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Scaling up Agroforestry to Achieve Food Security and Environmental Protection among Smallholder Farmers in Malawi

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Abstract. Malawi is a land-locked country in southern Africa. Three-fourths of Malawi's 13 million people rely on smallholder agriculture for their livelihoods. Increasing population, accelerating deforestation, poor soil and water management, and increasing poverty and land degradation directly impact the food security and human health of millions of Malawians. Cropping systems which combine cereal crops, agroforestry and small doses of inorganic fertilizers produce food-crop yields greater than inorganic fertilizers alone on degraded soils, as well as recuperating soil nutrients over a period of years. These agroforestry practices improve the livelihoods of farm families, lower risks associated with fertilizer price increases and drought and at the same time improve biodiversity and nutrient and water cycling in the agro-ecosystem. The World Agroforestry Centre (ICRAF) has a long history of agroforestry research and development in Malawi dating back to the 1980s. In 2007-2011, ICRAF implemented the Malawi Agroforestry Food Security Project (AFSP) through financial support from Irish Aid. ICRAF's task in AFSP was to build a strong partnership to reach 200,000 farming families in 11 districts. The purpose of AFSP was to combine tested agroforestry practices, effective partnership and informed policies to increase food security and income, and improve livelihood opportunities for rural communities in Malawi, through accelerated adoption of fertilizer trees, fruit trees, fodder trees and fuel-wood trees. To accomplish these purposes, ICRAF provided the farming communities with planting material (tree seeds and seedlings), and the knowledge of how to care for them and effectively combine them with food crops. The beneficiaries of the project saw increases in household food security and nutrition. However, difficulties were encountered in transporting tree seeds and seedlings across eleven districts in a timely fashion, and in managing the flow of reporting and disbursements of funding among such a large group of collaborators. Several solutions were implemented which improved performance in these areas, and which allowed the group to reach very near the targeted number of participants, and to plan for a second phase of the project.

Keywords. Agroforestry, food security, Malawi, World Agroforestry Centre (ICRAF), development partners, soil degradation

1 Introduction

Malawi is a land-locked country in southern Africa that lies along the southern portion of the East African Rift Valley (Figure 1). Three-fourths of Malawi's population of 13 million rely on smallholder agriculture for their livelihoods. Increasing population, accelerating deforestation, poor soil and water management, and increasing poverty and land degradation directly impact food security and human health of millions of Malawians as well as affecting educational systems, water security, infrastructure, and major economic sectors, especially agriculture and tourism (Government of Malawi (GoM), 2009).

From the 1990s through the early years of this century, Malawi was a food insecure country, relying on food aid even in years of good rainfall. The poor harvests were the direct result of soils that had over the years been overused, degraded and exhausted. Most smallholder farmers did not use inorganic fertilizers due to high costs, and there were recurring food shortages and malnutrition among children and the elderly (Akinnifesi *et al*., 2007). Continuous cultivation of maize, the major food crop, on land with neither organic nor inorganic fertilizers led to low yields and resulted in inability

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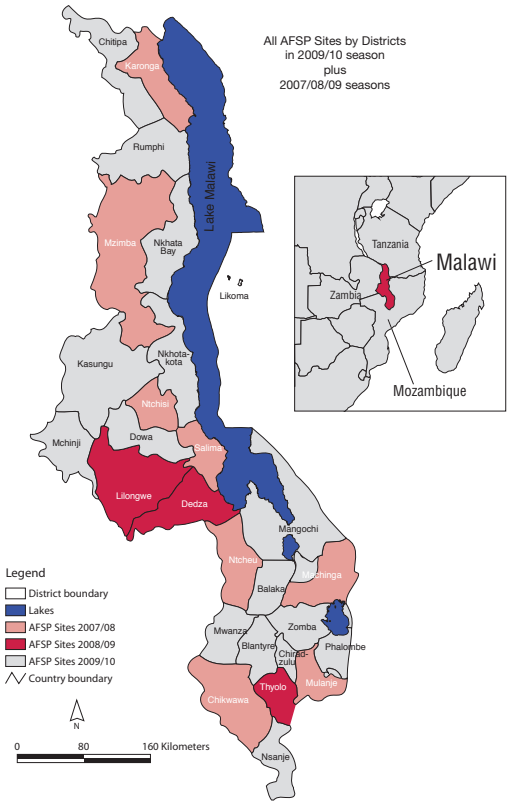


Figure 1. AFSP sites in Malawi

to afford purchases of improved seed and inorganic fertilizer in following years. Poverty and vulnerability to shocks (drought, high food prices, sickness, loss of employment) lowered productivity and women, children and the elderly have been disproportionately affected by these shocks (Dorward and Chirwa, 2011). In this context, production shocks from increasing variability in rainfall and temperatures due to climate change pose a much greater risk to farming families than would be the case in more developed countries.

While increased use of inorganic fertilizers in the past seven years have improved maize yields over the short term, inorganic fertilizers have masked soil nutrient depletion, rather than correcting it, especially soil micronutrients, thus bring into question the possibility of maintaining production levels over the long-term. Many Malawian soils remain nutrient-depleted, and maize production on such degraded land produces lower yield efficiencies than on adequately nourished land, even given adequate rainfall (Sileshi et al., 2011). Cropping systems which combine cereal crops, agroforestry and small doses of inorganic fertilizers have been shown to produce food-crop yields greater than farmers' use of inorganic fertilizers alone, and have additional benefits of helping recuperate soil nutrient balance over a period of years (Akinnifesi et al., 2007). Integration of agroforestry practices into these farming systems improve the livelihoods of farm families by increasing the range of products available and opportunities to earn cash income, lower risks associated with drought and at the same time improve biodiversity and nutrient and water cycling in the agro-ecosystem. Although the benefits to livelihoods and ecosystems may be clear, there is a one to three-year lag between the first use of agroforestry and the appearance of the benefits. The poorest farmers may lag in adoption of the systems despite knowing the benefits, as their priority is to meet immediate household food and income requirements (Ajayi et al., 2008).

Though agroforestry has been promoted in Malawi for some years dating back to the inception of the European Union (EU) funded ADDFOOD project in 1989, most projects have been limited to a small geographical area, while the problem of land degradation is widespread and affects most of the 3.5 million farming households across Malawi. In 2007-2011, the World Agroforestry Centre (ICRAF)-Southern Africa gathered a diverse group of development partners including government departments, farmer organizations, Community Based Organisations (CBOs) and Non-Governmental Organisations (NGO) partners in a team effort to provide knowledge and tree seeds and seedlings to smallholders in 11 of Malawi's 28 districts as part of the Agroforestry Food Security Project (AFSP) funded by Irish Aid. It is believed that projects that offer free tree seed and seedlings, and training in how to plant and care for and integrate the trees with cropping systems help to overcome the barrier to adoption among the poorest smallholders. The major sources of costs for investing in agroforestry trees for smallholders is the cost of seed and seedlings and labour for land preparation and tree establishment, most of which is incurred upfront, while farmers have to wait for a year or more before they start to realise benefits. Poor farmers may lack financial resources for meeting the upfront costs of investing in agroforestry, but once established the trees produce seed that farmers can collect and use to expand the size of their plantations and for replanting in the future. This is in contrasts with commercial seed for some of the annual crops (e.g., maize) grown by farmers where there is need to purchase improved seed every year.

2 Project Objectives

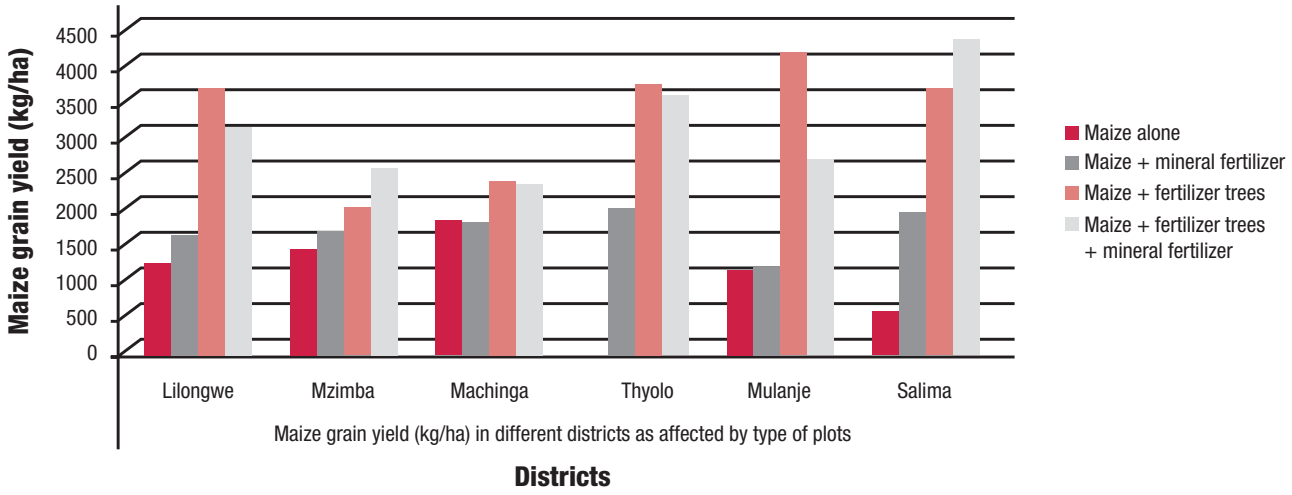
The purpose of AFSP was to combine tested agroforestry practices, effective partnership and informed policies to increase food security, income, and livelihood opportunities for rural communities in Malawi and protect the environment, through accelerated adoption of fertilizer trees, fruit trees, fodder trees and fuel-wood trees (ICRAF, 2011b). The specific objectives of the project were:

(a) Target, prioritize, adapt and demonstrate fertilizer, fodder, fruit and fuel-wood trees portfolio options in eleven selected districts with suitable biophysical, geographical and social niches for agroforestry interventions, including vulnerable sub-populations (HIV/AIDS afflicted, food insecure, poor, women);

(b) Engage partners in developing and applying strategies for sustainable supply and delivery systems of quality tree germplasm to meet potential massive demand by smallholder farmers;

(c) Engage, mobilize and sensitize policy makers to formulate appropriate policy mechanisms and instruments for

Figure 2. Maize grain yield in six districts as affected by agroforestry and fertilizer use.



mainstreaming agroforestry and catalyzing its adoption at the district and national levels;

(d) Improve strategies for accessing functional and efficient input markets and market support systems for agroforestry products that increase prices paid to farmers for their outputs and reduce costs incurred by farmers for needed inputs;

(e) Strengthen and mobilise the capacity of national and local institutions and development agencies in scaling up agro-forestry and develop strategies for institutionalizing agroforestry research for development in Malawi;

(f) Mainstream agro-forestry into national development plans and community based land-use and management practices.

3 Project implementation

To accomplish these purposes, ICRAF built partnerships with government departments, farmer associations, NGOs and CBOs. ICRAF functioned as the convener, and most of the partners participated in the project design and implementation. ICRAF signed a memorandum of agreement with the main partners, and directly disbursed funds to the Departments of Agricultural Extension Services (DAES), Land Resources Conservation Department (LRCD), Department of Agricultural Research Services (DARS), and Department of Animal Health and Livestock (DAHL) of the Ministry of Agriculture, Department of Forestry (DoF), Bunda College of the University of Malawi, Mzuzu University and National Farmers' Association of Malawi (NASFAM). DAES, LRCD and NASFAM have large networks of extension officers in all districts in Malawi and were ideally placed to facilitate in the organization of farmer groups, training, delivery of services (e.g., distribution of seeds and information and communication materials) and monitoring and evaluation.

Most of the CBOs and NGOs in Malawi operate in only one or two districts, while the government maintains agricultural extension officers and land resource conservation personnel in all districts. Districts were chosen to give broad representation across the three regions and eight agroecosystems present in Malawi. However, the government's extension services are not equally strong in all districts, and are supplemented by the efforts of NGOs and CBOs where they are present. Mapanga CBO in Thyolo district was actively involved in distributing tree seed and seedlings and providing support services to farmers. Through the various partnerships, ICRAF channelled to the farming communities planting material (tree seeds and seedlings), and the knowledge of how to care for them and effectively combine them with food crops.

Farmers in each district were given their choice of agroforestry tree seeds and fruit tree seedlings, so far as supply and logistics allowed. Fertiliser trees were the most widely planted by farmers (planted by all participating households), followed by fruit trees (24%), and small numbers of household planting firewood trees and fodder trees. If left to grow for two seasons or more as would be the case for farmers engaged in rotational fallows or fertiliser tree seed production, fertiliser trees can also produce wood that is big enough for use as firewood. Of the fertiliser trees, the most commonly distributed seeds were improved *Tephrosia vogelli* and *Sesbania sesban* (at 93% combined), with smaller amounts of *Gliricidia sepium* and *Faidherbia albida* (ICRAF, 2011b). The first two species were managed as either rotations or relay intercrops, depending on availability of land for rotations. Gliricidia and faidherbia were managed as dispersed intercrops. ICRAF has not promoted alley cropping systems in Malawi, as the rainfall in most areas is not sufficient to avoid competition of the trees with cereal crops. Some farmers preferred tephrosia because it could be directly sown in the field, avoiding the laborious nursery process. Other farmers preferred gliricidia, because although it required nursery management it only had to be planted once, and would resprout after annual coppicing for leaf manure. Gliricidia, however, produces only small amounts of seeds, and so the demand for it was always greater than the supply. The most commonly distributed fruit seedlings were papaya *Carica papaya* and mango *Mangifera indica*, respectively (ICRAF, 2011b). Papayas were the simplest and most popular fruits

for adoption by both the project and the smallholders because they did not require grafting. Mangos were next in popularity, mostly because of a general preference for the fruit for home consumption and local sale.

Partners for AFSP were chosen for their ability to contribute to a team that reached smallholders at the farm level across eleven districts. CBO's were also included, though they are smaller scale, because of their ability to bring contextual issues such as gender, HIV/AIDS, and governance into the management of what is essentially a natural resource management project. AFSP sought to capitalise on and further strengthen coordination of efforts among development partners, as exemplified in the relationship between LRCD, Extension Services, lead farmers, and farmer participants. LRCD maintains only two officers in each district to teach soil and water conservation practices, making it impossible for them to directly reach thousands of participating households in each target district. The LRCD officers train agricultural extension officers and lead farmers who in turn train and provide information on soil and water conservation to the rest of the farmers in the communities. During the AFSP staff of the Department of Agricultural Extension Services (DAES) identified, sensitized and trained farmers, and also distributed tree seeds and seedlings to participants. The extension officers also identified lead farmers to be trained to do farmer-to-farmer training at the village level. ICRAF training officers and LRCD staff trained the extension officers and lead farmers in each district on how to integrate agroforestry trees in the local farming systems.

Participation by farmers was voluntary at the village level, and the participants self-organized into groups for training. Participation of men and women at the village level was roughly equal; however women's participation in field days, trainings, and demonstrations was slightly less than that of men. Lead farmers were often chosen by each group. The extension officers and lead farmers in turn trained the participating smallholders. Farmers were given intensive modular trainings in tree nursery care, and planting and management of trees in appropriate niches in cropping systems, to empower them to produce organic leaf fertilizer, fruit, fuelwood, and fodder for livestock (Figure 2) (ICRAF, 2011a). ICRAF partnered with major tree seeds suppliers, the Forestry Research Institute of Malawi (FRIM), and the Land Resources Centre in the private sector to provide tree seeds. Grafted seedlings for fruit trees were produced in ICRAF's central nursery located at Makoka Agricultural Research Station, and Bvumbwe Agricultural Research Station of DARS.

The most important of the activities was that of the farmers who took the seeds and seedlings, and planted and cared for them on their own farms, reaping the benefits of the soil-building leaf matter, fruit, livestock fodder, and cooking fuel. Although the main focus of the project was the farm household, AFSP also built the capacity of national partners, academics, and students through curriculum revision projects in University of Malawi and Mzuzu University. The total capacity-building effort covered a wide range of clients ranging from farming communities to government and NGO development personnel, to universities, so that agroforestry would have a sustainable knowledge base specific to the Malawian context.

4 Accomplishments and difficulties

Implementation of AFSP brought both accomplishments and difficulties. A total of

184,463 farmers were reached through the project (Table 1), and these farmers saw increases in maize production thus contributing to improvement in household food security and nutrition (Figure 3). According to an external review of the project, the main strength of the AFSP is its relevance to the Malawi Growth and Development Strategy, the Agricultural Sector Wide Approach as well as the Millennium Development Goals. The review also concluded that the project has: (1) improved household food security and nutrition; (2) strengthened partnerships among stakeholders; (3) built capacity of farmers and extension staff; and (4) mainstreamed agroforestry in university curricula and cross cutting priority areas including gender equality, governance and HIV/AIDS. An assessment of impact of the project in terms of maize yield was conducted across six districts. The results show doubling of maize yields with the addition of agroforestry to the cropping systems (Mwalwanda et al., 2012). One factor that facilitated team-building and team-oriented operations among disparate governmental and non-governmental partners in this project was the relevance of agroforestry to efforts by the Malawi government and local and national NGOs to develop agriculture and protect the local agro-ecosystems.

Figure 3. Women being trained in tree management.

Cooperation between ICRAF, LRCD, and Extension Services was largely responsible for the ability of the project to reach a relatively large scale, however participation was uneven across districts. For example, farmers receiving agroforestry tree seed in 2010 numbered more than 5,000 in both Mzimba and Lilongwe districts and less in the other districts (ICRAF, 2011b). Mzimba district is physically larger than the other districts, and ICRAF's offices are located in Lilongwe district. Farmers across all districts received similar amounts of seed, but they chose different species. Tephrosia was the most common choice in Mzimba and Lilongwe districts. Demand for gliricidia was strongest in Karonga district, possibly because gliricidia is already much used there, and the example drove increasing demand. Faidherbia, on the other hand, was much less in demand in Salima district, where it is also a common intervention for

Table 1. The number of households reached, extension staff trained and amount of seed distributed by AFSP

	2007/8	2008/9	2009/10	2010/11	Total
Number of farmers reached	42,419	65,522	91,022	37,656	184,463
Number of farmers trained1	1,322	17,141	28,622	33,723	80,828
Number of extension staff trained 123	658	191	255	1,227	
Amount of seeds distributed (tons) 24	22.3	17.5	9.6	73.4	
Fruit seedlings distributed	27,000	137,000	173,790	29,000	366,810

[1] Lead farmers and participants in nursery production and seed production activities.

soil fertility. Faidherbia, however, produces relatively more seed than gliricidia, and local seed probably filled local demand. Though the AFSP was relatively successful in scaling up agroforestry use in two extension areas in each of eleven districts, this is only a small portion farming households, which number over three million. A second phase of AFSP is planned, and further efforts will also be needed from government, NGO, and CBO groups outside of the AFSP project itself to fill the demand for agroforestry on farmland in Malawi.

The implementation of AFSP was not always smooth. The first major difficulty encountered was that of transporting seeds and seedlings from the nurseries to the farmers in the districts especially at the beginning of the project. During the first year, ICRAF provided much of the transport for the seeds, and sometimes arrived late, having too few vehicles and personnel to undertake the task. In subsequent years, the agricultural extension service loaned vehicles and personnel, which helped to improve the timeliness of the deliveries. To overcome this challenge, the project encouraged and trained individual farmers in tree seed production and marketing to provide a source of tree seeds at the village level. These farmers were also trained to form tree seed associations, and to manage tree seeds storage, and sales within cooperative groups. These activities increased the flow of tree seeds within the project's areas.

Transporting fruit seedlings from agricultural experiment stations in the south of Malawi to eleven districts was more problematic than transporting tree seeds. The fruit seedlings sometimes arrived late, and often were weakened by the conditions of transport. One remedy for this problem was to train farmers in operation of community tree nurseries (Figure 4), and have trained personnel visit to graft the seedlings. Another remedy was supporting agricultural experiment stations in the center and north of the country to grow seedlings for the project in their region. These remedies increased the flow of both indigenous and exotic fruit seedlings to the farmers in the project, but demand for the fruit seedlings exceeded the number delivered in each year.

Both the level of participation and crop performance varied among the districts. The effect of fertilizer trees was greatest in Salima district, as were overall yields (Figure 3). Both yields and the agroforestry effect were less in Mzimba and Machinga districts. Of the eleven districts participating in the AFSP, the eight most active were recommended for a planned second phase of the project: Dedza, Lilongwe, Thyolo, Karonga, Machinga, Mzimba, Mulanje and Salima.

Figure 4. Farmers demonstrating village nursery operations.

The second major difficulty was the late reporting of AFSP annual results from the districts and department offices, and subsequent late disbursement of funding. This was a problem in the middle to late years of the project, and will be remedied in the second phase of the project. Some districts were late in reporting district-level information on AFSP to the government departments, who were in turn late in compiling multi-district reports for ICRAF. ICRAF was then delayed in reporting overall results to Irish Aid, a pre-requisite for subsequent funding disbursement. Rather than risk delaying the farming-season-driven cycle of project activities, ICRAF often pre-financed operations. A pilot project, Evergreen Agriculture which tested the possibilities of interfacing at district rather than department level was implemented by ICRAF in the districts of Kasungu, Mchinji and Chiradzulu in 2010. Based on lessons learned during this project, during planning for the second phase of AFSP in 2012 and

subsequent years, ICRAF and partners have proposed to Irish Aid that ICRAF should interface with the LRCD and extension offices directly at the district rather than the department level for reporting results and disbursement of funds. ICRAF will also regularly monitor the compilation of data and information required for financial and technical reporting and provide needed support to the project implementing team at the district level. This will allow project districts that report on schedule to receive funding for subsequent activities, without being delayed by the lack of reporting by colleagues in other districts.

5 Impact and implications for sustainability

The impact of the AFSP was greater in terms of household food security and in terms of scale of operations in the participating districts than previous agroforestry projects in Malawi. Agroforestry cropping systems increased the yield of the major staple crop, maize by near 100% under smallholder conditions. The fertilizer, fruit, and fodder tree systems which have simple seed management requirements are easily sustainable among smallholders, as they can produce tree seeds for future use within the farming system. Sustainability of fruit tree systems is more complex because of the need for grafting. However, demand for fruit trees is also high, and will give incentive to efforts to maintain the flow of grafted seedlings to smallholders. Overall, the project improved food security and livelihoods among participants. Over the longer term, because of improved soil nutrient and water cycling, these systems should also improve ecosystem function and the resilience of the food production system. Increased emphasis on village-level nurseries should increase the production of fruit seedlings locally in the participating villages. Local participants gained technical knowledge about agroforestry/maize cropping systems that will give them confidence in making natural resource management decisions at the farm and village level. They also gained experience in organizing themselves to access goods and services outside the village. Valuable connections were forged between government departments and private extension services, which strengthened delivery of agricultural knowledge and services within the districts. Lessons learned in institutional arrangements leading to the recommendation for individual district reporting should facilitate the flow of resources for project functioning in the second phase of AFSP.

6 Conclusions

AFSP assisted 184, 463 farmers in learning and using agroforestry cropping systems that could help them to cope with increasingly variable rainfall and temperature patterns driven by climate change. It also allowed the partners to verify some of the positive effects of these trees on livelihoods. ICRAF also tested a public/private partnership model for scaling up agroforestry technologies in Malawi, and implemented several problem-solving strategies during the project. Mainstreaming of agroforestry within the curricula of University of Malawi and Mzuzu University will strengthen agroforestry knowledge within the private and public sectors of agricultural development services. Cooperation between government departments such as LRCD and DAES with private extension services such as NASFAM and CBOs such as Mapanga strengthened the delivery of agroforestry tree seeds, seedlings and services at the village level in the respective districts and allowed the project to operate at a broad scale. The scaling up strategy that was successful in Malawi, however, depended on particular international, governmental and local partners and would need to be adjusted for differing institutions in other contexts.

7 Acknowledgements

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