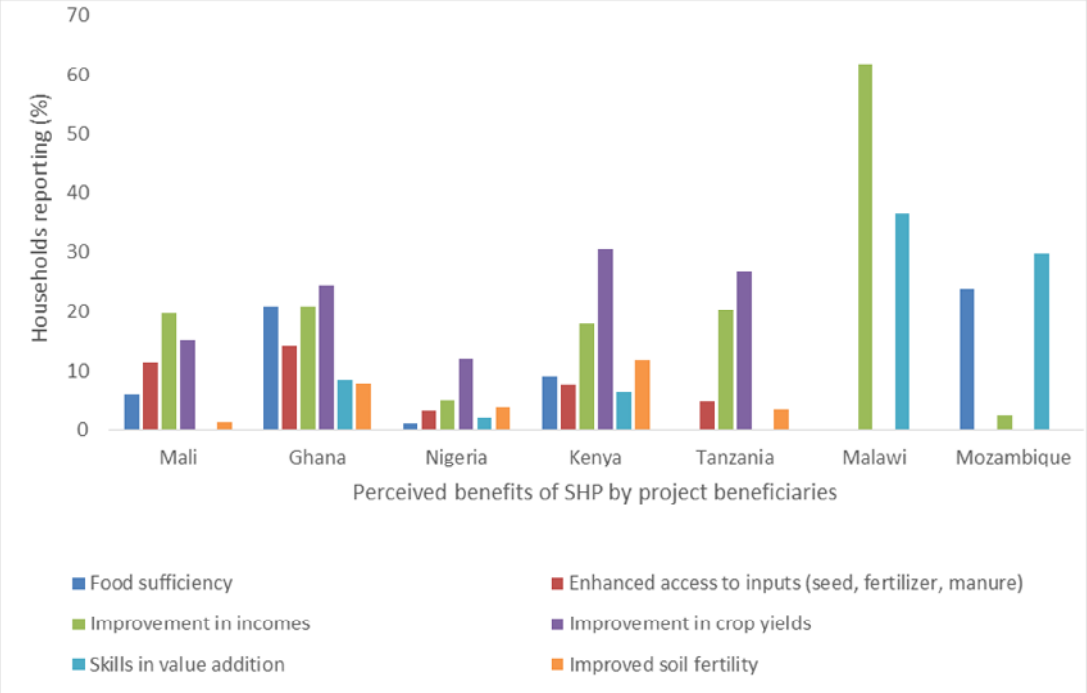
SHP project beneficiary households reported on changes occurring on the farms and in their households as a result of taking up ISFM technologies (Table 7.6). Improvement in soil texture was widely observed by households in countries except Mozambique, as well as improved water holding capacity of the soils. High numbers of farmers reported they are now using improved seed varieties and agronomic practices, including Fertilizer. Households also increased variety of crops grown, including for market.

Table 7.6 Changes reported as a result of adopting ISFM technologies by beneficiary households (percent)

Parameter Changes (improving)	Kenya (123)	Ghana (n=184)	Mali (n=180)	Nigeria (n=120)	Malawi (n=201)	Mozambique (n=170)
Soil texture on farm	84	61	74	92	85	19
Water holding capacity	84	61	74	92	85	19
Use of improved seed varieties	86	79	67	79	80	28
Use of improved agronomic and post-harvest practices	63	34	53	51	72	34
Use of fertilizer	64	53	70	59	71	38
Variety of food crops grown for household consumption	71	48	43	46	83	36
Area under crop	32	11	32	26	60	38
Variety of crops grown for market	63	35	49	62	71	45

SHP project beneficiary households were asked about the overall impact of participation in the project (Figure 7.2). Responses were overwhelmingly positive and included: improvement in incomes (particularly Malawi), improved crop yields (Ghana, Kenya and Tanzania), improved skills in value addition (Mozambique) and food self-sufficiency (Malawi and Mozambique). This indicates that beneficiaries attribute at least some of the production, income and food security benefits to SHP project activities.

Figure 7.2 Perceived benefits of SHP participation by project beneficiaries



8. SHP Programming

8.1 SHP Theory of Change

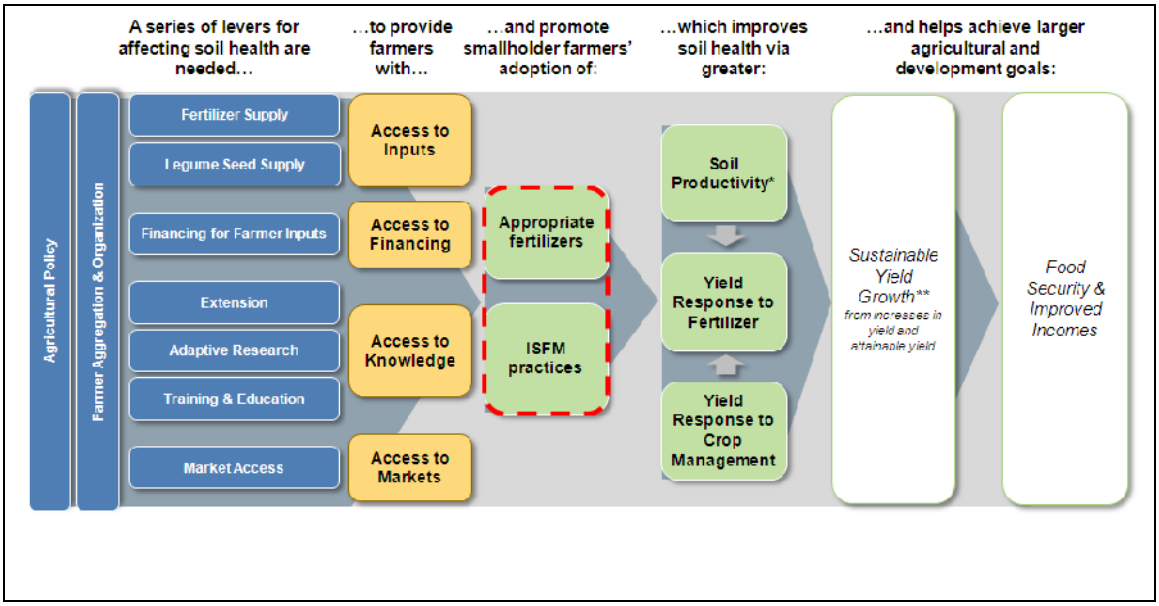
SHP core competencies relate to knowledge of how ISFM practices can improve productivity and approaches to improving fertilizer supply. Improved soil health is key to increasing production, productivity and incomes. However, SHP recognize that their interventions must contribute to a more holistic theory of change and that in order for farmers to adopt ISFM practices in ways that are economically viable, inefficiencies across the value chain must be addressed (see Figure 8.1).

The Program theory of change shows a series of levers for affecting soil health – SHP and other AGRA Program activities, as well as an enabling policy environment and farmer organisations. These provide farmer access to inputs, finance, knowledge and markets which promote farmer adoption of integrating use of limited amounts of fertilizer with other ISFM practices. Use of ISFM will improve soil health - optimizing the yield response to both fertilizer and complementary crop management practices. This helps achieve agricultural and development goals: sustainable yield growth results where the output value exceeds costs of production and where nutrient mining and soil degradation is reversed, leading to improved food security and incomes.

The theory of change provides a useful visualization of the interventions required to bring about Program outcomes and wider development goals. The ToC together with the Program goals shows a highly ambitious vision. The assumption is that SHP works with partners to achieve outcomes and goals and this is referred to elsewhere in the document. However, as discussed, functional and capacity constraints mean that SHP cannot do everything itself. It needs to rethink its role towards supporting and facilitating other actors to use these levers effectively. It would be a useful exercise to revisit the Theory of Change and unpack the assumptions behind it, identifying where SHPs comparative advantage lies and how it should use those to leverage change.

It is recommended that SHP should focus on identifying, supporting and facilitating the right partners to implement the SHP Theory of Change – rather than trying to include all these activities within projects. At field level this could best be done through supporting Innovation Platforms (see Chapter 4).

Figure 8.1: SHP Theory of Change



**Soil productivity is the capacity of the soil to be a growth medium for plants, to make the plant resilient to stress and to help convert solar energy into carbohydrates.*
***Sustainable yield growth is yield growth that is socially, economically, and ecologically sustainable over time*

8.2 Equity and Inclusion

Investing in Soil (AGRA, 2014) presents a useful pyramid of target groups of AGRA SHP projects (Figure 8.2). The main priority groups are market-ready smallholders, followed by vulnerable but viable smallholders. Commercial smallholders and highly vulnerable smallholders are not main targets. Value chain actors, direct service providers and secondary service providers are also targeted under the subprograms. The rationale behind the choice of target group is related to expectations over the ability of the project to reach these smallholders and make a difference. For vulnerable but viable smallholders the assumption was that that if they were organised into groups, provided with training and advice, facilitated access to inputs and markets, they could transform their production and livelihoods. For market-ready smallholders, the observation is that they are already using some improved inputs and market some of their produce, so the aim would be to increase rates of commercialisation.

A targeting approach involves identifying the needs, capabilities and contexts of smallholders and providing appropriate needs-based support. A challenge is categorising people into simple groupings. Also the number of smallholders in each category is fluid and not easy to pin down. AGRA works through groups as the most efficient way of reaching the maximum number of smallholders.

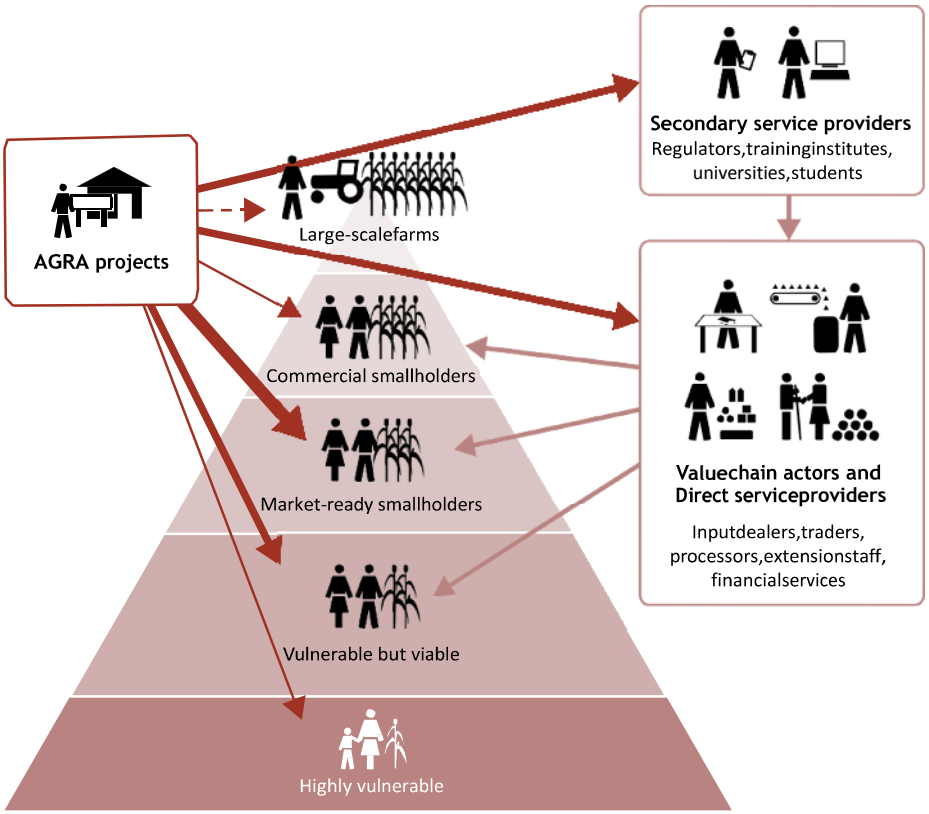


Figure 8.2: Farmer groups targeted under SHP

Findings from the evaluation show that, according to their own self-assessment, farmers participating in the Program across the surveyed countries were mainly in the poor groupings of their communities at the start of the Program, with some, particularly in Tanzania being very poor. There were few cases of better off smallholders. This implies that the project has targeted mainly vulnerable but viable households as well as some highly vulnerable and a few market-ready smallholders. There appears to have been some transformation over the 5 years since the start of the Program: many project households have become moderately poor or moderately better off in their communities and generally attribute this to their participation in an SHP project (see Chapter 7). This suggests that a significant proportion of project participants are moving towards becoming market-ready smallholders.

To ensure Program outcomes are equitably distributed, there is need to develop an inclusion strategy examining constraints and opportunities for women, young people and vulnerable groups to participate effectively in project activities and decision-making and take control over resources and benefits.

8.3 Landscaping and Partnerships

There is general agreement that tackling the widespread soil fertility constraints in African agriculture is one of the central components in achieving a Green Revolution in Africa (Future Agricultures 2008). The African Fertilizer Summit of 2006and the Abuja

Declaration set the scene for major investments in boosting Fertilizer supplies. CAADP was active in supporting the follow up to the summit, working to improve markets and trade. Other initiatives included: the Millennium Villages Program, Sasakawa-Global 2000, and the Association for Better Land Husbandry. The launch of AGRA was a major contribution to the effort of improving Africa's soil: AGRA is perceived internationally as one of the leading players in soil fertility in Africa.

At country level a number of governments are also prioritising improved soils and have developed input subsidy Programs as a way of promoting use of Fertilizer and other improved inputs by resource-poor smallholders.

There are very diverse approaches to addressing the problem of soil fertility – whether promotion of inorganic Fertilizers, organic Fertilizers, or a combination of the two (as with ISFM); and through primarily market-based solutions, to research and extension public goods initiatives. ISFM projects are positioned across this broad spectrum of technologies and institutions.

A large number of actors are addressing soil fertility at different levels. Some of these are shown in Annex. SHP has made considerable efforts to network and link with many of these organisations at different levels. These include international organisations – including BMGF partners, CGIAR institutions, and dissemination agencies. However, the level of interaction and degree of convergence with these Programs is variable.

BMGF research Programs such as N2Africa and TL2 have a general mandate on Africa wide upstream research, whilst SHP ISFM Program focuses on adaptive research and scaling out technologies. This delineation should allow for a clear focus or responsibilities, whilst at the same time providing opportunities for cooperation. However, in practice, the division in responsibilities seems to be hazy and with communication gaps, so that SHP and other BMGF organisations are sometimes funding the same partner. Efforts are being made to improve this, with the involvement of both directors of SHP and other BMGF projects on the respective Boards.

Strategic partnerships have been made with a number of national, regional and international organisations who are providing a range of back-stopping and advisory services to the Program. The impact of these inputs can be seen in areas such as communications, where the project has linked with IIRR to produce high quality outputs, in a facilitation and value-addition role. Another example is IPNI, who are coordinating the national Soil Health consortia and the screening and archiving of information on ISFM at national and regional level. As discussed in Chapter 4, this is a generally successful project with IPNI playing an important facilitating and capacity building role. However, appropriate partnerships for long-term management of data and back-stopping the consortia need to be considered.

Overall, it would be useful for SHP to carry out an externally facilitated review of partnership arrangements. Other partnerships include CTA especially on use of ICT4extension

8.4 Grant management

SHP has achieved a very high rate of project commissioning: an average of 19 grants per Program Officer (PO); ranging from 12 (new PO) to 36 for Senior PO. By January

2015 94 percent of available funds had been awarded as grants (Table 8.1). The level of grant-making is a significant achievement and demonstrates the dedication and ability of Program Director and staff in SHP.

Sub-program investments	No. grants	Value (US$)	Total available	Balance (US$)	Grants awarded out of total available funds (%)
ISFM Scale out	75	66,730,703	74,093,837	7,363,134	90
Fertilizer supply	22	36,348,988	36,598,988	250,000	99
Soil policies	4	1,158,306		0	100
Training and Education	19	11,780,278	11,780,278	0	100
Total	120	116,018,275	123,631,409	7,613,134	94

Table 8.1: Grants awards as a proportion of grants available at January 2015

There are several downsides to the large size of the SHP grants portfolio. Monitoring and mentoring such a large number of grantees is challenging. The burden on individual POs is high, worsened by the spread of grants across the 13 countries. New POs have been added to the Program particularly in West Africa but they are also building up their own portfolios.

Following recommendations in the Mid Term Review, SHP has enlisted backstopping and advisory support from regional and international organisations in its Training, ISFM and Fertilizer sub-Programs. Whilst this approach can assist project management in the short-term, it increases costs and so other approaches should be considered.

SHP has a large number of relatively small grants. Clustering grants or granting larger scale grants could be an efficient way to manage resources and achieve greater impact. For example, a $5 million grant over 5 years could effectively incorporate research, extension, credit and marketing activities if designed using an innovation platform approach. Such larger projects can make a visible impact and their activities and outcomes become self-sustaining (see IITA's PROSAB project in Borno, Nigeria for a case study of a success market-oriented sustainable agriculture Program).

It is recommended that a small number of medium-sized ISFM scale-out projects (one per P1 country) are developed based on innovation platform and participatory approaches as a vehicle for integrating ISFM into inputs, output and credit markets and reaching a larger number of smallholders in a sustainable way.

Overall there had been a successful conclusion of 12 grants to 2014, with active grants at 102. Three grants were cancelled: two were not taken up by the national government and one organisation changed strategy (2.5 percent of total grants).

The number of no-cost extensions is high. It is currently running at almost 40 percent and is across all sub-Programs: 30 for SHR&E; 7 for SHF and 10 for Training. Reasons given by the Program and grantees include: delays in sending/receiving grant due to administrative issues by either party; insufficient time period for the grant to implement activities; grant received after the start of the academic year (SHT); and staff capacity or changes at project level.

It is recommended that all projects include an Inception phase for training in project systems, recruitment and procurement. It is also recommended that project period and scheduling should be tailored to the activities of the project, rather than a one-size fits all approach. A Post-Implementation phase should also be added for finalisation of reports and publications and completion of activities where these could not reasonably be completed during the Implementation phase of the project.

Audit recommendations on SHP projects have been 82 percent partly satisfactory; 9 percent satisfactory; and 9 percent unsatisfactory. The Grants Unit has been addressing this by providing capacity building to grantees through orientation workshops and one-to-one review and coaching. These have been a useful way of improving performance and reaching out to difficult to reach grantees. As grant-making expands it is likely that there will be a higher proportion of grantees requiring grant management capacity building. The Program has tried to cover this themselves, with some assistance from service providers.

It is recommended that specialised regional project management support institutions provide capacity building to the grantees to free up Program staff to focus on project oversight.

9. Findings and Recommendations

The evaluation has looked at SHP performance at Program, sub-Program, project and beneficiary level. The Program is on track to reach its targets by end of 2015. There are a number of challenges in verifying exact numbers of beneficiaries and size of benefits due to the presence of other program activities in some cases, and project estimates of uptake of technologies and numbers of agrodealers active. However, even with a large margin of error, the achievements are significant.

To develop and sustain the Program a number of recommendations are made.

9.1 ISFM Scale-out

The ISFM scale up approach has evolved from increasing awareness through demonstrations to linkages with a range of stakeholders including researchers (testing some ISFM technologies), extension (demonstrating ISFM technology), input suppliers (to provide fertilizer and other inputs), farmer organisation (to mobilize farmers into groups) and buyers of agricultural produce (for output markets).

- *The Program should critically look at how support arrangements put in place by the project would continue after phase-out. Options are to facilitate a further funded phase; mainstreaming into Government Soil fertility Programs; and how to tap into Private sector.*
- *The Soil Health Program needs to develop a model and guidelines for developing sustainable innovation platforms for the promotion of ISFM with strong links to SH Consortia. Farmers groups such as the GACs need to operate as Agricultural Innovation Platforms (AIP), interacting and engaging with different actors, for example researchers on developing/adapting the technologies, private buyers to market their crops and extension workers for skills and information on the technologies.*
- *ISFM should include organic matter, micronutrients management and Conservation Agricultural practices such as minimum disturbance of soil, maintaining permanent soil cover and promoting crop associations (intercropping/rotation of cereals with N –fixing legumes)*
- *Soil science principles underlying ISFM need to be communicated with farmers.*
- *Participatory Action Research approaches should be generally adopted as the appropriate approach. There needs to be clarity on the research questions, and in whether the project is mounting demonstrations or experiments.A participatory extension demand driven service delivery is required for farmers to secure sustained benefits.*
- *A participatory extension demand driven service delivery is required for farmers to secure sustained benefits.*

9.2 Extension support function

- *Recommend: Participatory extension approaches Participatory Learning and Action Research, Participatory Technology Development, Farmer Field Schools and Farmer Field Fora and the Participatory Development Approach that*

strengthen the demand side of extension, strengthen the supply side and strengthen the Organising the Response – the Policies for Services

- *National Soil Health Consortium should identify a range of ISFM options for smallholders for different socioeconomic and agro-ecological contexts. IPNI should review and provide appropriate levels of capacity support to SHC members. Harmonisation of ISFM data across regions and the continent might best be handled by regional research organisations mandated with coordination and harmonisation*

9.3 Fertilizer supply and policy

The sub-program is promoting an integrated approach to enhance the supply of different fertilizers, support improvement of fertilizer related policies and regulations, fertilizer quality control along the value chain and fertilizer blending and small packaging to ensure appropriate fertilizers in type and size are available to farmers. But there are different levels of integration of the different components of the fertilizer supply sub-program in different countries.

- *There is need to match existing institutional mandate and competence in providing grants to build their capacities. Enhance fertilizer inspections and enforce the laws and regulations effectively*
- *Stronger partnerships should be developed with (inter)national researchers to look at the issue of micronutrients. Lime distribution should be integrated in government fertilizer policy.*

- *More successful Agro-dealer Development Project need to be reviewed to provide useful lessons for strengthening National agro-dealer associations and aligning their functions with the national goals and priorities.*
- *Agro-dealers should be supported to improve their profitability through improved marketing and record keeping skills. AGRA/SHP should link agro-dealers to extension providers, especially by tapping into lead farmers. Government policy and programs should encourage agro-dealers to carry out more ISFM research in-house by providing more extension services from the Ministry of agriculture. Such Programs should also include agro-dealers in stakeholder decision-making meetings. Government should encourage access to credit facility by agro-dealers and at a lower interest rate.*

- *When dealing with government officials to distribute inputs to farmers, credit terms should be clearly stated and strict follow-up made lest farmers think it is a free input from the government.*

9.4 Training and Education Sub-Program

Since the inception of the AGRA SHP training sub-program 177 post-graduate students from 13 countries have been enrolled in MSc or PhD Programs and the first 69 MScs and 9 doctorates have been awarded. Laboratory staff have been trained and equipment donated to labs to increase soils analysis capacity.

- *Now that graduates are returning to their posts it will be important to conduct a follow-up to determine how they are using the skills learnt and the extent they are*

contributing to transformation of their organizations

- *Universities need to be facilitated re-examine their curricula with expert assistance to identify gaps in teaching particularly to move courses towards a more holistic understanding of soil rhizosphere processes and how ISFM practice contributes to long term soil health. Selected centers of excellence should be established with long-term trials at benchmark sites representative of key farming systems to provide field laboratories for student experimentation.*
- *Curricula should include a unit that establishes a linkage between national priorities, ISFM and context at farmer level and provides students with the analytical tools to understand how ISFM options can be adapted at a local level. This will need greater attention to economic issues and spatial analysis*
- *Students should be encouraged to investigate and analyse ISFM in relationship to existing farming systems, ensuring appropriate site characterization to understand the extent of extrapolation. Research must be based on a thorough understanding of previous work to identify gaps in knowledge so that new research questions are addressed.*
- *AGRA should work with the universities and other partners, such as USAID iAgri in Tanzania and RUFORUM to review Research Methods provision and develop plans to upgrade this and ensure sufficient staff are trained and appointed.*
- *Prior to any future training grants being awarded a thorough review of the impact of the Wageningen support should be undertaken to ensure lesson learning.*
- *Staff would like greater links with other universities in the AGRA SHP post-graduate training partnership to learn lessons from each other, develop joint research and organise teaching exchanges. One way of achieving this would be to establish a Community of Practice among faculty members focused on the issues of curriculum delivery for ISFM and student research quality.*
- *The potential of the leadership to deliver quality training in a timely manner should be a key criterion in selecting grantees training institutions in future.*
- *There needs to be clear communication and agreement about budgets which should be related to university scales prior to contracts for training grants being signed.*
- *Uuniversities should be engaged in a discussion on the appropriate standards for publication prior to graduation. It may be better to require students to have presented papers at a conference, which should be included in the thesis and for PhDs include draft journal manuscripts.*
- *SHP projects can provide sites for student research and valuable context. However it will be advisable to identify these opportunities ahead of students choosing projects so project managers are aware of any resource considerations.*
- *AGRA SHP needs to consider how to address maintenance of lab equipment which is largely associated with the "project-cycle" of donor support.*
- *It is suggested that the labs assisted by the AGRA SHP should be facilitated to form a network to share knowledge on best practice. Such networking activity would need co-ordination and a modest budget but would consolidate gains made by the investment AGRA SHP has made to improve laboratory capacity.*

9.5 SHP Programming

The ToC together with the Program goals show a highly ambitious vision. To achieve this in a sustainable way, some programming issues need to be addressed.

- *Revisiting the Theory of Change is recommended to unpack the assumptions behind it, identifying where SHP's comparative advantage lies and how it should use this to leverage change. It is recommended that SHP should focus on identifying, supporting and facilitating appropriate partners to implement the SHP Theory of Change – rather than trying to include all these activities in projects. At field level this could best be done through supporting Innovation Platforms.*
- *To ensure Program outcomes are equitably distributed, there is need to develop an inclusion strategy examining constraints and opportunities for women, young people and vulnerable groups to participate effectively in project activities and decision-making and take control over resources and benefits.*
- *It is recommended that all projects include an Inception phase for training in project systems, recruitment (e.g. of students) and procurement. It is also recommended that project period and scheduling should be tailored to the activities of the project, rather than a one-size fits all approach. A Post-Implementation phase should also be added for finalisation of reports and publications and completion of activities where these could not reasonably be completed during the Implementation phase of the project.*
- *It is recommended that specialised regional project management support institutions provide capacity building to the grantees to free up Program staff to focus on project technical oversight.*
- *It is recommended that a small number of medium-sized ISFM scale-out projects (one per P1 country) are piloted, based on innovation platform and participatory approaches as a vehicle for integrating ISFM into inputs, output and credit markets and reaching a larger number of smallholders in a sustainable way.*

APPENDIX 1: Evaluation Framework

Theme	Issues	Evaluation Questions	Indicators	Data sources and methods
Quality and Relevance of Design	• Determinetherelevanceor appropriatenessofthePro gramtheoryofchange, design, strategies and determine whether or not they are adequate to realise the intended program objectives	• How relevant/appropriate is the Theory of Change to meeting objectives and how has it been internalised by the sub-programs? • How relevant is the program to national priorities? Andto target group? • How appropriate are the underlying hypotheses? • How appropriate is SHP design and strategy? How integrated are sub-programs? • What changes in program context, threats and opportunities have occurred since inception; how has the program responded? • How is targeting addressed (against smallholder pyramid)?	• Degree of relevance of Theory of Change and Programs to national and stakeholder priorities, • Extent of alignment of program strategies with ToC • Changes in program strategy in response to change in landscape (external) • -Changes in program design and strategy in response to changes in AGRA strategy	• ISFM peer review • Interviews with policy makers, program staff donors, researchers • Documentation review • SWOT analysis
Program impact:	• Critically assess to what extent the program achieved objectives, output and whether these are beginning to yield into outcomes, whether intended or	• What outputs have been achieved against targets at all levels? (validate program data) • What changes (intended and unintended) have occurred? • To what extent have ISFM practices been scaled-out through different SHP interventions? • How effective have program inputs	• Change in ISFM knowledge and sources accessed by beneficiaries*(by type, sex, status)* • Change in no., type of ISFM technologies adopted • Change in quantity,	• Document review • Key informant interviews with researchers, extensionists, agrodealers, policymakers • Focus group discussions with AD • Household survey – beneficiaries and non-beneficiaries

	unintended	been in achieving program outputs/outcomes? • How far has the program reached different target groups? • How strategically important are program achievements?	quality and price of inputs accessed by beneficiaries from different sources • Change in amount marketed and market outlets • Change in beneficiary production, sales, income, food security, assets, livelihood sources, profitability, wellbeing (Steps) • Change in access to (distance) and learning from (inputs, extension)agrodealers • Capacity building for researchers and students – no. and relevance of PhDs, MScs; change in research and development capacity • No. technologies generated, adapted; resources leveraged. • Intermediate outcomes: • CB: Extension – Change in knowledge of ISFM and VC;extension	• Case studies on researcher, policy, extension, agrodealers, traders, financiers • University and student records, dissertations, interviews with staff and students; e-survey

			approaches and methods used; no. of farmer-partner linkages brokered; • CB: ADs/traders – change in reach, delivery time, info • CB: Farmer extensionist – change in knowledge of ISFM and VC; farmers reached (no and type) • Policy outcomes: Change in Fertilizer regulatory framework, ISFM policy framework; Evidence of inputs into ISFM policy processes	
Efficacy of models	• Assess the efficacy of the different models utilized by the program, for instance, in scaling-up ISFM practices, financing mechanisms for farmers to access inputs (particularly improved legume seeds and fertilizers), and the produce marketing support initiatives	• What models have been tested/utilised by the program and what have been the results: i) ISFM technology models(Fertilizer, organic) ii) Extension models (Demos, FLE, AD led, Radio, ICTs) iii) Scaling out models (Going Beyond Demos; density of interventions; complementarity models – partners, links with input and output markets) iv) Financing models v) Marketing support models vi) AD models vi) Policy models(Regulatory -Fertilizer, SH	• Performance of different models in addressing needs of target group by farmer type, by context, agroecology, value chain, institution, market/food orientation	• Document review • Key informant interviews with program and AGRA staff, national and international ISFM stakeholders • Beneficiary survey • Participant observation

		Consortia, Policy nodes/hubs) vii) Institutional models – Farmer Associations, Public-private, Anchor farm)		
Integration with other programs–	IdentifytowhatextentSHPintegratesandalignswithotherAGRAprograms,thequalityofpartnershipsbuilt,ifany,withnationalandinternationalresearchers;soilscientistsandotherstakeholdersinsupportingprogramdeliveryandwhetherthesearesustainable	• What is unique about SHP approach? • How does SHP integrate and align with other AGRA programs – formally and informally? • To what extend has other AGRA programs learnt lessons from SHP approach? • How and to what extent has SHP built partnerships with national and international researchers and other stakeholders? • How sustainable are these?	• Change in level of integration between SHP subprograms, SHP and other AGRA programs, and SHP and partners • Number, quality and depth of formal and informal partnerships formed • -Results from SHP's engagement with external partners • Changes in approaches and implementation strategies by SHP, AGRA and partners' programs as a result of SHP experience	• Document review, Key informant interviews with program and AGRA staff, national ISFM stakeholders • Institutional mapping
Efficiency	• Ascertain to what extent the program was effective and efficient in achieving its intended objectives; Assess whether the program has been cost effective in achieving the desired outcomes and the likelihood that those results will be sustained over the medium to long	• How cost effective are the different models? • What has been the level of utilisation of resources against budgets? • What is the quality of results against cost of achieving these in different contexts?	• Value for money - for different types of institutions, ISFM and extension models • Burn rate of sub-programs • Unit cost of delivering outputs (indicative) • Comparison of SHP	• Document and financial report review, Interviews with program staff • Value for Money Analysis • Comparability Analysis

	term		studentships at different universities with other programs	
Management issues	• Assess management issues, structures and delivery mechanisms and how they have affected program results	• How appropriate are overall organizational structure of SHP staff configuration, execution modalities, and quality of grant making and management approach, arrangements for implementing grants? What are capacity gaps, utilization of the expertise of the SHP Technical Advisory Committee, use of technical assistance/consultants and how havethey affected program results?	• Value and grants/number of projects to program staff • Changes in program implementation arrangements in response to program reviews (e.g. MTP), consultants reports, TAC inputs • Management, institutional and other issues affecting subprogram performance (including Training)	• Interviews with AGRA, program, TAC staff; Review of project documents, consultants reports • Participant observation
Challenges and Lessons	• Identifychallengesand documentlessonslearn edandbestpracticesth atwillinformfuturestrate gicprogramdecisions.	• What is the strategic importance of SHP achievements? • What have been the lessons learnt from assessment of program models/ portfolio of investments (e.g. ISFM scale-out, combination of technologies)? • What has worked, and what hasn't and in what context? • What has been learned and how will this be built upon in next Phase of program?	• Benchmarking of SHP Theory of Change and Programs against leading global ISFM initiatives • Documentation of lessons • Identification of best practices: Partnerships, ISFM, Extension models for ISFM VC, Support for	• Document review • Key informant interviews with program and AGRA staff, national and international ISFM stakeholders

		• What are best practices in program, subprogram, project implementation? • What are the challenges, lessons learned in program, subprogram and project implementation? • How did the lessons learned during the Program Strategy Refresh help to improve program investments and management?	ISFM – Agro-dealers, Financing.	

APPENDIX 2: Evaluation approach in the SHP countries

Country	Beneficiary Survey	Qualitative study: Focus group discussions, key informant interviews	Literature review, e-survey
Tanzania	X	X	X
Mozambique	X	X	X
Ghana	X	X	X
Mali	X	X	X
Nigeria	X	X	X
Ethiopia		X	X
Malawi	X	X	X
Zambia		X	X
Rwanda		X	X
Kenya	X	X	X
Uganda		X	X
Burkina Faso		X	X

APPENDIX 3 KEY INFORMANTS INTERVIEWED

Country	Name	Position	Institution
REGIONAL	Dr Isiah Nyagumbo	Agronomist- Conservation Agriculture	SIMLESA,CIMMYT-International Maize and Wheat Improvement Centre, Southern Africa
	Prof Paul Mapfumo	Coordinator	Soil Fertility Consortium of Southern Africa (SOFESCA); Africa Soil Health Consortium Technical advisory group
	Dr Regis Chikowo	Africa RISING coordinator, Malawi	International Institute of Tropical Agriculture (IITA)
	Dr Shamie Zingore	Regional Director, Africa	International Plant Nutrition Institute
	Dr James Mutegi	Soil Scientist and FS Analyst	IPNI Africa Program
	Prof. Justice Nyamangara	Professorial Chair, Environmental Science & Technology	Chinhoyi University of Technology/ICRISAT
	Prof Ken Giller	Chair, N2Africa Program Advisory Committee	Wageningen University and Research Center
ETHIOPIA	Dr Selamyihun Kidanu	Director, Soil Health & Fertility Management	Agricultural Transformation Agency
	Dr Tesfaye Shimber	Director, Land and water Research Directorate	Ethiopian Institute of Agricultural Research
	Dr Negash Demissie	Soil Science researcher and coordinator for AGRA at EIAR	Debre Zeit Research Center, Ethiopian Institute of Agricultural Research
	Dr Zebene Mekru	Soil Science researcher and focal person for AGRA at National Soils Lab	National Soils Laboratories
	Dr Abebe Fanta	Lecturer and Focal person for AGRA MSc program in Soil Sciences	Haramaya University
	Ayele Akuma	Department Head, Natural	School of Natural Resources Management

		Resources Management Department	and Environmental Sciences, Haramaya University
	Dereje Regassa	Coordinator, AGRA SHP coordination office	Natural Resources Development and Protection directorate, Ministry of Agriculture
GHANA	Prof Richard Akomah	Provost	Kwame Nkrumah University of Science and Technology (KNUST)
	Dr Charles Quanasah	Co-ordinator SHP MSc in Soil Health	KNUST
	Dr Robert Abaidoo	Dean of Post Graduate Studies	KNUST
	Dr Charles Kwoseh	Head of Crop and Soil Science Department	KNUST
	Dr Vincent Logah	Lecturer, Crop and Soil Science Department	KNUST
	Dr Andrew Opoku	Lecturer, Crop and Soil Science Department	KNUST
	Dr Nana Ewesi Mensah	Lecturer, Crop and Soil Science Department	KNUST
	Mr S Acquah	Chief Lab Technician	KNUST
	Mr Abdul-Aziz Bawa	Lab Technologist	University of Development Studies
	Mathias Fosu	PI	Council for Scientific and Industrial Research- Savanna Agricultural Research Institute Nyankpala
	B.D.K Ahiabor	Regional coordinator	CSIR-SARI
	Alhassan Issahaku Ibrahim Tibo Stephen Duodu Abdul-Aziz Latif	Technical Officers	CSIR-SARI
	Emmanuel Vorleto	Senior Laboratory Technician	CSIR SARI
	Naresh Shukla	Group Manager	CSIR- SARI
	Hajia Hawa Musah	District Director of Agriculture	Ministry of Food and Agriculture Tolon District
	Cosmos Nyar	District Agricultural Officer (DAO) in charge of Extension	MoFA Tolon
	Idris Zanabongo	District Agricultural Officer (DAO) in charge of Livestock	MoFA Tolon

Baba Musah	Management Information Systems/ M&E	MoFA Tolon
Janet Chigabaita		Savanna Farmers Marketing Company/ Northern Sector Agricultural Investment Coordination Unit
Iddrisu Issah Iddrisu Amidu Iddi Sumani	Agrodealers	Tolon
Alhaji A. Ganiyu Sulemana	CEO	GANORMA Agro-chemical Company Tamale
Issahaku Issah	CEO	Wumpini Agro-chemcials Company, Tamale
Alhaji Antiku Abdulai	CEO	Antika Company Ltd, Wa
Sefa Boakye	CEO	Sefa and Jane Agro-chemical Company, Kumasi
Angela Afrakuma	Sales Department	Sefa and Jane Agro-chemical Company, Kumasi
Eric Asamoah Gideon Asamoah Ekow Gaisie Anim Boafo Edward Yeboah Kwabena Abrefa Nketia	Research Scientists	CSIR - Soil Research Institute, Kumasi
Alex Adzor	District Agriculture Officer	MoFA Asante Akim South District
Bernard Adiku	District Agriculture Officer	MoFA Wenchi Municipal
Owusu Boahen	District Agriculture Officer	MoFA Wenchi Municipal
Alfred Anaman	District Agriculture Officer	MoFA Wenchi Municipal
Collins Tabiri	District Agriculture Officer	MoFA Ahafo Ano South District
Emmanuel Dzamesi	Coordinator 2010 SHP 007	Africare, Hohoe
Joseph Sunu	DAO	MoFA – Jasikan District
Mathew Abotsi	DAO	MoFA – Jasikan District
Emmanuel Minnah	DAO	MoFA – Jasikan District
Francis Abeka	Branch Manager	Sinapi Aba Savings and Loans, Hohoe Branch
Cephas Agbesi	Agrodealer	CEPFORT Agrochemicals, Asukawkaw
Emmanuel K. Asior	Coordinator	Christian Rural Aid Network (CRAN)
Sebastian Ike Agbodzi	Technical Officer	CRAN

	Ben Kemetse	CEO	M&B Seeds and Agricultural Services, Ghana Ltd. Ho
	Dr Zacharie Zida	SHP Program Officer	AGRA SHP
	Dr Asseta Diallo	SHP PO	AGRA SHP
	Dr Aboubacar Toure	PASS PO	AGRA PASS
	Dr Issoufou Kapran	PASS PO	AGRA PASS
	Dr Kehinde Makinde	PASS PO	AGRA PASS
	Abdou Konlambique	Markets Programme Officer IFDC Office	AGRA MAP Accra
	Victor Clottey	Head	CABI, Accra
	Felicia Amprofi-Ansah	Director	MoFA-Plant Protection and Regulatory Directorate
KENYA	Prof Waceke Wanjohi	Dean School of Agriculture and Enterprise Development	Kenyatta University
	Dr Danga	Lecturer, Soil Science	Kenyatta University
	Dr Mwangi	Grants Office	Kenyatta University
	Urbanus Mutua	Program Manager	UCCS
	Emmanuel Mutie	Project Officer	UCCS
	Elijah Mogoi	Project Officer	UCCS
	David Achillo	M&E officer	UCCS
	Kamae Mwailu	Agro-dealer	Mwailu Enterprises
	Ruth Muteti	County Director of Agriculture	County Government -Makueni
	Joseph Kathee	Divisional Agricultural Extension Officer	Nguuni Division
	Daniel Musila	Agric Extension services Officer	Kathonzweni Division
	Jonathan Munyao	Crops officer	Kathonzweni Division
	Prof Ruth Oniang'o	Director	ROP
	Michael Okumu	Data Management &IT Officer	ROP
	Sylvester Aura	Program Manager	ROP
	Doris Anjawa	Project Coordinator	ROP
	David Bakaya	Researcher--Soils	KARI-Kakamega
	Martin Odendo	Researcher—Social Economics	KARI-Kakamega
	George Ayaga	Ag. Centre Director	KARI-Kakamega
	Patrick Oucho	Socio-Economics—Field Staff	KARI-Kakamega
	Nahashon Ambitsi	Socio-Economics—Field Staff	KARI-Kakamega

	Abigael Nekesa Otinga	Lecturer—Soil Science	University of Eldoret
	Walter Munywee	Agricultural Engineer	Sub-County Government (Luanda)
	Calleb Waswa	Agricultural Officer	Sub-County Government (Luanda)
	Isaac Livumbazi	Agro-dealer	Serem AgroVeterinary
	Francis W. Wefwafwa	Regional Coordinator—Bungoma South	One Acre Fund
	Dr Anne Muriuki	Kenya Soil Health Consortium	KALRO
	Dr Nesbert Mangale	Kenya Soil Health Consortium	KALRO
MALI	Sory Diawara	Director General	Dynapharm, Bamako Input supplier
	Mme Coulibaly Maimouna Sidibé	Director General	Faso Kaba, Bamako Input supplier
	Baboye BOCOUM	Commercial Director	SOMADECO (Société Malienne d'Equipements et de Commerce), Bamako Input supplier
	Bakary Youba Coulibaly	Researcher	IER (Institut d'Economie Rurale/SRA (Agronomic research station) Cinzana
	Brehima Keita	Extension officer	Agriculture Sector, Sikasso
	Diakalia Sogodogo	Researcher/ Prgramme manager SHP003	IER (Institut d'Economie Rurale/SRA (Agronomic research station) Cinzana
	Ousmane Diakite	Extension officer	Regional Directorate Agriculture, Sikasso
	Ousmane Dembele	Programme officer	Agriculture Sector, Bougouni
	Elize Goita	Programme officer	Agriculture Sector, Bougouni
	Moussa Dembele	Programme officer	Agriculture Sector, Koutiala
	Youssouf Coulibally	Head of Extension office	Sub-district Cinzana-Gare
	Adama Camara	Director General	Soro Yiriwa Micro Finance Organization, Bamako
MALAWI	Dr Lowole	Head of Department of Crop and Soil Science	Lilongwe University of Agriculture and Natural Resources (LUANAR)
	Dr J.H.A. Maida	Coordinator, MSc Soil Science	LUANAR
	Prof Vincent Kabambe	Malawi Soil Health Consortium	LUANAR
	Loyce Tembo	Malawi Soil Health Consortium	LUANAR
	Mr Emmanuel Mbewe	Chief Lab Technician	LUANAR
	Dr V. Kabambe	Lecturer in Agronomy and ISFM	LUANAR
	Dr H. Msiska	Lecturer Department of Crop and Soil Science	LUANAR
	Sam Phiri	Project Manager	National Association of Smallholder Farmers of Malawi (NASFAM)

	Charles Zawanda	Association Field Officer	NASFAM
	Mr Longwe	Association Business Manager- Nathenje	NASFAM
	Blame Mkwala	Association Business Manager	NASFAM
	Mr Austin Ngwira	Director for Community Outreach	Clinton Development Institute
	Mr Msunje	Agriculture Extension Development Coordinator - Chamama EPA	Ministry of Agriculture, Irrigation and Water Development
	Mr R. Mtonga	Agriculture Extension Development Coordinator Chamama EPA	Ministry of Agriculture, Irrigation and Water Development
	Mr Yotamu	District Agricultural Development Officer	Ministry of Agriculture, Irrigation and Water Development
	Mr Mkombedzi	District Agricultural Development Officer	Ministry of Agriculture, Irrigation and Water Development
MOZAMBIQUE	Luis Casimíro Savanguane	Project Assistant and Co-Manager: 2010 SHP 021	Instituto de Investigação Agrária de Moçambique Centro Zonal Centro Estação Agrária de Sussundenga
	Magalhães Amade Miguel	Project Manager Grant No.: 2010 SHP 003	Instituto de Investigação Agrária de Moçambique, Centro Zonal Centr
	Mr. Domingos Dias	National Coordinator	SIMLESA Mozambique
	Ms. Marie Do Cue	Extension Worker	Ministry of Agriculture
	Mr Alcides	Extension Worker	Ministry of Agriculture
	Mr. Aduwe	Agro-dealer	Angonia District
	Mr Carlos Alberto	Extension worker	Government Extension Services
	Mr Ambrosio	Director	Community Radio Station
NIGERIA	Prof Ahmed Falaki	Executive Director	Institute for Agricultural Research, Ahmadu Bello University
	Prof. I.Y. Amapu	Professor, ISFM	Institute for Agricultural Research, Ahmadu Bello University
	Prof. J.G. Akpoko	Professor, Agricultural Economics	IAR, Ahmadu Bello University

	Dr. Yusuf Abdullahi	Training and Extension Officer	IAR, Ahmadu Bello University
	Jonathan Shekari	Technical Assistant	IAR, Ahmadu Bello University
	Suleiman Umar	Agricultural Economist	IAR, Ahmadu Bello University
	Raba Isyaku Abdullahi	Project Manager 2009 SHP 019	KNARDA, Kano
	Prof. Jibrin Mohammed Jibrin	Assistant Project Manager	Bayero University Kano
	Ibrahim Baba Mohammed	Professor	Bayero University Kano
	Mohammed Ibrahim Dangi	Professor	Bayero University Kano
	Dr Abdoulaye Tahirou	Agricultural Economist	IITA
	A Boman	Managing Director	Nagari Seed Company Ltd, Zaria
	Abdulaziz Mai	Assistant secretary I	Dawanau International Grains Market
	Yau Nuhu Tumfafi	Asst secretary II	Dawanau International Grains
	Alhaji Danliti Ibrahim Yiyi	Vice President	Dawanau International Grains
	Lawan Gwadabe	CEO	Seed Project Co Ltd, Kano
	Dr Clement Woje	Project Manager	Millennium Village Project, Pampaida
	Ezekiel Jatau	Agricultural Value Chain Coordinator	Millennium Village Project, Pampaida
	Mrs. Chinwe Osuji	Project Manager (AGRA SHP)	Babban Gona Farmer Services Limited
	Augustine Woje	Extension officer	Babban Gona Farmer Services
	Ephraim Hellandedu	Extension officer	Babban Gona Farmer Services
	Yakubu Musa	Agrodealer	SAMINAKA Agrodealers, Kaduna, Kano State
	Saleh Adamu		
	Ibrahim Audu		
	Ibrahim Chiukure	Agrodealer	Jengre Plateau State
RWANDA	Dr Vicky Ruganzu	Project Coordinator, Grant No.: 2009 SHP 018	RAB
	Jean Bosco SAFARI	CEO& AGRA-RADD II Project Manager	AGRIFOP

	Ngoga Tenge Gislain	Project coordinator, Grant N°: 2009 SHP 034	
	Dr Charles Murekezi,		Rwanda Fertilizer program
	Dr Emmanuel Mgomiraronka		Rwanda Fertilizer program
	Dieudonne Tigele	Project Coordinator	Rwanda Lime Production Project
	Alphonsine	Assistant Project Coordinator Rwanda Lime Production Project	SOPAV
	Augustin Musoni		Legume Programme
	Emmanuel Karegeya	Agrodealer	Counnagri Shop
	J'Baptiste Kagarama	Agro Dealer	Dehimng shop
TANZANIA	Dr Mary Mgonja	Country Head	AGRA
	Dr E. Marwa,	Head Soil Science Department	Sokoine University of Agriculture (SUA)
	Dr A. Kaaya	Soil Science Department; Co-ordinator SHP training	SUA
	Prof. Msaky	Soil chemist, Soil Science Department	SUA
	Prof F. Rwehumbiza	Co-Ordinator MSc. Soil Science	SUA
	Dr Consolatha Mhaiki	Chief Laboratory Technician	SUA
	Dr. Kalumuna Matilda	PI	ARI Mlingano, Ministry of Agriculture Food Security and Cooperatives
	Mr. Kajugusi	Director of Extension services	Ministry of Agriculture, food Security and Cooperatives
	Beatus Malema	Assistant Director Crop Development	Ministry of Agriculture, Food Security and Cooperatives
	Dr. Mkangwa	Officer Incharge	ARI Mlingano, Ministry of Agriculture Food Security and Cooperatives
	Mrs Ishumi	Manager	Fertilizer Agro dealer
	Dr January Mafuru	Zonal Director Northern Zone	Ministry of Agriculture, Food Security and Cooperatives
	Marietha Owenya		ARI Selian
	Dr. Makene	Assistant Director Special Programme	Ministry of Agriculture Food security and Cooperatives
	Dr. Fidelis Myaka	Director Research and Development,	Ministry of Agriculture, Food Security and Cooperatives

	Rose Kitambi	Acting Incharge TFRA	Tanzania Fertilizer Regulatory Authority, Ministry of Agriculture food Security and Cooperatives
	Professor Johnson Semoka	PI	Sokoine University of Agriculture
	Dr Nyambilila Amuri	Soil chemist	Sokoine University of Agriculture
	Eng. George Shumbi	Principal	MATI - Igurusi
	Mr. Mmari	PI	ARI Uyole
	Jerry Ngairo	PI	ARI Uyole
	Benjamin Kiwovele	Acting Director	ARI Uyole
	Tatu Msuya	Extension Officer	Kilosa District Council
	Dr. Bhakilana Mafwere	Manager	Bhakilana Agro-dealer
	Vumilia Kondo	Journalist	Abood Media
	Bakari Semboja	Ward Extension Officer	Kilosa District Council
	Clay Sarumba	Extension officer	Mbozi District Council
	Clement Mamuya	Ward Extension Officer	Mbozi District Council Iwalanje village
	Martin Damas Sume	Farmer	Kilosa District Countcil
	Daudi A. Bukuku	Farmer, Senjele Village	Mbozi
	Godwin Mwanjala	Farmer, Igurusi	Majengo, Mbarali
	Mary Nandofi		
	John Mbwama	Farmer, Iwalanje AMCOS	Mbozi
	Eva Thobias		
UGANDA	Moses Nangulu	Executive Director	Uganda National Agrodealers Association
	Prof Bernard Bashaasha	Principal, College of Agricultural and Environmental Sciences	Makerere University
	Dr Luckman Mulumba	Course Director, MSc Soil Science	Makerere University
	Prof Tenywa	Editor-in-chief and Faculty member	African Crop Sciences Journal/ Makerere University
	Bonny Ballikuddembe	Senior Technician	Makerere University
	Crammer Kaizzi	Senior Researcher-Soils	NARO-Uganda
	Namugamba Margaret	Program Manager	Africa2000 Network
	Tweheyo Herbert	Extension Worker	Mbarara
	Woniala Isaac	Extension Worker	Mbale
	Ayo Peter	Extension Worker	Mbale
	Kisakye David	Extension Worker	Iganga

	James Lugwana	Agro-dealer	Kamwaka Farm Supplies
	Rachel Nambozo	Agro-dealer	Trust Chemicals Uganda Ltd
ZAMBIA	Victor Mukwa	Agricultural Research Officer	Zambia Agricultural Research Institute
	Geofrey Siutemba	Zambia Soil Health Consortium	ZARI
	Ndashe Kapulu	Senior Research Officer	ZARI
	Sydney Phiri	Agricultural Research Officer	ZARI
	Rabbry Samana Banda	Chief Technician	ZARI
	Violet Nkhoma	Research assistant	ZARI
	Michael Muleba	Executive Director	Farmer Support Organisation Programme
	Aubrey Chipungu	Finance Officer	Farmer Support Organisation Programme
	Jay Pondoliker	Manager	Zambian Fertilizers
	Gene Phiri	Sales & Marketing Manager	Zambian Fertilizers
	Dr Elijah Phiri	Department of Soil Science	University of Zambia,
	Prof. Obed Lungu,	Department of Soil Science	University of Zambia,
	Mrs Lydia Chabala	Department of Soil Science	University of Zambia
	Dr Chizumba Shepaule	Department of Soil Science	University of Zambia
	Mirriam Phiri	Department of Soil Science, MSc Student	University of Zambia
	Gwen Chilombo	Department of Soil Science, MSc Student	University of Zambia
	Brian Gondwe	Department of Soil Science, MSc Student	University of Zambia
	Gideon Musukwa	Chief Technician Department of Soil Science laboratory	University of Zambia
	Patson Simbule	Department of Soil Science laboratory	University of Zambia,
	Charity Machalwe	Senior Technician, Department of Soil Science laboratory	University of Zambia
	Pande Hungani	Department of Soil Science laboratory	University of Zambia,
	Queen Usoni	Department of Soil Science laboratory	University of Zambia
	Uzi Jojn Banda	SHEQ Coordinator	Mount Meru Millers
	Gaureshkumar Rana	Business Development Manager	Mount Meru Millers
	Camp Somati	Extension Officer	Agricultural Extension, Chivombo

	Daisy Mwambula Mary Tembo Julia Ncube Njamee Malilwe Costwell Chisowa Advent Mabuto Phinea Mujabi Samson Mutupa	Lead Farmers	Chivombo

APPENDIX 4 Chapter 4 p-values

Awareness of ISFM technologies beneficiaries and non-beneficiaries

Pearson Chi-Square asym. Sig. (2-sided)							
	Mali	Ghana	Nigeria	Kenya	Tanzania	Malawi	Mozambique
Use of inorganic fertilizers	0.240	0.083	0.001	0.003	0.001	0.004	0.110
Growing legumes	0.223	0.001	0.029	0.002	0.001	0.001	0.001
Use of farm yard manure	0.410	0.001	0.001	0.163	0.001	0.001	0.001
Composting	0.001	0.001	0.004	0.155	0.001	0.001	0.004

Sources of awareness of ISFM technologies

Pearson Chi-Square Asymp. Sig. (2-side) between beneficiaries and non-beneficiaries			
	Inorganic Fertilizer	**Legume crops**	**Compost**
Family member, other farmer (not SHP group member)	0.001	0.037	0.219
Other farmer (SHP group member)/Lead Farmer	0.001	0.001	0.001
Radio	0.731	0.355	0.867
Extension worker	0.001	0.211	0.021
Field day	0.002	0.003	0.001
Researcher	0.857	0.178	0.196
Demo	0.004	0.196	0.001
CBOs/Farmer groups	0.379	0.246	0.764

Practising ISFM technologies (beneficiaries v non-beneficiaries)

p-values	Kenya	Tanzania	Ghana	Mali	Nigeria	Malawi	Mozambique
Inorganic fertilizers	.0002	.000	.000	.140	.000	.047	.026
Farm Yard Manure	.028	.003	.000	.836	.009	.000	.000
Composting	.053	.000	.008	.030	.004		
Growing Legume crops	.004	.000	.000	.604	.035	.000	.000

T-test for equality of means between beneficiaries and non-beneficiaries.	Yields													
	Ghana		**Nigeria**		**Kenya**		**Tanzania**		**Malawi**		**Mozambique**		**Mali**	
	2009	2014	2009	2014	2009	2014	2009	2014	2009	2014	2009	2014	2009	2014
Maize	0.367	0.841	0.387	x	**0.045**	**0.002**	0.336	**0.014**	0.129	0.391	0.328	0.158	**0.015**	0.057
Rice	0.311	0.215	0.41	0.357	x	x	x	x	x	x	x	x	0.999	**0.026**
Groundnut	x	x	0.178	x	x	x	0.954	0.211	0.793	0.107	0.390	0.985	0.264	**0.041**
Soya	x	x	**0.031**	x	x	x	x	x	0.962	0.112	0.487	0.357	x	x

APPENDIX 5. Participatory Action Research

Participatory Action Research involve a reflective process of progressive problem solving led by individuals working with others to improve the way they address issues and solve problems. PAR is generally applied within social learning contexts, where multiple actors collectively construct meanings (problem definition, objectives) and work collectively toward solutions. The PAR process is often describes as "a spiral of steps, each of which is composed of a circle of planning, action, and fact-finding about the result of the action". Iterative cycles of organizational or community-level action and reflection makes change processes more robust and effective by ensuring that systematic learning and sharing take place, by fostering continuous adjustment of actions to align them with agreed upon objectives, and by empowering the actors themselves to learn and adapt. PAR combines two primary activities: research and a facilitated process of social learning guided by a shared vision or set of goals to be achieved.

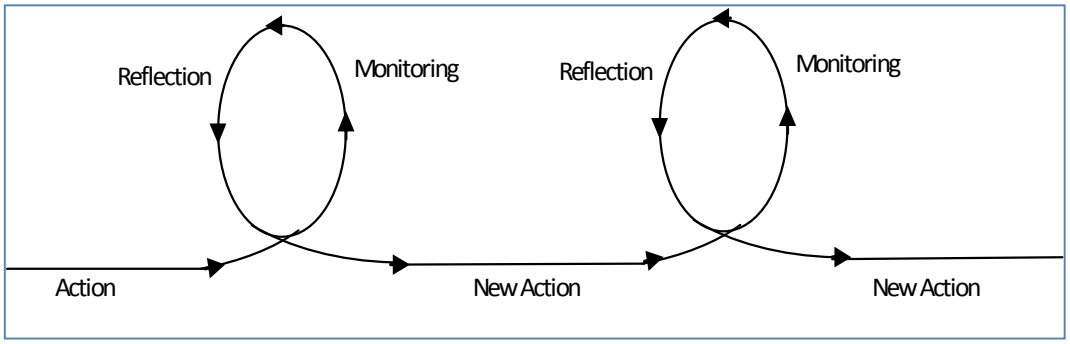


Figure 0.1 Graphical illustration of the iterative cycles of learning and doing in the Participatory Action Research process.