Agroforestry for sustainable rural development in the Zambezi Basin

Improved fallows with sesbania in eastern Zambia

summary proceedings of a consultative workshop
22–26 April 1996, Chipata, Zambia

Freddie Kwegiga
Donald Phiri and Anna-Lisa Raunio
Agroforestry for sustainable rural development in the Zambezi Basin

Improved fallows with sesbania in eastern Zambia

Summary proceedings of a consultative workshop

22–26 April 1996, Chipata, Zambia

Freddie Kwesiga, Donald Phiri and Anna-Lisa Raunio

INTERNATIONAL CENTRE FOR RESEARCH IN AGROFORESTRY
The Zambezi Basin Agroforestry Project is funded by the Canadian Government through the Canadian International Development Agency.

The authors would like to thank Kellen Kebara, Thomas McOwiti and Dali Mwagore for assisting in the editing and production of this document.

first published in 1997

International Centre for Research in Agroforestry
PO Box 30677, Nairobi, Kenya
OVERVIEW

Introduction
The workshop took place 22–26 April 1996 at Luangwa House hostel in Chipata, Zambia. It was organized by the agroforestry research team in conjunction with the farming systems team, the Soil Conservation and Agroforestry Extension (SCAFE) Project and the agricultural extension systems team in Eastern Province. The workshop was convened and facilitated by the principal agricultural extension officer, Eastern Province, and was officially opened by the permanent secretary, Eastern Province.

Participants
Participants included researchers from the International Centre for Research in Agroforestry (ICRAF), the Ministry of Agriculture, Food and Fisheries (Research Branch), SCAFE coordinators and advisers from Eastern and Central Provinces, all district agricultural officers from Eastern Province, the officer in charge of all farmers’ training centres in Eastern Province, selected block and camp officers from the province, farmer representatives from Chipata District, and a representative of the provincial agricultural officer, Southern Province.

A number of non-governmental organizations (NGOs) were represented. They included the Finnish Volunteer Services, World Vision International, the Lutheran World Federation, the Baptist Church of Zambia, the Reformed Church of Zambia, and the Catholic Church of Zambia. ICRAF was represented by its regional coordinator for southern Africa, based in Lilongwe, Malawi, the systems improvement coordinator based at ICRAF headquarters in Nairobi and a senior scientist based in Malawi. The Finnish Volunteer Services was represented by their resident representative based in Lusaka, a development officer in Eastern Province, and the organization’s overall agriculture coordinator for Zambia. World Vision International was fully represented by all officials in the province and development personnel from all districts in Eastern Province. The Swedish Embassy in Lusaka was represented by a counsellor, Christer Ågren, who attended part of the deliberations and the field day at Msekhéra.
Funding

We are grateful to the Canadian International Development Agency (CIDA) who, through ICRAF, provided funding for the workshop. The Swedish International Development Cooperation Agency (Sida) provided additional funds through SCAFE. The Finnish Volunteer Services provided funding to support some participants, as did the government of Zambia. We are also very grateful for the continued support of the Swedish government through Sida, which is funding the agroforestry research team, the farming systems research team and SCAFE in Eastern Province.

Background to the workshop

The main purpose of the workshop was to exchange information and to improve linkages among research, extension, NGOs and farmers using improved fallow technology as an alternative to commercial fertilizers. The widespread enthusiasm for improved fallows in Zambia has been prompted by the need to find practical solutions to acute problems in the smallholder agricultural sector in Zambia, namely:

- The declining productivity of soils due to continuous crop cultivation without adequate fertilization
- The fact that the present short-duration weed or grass fallows of 1–5 years are inadequate to restore soil fertility
- The prohibitive cost of fertilizers that farmers need to reverse the trend

In the absence of appropriate alternatives, many small-scale farmers have had to accept the current low crop yields, leading to food insecurity and malnutrition.

The agroforestry research team has been researching alternative technologies to replenish nitrogen—the nutrient required in the largest quantities for maize and one which is most commonly limiting for agricultural production in southern Africa—in the soil. Since nitrogen can be directly captured from the atmosphere, technologies based on nitrogen-fixing plants are more likely to be accessible to small-scale, resource-poor farmers, who produce over 80% of Zambia’s staple food crop, maize. In eastern Zambia maize occupies approximately 83% of the cultivated land area. This predominance probably resulted from the
drives of the national research and extension bodies to increase maize production, especially in the smallholder sector, and to achieve and maintain self-sufficiency in maize production.

The goal of self-sufficiency in maize production advocated by the government was achieved in some years through excessive state intervention. State monopolies guaranteed the marketing of the harvest and supplied hybrid maize seed and fertilizers on credit, and at heavily subsidized prices. All this was at a great cost to the economy.

While the agricultural policy was aimed at providing food security at national and household levels, most of Zambia’s soils were and still are deficient in plant nutrients, especially nitrogen and phosphorus. Good yields of maize cannot be obtained without fertilizers. For instance, an economic yield of hybrid maize requires 120–200 kg N ha\(^{-1}\) yr\(^{-1}\).

But recent economic structural adjustments have resulted in the government realizing that regulation and control of agricultural production, marketing and pricing, coupled with heavy subsides, are unsustainable and discouraging to agricultural development. The effect of this change in policy means that farmers have had to shift from dependence on fertilizer to alternative strategies.

**Improved fallow technology**

Fallowing is not a new concept in Zambia. Traditional systems like ‘chitemene’ in northern Zambia rely on long fallow periods to build up soil fertility. It is estimated that 20–30 years are required to build up soil fertility if the miombo tree vegetation is lopped during land preparation for chitemene systems. However, if the trees are clearfelled, over 40 years would be required to provide sufficient tree growth for another cycle of chitemene. This is not practical anymore. There is high population growth (over 3% yr\(^{-1}\)), and trees are not given enough time to grow. Therefore, farmers revisit chitemene fields in less than 10 years, at the cost of reduced biomass, incomplete soil fertility restoration and subsequent low yields.

In eastern Zambia, farmers have always relied on short grass or shrub fallows, known locally as ‘cisala’. In northern and eastern Zambia, grass fallows of varying duration (1–5 years) are common, but because of increasing human and livestock populations, longer fallow periods are
not practical. Therefore the process of natural soil fertility restoration is not completed, hence the need for improved fallows.

Improved fallows are defined as targeted use of plant species to achieve the aims of natural fallows in a shorter time or a smaller area. Improved fallows utilize fast-growing trees and shrubs. For example, if the main problem is nitrogen, leguminous trees that fix atmospheric nitrogen can be used.

Technologies based on the use of nitrogen-fixing plants are more likely to be accessible to a larger number of small-scale farmers. Therefore, research was initiated to identify, screen and test a wide range of leguminous trees and shrubs as possible sources of nitrogen fertilizer for crop production, taking advantage of their fast growth and the high nitrogen content of their leaves and litter.

**Improved fallows with sesbania**

Among the various multipurpose trees and shrubs identified and screened, *Sesbania sesban*, which is native to the region, was outstanding. *S. sesban* displayed rapid and vigorous growth, high biomass production, high quality litter, ease of propagation from seed and easy removal by clearfelling to harvest firewood. Because of these attributes, sesbania was recommended as an excellent tree for soil fertility improvement in short-duration improved fallows.

Between 1987 and 1996, research by the Zambia/ICRAF Agroforestry Research team based at Msekera in Eastern Province has shown that improved fallows of 2–3 years with *S. sesban* can increase maize yields significantly. These results have been demonstrated in on-station research for about a decade now. And since 1992, several farmers have confirmed these findings. As a result, we have assisted more farmers to establish nurseries and improved fallows to test this technology widely.

Also involved in evaluating the potential of improved fallows with sesbania are NGOs such as the Lutheran World Federation, World Vision International and the Finnish Volunteer Services, churches, extension personnel from organizations such as SCAFE, district agricultural officers, block and camp officers, farmer groups, and farming systems researchers. It is difficult to establish how many farmers are testing or have adopted improved fallows in the country, but it is estimated that over 1000 farmers are participating in the wider trials.
Given the consistency of the on-station and on-farm results and the increasing number of farmers and agencies interested in improved falls, there was need to coordinate and streamline the approach to on-farm evaluation of the technology. This is essential if more farmers in the province are to be reached, and to extend the technology to other areas outside the province—such as Southern, Central, Lusaka and Western Provinces—that have similar environments.

This workshop was convened to bring together these various groups to strengthen linkages, discuss and agree on a common agenda and to accelerate adoption of the technology by other farmers who might not yet be aware of the benefits of the technology.

**Purpose of the workshop**

The workshop goal was to bring together all agencies—international, local, church, NGO, farmer, extension and research groups working with farmers on improved falls in Zambia—to consolidate current knowledge and share information on improved fallow technology, including strategies for expansion.

**Workshop objectives**

- To review research and extension information on the improved fallow technology and take stock of the progress so far made
- To improve linkages among research, extension, farmers and NGOs working on improved falls
- To enhance monitoring and evaluation of the improved fallow technology, with in-built feedback mechanism for information flow among research, extension, farmers and NGOs
- To improve the capacity to disseminate the technology to a large number of farmers over a wider geographical range in Zambia
- To develop ways and means of transferring the technology to areas outside the Eastern Province with similar problems and environmental conditions
- To develop a work programme and define responsibilities for scaling up improved fallow research and extension for 1997 and beyond
- To review and agree upon the structure and content of extension manuals on the improved fallow technology (including for nursery, fallow and crop phases)
MAIN DELIBERATIONS

Session 1: Opening

Participants watched an ICRAF/TVE video, Farming with Trees. Using examples of 4 families practising agroforestry in Zambia, Uganda, Peru and Indonesia, the video helped define the concept of agroforestry. Then followed welcoming speeches by the provincial agricultural officer and the permanent secretary for the Eastern Province.

Opening remarks

C. Chinfwembe, Provincial Agricultural Officer, Eastern Province

In the colonial days, soil conservation was seen as something imposed on the people since it was carried out without explaining to them the benefits of the soil conservation structures they were forced to construct. Gradually, after independence, the approach changed, with more attention being paid to what people knew and what they wanted, as evidenced by ethnobotanical studies carried out by ICRAF. In agricultural extension, there was a strong emphasis on maize production, which was pursued single-mindedly, causing soil degradation in many places.

A recent ZAREP (Zambia Agricultural Research and Extension Project) evaluation pointed out that current research-extension linkages are inadequate. This consultative workshop involving representatives of research, extension, NGOs and farmers, is one such linkage forum. It is time to start joint planning with farmers and forget the old antagonism between research and extension.

In the past, most research trials were established at research stations. Nowadays, on-farm trials have increased in importance and relevance. The Zambian training and visit (T&V) system has undergone a lot of modifications, reflecting diverse farming situations. It has concentrated on small-scale farmers. The T&V system has close contacts with NGOs who have been running their own extension programmes, but at times, these 2 give contrary recommendations to farmers. It is therefore necessary to harmonize these messages for the benefit of the farmer.

The Agricultural Sector Investment Programme (ASIP) is concerned with how best to serve farmers. On the other hand, farmers' indigenous knowledge technologies (IKT) can also qualify them as researchers.
Their knowledge and creative capacities need to be considered when introducing new technologies.

With the current research breakthrough on improved fallows, we need to work out strategies and plans on how to transfer the technology to the users and how best to implement it with the limited resources we have, so that the maximum impact can be achieved. Since all the districts in Eastern Province are covered by SCADE, we have to identify priority areas, so that after such an area has been covered we can move on to the next. We want to use the community approach in targeted pilot areas instead of the scattered on-farm evaluation currently in place.

We look forward to your active and fruitful participation in this workshop. Thank you very much.

*Opening speech*

*Dr H Mtonga, Permanent Secretary, Eastern Province*

I wish to take this opportunity to welcome our visitors from outside Eastern Province. You are warmly welcome to Chipata and to Zambia. To those who hail from this province, we still welcome you to Chipata and to this workshop.

This workshop aims at improving linkages among research, extension, NGOs and farmers using the improved fallow technology as a practical solution to the soil-fertility problems.

The productivity of land has been declining because of continuous cultivation of maize, which depletes the nutrients in the soil. Annual fires, deforestation and subsequent soil erosion have all added to the general land degradation. The fertilizers that the farmers yearn for are not only too expensive, but when applied indiscriminately can impair the soil and the environment. Furthermore, the current short-duration weed or grass fallows are insufficient to restore soil fertility.

Given these circumstances, conventional ‘green revolution’ technologies will remain unattainable for the majority of our small-scale farmers in Zambia. In the absence of appropriate farming technologies, the people of Zambia may have no choice but to accept low levels of production and food insecurity, and continue experiencing the catastrophe of nationwide malnutrition.
The good news, though, is that researchers have come up with this alternative technology, which seems to fit in with current strategies to tackle the soil fertility problem by providing nitrogen cheaply for added maize productivity.

Therefore, the first step in research has been to identify, screen and test a wide range of leguminous, nitrogen-fixing trees and shrubs as a source of organic nitrogen fertilizers for crop production. Of those that researchers screened, I am told the most outstanding was the indigenous plant *Sesbania sesban*.

The Zambia agroforestry research team based at Msekera in Eastern Province has shown that improved falls with *Sesbania sesban* can, after 2–3 years, significantly increase maize yields. Since 1992, the team has assisted several farmers to establish tree nurseries and to establish their own sesbania falls to widely test the new technology. Currently, it is estimated that over 1000 farmers dispersed over a wide area are practising the technology in Eastern Province.

I understand that several governmental and NGO agencies and organizations are also involved in the process. I wish to commend all these organizations for getting involved in such a noble cause.

The consistency of on-station and on-farm results, coupled with the increasing number of farmers and agencies interested in this technology, has given rise to a growing need to coordinate and to streamline the approach so that many more farmers can be reached in the province and beyond. We are particularly happy that representatives from other provinces, led by their principal agricultural officers, are present here with us.

As participants, we are here this week to bring together various ideas and to discuss and agree on a common agenda—to accelerate adoption of this technology for use by our farmers.

At the same time I wish to sincerely thank those who have supported this initiative in various ways, particularly the Canadian International Development Agency (CIDA), which made available funding—through ICRAF—to support district and camp staff and our farmers. We are also very grateful to the Finnish Volunteer Service for their generous contributions, and to the Swedish government for their support for
ICRAF, SCAFE and the farming systems teams in the Eastern Province. As we thank all those donors for their support, we should also be mindful of our responsibility to build this country. By and large, donor funding should be the secondary and not primary resources in building our nation. As I have often said, Zambia’s energies should never be replaced by foreign aid. My government has sponsored and funded several other agricultural activities, which goes to prove the seriousness that the government attaches to agriculture. It is, therefore, unrealistic to argue that the government does not provide an enabling environment to farmers.

Mr chairman, it is for this reason that the major objectives of this workshop should focus on the activities that call for the participation of Zambians themselves, whereas the international and local agencies are there simply to supplement our efforts. Ladies and gentlemen, this country is ours, it belongs to us. Its problems are ours, so is its success. Donors are using their taxpayers’ money. We honestly cannot take pride in that. I must also caution that that money is not free at all and can never be fully repaid.

Out of the 6 objectives of this workshop, I consider the one about ‘linkages among research, extension, farmers and NGOs working together on improved fallows’ as one of the most important ones. Let it be known that money spent on research without application of the findings for the betterment of the society is money wasted. Research is not an end on its own; on the contrary, it is a means to an end, which is a richer and prosperous future. It beats me to see in government, departmental, college and university libraries huge research information gathering dust year in and year out.

We shall be here for a whole week during which time we will discuss a lot of issues and come up with workable recommendations. Some of the important issues to be addressed in this workshop, Mr chairman, include concerns of sustainability and a vision of how you could scale up your operations.

Realizing that improved fallows will be established on very depleted soils and that farmers who are likely to fallow are resource poor, the need to select germplasm that is well adapted to the nutrient stress situation is essential. In addition, there is need for at least a minimum investment in tree crops. This is essential as even small inputs of such investments can
bring great benefits through increased productivity and sustained crop yields. Researchers need to test these hypotheses and provide recommendations because our soils are deficient in both nitrogen and phosphorus.

Furthermore, there is need to replenish the harvested wood from improved fallows. However, we must also address the problems associated with pests and diseases, the effects on soils of monocropping maize, shorter fallow periods, shrinking farm sizes, and frequent drought conditions and associated crop failure. This workshop, Mr chairman, is a forum where researchers should provide interactive views and explore beyond their intellectual horizon possible and realistic remedies. It is the only way to bring you to challenges of human existence.

Through extension agencies, we would like to expand on-farm testing of improved fallows. Rather than having to traverse the province to monitor 1000 or so farmers practising improved fallows, we need to scale up the programme to involve many more farmers in the coming years, say 1000 to over 30 000. One way of doing this is by a systematic approach such as using the village or community catchment model. If we used a village as a model we could then easily measure the impact of improved fallows, soil conservation or other technologies. We could easily monitor resource availability, multiplier effects of resource conservation, and other issues that we are currently unable to monitor when working with farmers who are distributed in many locations in the province.

We can take a gradient approach; using villages in low population areas where falling can easily be carried out and those where it is no longer possible to fallow. With these approaches, we need all available resources to get positive results. Therefore, there is need to involve all the key players, many of whom are NGOs.

With the involvement of NGOs and extension agencies, we need to develop support tools for the anticipated expansion. Luckily, we have been assured that ICRAF will this year produce an extension manual on nursery and fallow management of improved fallows with sesbania to facilitate envisaged expansion. This manual will be developed with input from extension, NGOs, farming systems, SCAFE, the agroforestry team, farmers and we in this workshop. It is at this workshop that we shall review and discuss the content and structure of the manual to make it more participatory and user friendly.
I would like you to consider ways of transferring the improved fallow technology to farmers in your areas. Already, Zambia's agricultural research system operates on the ecozone approach, which, by using support systems such as the geographical information systems (GIS), helps to modify and lessen research expenses. We should use this to extend the improved fallow technologies to similar environments in Southern, Central and Western Provinces. We are inviting the farming systems research teams, provincial agricultural officers, SCAFE, World Vision, LWF and the Finnish Volunteer Services to explore possibilities of extending this technology to more farmers.

I am aware that seed and other necessities could be limiting factors for large-scale extension of this technology. You have to establish seed orchards in isolated areas—to avoid genetic contamination—for future use. We also hope we are not asking too much of ICRAF for seed, or the Kenya Forestry Research Institute (KEFRI) for rhizobia, or other suppliers of sesbania seed to support our efforts during the first year of operations before farmers can produce enough of their own seed.

Finally, I wish to sincerely thank the organizing committee, the management of Luangwa House for providing the splendid environment, the donors for financial support, the catering services, and you the participants. It is my hope that you will find this workshop memorable and to which you will have a continued recourse many years to come. More importantly, note that you are not at this workshop by accident. There are no accidents in God's world. It is in the divine plan that you should be a co-worker with God; that you should serve God by serving another human being. Aren't you ladies and gentlemen the blessed ones?

Thank you.
Improved fallow research in Eastern Province

F Kwesiga, S Mwanza, D Phiri, P Simwanza, F Place and S Franzel

Background

Maize is the dominant crop for the majority of Zambia’s population. In eastern Zambia it occupies approximately 83% of the cultivated land area. Soon after independence, the government’s major national research and extension objectives were to increase maize production, especially in the peasant sector, to achieve and maintain self-sufficiency in food production, and to generate a major share of the country’s future export growth. The agricultural policy was aimed at providing food security at national and household levels and encouraging full exploitation of the country’s vast natural resources. However, most of the soils in Zambia, including those of eastern Zambia, are deficient in plant nutrients, especially phosphorus and nitrogen. Good yields of maize cannot be obtained without fertilizers. An economic response for hybrid maize requires between 100–200 kg N ha$^{-1}$.

The objective of policy of self-sufficiency in maize advocated by the government was sometimes achieved through excessive state intervention. State monopolies supplied hybrid maize seed and fertilizers on credit and at heavily subsidized prices at great cost to the economy. Recently, in line with economic structural adjustment, the government has accepted that heavy subsidies were unsustainable and discouraging to agricultural development, and has withdrawn from the regulation and control of agricultural production, marketing and pricing. These changes in policy have made farmers shift away from using fertilizers to other strategies.

Improved fallow technology

Improved fallow research is set against the backdrop of expensive fertilizers, depleted soils, declining food production, erratic rainfall, a high population growth rate and the shortening of the traditional fallow period. Those most affected by these problems are those least able to withstand pressure on their resources, the small-scale, resource poor
farmers. In the absence of appropriate technologies, these farmers have to make do with low levels of production, increased food insecurity and malnutrition.

However, nitrogen, the nutrient required in the largest quantities for maize production, can be directly captured from the atmosphere. Technologies based on the use of nitrogen-fixing plants are likely to be more accessible to small-scale farmers. Therefore, our initial step was to screen and test a wide range of leguminous trees and shrubs as sources of nitrogen fertilizer, taking advantage of their fast growth and the high N-content in their leaves and litter.

**Improved fallows with sesbania**

Among the various multipurpose trees and shrubs screened, *Sesbania sesban*, which is native to the region, was outstanding, with its rapid and vigorous growth, high biomass production, high-quality litter, ease of propagation from seed, and ease of removal by clearfelling to harvest firewood. Because of these attributes, sesbania is an excellent tree for soil fertility improvement in short-duration fallows.

Nitrogen fixation rates of up to 350 kg ha\(^{-1}\) yr\(^{-1}\) have been recorded in India (ICRAF/NFTA 1989). Fresh leaves and litter of sesbania contain up to 4 and 2% nitrogen, respectively. Indeed, fallowing is not a new concept in Zambia: 'chitemene', a form of shifting cultivation, is a fallow-based agricultural system practised in the low population, high rainfall zone of the miombo savannah in northern Zambia. In the rest of Zambia, grass fallows of 1–5 years co-exist with continuous maize cultivation and cattle grazing. Our research strategy was to use these grass fallows as the entry point and transform them into leguminous fallows to accumulate nitrogen, smother weeds and improve soil properties (Kwesiga and Chisumpa 1992).

**Agronomic potential of sesbania fallows**

Growing *Sesbania sesban* trees at 1 m x 1 m or 10 000 trees ha\(^{-1}\) in fields depleted of nutrients or in fallow land for 2–3 years and then introducing hybrid maize after the fallow is cleared has produced encouraging results in the southern Africa region.

Maize harvests after sesbania fallows were at least double those in fields where maize was continuously cultivated without inorganic fertilizers. At Msekera, average maize yields of 2.3, 5.6 and 6.0 t ha\(^{-1}\) were obtained
after 1, 2 and 3 years of sesbania fallows, respectively, compared with 1.5 t ha$^{-1}$ from continuous maize plots without fertilizers (Kwesiga and Coe 1994). This level of production is significantly higher than the average yield of 0.2 t ha$^{-1}$, which farmers normally obtain in severely degraded soils in most of Zambia. In addition, sesbania fallows produced 10–20 t ha$^{-1}$ of fuelwood after 1–3 years of fallowing. Fuelwood produced on farm may ease the workload of women and children who normally have to travel long distances in search of fuelwood, and also reduce the pressure on the remaining woodlands in the area.

At Makoka Research Station near Zomba in southern Malawi, improved fallows with sesbania produced fuelwood of 5, 17, 27 t ha$^{-1}$ after 1, 2 and 3 years, respectively. Cumulative litter fall was 8.1, 14.3 and 37.7 t ha$^{-1}$ for 1, 2 and 3 year fallows, giving total above ground biomass of 13, 31 and 45 t ha$^{-1}$, respectively (Maghembe et al. 1995). From these production figures, the amount of potentially available nitrogen in foliage and litter is estimated to be 220, 360 and 800 kg ha$^{-1}$ after 1, 2 and 3 year fallows, respectively (Maghembe et al. 1995). These amounts of accumulated nutrients far exceed those removed in the woody biomass and those required for maize crop in the region.

At Chipata we investigated the effect of inorganic fertilizers on sesbania fallows in an attempt to establish if yields improved, and to make recommendations to those farmers who could still afford to use fertilizers. The responses were compared with those achieved by maize following a 2-year grass fallow (Kwesiga et al. 1996).

Whereas the growth of sesbania was adversely affected by the 1992 drought, producing only 2 and 7 t ha$^{-1}$ of wood biomass from 1- and 2-year fallows, subsequent maize yields were higher than those following grass fallows (Kwesiga et al. 1996).

Interestingly, the shape of the nitrogen-response curve was similar for all fallow types, but progressively shifted upwards for 1- and 2-year sesbania fallows (Dzwela and Kwesiga 1994). At Chalimbana, near Lusaka, 3-year sesbania fallows resulted in maize yields 60% higher than in fully fertilized controls (Kamara et al. 1994). These results clearly illustrate the agronomic potential of improved fallows with sesbania across several locations in southern Africa.
Screening a range of MPT species for fallow improvement

Having realized that *Sesbania sesban* has drawbacks such as susceptibility to the leaf-defoliating beetle (*Mesoplatys ochroptera*) and root-knot nematodes (Karachi 1995) and low calorific wood and the fact that it has to be re-established after the soil-depleting cropping phase, we screened other species that did not have such problems.

First, we chose those species that could be seeded directly. These were *Tephrosia vogelii*, *Sesbania macrantha* and *Cajanus cajan*. They were evaluated against *Sesbania sesban* for 1- or 2-year fallows. Three-year fallow species included those that could coppice (to eliminate re-establishment). These included *Gliricidia sepium*, *Leucaena leucocephala*, *Calliandra calothyrsus*, *Flemingia macrophylla* and *Senna siamea*.

Results showed that *Tephrosia vogelii* and *Cajanus cajan* performed well as direct-seeded species for both 1- and 2-year fallows. However, 2-year sesbania fallows (established as bare-rooted seedlings) continued to be the most productive in terms of fallow biomass and maize yield. In the drought of 1994, 2-year sesbania fallows produced maize grain yields of up to 5.5 t ha⁻¹, compared with 3.4 t ha⁻¹ for fully fertilized continuous maize (Kwesiga et al. 1994).

Results from screening 3-year fallow species showed that *Senna siamea* was outstanding in wood biomass production (32 t ha⁻¹), followed by *Leucaena leucocephala* (29 t ha⁻¹), *Sesbania sesban* (24 t ha⁻¹), *Gliricidia sepium* (21 t ha⁻¹), *Flemingia macrophylla* (18 t ha⁻¹), and *Calliandra calothyrsus* (11 t ha⁻¹). These figures should be interpreted bearing in mind that the tree fallows were established in the drought of 1992 and harvested in the drought of 1994.

When the fallow effects were tested with hybrid maize (MM604), the sesbania fallow was outstanding (5.6 t ha⁻¹) and better than the fertilized control (4.4 t ha⁻¹). *Gliricidia* and *leucaena* fallows produced 4.3 and 4.2 t ha⁻¹, respectively. Maize growth in *Senna siamea* plots showed severe N-deficiency 4 weeks after germination and at harvest; maize yield was only 1.86 t ha⁻¹ and not significantly different from that obtained in plots that were continuously cropped with maize for 4 years without fertilizers.
Economic evaluation of improved fallows with sesbania: cost-benefit analysis

The move by the government to remove fertilizer subsidies in restructuring the agricultural sector was rapidly implemented. While it made fertilizers less affordable by small-scale farmers, it has made some agroforestry technologies relatively attractive and acceptable as alternatives for sustainable land-use management. This is particularly true of improved fallows with sesbania sesban, which many farmers now consider a potential substitute for fertilizer. Because of this potential, extension agents have exerted enormous pressure to have the technology released to farmers. However, before the technology could be ‘released’ with confidence, various socioeconomic issues related to profitability, efficiency, feasibility and sustainability had to be investigated to ensure that it was appropriate from an economic perspective.

Methodology

The objective of this analysis was to examine the economic feasibility of improved fallows from the farmer’s perspective. Ideally, on-farm data would be used to conduct such evaluations, but the available economic data on the technology are from on-station research. The evaluation utilizes actual yield data from on-station trials conducted between 1988 and 1993, but does not use actual prices and costs from these years. Instead, the real costs and prices expected to prevail during the next few years were used. In this sense, the analysis was an ex-ante economic evaluation of the technology. This methodology helps us to understand whether the technology would be attractive to farmers facing the decision to adopt improved fallows, given current economic conditions in Zambia.

Furthermore, in order to understand the economic potential of improved fallows with sesbania, it is necessary to evaluate costs and benefits associated with traditional and other improved soil-fertility management strategies that farmers use. There are currently several options farmers in eastern Zambia could choose to manage a maize field that has lost its fertility: 1) crop maize without inorganic fertilizers, 2) crop maize with fertilizer, 3) rotate or intercrop with a legume crop, 4) put the field under grass fallow, 5) apply kraal manure, or 6) use green manure.
In this analysis, the costs and benefits of the first 2 options of continuous maize cropping with or without fertilizer are compared with 3 improved fallow options: 1) a 1-year Sesbania sesban fallow planted from seedlings followed by continuous maize cropping without fertilizer, 2) a 2-year sesbania fallow using seedlings followed by continuous maize cropping without fertilizer, and 3) a 3-year sesbania fallow planted from seedlings followed by continuous maize cropping without fertilizer.

**Data collection**

In all cases, labour input and output data were gathered from on-station trials at Msekera Research Station, Chipata. Price information was collected from relevant input supply institutions. The costs and values used in the analysis are summarized in table 1.

Table 1. Cost and values used in the cost-benefit analysis of improved fallows, Chipata, Zambia

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost/return (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Sesbania sesban</em> pure fallow</td>
<td>0.95</td>
</tr>
<tr>
<td>Hybrid maize seed (20 kg ha⁻¹)</td>
<td>2.02</td>
</tr>
<tr>
<td>Sesbania seedlings (per 1000)</td>
<td>17.14</td>
</tr>
<tr>
<td>Maize yield value (per 90 kg bag)</td>
<td>9.52</td>
</tr>
<tr>
<td>Fuelwood value (t⁻¹)</td>
<td>1.91</td>
</tr>
</tbody>
</table>

The time horizon used in the analysis was 6 years, which was regarded as necessary in order to incorporate the residual effect of the technology.

The 1992–1993 season was chosen as the base year for all calculations. Choosing an earlier year would have created considerable difficulties in data interpretation given the high rates of inflation in Zambia. During 1992–1993 season, the Zambian kwacha (ZMK) exchanged at between 500 and 555 to 1 USD. An exchange rate of ZMK 525 to 1 USD was used in the analysis.

The standard unit of observation was on a hectare. This facilitates the comparison of this work with others. However, one should be aware of
the actual area farmers would put under fallow. If the size is 0.5 ha, the cash requirements for the seedlings (as well as for the fertilizer and labour) would be much less than indicated in the tables. This has important implications on the number of potential target groups.

**Labour requirements for maize and trees**

The labour data for maize (table 2) were gathered directly from on-station observations, while the post-harvest data were obtained from the Ministry of Agriculture. The figures reflect averages from hand-hoe cultivation. The only modifications made to these were harvest and post-harvest tasks where the labour hours were adjusted to correspond with yields. During the drought year of 1991–1992, labour for weeding, harvesting and other post-harvest activities was reduced to equivalent levels for all options.

**Table 2. Labour requirements (days ha\(^{-1}\)) for maize and fallow management, Chipata, Zambia**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Maize without fertilizer</th>
<th>Maize with 112 kg N ha(^{-1})</th>
<th>Sesbania fallow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery management</td>
<td>-</td>
<td>1</td>
<td>26</td>
</tr>
<tr>
<td>Land preparation</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Maize planting &amp; fertilizer application</td>
<td>3</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Tree planting</td>
<td>-</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>Weeding</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Maize harvesting</td>
<td>12</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Fallow clearing</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Maize post-harvest</td>
<td>20</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>Total labour required</td>
<td>79</td>
<td>91</td>
<td>80</td>
</tr>
</tbody>
</table>

Labour for tending trees (table 2) was directly observable from on-station trials. The only difference in labour requirements between the fallows of different duration was at harvesting time, which increased slightly with biomass production. In general, these labour data could overstate on-farm requirements owing to the tiny plots used and the sharing of tasks by many individuals. However, the opposite could also
be true since much of the work was closely supervised. On the other hand farmers might not put in the same effort as we did on station.

The cost of labour of USD 0.95 day$^{-1}$ (including the value of meals) was consistent across all rural areas of eastern Zambia. This cost reflects the wages received during peak labour periods which were the only times in the season when labour was hired by most households. Indeed, even in formal employment, a day’s labour costs only USD 1.

**Fertilizer**

The price of fertilizer changed drastically over the course of the trials. The 1993 price of USD 17.1 per 50 kg was the highest (in real terms). Because the government has pledged to continue pursuing its policy of market liberalization, the current price level is expected to be maintained in future.

**Cost of seedlings**

We estimated the cost of seedlings to be about USD 9.52 ha$^{-1}$. This estimate was based on the assumption that farmers would purchase their seedlings from a local nursery whose prices cover production costs and include a small mark-up. There are very few nurseries in eastern Zambia, and supply data were available from only our station nursery. We also assumed that the farmer would not be required to incur costs in protecting the trees from animal browsing and damage. This turned out to be untrue, however, as goats were reported to browse *Sesbania sesban* in Feni, Kalunga, Kagoro and other parts of Eastern Province, particularly during the establishment phase in November, and in the dry season.

**Fuelwood**

*Sesbania sesban* produces a significant amount of woody biomass, especially when the stand is well established. The price of USD 1.9 t$^{-1}$ for fuelwood is quite low, but accurately reflects the value of fuelwood in the rural areas in eastern Zambia. Households have access to fuelwood from communal (miombo) woodlots. Moreover, *Sesbania sesban* is not very well known; this makes its fuelwood less valued than that of other species.
Maize yield

A common hybrid variety, MM604, was used for comparison for all the options (table 3). Work done by IFPRI (1991) in eastern Zambia raises some doubts as to the suitability of hybrid maize as a control. The study found out that farmers would not adopt hybrid maize without using commercial fertilizers. The maize grain yield values given in table 3 are actual recorded yields for each of the years at Msekera Research Station.

Table 3. Treatment options and maize yield data (t ha\(^{-1}\)) used in the cost-benefit analysis from an improved fallow trial, Chipata, Zambia

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous maize</td>
<td>0</td>
<td>1.8</td>
<td>1.6</td>
<td>1.2</td>
<td>1.9</td>
<td>0.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Continuous maize</td>
<td>112</td>
<td>6.6</td>
<td>6.1</td>
<td>4.9</td>
<td>4.3</td>
<td>0.9</td>
<td>5.6</td>
</tr>
<tr>
<td>1-year fallow</td>
<td>F*(5)</td>
<td>2.3</td>
<td>3.8</td>
<td>4.4</td>
<td>0.5</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>2-year fallow</td>
<td>F F(10)</td>
<td>5.0</td>
<td>5.6</td>
<td>0.6</td>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-year fallow</td>
<td>F F F(15)</td>
<td>6.0</td>
<td>0.8</td>
<td>3.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Numbers in brackets indicate fuelwood biomass harvested after each fallow (F) period.

Experience with other agricultural technologies shows that performance is usually better on-station than on-farm because of management differences and biophysical conditions.

Results and discussion

On-station results clearly show that fertilizer use on maize was the best strategy; the surplus generated by this option, with a net present value (NPV) of USD 1231, was by far greater than that from the other options. It was 324% more than for maize without fertilizer. However, it should be noted that many farmers in Zambia have difficulties obtaining fertilizer or have complained of having incurred heavy financial expenditures on fertilizer since the recent removal of the fertilizer subsidy and the increase in interest rates. Therefore, fertilizer use is not an
attractive option on farms. Continuous maize cropping without fertilizer was the poorest performing option (table 4).

One and 2-year fallows appeared substantially profitable over the 6-year test period; they generated 81% and 95% more returns, respectively, than continuous maize without fertilizer (table 3). Maize yields from the 3-year fallow were disappointing; only 5.5% better than for plots without fertilizer. These poor yields could have occurred because the trial data only covered 3 years of cropping, 1 of which was a drought year.

Table 4. A summary of cost-benefit analysis of continuous maize and improved fallows, Chipata, Zambia (USD ha\(^{-1}\))

<table>
<thead>
<tr>
<th>Option</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Continuous maize (no fertilizer)</td>
<td></td>
</tr>
<tr>
<td>Net benefit yr(^{-1})</td>
<td>113</td>
</tr>
<tr>
<td>Accumulated net benefit</td>
<td>113</td>
</tr>
<tr>
<td>Continuous maize (112 kg ha(^{-1}) N)</td>
<td></td>
</tr>
<tr>
<td>Net benefit yr(^{-1})</td>
<td>460</td>
</tr>
<tr>
<td>Accumulated net benefit</td>
<td>460</td>
</tr>
<tr>
<td>1-year improved fallow</td>
<td></td>
</tr>
<tr>
<td>Net benefit yr(^{-1})</td>
<td>-139</td>
</tr>
<tr>
<td>Accumulated net benefit</td>
<td>-139</td>
</tr>
<tr>
<td>2-year improved fallow</td>
<td></td>
</tr>
<tr>
<td>Net benefit yr(^{-1})</td>
<td>145</td>
</tr>
<tr>
<td>Accumulated net benefit</td>
<td>-145</td>
</tr>
<tr>
<td>3-year improved fallow</td>
<td></td>
</tr>
<tr>
<td>Net benefit yr(^{-1})</td>
<td>-145</td>
</tr>
<tr>
<td>Accumulated net benefit</td>
<td>-145</td>
</tr>
</tbody>
</table>

*year 5 was the drought year of 1992

The data clearly indicate that in all fallow treatments, there is a substantial lag time before farmers can be expected to equal or exceed the net returns achieved through continuous cropping without fertilizer (table 3). The 1- or 2-year fallow options became more profitable than
continuous maize with no fertilizer only after the 4th year maize harvest, and the 3-year fallow only pays off in the 6th year. Such a delay is likely to be a serious problem for resource-poor farmers, and is thus a probable constraint to adoption.

In analysing risk, it is important to point out that, from a biophysical perspective, improved fallows provide a continuous benefit stream over 7 years. Thus if there were any external attacks on the trees during the fallow period—for example, from leaf-defoliating pests such as *Mesoplatys ochroptera*—there still would remain accumulated benefits to the soil. This inherent characteristic of the improved fallow makes it less risky than many other types of investments.

In the analyses, improved fallow technologies performed well under climatic risk. Single droughts in any year still leave the 1- and 2-year fallows being far superior to maize without fertilizer. However, the 3-year fallow appeared more susceptible to drought, and its net benefits may fall below those of maize without fertilizer.

Labour shortages for tree planting significantly reduced the net values of all improved fallow technologies. However, such constraints would only be a problem in the initial stages of fallow establishment. Once fallows are established, their higher yields could play a major role in reducing labour problems since less land will required to generate the same quantity of maize, or excess maize will be sold and proceeds used to hire labour. In terms of the labour calendar, only a few tasks associated with the technology create conflicts as most of the activities are flexible and can be accommodated at various times.

**From on-station research to farmers’ fields**

*Farmer-managed trials*

Between 1992 and 1994, on-farm tests were conducted on 8 farms to find out how best to establish improved fallows with sesbania sesban. Trees established using bare-rooted seedlings emerged as the farmers’ preferred choice. In 1994, we decided to greatly expand this participatory on-farm research. First we assisted 4 farmers’ training centres (FTCs) and 6 individual farmers to establish nurseries in Chipata, Chadiza and Katete Districts. Using bare-rooted seedlings from these nurseries and in some cases direct sowing, 158 farmers initiated
type 2 (researcher-designed, farmer-managed) and 37 initiated type 3 (farmer-designed, farmer-managed) improved fallow trials (table 5).

Table 5. On-farm trials in the Chipata area, 1994/95

<table>
<thead>
<tr>
<th>Technology</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sesbania sesban pure fallow</td>
<td>58*</td>
<td>22**</td>
<td>80</td>
</tr>
<tr>
<td>Tephrosia vogelii pure fallow</td>
<td>44</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>Cajanus cajan pure fallow</td>
<td>26</td>
<td>8</td>
<td>34</td>
</tr>
<tr>
<td>Sesbania sesban intercropped with maize</td>
<td>12</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Tephrosia vogelii intercropped with maize</td>
<td>10</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Cajanus cajan intercropped with maize</td>
<td>9</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
<td>43</td>
<td>202</td>
</tr>
</tbody>
</table>

* Includes 2 who started in 1992/93  
** Includes 6 who started in 1993/94  
Note: Type 2 trials are researcher designed, and type 3 trials are farmer designed. All trials are farmer managed.

In the type 2 trials, farmers selected 1 of the 6 improved fallow technologies (figure 1) and established it in a 400-m$^2$ plot. These options were compared with continuously cropped maize, with and without fertilizer, each planted in a 200 m$^2$ plot. The 6 options included Sesbania sesban, Tephrosia vogelii and Cajanus cajan planted in pure stands or intercropped with maize during the establishment year and then allowed to grow into a pure stand fallow in year 2. Sesbania was planted using bare-rooted seedlings, and tephrosia and cajanus by direct sowing. Researchers were involved in laying out about half of the 1994/95 type 2 trials, whilst extension staff helped farmers plant the rest. The project provided the farmers with hybrid maize seed and fertilizers, and occasionally helped transport seedlings from nurseries to the farm. Farmers supplied all the labour for nursery development and managed the trials in the manner they wished. They were advised to treat all the plots the same way—for example, to weed maize plots at the same time—in order to ensure that the results would be comparable.

Type 2 and type 3 trials are important for monitoring farmers’ assessments of the technologies and providing feedback to researchers and
extension staff. In addition, type 2 trials are useful for assessing yield response and the economics of the technology under farmers’ management. Type 3 trials help monitor how farmers modify and adapt the technology.

Figure 1: Choices farmers had to make on the various improved fallow strategies.

In type 3 trials, farmers were given seeds and seedlings and advised on management techniques for improved fallows, such as fallow length, tree density and method of planting. They then designed their own trial, planting the trees where they wished on their farms. Each farmer planted between 400 and 900 trees, covering about 0.04 to 0.09 ha. In addition, many of the type 2 trial farmers obtained extra seedlings to initiate their own type 3 trials. These farmers planted on average about 0.25 ha, depending, in part, on the availability of seedlings.
Although the bulk of the farmers experimenting with fallows established their trials in the 1994/95 season, 2 farmers in Chipata South District established their type 2 trials in the 1992/93 season. The treatments, established in 10 x 10 m plots and replicated twice on each farm, were different for the 2 farms (table 6), but the controls were kept similar. In 1995, the 2 farmers harvested their first crop of maize after clearing the fallows.

Table 6. Growth of *Sesbania sesban* and subsequent maize yields (t ha\(^{-1}\)) in researcher-designed, farmer-managed trials in Chipata, Zambia

<table>
<thead>
<tr>
<th></th>
<th>Mr Mphanza</th>
<th>Mr Mumba</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fallow biomass (t ha(^{-1}))</td>
<td>Maize yield (t ha(^{-1}))</td>
</tr>
<tr>
<td>2-year sesbania fallow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct sown</td>
<td>2.46</td>
<td>2.79</td>
</tr>
<tr>
<td>Bare-rooted seedlings</td>
<td>5.41</td>
<td>6.90</td>
</tr>
<tr>
<td>Potted seedlings</td>
<td>4.40</td>
<td>5.93</td>
</tr>
<tr>
<td>2-year grass fallow</td>
<td>-</td>
<td>2.89</td>
</tr>
<tr>
<td>Continuous maize (+ f)&lt;sup&gt;1&lt;/sup&gt;</td>
<td>-</td>
<td>5.65</td>
</tr>
<tr>
<td>Continuous maize (- f)</td>
<td>-</td>
<td>2.80</td>
</tr>
<tr>
<td>SED</td>
<td>0.86</td>
<td>1.04</td>
</tr>
</tbody>
</table>

<sup>1</sup> Fertilized maize received 112 kg N ha\(^{-1}\)

The trial on Mr Mphanza’s farm evaluated methods of establishing sesbania. In terms of above-ground biomass production of the fallow and subsequent maize yields, there was no significant difference between fallows established using potted and bare-rooted seedlings. However, sesbania established using direct sowing was distinctly poorer (table 6). Both bare-rooted and potted seedling fallows resulted in remarkable increases in maize yield compared with those achieved in unfertilized continuous maize and maize following a grass fallow. Maize yields from improved fallows with sesbania established through seedlings were similar to those obtained from fully fertilized maize plots.

Mr Mphanza was very impressed with the results and has established his own nursery for raising bare-rooted seedlings. From this he has on his own initiative expanded the area under sesbania fallow.
Mr Mumba's 2-year sesbania fallow achieved good growth and maize yield (12.1 t ha⁻¹). However, he planted a test maize crop late in January after clearing the fallow. This resulted in low overall yields, but yields of maize planted after the 2-year sesbania fallow were substantially greater than those from continuous, unfertilized maize and maize following a 2-year grass fallow. Maize yields from the 2-year improved fallow were equivalent to those achieved from fully fertilized maize plots (table 6).

The bulk of the type 2 trials was established during the 1994/95 season, which was characterized by early, erratic and low seasonal rainfall. At Msekera Research Station, which has a long-term average of 1000 mm, only 580 mm of rain was recorded. As a result of the drought conditions, many trials had to be re-seeded 2–3 times. This experience was shared by many farmers throughout eastern Zambia.

Six months after collaborating farmers had established their fallows, researchers undertook a survey of 110 of the 157 farmers who had established type 2 trials to assess the survival of the fallow species being tested in Chipata, Chadiza and Katete Districts. Most of the farmers surveyed had established the fallows as pure stands, but 29 of them, all in Chipata District, had established their fallows as an intercrop with maize (table 5, figure 1).

Clearly, the early erratic rains affected the survival of the fallow species, particularly the bare-rooted seedlings of sesbania, which, on-station, in a normal year usually achieved close to 100% survival in the first year. However, tephrosia and cajanus survived better (table 7). Their high survival rates could be attributed to the relative ease of 'gapping up' direct-seeded species compared with bare-rooted seedlings which were either in short supply or grew too large for successful transplanting as the season advanced.

Farmers cited periodic drought as the principal reason for poor survival, with weed competition (aggravated by drought) and livestock browsing being the next in importance. Poor quality seed was also a problem with cajanus, whilst late planting affected sesbania. When we compare pure with intercropped stands, it is apparent that competition for water between maize and sesbania, tephrosia or cajanus affected the survival of the fallow species (table 7).
Researchers, extensionists and NGOs are working extensively with farmers in the area who are willing to establish sesbania fallows in their fields, showing them the basic techniques for propagating and planting the trees and explaining the benefits of improved fallows. Many farmers in the region who are planting sesbania are forming groups and clubs to spread the technology.

Table 7. Survival rates (%) of pure and intercropped stands of sesbania, tephrosia and cajan

<table>
<thead>
<tr>
<th>District</th>
<th>Establishing method</th>
<th>Sesbania sesban</th>
<th>Tephrosia vogelii</th>
<th>Cajanus cajan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chipata</td>
<td>Pure stand</td>
<td>62</td>
<td>92</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>Intercrop</td>
<td>49</td>
<td>83</td>
<td>59</td>
</tr>
<tr>
<td>Chadiza</td>
<td>Pure stand</td>
<td>39</td>
<td>57</td>
<td>62</td>
</tr>
<tr>
<td>Katete</td>
<td>Pure stand</td>
<td>65</td>
<td>65</td>
<td>51</td>
</tr>
</tbody>
</table>

Note: In the 1995/96 season, over 500 farmers were experimenting with improved fallows in their fields.

This relatively simple technology has brought fresh hope to thousands of poor farmers in the region. One reason that the technology is proving to be so popular is that the spirit of enterprise that drives it is shared between the people who developed the technology—researchers and extensionists—on the one hand, and the farmers for whom it was developed on the other. This enthusiasm is epitomized by the following example. During the dry season of 1995, a lorry load of 78 farmers arrived unannounced at Msukera Research Station. They came from a village close to one of our on-farm trials and they had taken the initiative to come and find out what improved fallows were all about! The farmers were members of several self-help groups. They were accompanied by their camp officer. Project staff gave them a tour of the station and nearby on-farm trials, provided them with sesbania seed and instructed them on raised-bed nursery methods for producing bare-rooted seedlings.

Several months passed without contact. In December 1995, we decided to visit the village—also unannounced—to see how the farmers were doing. The camp officer quickly assembled the farmer group leaders,
who were quite happy to show our project staff their nursery. It was beautifully managed, well watered, completely free of weeds, and had 40 000 seedlings ready for transplanting.

The group leaders explained to us how their members managed the nursery, and had assembled a list of several hundred farmers who would receive seedlings once the rains began. Such stories are now very common in eastern Zambia where *Sesbania sesban* and improved fallows are becoming household names.

During the 1995/96 planting season, enthusiasm was still very high among the farmers. However, the nurseries they had set up could not meet their requirements. Many of the farmers wanted to plant relatively large plots (more than 0.25 ha), but could not obtain enough seedlings. Many farmers resorted to planting sesbania that regenerated from cleared fallows. Some of them travelled more than 20 km for seedlings using hired ox carts. Sesbania plants regenerating in our plots were not spared either: camp officers and personnel from World Vision International’s community development projects collected these to supply to farmers.

With so much excitement about and high expectations for improved fallows, particularly of sesbania, several constraints associated with their adoption can be expected:

- Risk and uncertainty, for example from drought, pests and diseases
- Small farm sizes
- Lack of knowledge on the technology, hence the need for farmers’ manuals
- Land tenure, for example free range livestock during the dry season may damage trees, especially *Cajanus cajan* and tephrosia
- Labour shortages
- Lack of seed and inoculum
- Traditional annual fires
Discussion

Variability in rainfall distribution

Farmers felt that the performance of the fallow species was affected by erratic rainfall at the beginning of the season. However, the growth performance of the species was also related to the initial soil status and plot management. Most fallow species were established in severely depleted fields, and some seedlings had stayed too long in the nursery before they were transplanted.

Implications for adoption

The extent of the difference in yields between fertilized fields and other options would suggest that farmers with access to fertilizer should use it for soil fertility improvement. However, the fertilizer option requires the most cash outlay, and there are chronic difficulties in obtaining fertilizer. Farmers have also mentioned that continuous use of fertilizer results in soil acidification. This issue requires further investigation.

In the absence of fertilizers, it makes economic sense for a resource-poor farmer to invest in the improved fallow technology for the production of maize. The 2-year improved fallow with sesbania has been found to be superior in terms of profitability and efficiency of labour to both 1-year and 3-year fallows with the same species. The 3-year fallow performs poorly in generating wealth but is superior in biomass (fuelwood) production.

Improved fallow technology has the flexibility to accommodate a variety of situations. Research data analysis to date has been exploring the flexibility of the length of the fallow period and the use of 4 species. However, little is known about how other variants (for example, alternative establishment methods, lower planting densities, relay cropping or intercropping species with a crop, other species) may benefit households with different characteristics.

Target groups

Target groups can be identified by a variety of biophysical, socio-economic and fallow management variables. Some important variables for eastern Zambia include farm size, labour supply, income level, presence of browsing animals, and use of fertilizer and of oxen. These variables are interrelated. As the level of income rises, farmers can first
increase their labour through hiring, then buy hybrid seed and fertilizer, and then purchase livestock, including oxen, which would allow them to expand the cultivated area. Therefore, ownership of oxen or a large cultivated area will normally imply a high level of income, the use of fertilizer and hired labour.

**Farm size.** Farmers with larger farms can afford to place more land under fallow. However, it does not follow that fallow areas will necessarily be larger on larger farms. Large-scale farmers are often in better financial positions to cultivate more land and to use fertilizer. Further work needs to be done to estimate fallow periods and their link to farm size, especially as they relate to areas of high population pressure, such as the Shire Highlands in southern Malawi.

**Labour supply.** The establishment of improved fallows requires high labour input during peak periods at planting and weeding. Therefore, households with greater internal labour or ability to hire external labour will have an easier time establishing improved fallows. Studies suggest that traditional households that plough using hoes may have more internal labour available at planting and weeding, but wealthier households that own and use oxen are willing and able to hire labour during peak periods. The question then is whether they would hire labour for improved fallows.

**Wealth/income.** There may be significant cash requirements for fallow establishment using purchased seedlings or seedlings from on-farm nurseries. However, the amount of cash required for seedlings is lesser and the frequency of its demand much lower over time than for fertilizer, which is purchased every year. Hence, the technology has potential for households with some ability to raise initial funds but cannot afford fertilizer. The very wealthy households are likely to prefer fertilizers.

**Susceptibility to browsing.** Communal grazing prevails throughout the plateau region of Zambia and may hinder adoption of agroforestry technologies. Fortunately *Sesbania sesban* has been found to be relatively unattractive to livestock in the region. For more palatable species or where fodder sources are scarce, grazing could be a real problem. Improved fallows will be adaptable and have more success in areas where grazing practices are more controlled and where fencing is common. In Zambia, fencing is more prevalent in dimbas (wetland fields) and on state land in which boundaries and the value of crops are recognized.
Wealthy farmers fence their land because they need to protect their investment and they have the resources to finance fencing. Even though wealthy farmers are more likely to use improved fallows, our target is currently restricted to poor, small-scale farmers.

**Use of fertilizer.** Results from the cost-benefit analysis suggest that households that can afford and use fertilizer should be encouraged to continue to do so. However, informal interviews with farmers showed a strong aversion to fertilizer use given that the government subsidies on it have been removed and bank interest rates are escalating, making it very expensive for farmers to borrow money for farm inputs. This implies that farmers might not receive the great benefits from fertilizer use as are received in on-station plots. It may also mean that with the current interest rates, the risks from fertilizer use are too high. Consequently, there may be potential for some fertilizer users to consider sesbania fallows if the current fertilizer pricing conditions persist.

**Use of oxen.** Classifying rural Zambian households on the basis of oxen use is a common practice among researchers. One major impact of oxen use is on the labour requirements and allocation by households. A 1991 study by IFPRI indicated that male and female labour requirements would decrease by 16.4% and 2.6% ha\(^{-1}\), respectively if farmers adopting hybrid maize and fertilizer used oxen for cultivation. Oxen use permits the expansion of land under cultivation. How oxen use would affect adoption of improved fallow technology needs to be evaluated.

**Duration and size of improved fallow**

It is a traditional practice for farmers in the region to leave land fallow for 1–5 years to regain its fertility. Therefore, the improved fallow periods of 2–3 years targeted in this research seem to be compatible with the traditional practice. Farmers sometimes unintentionally leave their land fallow, mainly when they lack maize seed, during droughts or when there is labour shortage. These ‘fallows’ are not candidates for improved fallow systems.

Although our analysis is on a hectare basis, it is the level of soil degradation and household resources and objectives that will determine the amount of land, if any, that farmers place under improved fallows. This may not be related to farm size. Moreover, smallholder farmers will expect any new technology they adopt to meet their subsistence requirements first. For an average household, which in this region has 6
people, this translates to 12 bags of maize (1.08 t), which may require as much as a hectare of land to grow. In such a situation, labour and total land holdings may restrict the amount of land available for fallow.

Policy implications

The government can play a direct role in reducing the costs associated with planting materials, for example, by 1) stocking both agroforestry and forestry species in government nurseries and expanding the nursery capacities and number, 2) providing seeds to private and NGO nurseries, and, 3) guaranteeing the price of either seeds or seedlings to encourage more tree planting. Apart from increased crop yield, the increased number of trees on farms would reduce the demand for fuelwood from the miombo woodland and result in greater environmental protection.

In the opinion of many farmers, the most desirable tree protection policy would be to review herding policies in the region to prevent off-season grazing of croplands harbouring trees. This would place all the costs of the policy shift on herders, but strict chiefs can enforce this. Such a rule is likely to be resisted by livestock owners, especially since most large livestock owners are politically influential. But in eastern Zambia, where land is relatively abundant, it should be possible to accommodate livestock in such agroforestry systems. A possible solution would be to close off a portion of the cropland to livestock for a period of time on a rotational basis to protect the trees established.

An important component of the benefits from improved fallows is the fuelwood generated from the woody biomass. Currently there are ample supplies of wood from local forests and woodlots in some parts of eastern Zambia, and fuelwood can be acquired without cash outlays. While collecting fuelwood requires some labour input, it may not represent an important cost during most of the year, though this may not be true for female-headed households (fuelwood gathering is a woman’s affair). Government policies that protect greater areas of natural forest can also encourage tree planting by farmers and in general increase the value of trees and their products to farmers. This will have the effect of increasing the attractiveness of improved fallows. However, implementing such a policy would have to be carefully planned to avoid causing unnecessary hardship on households. Furthermore, government policies that are directed towards other activities will also have an impact on the desirability of improved fallows. The recent removal of government
subsidies on fertilizer is a good example of this. This has made fertilizer
less profitable and out of reach of many farmers. As a consequence the
relative attractiveness of improved fallows has increased. While it is im-
portant to examine carefully the totality of policies, improved fallow
technologies seem to make even more sense in the absence of other
more affordable soil-management technologies, and their dissemination
should be further encouraged.

Seed quality

Farmers complained that the Cajanus cajan seed was of poor quality,
and thought it contributed to the poor performance of improved
fallow of that species. Good quality planting material is a pre-requisite
for the success of the technology. Although the quality of bare-rooted
seedlings of sesbania and tephrosia seed was satisfactory, the need for
quality planting material suggests the necessity to establish seed
orchards.

Pests

Many sesbania species fallows in all 4 agricultural districts where the
trials were located experienced serious attack from the mesoplatys beetle
(Mesoplatys ochroptera). Farmers who could afford it applied a pesticide
used to control cotton weevils to control the pest. Elsewhere in
Chilembwe (Katete District), maize was attacked by army worms, but
this was not a serious outbreak.

Management of the technology

There were obvious problems in the management of the fallows.
Variations were observed in weeding and ridging. Some farmers made
low and narrow ridges while others constructed big and high ones. It
was common that farmers did not weed their fallows due to illness or
when they had to participate in other social functions. At harvest some
farmers mixed maize yields from fertilized and non-fertilized plots.
These are practical problems that may influence the performance and
the subsequent evaluation of the technology.

Livestock damage and fire risks

Farmers complained that lack of title deeds for their land made it diffi-
cult for them to take effective measures to control bush fires and animal
browsing, which are permitted after crop harvest by land tenure prac-
tices. Farmers suggested that such factors were likely to constrain adop-
tion of many agroforestry technologies. A new agroforestry farmer in Feni camp was very disappointed when mice hunters completely gutted his plot of sesbania. We also received reports of goats browsing sesbania in Katete and Chadiza Districts and causing severe damage to the trees. It thus remains a great challenge at the policy level to promote the use of agroforestry technologies for sustainable agriculture in eastern Zambia’s fragile land tenure system.

**Enthusiasm**

In spite of the problems highlighted and discussed above, the impact of the good yield results of maize from improved fallows with sesbania is enormous. These results have created great enthusiasm in a large number of farmers experiencing soil-fertility problems. At the village level, many farmers have formed groups and clubs to promote the testing of the technology. Some groups have already identified dimba niches where they will prepare communal nurseries to raise bare-rooted seedlings of sesbania.

In March and April 1995, 8 farmers’ groups from several camps visited Msekerera station en route to other farmers testing the technology in a cross-farmer visit organized by the research team. Over 500 farmers have participated in field visits and demonstrations organized by researchers and camp officers in eastern Zambia. Farmers interacted extensively and exchanged field experiences. Many NGOs, including the Lutheran World Federation and World Vision International, and church groups are working with farmers to promote improved fallows and other agroforestry technologies in various communities within the province.

**Collaboration**

The effective collaboration established among research, extension NGOs and farmers has enhanced enthusiasm among camp staff and has created a positive momentum in researcher–farmer rapport in research. But adequate incentives are needed to sustain the momentum. At the policy level, the government has shown support for agroforestry research in the country by allocating it a budget in the Research Branch of the Ministry of Agriculture, Food and Fisheries (MAFF). This will help supplement the resources for agroforestry development in the country.
Soil fertility management within SCAFE programmes

Mr CL Phiri, Provincial SCAFE Coordinator

Background

The Soil Water Conservation and Agroforestry Programme (SCAFE) was begun in 1985 in 1 district of Eastern Province before spreading to other districts. Its objective was to manage the soil and water resources for sustainable crop production. The principal activities of SCAFE include land-use planning, development and management, and soil conservation.

The benefits of soil conservation are long term. Because establishing soil-conservation structures consumes a lot of resources (that is, it is economically negative), soil conservation has rarely been in the short-term interest of land users except in terms of maintaining soil fertility.

The definition of soil fertility varies according to different soil scientists. However, local farmers define it simply as ‘the power in the soil that sustains production of any crop’. Others call it ‘the thing in the soil that allows you to see your crop, for example maize, get green even without inorganic fertilizer’. They also define the absence of fertility in the soil by ‘the yellowing of a crop’ and ‘the stuntedness of maize plants’. The more observant farmers describe it as ‘less power in the soil, which makes you see your crop grow to 1 m, when it tassels and yellows, leaving you poorer than before’.

These farmers’ definitions have both intellectual and scientific dimensions, but the bottom line is that fertility leads to maintained or higher yields. Their level of understanding notwithstanding, farmers are concerned mostly with higher or sustained yields. Therefore, whatever farmers call fertility, however they describe it, and whatever other definitions exist, the cardinal point is that it must be maintained, improved, sustained or ‘conserved’.

Conserving the soil means maintaining its fertility. In this regard, it is not possible to separate the 2, that is, conserving the soil without improving or maintaining its fertility. Any good soil contains some amount of fertility, enabling a farmer to produce good crops continu-
ally, hence the need to maintain the fertility levels in the soil by its
careful management.

**Aims and objectives**

The aims of soil conservation in Eastern Province are to achieve maxi-
mum sustained productivity from land by controlling soil loss to ac-
ceptable levels and maintaining soil fertility and structure. ‘Maximum
sustained productivity’ means having the highest yields over a long pe-
riod of time. The main objectives emphasize productivity, sustainability
and adoptability.

SCAFE’s activities have been in the application of agronomic, agrofor-
estry and physical measures to soil conservation. These measures are
not alternatives but must support each other and must be used
together.

It should be emphasized that physical measures control runoff and must
be included on all cultivated land with slopes steeper than 2%. Agro-
nomic and agroforestry measures control mainly rain splash and im-
prove the soil. Once the physical structures are in place, soil fertility
improvement measures can safely be employed depending on the per-
centage of slope of the field in question. If this sequence is overlooked,
the nutrients that are supposed to be conserved are washed away with
the soil.

Physical structures are usually established to provide future benefits.
The costs involved in their construction have always outweighed the
benefits. The question then is: ‘Why construct physical structures that
won’t add to yields. Aren’t these a burden to the farmer?’

Indeed, the concern is genuine and is worth considering. Yet, just as you
do not need soil improvement measures in fertile soils, you also do not
need any physical measures on a field where a farmer cannot see the
signs of erosion let alone agree to adopt such an intervention! Under the
SCAFE programme, the number of farmers reported to have con-
structed physical measures is larger than of those who have opted for
any other intervention throughout the province. This indicates the
magnitude of soil erosion by runoff in the province and the farmers’
awareness of its consequences.

To what extent these farmers will benefit from these structures in the
short term will largely depend on the steepness of their slope and their farming practices. When farmers were asked why they cultivated up and down the slope or why they ridged along the slope, they said that they did not want to see their soil washed down the slope into the dambos (valleys). This also indicates that certain practices that we might consider ‘wrong’ are executed not out of ignorance but because of the need to solve problems. Consequently, physical structures, contour ridging and cut-off drains are required, depending on the severity of erosion by runoff.

Since arable land on slopes of more than 3% is more vulnerable to soil erosion than natural woodland or bush, the need to conserve the soil on the slopes is imperative. If physical structures are constructed on all cultivable land, soil erosion can be stopped altogether, dam and river siltation minimized and the precious rainwater prevented from being lost through runoff. Once the soil has been ‘conserved’, we can employ the necessary soil fertility improvement measures.

Having had the privilege of working with small- and medium-scale farmers in Eastern Province and with SCAFE for 9 years, I can include some case studies for illustration, bearing in mind that whatever the definition of ‘soil fertility’ is, the farmers’ ultimate goal is good soil productivity.

Case study 1

Mr E Nyau of Chipata South District was doing fine in his farming enterprise. He and his family were using a tractor that he bought on loan some time ago. The arable land on his farm was at that time about 5 ha and his main crop was maize.

Although he saw signs of erosion on his field, he initially ignored them since he could easily plough over them with the tractor and bury the evidence of erosion. However, the erosion increased to the point where he could not longer ignore it. At his own request, his field was ‘pegged’ by extension staff so that he could construct bunds. To his disappointment, the pegged line was ‘not straight’, and he threw away the pegs. When he did this a second time, the extension staff left in annoyance to concentrate their soil conservation efforts elsewhere.

During the 1987/88 season, Mr Nyau got another loan—in the form of farm inputs—from one of the lending institutions amounting to 175 000
Zambia kwachas. He planted hybrid maize, which had impressive germination as he had applied basal fertilizer.

But 1 night in January it rained heavily. The farmer woke up in the morning planning on how he would apply top dressing fertilizer to his field. Looking towards the field, however, the ‘green greeting’ he was expecting from his maize crop did not materialize; instead he saw a field swept nearly clean by rainwater. Looking further down the slope, he saw that his crop had been washed down the slope into the dambo. Rills and gullies had formed overnight and most of the top soil was gone.

It was then that he visited the nearest extension officer for assistance; quick action to prevent further soil loss from his farm. Further erosion would render him completely destitute, and would force him to default on his loan repayment. Mr Nyau had learnt the hard way and had no objections to the very ‘stringent’ measures he was asked to put in place; at any other time he would have termed them ‘unrealistically’ costly. He worked closely behind the man who was pegging, making the field a mass of graded bunds designed to protect the soil while draining the rainwater. That same week he re-planted the hybrid maize, but had to apply only a quarter of the recommended rate of fertilizers because he had very little left over.

**Results**

- The plants grew reasonably well and yielded a good harvest though they were planted 1 month later.
- The field was saved from further runoff.

**Case study 2**

The farmers at a village in Chipata South District near Manjanja Agricultural Camp were thinking of leaving their village to look for better land elsewhere. It seemed that however hard they worked their fields the yields were always dismal. Desperate and discouraged, they consulted the nearest agricultural extension officer who, in turn, contacted the district officers. A diagnostic and design survey was carried out and the following problems were identified:

- The low crop yields were due to low soil fertility caused by erosion
- The crops were yellowing during the vegetative stage due to lack of nitrogen in the soil
Action and results

The Manjanje community was organized and advised on what course of action to take. With their permission, the whole catchment area was graded. That year, the farmers planted maize and got a good harvest. One farmer was particularly happy and commented, ‘My plot yielded 4 bags (360 kg) of maize compared with the 4 tins (64 kg) I used to get. I hope I will get more next year’.

Case study 3

Mr M Tembo of Kamlaza camp, Chipata South District, was a farmer with a good credit rating with a local lending institution. Obtaining credit facilities was therefore not a problem for him. His main problem was that some parts of his large field remained unproductive no matter how much fertilizer he applied.

So he contacted the nearest agriculture extension officer, and was advised on what measures to take. He constructed some graded structures, and the following year he got a very good harvest.

The graded structures were designed to direct the rainwater water into a depression where the farmer opted to grow rice. This brought further benefits in terms of producing rice for sale and consumption.

At one of the courses he attended, Mr Tembo learnt about the use of manure as a soil improvement measure. Looking back to his own village where almost all the animals were kept knee deep in their dung, he opted for kraal manure. He wisely chose the most degraded part of his field where almost nothing was growing. He demarcated the plot into 4 blocks of 10 m x 10 m as follows:

- A block where the recommended quantity of manure was applied (10 ox carts per ‘lima’)
- A block where half rate of manure was applied
- A block where commercial fertilizer was applied at full rate (200 kg N ha⁻¹)
- A block that acted as a control—no fertilizer or manure.

Mr Tembo was taught how to treat the manure and when to apply it. Following the instructions given to him by the officers, he did a com-
In the course of the trials, other farmers came to observe the demonstration of farming with kraal manure. They visited during both the crop growth and harvest stages. We could clearly see the excitement of farmers during these visits. Most of them promised to sweep clean their cattle kraals (and therefore, indirectly provide better resting places for the animals) and to use kraal manure as fertilizer.

**Results**

The yields following the application of kraal manure were excellent. Indeed, even applying just 50% of the recommended rate of kraal manure produced better results than commercial fertilizer. However, only a few or no cobs were harvested from the control plots. The following year Mr Tembo expanded his field and applied more than 40 ox carts of treated manure ha\(^{-1}\). The manure drastically reduced the need for inorganic fertilizer, but his yields remained impressive and convinced him to expand the area under manure during the 3rd year.

Farmers who toured Mr Tembo’s trials were impressed with his yields. As a result more than 300 farmers participated in the manure application trials in Chadiza alone, and many more have been willing participants in similar trials for more than 4 years.

**Other soil improvement options**

Apart from kraal manure, we have tried other materials for soil fertility improvement, including sunhemp (whose seeds were bought from an NGO in Chipata and distributed to farmers), velvet beans and, to some extent, *Leucaena leucocephala*.

Sunhemp seeds were distributed to many farmers participating in the programme until severe drought wiped out most seed crops. This made it difficult for the programme to obtain the seed to distribute to more farmers. However, the few farmers who managed to keep some seed are still applying green manure in their fields.

**Rationale and strategies**

The aim of this paper is not to glorify SCAFE as a programme or to highlight some individual efforts or achievements. Nevertheless, numerous farmers have benefited from the programme’s interventions either as groups or as individuals. The case studies given here are meant to paint a picture of the situation. The intentions of this paper are:
• To seek cooperation and coordination with other actors so that technologies are integrated. Farmers must produce more food at minimal cost

• To urge a concerted effort from all of us to give our farmers a better life

• To show that through the Department of Agriculture Extension services, we can deliver technologies to farmers who are more than ready to try new technologies from research.

• To show how, with discipline and determination, we can work closely with farmers to ensure that new technologies, including improved fallows, can succeed

**Strategies**

1. Identify target areas and groups to work with. Expose them to the technique in question and work constantly with them until you succeed. Being with a farmer most times is the key to successful technology transfer

2. Identify fields that have been left fallow and find out why. Those are key fields whose owners may need just a little exposure to the technology to convince them to go back to their fields and implement the improved fallow technology

3. Go back to the early adopters in SCAFE and note those that still have physical structures in their fields but are desperately in need of fertilizers but cannot afford them. Those might be easier targets for improved fallow technology.

4. Design realistic programmes that will be easy to implement and monitor.

**Extension of sesbania fallows: SCAFE point of view**

_Al Raunio_

Good, fertile soil is the most resistant to erosion. SCAFE promotes improved land husbandry—that is, soil conservation structures, conservation tillage practices, and different methods of soil fertility man-
agement. The SCAFE approach includes soil improvement measures such as the use of kraal manure, compost, green manure, crop rotation, natural fallow and improved fallows.

So far we have put greater emphasis on physical soil conservation measures, which have been the most obvious of the activities visible in the field for years, as Mr Charlton Phiri pointed out in his presentation. The structures have been re-emphasised for increased water conservation.

A closer look at the SCAFE approach reveals that many recommendations have undergone relatively little research. Agroforestry may be an old practice but it is a new science and is not covered much in the curricula of agricultural and forestry colleges. This is not true for hybrid maize and inorganic fertilizers. Currently, in Zambia there has been little or no research directed at alternative technology for soil conservation. An earlier campaign to popularize kraal and inorganic fertilizers meant that little or no research was directed at alternative methods. This campaign resulted in weed problems as insufficient attention was paid to the treatment of manure before application. Besides, it appears that alternative soil fertility management techniques are not covered adequately in crop husbandry curricula.

SCAFE has been criticized as being too rigid in its approach. According to the project document, the approach should be ‘holistic and participatory’. There were changes in the approach in the early 90s, from working with contact farmers to farmers’ group in Eastern Province. A step to a more participatory direction is the introduction of the ‘menu approach’.

In this approach the extension officer analyses the farmers’ strengths and constraints and describes for them the advantages and disadvantages of different soil improvement measures. The farmer then decides which method suits his or her situation best.

Moving from the single message approach to the menu approach puts more demands on the extension service, particularly on the frontline extension staff. Extension staff will need to have thorough knowledge of a wide range of topics and a capacity to analyse individual farmers’ situation. Consequently, they need a lot of training and training material. The ongoing preparation of integrated soil fertility management
manual by farming systems research and agroforestry research teams, with inputs from SCAFE, will go a long way in compiling the available experience and research data for training extension officers. Improved fallows with sesbania and other species will be part of it.

While the information on other soil fertility measures is rather sketchy, the improved fallow technology with sesbania is by far the best researched, particularly in Eastern Province. Hence, a manual on improved fallows alone would be quite justified.

**Improved fallows in the SCAFE programme**

According to its mandate, SCAFE promotes 'known and proven technologies'. This has been, at times, problematic in the light of very little information on many technologies, particularly on soil fertility improvement measures. Improved fallows have evolved from experimental stages. Although this technology it has been on our list, we have been hesitant in promoting it, because we have not been certain about its status. In Eastern Province, sesbania has become increasingly well known, but we have not been sure whether it has been sufficiently proven. At times, however, when farmers have collected seeds of sesbania during their visits to Mseekera and on-farm trials and gone ahead to try the technology on their own, SCAFE has been blamed for promoting a technology that is not yet proven or released by researchers. Because of the high demand from farmers, SCAFE has been trying to push on the preparation of the sesbania improved fallow manual for over a year.

The launching of the improved fallow manual would mark a milestone in the technology, showing that it is sufficiently developed and can safely be included in the SCAFE programme. My understanding is that SCAFE and the extension service will then promote this proven form of the improved fallow technology, while ICRAF will continue to pursue different research aspects of the technology, both on-station and on-farm.
Potential of improved fallows in farming systems in Eastern Province

Mr Thomas Rausen, Agronomist, FSRT, Msekeri

Introduction

Declining soil fertility is considered by farmers and researchers to be a major constraint to small scale agricultural development in Zambia. Considering the heterogeneity of socioeconomic conditions of small scale farms in the area, it is unlikely that a universal solution to soil fertility problems can be found. A number of criteria that influence farmers’ adoption of technologies related to soil fertility management need to be considered.

The technology ideally should

- Offer high returns to labour
- Be productive (result in clearly visible improvements)
- Require little capital
- Involve low risk
- Have some short-term appeal/benefits
- Be simple
- Be flexible
- Be sustainable

A number of potential technologies for soil fertility management are well known, and research on them as well as practical experiences are documented. These include:

- Inorganic fertilizers
- Soil conservation technologies
- Use of kraal manures
- Crop rotation
- Planted pastures
- Green manures

Improved fallows with *Sesbania sesban* for 2–3 years are a new technology building on the traditional practice of long duration natural
falls. These improved fallows have proved to be very effective over several seasons following the fallow stage, and they require little capital input. Furthermore, some species produce firewood of acceptable quality, and reduce weed infestation (including striga) in crops following improved fallows. However, some drawbacks still need to be overcome—

- *Sesbania sesban* requires a nursery phase for good establishment
- Defoliating beetles (*Mesoplatys ochroptera* and *Ootheca* spp.) can cause severe damage on young sesbania plants
- The fallow requires considerable labour inputs for planting and weeding in the first year as well as for protection against fire and livestock in the dry season

A matrix, summarizing the current knowledge on potential technologies, which scores features of the technologies against the aforementioned criteria, has been developed (see table 8). While more information on the ecological adaptation of the different technologies is required, the matrix allows some pre-screening of technologies and their suitability for different farmer’s socioeconomic situations. It is then suggested that farmers be given a ‘basket of choices’ of pre-screened technologies to allow them the opportunity to experiment with, adopt, reject or choose a combination of technologies.
Table 8: Proposed socioeconomic requirements, and the needs of different technologies for soil fertility management

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Natural fallow &lt;5 years</th>
<th>Erosion control (engineer approach)</th>
<th>Manure use</th>
<th>Rotation</th>
<th>Inorganic fertilizers</th>
<th>Green manure</th>
<th>Improved fallow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production increase</td>
<td>none</td>
<td>low</td>
<td>high</td>
<td>low-high (depending on crop)</td>
<td>very high</td>
<td>high</td>
<td>very high</td>
</tr>
<tr>
<td>Capital input</td>
<td>none</td>
<td>low (hoe, shovel)</td>
<td>medium</td>
<td>none</td>
<td>very high</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Labour input</td>
<td>none</td>
<td>very high(^{(1)})</td>
<td>medium(^{(1)})</td>
<td>none</td>
<td>low</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>Short-term benefit (appeal)</td>
<td>low (pasture)</td>
<td>low-medium</td>
<td>high</td>
<td>medium</td>
<td>very high</td>
<td>high</td>
<td>little(^{(2)})</td>
</tr>
<tr>
<td>Lasting effects (years)</td>
<td>little/note</td>
<td>long if maintained</td>
<td>1-3 seasons</td>
<td>continuous</td>
<td>1-2 seasons</td>
<td>1 season</td>
<td>2-4 seasons</td>
</tr>
<tr>
<td>By-products</td>
<td>few (pasture)</td>
<td>groundwater recharge</td>
<td>-</td>
<td>diversified output</td>
<td>none</td>
<td>fodder</td>
<td>firewood</td>
</tr>
<tr>
<td>Side effects</td>
<td>weeds</td>
<td>need for maintenance</td>
<td>weeds</td>
<td>improved food security</td>
<td>soil acidification nutrient imbalances</td>
<td>weed suppression (including striga)</td>
<td></td>
</tr>
<tr>
<td>Draught power requirements</td>
<td>none</td>
<td>helpful</td>
<td>high</td>
<td>helpful</td>
<td>none</td>
<td>medium unless intercropped</td>
<td>low</td>
</tr>
<tr>
<td>Risks</td>
<td>land tenure</td>
<td>breakage</td>
<td>increases weed infest</td>
<td>reduced</td>
<td>'burning' of crops</td>
<td>little</td>
<td>pests, livestock, fire</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Off-season work, \(^{(2)}\) Pigeon peas here are not considered as fallow crops, but food and cash crop
SESSION 3: DISTRICT REPORTS

Chipata South District

Mr V Mumba, DAO

Introduction

Land productivity in Chipata South has been declining because of continuous maize monocropping, deforestation and soil erosion.

SCAFE has been operating in the district since 1985, mainly dealing with soil conservation structures. From 1990 to 1991, soil fertility improvement measures were added to the programme. These measures were first tested in pilot areas, for example Feni camp.

Soil fertility management

Velvet beans (mucuna) and sunhemp were introduced for green manure, followed by an early maturing (Pool 16) maize variety. At first the production of velvet beans progressed so well that the district was supplying seed to Petauke/Nyimba and Lundazi. Velvet bean production, however, declined because of frequent droughts, consumption of seeds as food during famines, and misunderstandings about marketing prospects for the beans. Farmers using ox-driven implements also found it difficult to plough their fields because of entangling bean runners.

Sunhemp production also declined because of drought, resulting in loss of seed. Farmers were frustrated by expectations that the crop had commercial value.

After the decline of velvet beans and sunhemp, farmers turned to improved fallows, with a surprising response to Sesbania sesban, Tephrosia vogelii and Cajanus cajan, which were introduced to the area by ICRAF.

Extension staff, farmers and NGOs first got exposed to the improved fallow technology during field days at Msekeria Research Station in 1989. Maize performance after improved fallows with sesbania was so good that many people thought ICRAF scientists were cheating with their data. It was suggested that ICRAF tries to put similar trials on
poor, sandy soils on farmers’ fields. On-farm trials were established in 1992 in Eastern Block, which has a high population of both people and livestock, widespread deforestation, and sandy soils of very low fertility.

After nearly 5 years, farmers experimenting with improved fallows number 282, of whom 41% are women: cajan—25, tephrosia—71, Sesbania sesban—183, and Sesbania macrantha—3.

Most of the improved fallows in the eastern block have reached the crop stage and confirmed the benefits of improved fallows with sesbania as shown by examples from Feni (table 2). For the majority of farmers, particularly in the southern and western blocks, fallows are at the tree-growing stage. Direct sowing was practised by 20 farmers with cajanus and 61 with tephrosia. Nineteen farmers used potted Sesbania sesban seedlings, 90 planted bare-rooted seedlings, and 15 practised intercropping with cajanus, 107 with sesbania and 53 with tephrosia. The main intercrop was maize.

The experimenting farmers were selected by camp officers through the routine train and visit (T&V) meetings, field days, tours and courses. Over 1500 farmers have so far requested to try soil fertility management using improved fallows. The main bottleneck is nursery establishment, particularly because water is lacking during the dry season and this was exacerbated by 2 drought years in 1994 and 1995. Besides, extension officers could not handle all the demonstrations for lack of transport. Staff and farmers are not adequately trained in agroforestry techniques. Many traditional leaders are not participating fully in the programme, yet we need to involve them at an early stage as they influence land allocation.

**Kaphinde Camp**

*Mr Zulu, Camp Extension Officer*

In 1995, farmers from Kaphinde camp organized their own tour to Msekera Research Station to review results of improved fallows. They hired a truck, fuelled it and carried their food. During the 2 days at Msekera, they collected Sesbania sesban and tephrosia seeds and were trained in nursery techniques. When they returned to Kaphinde, they set up their own nursery using bare-rooted seedlings and inoculating the seedlings with rhizobia from sesbania soils collected from Msekera. They raised 200 000 seedlings (the target was 300 000), which were
divided between 85 farmers. Two other nurseries produced 4500 seedlings.

So far 77 farmers have established their own sesbania fallows, but 16 of these failed because of drought. Ten farmers are testing tephrosia. It seems most farmers prefer 2-year fallows for the sandy soils of Kaphinde. Their enthusiasm and expectations are very high. They value visits by researchers and to visiting fellow farmers whose trials have reached the crop phase.

Kalunga Farmers' Training Centre

Mr I Banda, Officer-in-charge

Improved fallow demonstrations were initiated by ICRAF staff at Kalunga, beginning with nursery establishment in November 1992. During the past 4 years, 1.7 ha of trials have been established at Kalunga Farmers’ Training Centre (FTC) by ICRAF and FTC staff.

With support from World Vision, the FTC staff have conducted courses on agroforestry and improved fallows. More support is needed for similar courses and field days.

Cooperation with local leaders needs to be strengthened to reinforce controlled grazing in the area. The FTC needs a diesel generator, a TV and video, video camera and tapes to enhance farmer training. We also need a cassette recorder to tape extension messages and songs composed by the Kalunga Agroforestry Club. These can motivate farmers, extension officers and NGOs.

Kalunga Camp

Mr Chikubi, Camp Officer

About 91 farmers have participated in the programme since 1993. During the 1993/94 season 38 farmers participated, and in the 1994/95, 44. So far, 18 of those participants have been women and the rest men.

In 1993, we raised sesbania seedlings in pots, but in subsequent years, we have adopted raised beds introduced by ICRAF to produce bare-rooted seedlings. Tephrosia and pigeon pea are directly seeded. In 1995, there were 5 group nurseries which, although somewhat affected by the
drought, produced additional seedlings. This was a manifestation of farmers interest and learning process.

Our successes can be attributed to strong linkages among researchers, extension officers and farmers in the area. Failures were caused by drought, livestock browsing, fires and poor management, partly because the technology and culture of tree planting is relatively new to the area. ICRAF should be congratulated for introducing this technology to Kalunga. [See table 9 for the results of different fallow management options by Jennifer Zulu, 1 of the early experimenters in Kalunga, Chipata South District.]

Table 9: Maize grain yield (t ha\(^{-1}\)) from Jennifer Zulu’s improved fallow and control plots

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Maize grain yield (t ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize + fertilizer</td>
<td>5.66</td>
</tr>
<tr>
<td>Weeded <em>Sesbania sesban</em> (2-year fallow)</td>
<td>4.42</td>
</tr>
<tr>
<td>Unweeded <em>Sesbania sesban</em> (2-year fallow)</td>
<td>4.00</td>
</tr>
<tr>
<td>Weeded tephrosia (2-year fallow)</td>
<td>3.60</td>
</tr>
<tr>
<td>Unweeded tephrosia (2-year fallow)</td>
<td>2.74</td>
</tr>
<tr>
<td>Continuous cropping without fertilizers</td>
<td>1.28</td>
</tr>
</tbody>
</table>

To attract more farmers, field days are better than meetings; the presence of research officers adds to the attraction. More training courses and video shows are needed. Better transport for camp officers would be an added incentive.

**Jerusalem Camp**

*Ms Kwaambwa, Camp Officer*

ICRAF started with researcher-designed, researcher-managed trials of improved fallows using *Sesbania sesban* in 1991. When I was posted to the area, I was exposed to improved fallows with sesbania when I attended a field day at Msekera. After that I recruited 24 farmers for improved fallows. Many of them intercropped sesbania or tephrosia with maize, but we do not yet have results from the farmer-managed trials.
Our future plans are to establish more nurseries and to recruit more farmers and to monitor the ongoing researcher-designed, farmer-managed trials.

**Sanjika Camp**

*Ms Mvula, CEO*

Four men and 10 women planted sesbania in 10 m x 10 m plots in 1994/95. Tephrosia was also tested by direct sowing. Some farmers intercropped tephrosia with maize, and the results were encouraging.

We have found that field days are the best way of reaching farmers and training them on the new technology. Most farmers prefer short-rotation fallows of 2–3 years, after witnessing the successful trials at Msekera, Feni and Kalunga.

**Feni Camp**

*Mv Peleka, CEO*

In 1993, we recruited a number of farmers through our regular T&V meetings to try improved fallows. That year 26 farmers succeeded in establishing improved fallows with sesbania. However, weeding of fallows was a problem, as farmers gave priority to maize not sesbania, resulting in poor establishment of the fallows.

In order to reach more farmers, ICRAF and GTZ should find some way of motivating the extension officers. The status, pay and morale of extension workers is currently very low but can easily be boosted by giving simple incentives (such as transport, allowances, training, etc). Such incentives can greatly enhance the delivery of technologies such as improved fallows with sesbania to farmers in the area.

In addition, to reach more farmers, more demonstration plots are needed to compare improved fallows to grass fallows. More mobile courses are needed at camps. Incentives should be given to camp officers and NGO officials at the grassroots level. Together—research, extension, NGO and farmers—we can tackle the declining soil fertility problem that is reducing food security in the area.
Madzimoyo Reformed Church of Zambia development programme

Mr D Mukelabi, Farm Manager

The agricultural project of the Reformed Church of Zambia is dealing with the improvement of soil fertility using nitrogen-fixing plants, and conservation of the soil by physical structures. We have been working with ICRAF, SCAFE and the Farming Systems Team since 1993. The project is carrying out extension among 1500 farmers in northern and southern blocks, and expects to expand these activities to western and eastern blocks in 1997.

The agricultural team of the project holds regular meetings with government personnel at district and provincial levels to appraise them on progress and problems in the field.

At the training centre we have a central demonstration area of 24 plots, all 22 m x 18 m, 15 of which are for soil improvement (using sesbania, tephrosia, pigeon pea, velvet beans or sunhemp established with bare-rooted seedlings or by direct sowing), and 9 for pastures (grasses and legumes).

Ten farmers have so far tried improved fallows in this pilot area; 3 of them used direct sowing with inoculum, and 7 used bare-rooted sesbania seedlings. Only 5 farmers were successful. The others failed because they did not have sufficient water for their seedlings or did not receive adequate supervision from the extension services (this is required because the technology is new).

The technology is disseminated to farmers' groups through visits and courses. The trained farmers in turn pass the message on to their neighbours or church members. The project is now targeting 500 farmers. We need transport and seeds at the right time so that our nursery operations are timely.
Khova Community Development Project, World Vision

O Tembo, Project Development Worker

Introduction

Khova Community Development Project is a community-based project in Chief Sairi’s area near Kalunga. It is funded by World Vision International, a Christian organization. It is concerned with food security at the household level.

We tried to tackle food production problems by issuing loans, but had to discontinue this as many farmers considered loans given by a Christian organization to be gifts.

Improved fallows

The project coordinator contacted Msekera Research Station in 1995 and learned that it was possible to grow maize successfully without fertilizer. We funded a training course for 17 farmers at Kalunga Farmers’ Training Centre, where ICRAF staff and farmers with experience about improved fallows were resource people. During the training course, farmers visited 1 of the adoptive research farmers, Jennifer Zulu. In the 1995/96 season, we established a small nursery which could only suffice for the needs of 2 farmers. These 2 planted 20 m x 20 m plots with sesbania. We also got more seedlings from the Jerusalem Camp and Kalunga Farmers’ Training Centre. These were planted by 8 farmers, while another 4 planted tephrosia in their fields.

Problems

Sesbania is popular food for some insects, such as (Mesoplatys ochroptera), that eat pumpkin leaves. We need solutions from researchers to control these pests.

During the first year of establishment, trees were browsed by cattle and goats that roam and freely graze the fields after the crop harvest. To protect sesbania trees, farmers will need to fence their fields, or chiefs to enforce legislation to control free range grazing and force farmers revert to herding. We have recruited only a few farmers because the technology is still new in the area. We shall work hard to educate more farmers on the benefits of improved fallows with sesbania. We also need training about the technology, including nursery techniques and management of the technology in the fallow and crop phases. This will enhance our capacity.
Reaching more farmers

To accelerate dissemination of the technology, influential leaders need to be approached and seminars and field days held to increase awareness. Simple incentives such as ICRAF T-shirts and caps are useful for popularizing the new technology.

Msekochika Catholic Church project

Mr T Banda

We learned about improved fallows from Msekera Research Station at a field day in 1988. However, we continued popularizing sunhemp in our area. So far 60 farmers are using it. Recently we started with sesbania technology, which is now at the nursery stage. So far we have planted sesbania on level bunds and we have used potted seedlings only. We have established 5 nurseries at our village training centres. Tephrosia has been intercropped with sunflower and the results are encouraging.

Few farmers have been reached because we lack knowledge on the sesbania improved fallow technology, which is new to our farmers. Besides, seedlings have been attacked by beetles, and livestock tend to browse them in the dry season.

For another attempt with sesbania, we need assistance in the form of training, pamphlets and transport. Farmers' groups, too, need incentives. Competitions, such as our ‘best farm’ one, are valuable when demonstrating new technologies.

Baptist Church

Pastor P Chisenga

As a minister of Chipata Calvary Baptist Church, I take a great interest in things that help to improve the living standards of our people.

I got interested in improved fallows from a paper that Dr Freddie Kwesiga presented at an environmental workshop in Katete in 1994 (Kwesiga 1994). We also saw sesbania fallows at Kagoro.

Personal observations

Improved fallows, particularly with Sesbania sesban, are a great success in agricultural research in Zambia. They may be the key to the survival
of peasants growing maize. A lot of farmers who have been privileged to try them have had encouraging results.

I would like to find out whether this technology can eliminate the use of fertilizers in vegetable production and make vegetable growing cheaper and at the same time improve the quality of vegetables. I planted sesbania in my backyard vegetable garden, but it is too early to draw any conclusions from the experience.

There has not been enough publicity about improved fallow research findings, though. There are no extension materials either. Extension officers are crucial in disseminating the technology to farmers. There is need for coordination among research, extension and NGOs.

Suggestions

All Zambians need to know about sesbania technology. The Ministry of Education should include it in the environmental science curriculum for both primary and secondary schools. Each school should have a pilot project involving sesbania.

Rural communities have to be well informed, and in this traditional leaders are the key persons. Also, communities in resettlement schemes need to be involved. There should be a pilot project in every resettlement scheme.

TV and radio programmes can spread the message to the general public too. Literature on sesbania has to be made available in schools, libraries and bookshops, both in English and the local languages.

The Ministry of Agriculture should provide adequate funds for sesbania research to facilitate the implementation of the above proposals.

Chipata North District

Mr S Chikambwe, DAO

Chipata North District has 5 Chewa and 4 Ngoni chiefs; 4 blocks and a farmers' training centre which also serves Mambwe District. The number of farm families is 18 600. Rainfall in 1994/95 was 546 mm, and in 1995/96, 841 mm. Major agricultural crops are maize, groundnuts, cotton and burley tobacco. The district is experiencing declining soil fertility and reduced crop yields.
Improved fallows

The use of sunhemp, velvet beans and pigeon peas for soil fertility improvement was quite popular before independence, but the practice died gradually until the 1980s when it was revived by SCAFE. ICRAF introduced, sesbania, tephrosia and gliricidia for improved fallow trials, and these are gaining popularity very fast.

In Chipata North District, 155 farmers are practising improved fallows. ICRAF monitors 107 of these whilst the others were initiated and are overseen by SCAFE. Fifty-five farmers used bare-rooted sesbania seedlings. Four demonstration plots are at the crop stage, and the rest are at the tree-growing stage. Direct-sown tephrosia (61 farmers) and pigeon pea (39 farmers) are mostly intercropped with maize. After observing results from different practices, farmers generally agree that a 2-year fallow is the minimum requirement for soil improvement. The district has established 19 nurseries, 5 of which are at farmers’ training centres and the rest in farmers’ gardens.

Analysis of the results

All the nursery-raised seedlings collected were bare rooted. In some cases, the seedlings were not enough for farmers’ requirements. The high fertilizer prices have forced farmers to try the improved fallow technology. Many farmers are already convinced that sesbania and tephrosia fallows are as effective as fertilizers in maize production.

Dissemination of the technology

ICRAF and SCAFE officers taught nursery techniques to extension officers who in turn passed the information on to farmers. All the farmers involved in the trials were recruited on merit, after attending field days, meetings and courses.

To speed up dissemination of the improved fallow technology, 1) more funds need to be allocated to courses and field days, 2) NGOs should be involved, 3) staff morale should be boosted, 4) efforts should be concentrated on pilot villages, and 5) research people should help in the expansion of fallow technologies. In our district, 200 farmers were recruited but only a few were attended to. There is an alarming demand for the technology in Chipata North District.
Tamanda Community Development Project of World Vision

We got exposed to the sesbania improved fallows in a workshop organized by ICRAF at Msekera in September 1995. Thereafter we organized a nursery workshop for 35 interested farmers in November 1995. A central nursery was established, but the seedlings were not enough. Thirteen farmers planted sesbania on a half lima plot (0.1 ha), but 1 failed because of drought.

In future, we shall arrange more tours to Msekera and get our local chief involved. Researchers should communicate their findings to farmers and give more attention to the control of beetles (*Mesoplatys ochoptera*).

Kalichero Camp

*Chirwa, CEO*

I first got exposed to the improved fallow technology during a field day at Msekera Research Station in 1993. We then took the technology to 1 camp in Chipata North District, and involved 2 farmers in testing sesbania and tephrosia in researcher-designed trials. The following year we extended the technology to a neighbouring camp where 41 farmers planted tephrosia, 19 bare-rooted sesbania and 2 *Cajanus cajan*.

One enterprising farmer, Mr J Banda, recruited a number of fellow farmers, but none of them planted because of lack of seedlings. The Catholic Church has also been promoting soil fertility management in the area using leucaena, and I think they ought to be introduced to improved fallows with sesbania as well. In my opinion, all camps, and not just the 3 now involved, need to participate in improved fallow work. We also need better transportation to enable us to organize tours and workshops for active farmers. Manuals and training materials are also needed, and ICRAF should conduct more seminars of this nature in future to expose the frontline extension staff to new developments in the improved fallow technology.

Katete District

*Mr Chivubswe, District Crop Husbandry Officer*

Much of Katete is characterized by high densities of humans and livestock. Deforestation, accelerated by charcoal burning, is causing short-
ages of forest produce. Soil fertility is declining. Malnutrition in the villages as a result of maize monocropping has become severe.

Improved fallows

Sesbania was first introduced to Katete by ICRAF. However, only 3 farmers have reached the cropping phase; others are still at the fallow phase. Seventy farmers have tephrosia fallows established by direct sowing, and 50 have sesbania fallows established with bare-rooted seedlings. There are 4 on-farm nurseries and 1 at the local farmers’ training centre. No intercropping is being carried out during the fallow phase.

Reaching more farmers

Lack of transport for extension officers is the main reason that only a modest number of farmers are adopting the improved fallow technology. For accelerated dissemination of this and other agroforestry technologies, we require 1) funds for fuel and allowances, 2) meetings and mobile courses to teach farmers about nursery establishment, 3) teaching aids, 4) radio programmes, 5) slide shows, and 6) motorcycles for camp and block supervisors.

Incentives for farmers, including tours to farmers’ training centres, Msekeri, and fields of other farmers who have successfully adopted the technologies, are also necessary as these are the main sources of practical information for farmers.

Research

On-farm trials to test shorter duration fallow species other than sesbania should be initiated. Research findings should be disseminated quickly rather than waiting for this type of workshop to do so.

Katete Farmers’ Training Centre

Mr AZ Phiri, Officer-in-charge

Katete Farmers’ Training Centre first attempted to establish improved fallows during the 1993/94 season with little success because the seedlings they used had stayed too long in the nursery. The following year, many farmers from Chilembe Camp succeeded in establishing improved fallows using a month-old seedlings obtained from the farmers’ training centre nursery in early December at the onset of the rainy season.
In 2 residential and 7 mobile courses (supported by the Finnish Volunteer Service and World Vision), 550 farmers were recruited. Fifty planted sesbania, 30 tephrosia and 10 pigeon peas. Trials with directly sown sesbania gave poor results. Our recommendation is that for scaling up dissemination of improved fallow technology, districts should form improved fallow committees, with all stakeholders being represented. Headmen’s involvement is also crucial for the control of livestock movement and of the use improved fallow plots during the dry season.

Mzime Camp

Mr Makinda, CEO

I learned about sesbania in the Extension Bulletin and Agriculture Handbook of SCAFE in 1994. The farmer’s training centre manager then encouraged me to raise sesbania at our camp. I recruited 17 farmers through village extension groups to do the same. The main problem during planting was drought, but our resourceful headman, Mr Fisi, managed to keep his bare-root seedlings alive by temporarily planting them in a trench and watering them until the weather improved for planting.

Three on-farm nurseries did quite well. Thirteen farmers planted sesbania, 3 tephrosia, and 1 pigeon peas.

Seedling failure in 1994/95 was caused by beetles, drought and poor management by the farmers (for instance, all tephrosia was browsed by livestock). In 1995/96, ICRAF was not able to provide enough seeds and fertilizers to set up any Type 1 and Type 2 on-farm trials. This was due to a change of policy by ICRAF on the supply of fertilizers for control plots. However, we still need other kinds of support, particularly in the form of transport and incentives.

Kagoro Camp

Mr Mwanza, CEO

I became aware of the sesbania improved fallow technology whilst working in Chilembwe camp. When I was transferred to Kagoro last year, I recruited 16 farmers to try out the technology. Earlier, a number of Kagoro farmers had adopted improved fallows with sesbania: 3 had sesbania at the fallow stage and 3 at the crop stage, 21 had directly
seeded tephrosia, 2 Sesbania macrantha, 25 sesbania fallows established from bare-rooted seedlings, and 16 had directly seeded pigeon peas.

Seedling failure was caused by drought, termites and livestock browsing. Lack of transport for extension personnel probably explains the low numbers of farmers experimenting with the technology.

Scaling up the trials can be accelerated by more training for farmers and camp staff, better transport for staff, who should also be sent on tours and given protective clothing.

Regular research-extension meetings are essential for improving linkages and dissemination of ideas for the benefit of the rural smallholder farmers.

**Mphangwe Community Development Project—World Vision**

In 1995 World Vision International (WVI) approached ICRAF to explain the concept of improved fallows. Thereafter, WVI organized tours and mobile courses, which led to the recruitment of 25 farmers to try the technology. A 2-day course on general agriculture and agroforestry was conducted at Katete Farmers’ Training Centres in November 1995. Thereafter, the project established a nursery, but the seedlings were destroyed by beetles. So Katete Farmers’ Training Centres and ICRAF provided seedlings for distribution to farmers. Twenty-three farmers established sesbania fallows by intercropping with maize, and only 2 farmers established pure-stand sesbania fallows. The farmers encountered a number of problems, for example, beetles and termites affected seedling establishment, and no gapping was done because of lack of seedlings. Experts recommended Decis, a cotton pesticide, for the control of the mesoplatys beetle.

In this area transport is a big problem as we have only bicycles. Staff motivation can greatly be improved by introducing a bottoms-up style of management and by providing protective clothing. Schools, women’s clubs and village committees should be encouraged to start nurseries and demonstration plots, but first there is need to train frontline camp officers and NGOs to be better versed in the technology.
Chadiza District

Mr S Daka, DAO

In 1993, ICRAF helped 6 farmers in Chidiza establish researcher-designed, farmer-managed trials with seedlings raised at the district forest nursery. Some of the sesbania trials have now reached the crop phase, but have not performed as well as we expected. Sesbania did not grow well, and the crops following sesbania fallows did not perform as well as they did at Msekerja. It may help if the fallow stage is extended to 3 years, which might increase sesbania biomass production and hence improve soil fertility.

Dissemination of the technology can be accelerated by involving local leaders, and giving incentives to extension officers. However, improved soil fertility should be a sufficient incentive to farmers. More training and training materials are required at all levels.

Kasongo Camp

Ms Simaila, CEO

In 1994, ICRAF recruited 95 farmers at Kasongo camp. Of these, 21 had pure plots of either tephrosia, sesbania or pigeon pea. The rest intercropped their fallow species with maize at the establishment stage. There was only 1 nursery site at the camp, but other potential nursery sites exist.

Our trials have not done very well, probably because the soils are a poor, sandy type. In future the experience of the early adopters will be crucial, especially during fallow establishment.

For motivation, training of staff, farmers and leaders is essential. Allowances should be paid regularly and researchers should supply seeds on time.

Mangwe Camp

Ms Sikombe, CEO

At our camp, poor transport slowed down distribution of seedlings to farmers. Drought, pests, diseases and domestic animals browsed the seedlings when they were at the fallow stage.
For a fresh start, field days, tours and courses are needed for farmers and headmen in Mangwe. We need resources to do this.

**Tafelansoni Block**

*Mr Mate, Block Supervisor*

I became aware of sesbania falls through the SCAFE Extension Bulletin and a tour to Msekerja in 1994.

During the first year, 19 farmers participated in the trials; I now have 72, most of whom have sesbania at the fallow stage. Twelve farmers have nurseries and 3 direct-seeded tephrosia. Attempts to seed sesbania directly failed because of its slow growth during establishment.

Transport problems limited our capacity to reach out to more farmers, and fact-finding tours would be a good incentive for extension staff. Regular follow-up by researchers should be emphasized.

**Chadiza Farmers' Training Centre**

*Mr Zulu, OIC*

Although I am new to the FTC, I was exposed to improved falls during a field day at Msekerja in 1990. Subsequently, we established type 1 trials at the FTC, with poor results compared with what we saw at Msekerja yesterday.

I think the FTC should have access to better transport—at least a motorcycle—to reach more farmers. Monthly meetings need to be reintroduced as well as joint tours with researchers, while allowances are necessary for staff survival.

**Nyimba District**

*Mr J Chanda, DAO, and Mr S Ziwa, District Land Use Planning Officer*

The population of Nyimba District is growing very rapidly (3% p.a.). The newly introduced improved fallow technologies can help greatly in soil fertility management and enhance food productivity for the ever-increasing population.
We first obtained sesbania seed in December 1994. Thereafter, we established trials in 3 plateau camps. Until yesterday’s field visits, we had intended to ask for possible first year benefits, but after our observations in the field, we feel that it is worthwhile to wait for 3 years—we just need to convince the farmers by bringing them to Msekera regularly so that they can see for themselves the benefits of farming with trees.

The farmers who are currently practising the improved fallow technology are members of women’s or farmers’ groups who visited improved fallow trials at Msekera Research Station. They then decided to try the technology themselves, in groups and as well as individuals. After some pushing, Msekera provided advice and seed. The women set up 6 nurseries; and 30 individuals and 3 clubs planted sesbania fallows. The clubs opted for type 3 trials as no researchers offered to design other types of trials.

Waiting for researchers also caused delays in outplanting, and the seedlings stayed too long in the nursery before they were planted out. So far the 30 plots on farmers’ fields are doing fine. Over 70 farmers are aware of the technology but are not able to establish improved fallow plots because of scarcity of seedlings. As the sesbania fallows are still at the tree growth stage (first year), the farmers are not sure about the actual benefits of the fallows.

To scale up dissemination of the technology, our target this year is 120 farmers. We shall begin by bringing these farmers to Msekera. We are targeting 20 women’s groups in 3 priority camps. But we need more visits by researchers to farmers’ fields to tackle any problems early. We also need funding for the field trips and training.

Petauke District

*Mr S Mwale, District Land Use Planning Officer*

We first became aware of the improved fallows technology in 1992/93 when we took farmers on a field trip to Msekera. ICRAF researchers then promised to visit Petauke in 1994/95, and we recruited a number of farmers as they had instructed, but the researchers never came. So far we have not yet established sesbania fallows; we had a small plot of sunhemp, but lost the seed because of drought. However, we may have to go for tephrosia and pigeon pea first because of their advantage as
directly seeded crops, and sesbania may follow later. At the moment what we need most is advice and input from research officers.

**Tiyeseko CDP—World Vision (Mawanda Camp)**

We heard about sesbania fallows in February 1996 from World Vision, and got Zambia kwacha 600 000 to take 20 farmers on a tour of Msekera. There they saw improved fallows with sesbania and their benefits to the maize crop. We shall try to establish fallows ourselves this year, working hand in hand with extension officers.

**Chama District**

*Mr L Mutale, DAO*

Eight farmers have established improved fallows—4 with tephrosia, 3 with sesbania and 1 with pigeon pea. SCAFE had earlier promoted velvet beans and sunhemp for green manure. However, ICRAF is not yet active in the district.

In Chama, we suggest that ICRAF looks into using *Faidherbia albida*, whose benefits are well known to farmers. On the other hand, the heavy infestation of striga weed in the district could be used as an entry point for introducing sesbania and other fallows that suppress weeds.

**Lundazi District**

*Mr E Lungu, DAO*

SCAFE has for long been tackling the problem of land degradation in Lundazi, using mainly sunhemp and to a lesser degree velvet beans. They have recently been promoting kraal manure as well.

A SCAFE agroforestry workshop with ICRAF resource persons introduced the idea of sesbania fallows in the district. In 1994/95, we established a nursery in the district, but the village extension group concerned disintegrated, and the sesbania seedlings were never planted. Two farmers have had 2-year fallows which are now at the crop stage, and their maize crops are doing fine in spite of late planting.

Currently, we have 102 farmers practising improved fallows: 50 have direct seeded tephrosia intercropped with sunflower and are waiting for further recommendations, 52 have sesbania at the tree stage, and 35 have
first-season sesbania. The farmers say they prefer 2-year fallows for they have a greater impact.

We feel that training needs to be strengthened and conducted in collaboration with NGOs, while field trips for farmers are most valuable in raising awareness. Most importantly, seeds need to be supplied on time.

It is also our belief that researchers should identify a number of 1-year fallow species and produce a manual involving extension officers. Joint workshops and exchange of reports should become standard procedures.

**Lutheran World Federation, Lundazi**

*Mr I Mwanza*

At Lundazi, we need to improve linkages with the Department of Agriculture, as Madzimoyo District has done. This year LWF has allocated USD 17 000 for agroforestry, which should be effectively utilized in promoting sesbania and other improved fallow species. LWF has established over 6 000 water wells in the district. These should be focal points for nursery establishment and demonstration of technologies. Currently LWF has a memorandum of understanding with ICRAF (see appendix 1).

**Mambwe District**

*Mr Nyendwa, DAO*

We first learned about sesbania fallows through SCAFE. In 1994, ICRAF set up trials at Masumba Research Station and on 7 farmers’ fields. All the farmers used potted seedlings. The research station used both potted and bare-rooted seedlings. At Masumba and Jumbe, the trials are at the crop stage, following 2 years of sesbania fallows.

Sesbania growth has been most impressive and the crop phase should result in a bumper maize harvest for the experimenting farmers. Mambwe, or the valley, is the natural place for improved fallows with sesbania. However, adoption has been slow, perhaps because the technology is new to the area.
Still, more on-farm nurseries should be set up, but bare-rooted seedlings and direct sowing should also be promoted to cut costs.

Finally, the district frontline extension staff at all levels need better motivation—in terms of field tours and fuel and spares for their means of transportation.

**Session 4: Working groups on strategies for scaling up improved fallows**

This session comprised working groups to map out strategies, set priorities and identify problems of scaling up improved fallow research and extension. The working groups were based on districts and, naturally, the DAOs chaired the groups, which included researchers, extension officers, farmers and NGO representatives.

The district groups were divided according to their level of advancement in testing improved fallows. Thus, the first 4 districts comprised districts that were quite advanced in improved fallows and had reached the crop stage—Chipata South, Chipata North, Katete and Chadiza Districts. Lundazi and Chama Districts formed another group, and the last group—the least advanced—included Mambwe, Nyimba and Petauke Districts. As it turned out, the districts nearest to Msekera research station were the most advanced while those further afield were least advanced in improved fallow technology.

The following is a summary of deliberations from each group discussion, describing the envisaged mode of expansion targets for 1) farmers to reach in the next 4 years, 2) seed requirements, and 3) expected problems such as livestock damage, pests and diseases and fire hazards, and how to tackle them.

**Group 1: Chipata South**

*Mode of expansion*

The group chose the village or community approach to extension because it is easy to supervise, has greater impact and saves on costs.

*Target areas*
Eastern and southern blocks, which have depleted and deforested landscapes.

**Farmers involved**

Five hundred farmers are already being reached by extension services, NGOs and researchers (ICRAF and FSRT); the new target is 1500 farmers each year for the next 4 years (resulting in a total of 6000 farmers at the end of the 4 years),

**Issues concerning nursery activities**

- Lack of water and having to travel long distances to reach water sources in the dry season
- Limited land suitable for nursery operations (dimbas are very few and if available would be utilized for growing vegetables)
- Reluctance by some farmers to participate in group nursery work. There is need to encourage more individual nurseries alongside group ones. This brings prestige of ownership and the spirit of competition and enterprise
- Limited knowledge by majority of farmers (need for training) on the technology. Community approach would be effective for training
- Little or no advantage has been taken of UNICEF and LWF wells. (Note: we now have a memorandum of understanding with LWF to utilize their wells for watering nurseries)
- There are greater advantages with group nurseries in that they are time saving in the sense that one can train more farmers at the same time and are easy to monitor
- Farmers without access to dimba gardens can establish demonstration plots and nurseries using communal wells for water.

**Seed requirements**

Assuming 190 kg of sesbania seed are needed each year by 1500 farmers, we will require 190 kg in year 1, 380 kg in year 2, 570 kg in year 3, and 760 kg in year 4.

Before arriving at these figures all limitations were looked at. The figures were arrived at thus:
Given a maximum of 50 m x 50 m plots or (0.25 ha) per farmer per year, each would require at least 2500 seedlings at 1 m x 1 m spacing. Therefore 1500 farmers require at least 3.75 million seedlings; this has been calculated to be about 190 kg of seed. It is assumed that seeds (Kakamega provenance) will be imported from Kenya in the first year. In subsequent years seeds will be available locally, and seed orchards will be set up by enterprising farmers with help from researchers.

**Solutions to ease implementation (research issues)**

a) Dry season free-ranging livestock grazing (also a policy issue)
   - Encourage group herding (chiefs and headmen are instrumental in enforcing this).
   - Long-term solutions have to be introduced, for example, live fencing using *Giricidia sepium*, euphobia, Mauritius thorn (*Caesalpinia decapitala* or chatata) should be encouraged as other possible technologies

b) Using repellants against livestock, for example
   - Tephrosia leaf and seeds crushed and sprayed on crops—farmers have limited experience in this
   - Using cow and goat dung to spray the trees—very laborious
   - Tobacco leaf crushed and sprayed on crops
   - Spraying chilli pepper on leaves

c) Defoliating beetles be controlled through
   - Using tephrosia as a spray
   - Cultural practices, for example early planting to enable early establishment and vigorous plant growth
   - Use of tolerant species/provenances
   - Using cow dung
   - Clean weeding to deny the pest a habitat in which to complete its life cycle

The group felt that use of pesticides negates the whole issue of low input, sustainable agriculture.

d) Control of termites
   - Use of mchekete (*Swaertzia madascarensis* pods crushed and made
into a solution as a pesticide)

- Early planting
- Discourage late weeding
- Use of tephrosia as a pesticide
- 'Mleza' pods as a pesticide

e) Fires
- Educating leaders and children on fire hazards to the environment and improved fallows (also a policy issue)
- Fire breaks (5 m wide) around improved fallows
- Keeping fields of groundnuts or potatoes around the sesbania or other improved fallows

Group 2: Chipata North

a) Model of expansion: target camps
- World Vision, Chanje area, 10 nurseries (group nurseries with a capacity of 50 000 plants each).
- LWF - Mafuta Camp—3 nurseries
- Nkhalikali/Lumamba—6 nurseries
- Chiparamba camp—5 nurseries
- Kalichero—4 nurseries

b) Targets

Size of plots 25 m x 25 m = 625 m²

For Sesbania sesban we need at least 20 farmers in a target camp to share seedlings from 1 nursery; hence with 28 nurseries, our target would be 560 farmers.

20 per nursery x 28 = 560 farmers
Tephrosia = 30 x 28 groups = 840 farmers

1,400 farmers in 1996/97

c) Seed requirements

560 farmers x 625 m² = 35 ha = 17 kg of Sesbania sesban
840 farmers x 625 m² = 52.5 ha = 50 kg of Tephrosia vogelii
d) How to overcome envisaged problems

- Livestock, not much of a problem but will still conduct awareness workshops for chiefs
- Labour—intercrop in the first year
- Fires—fire breaks as in Chipata South, and education of local leaders who have to enforce discipline
- Pest-resistant species and provenances should be identified by researchers
- Plant early
- Use mixed stands
- Complete weeding of *Sesbania sesban* improved fallow stands to deny mesoplatys larvae the habitat to pupate

e) Incentives

- Farmers—4 field tours, 28 mobile courses, 4 residential courses, 28 field days
- Staff—1 tour to Msekera, monthly allowances, transport: bicycles to 50% of camp officers, motorbikes for block supervisors; residential courses—at least 1 per year for all staff.

ICRAF was asked to provided support for

- 2 workshops every year to review the work in progress and plan for the future; 1 in February and another in September
- 4 quarterly meetings organized by the districts to share information with ICRAF, NGOs and farmers
- Prizes, for example caps, T-shirts, for best or innovative farmers
- Magazines (such as *Agroforestry Today*) to be made available to camp officers and farmers
- Colour posters for camps and farmers’ training centres
- Video tapes (English) at farmers’ training centres for education of farmers during residential courses
- Meal allowances for staff conducting these courses
- Fuel, spares for vehicles for district officers to supervise work regularly
- Motorcycle and bicycle spares for block and camp officers
• Stationery for all officers to write their monthly reports and other correspondence

• Support Urthenga with training and computers to upgrade their capacity to translate research findings in local languages.

**Group 3: Katete District**

*Description of the district*

Population of farmers—33 000

Brief on ecological zones

• Katete south
  • Katete north
  • Katete central
  • Katete west

a) Katete south
  • Rainfall: 1995/96—800 mm; 1994/95—400 mm. Rainfall was highly variable
  • Monocropping of maize
  • Depleted soils due to large villages and old settlements; village regrouping
  • Overpopulation
  • Overstocking
  • Overgrazing
  • Shallow, sandy soils, for example in Kagoro

b) Katete north
  • Rainfall: 1995/96—1058 mm, 1994/95—600 mm, highly variable
  • Sandy soils
  • No crop rotation—maize monocropping every year.

c) Katete central
  • Rainfall 1995/96—800 mm
  • Undulating land topography
  • Clay loam soils, slightly fertile
• Crop rotation with cotton is common

d) Katete west
• Sandy soils but virgin land
• Sparsely populated
• Good rainfall
• Crop rotation is common

*Number of farmers in the programme*
Currently 126 farmers are participating in the trials, 3 of them at the crop growing stage after 2 years of improved fallows with sesbania

*Model of expansion*
Targeted communities and pilot areas
• Encourage demonstration plots both at the farmers’ training centres and village centres or chief’s palace
• Campaign through drama, mobile courses, field tours, training and visit involving NGOs, field days, posters, T-shirts
• Advantages: more farmers will be reached and recruited; awareness will be created; more farmers will increase hectarage
• Priority areas—southern and northern zones to act as pilot areas. Farmers from other regions will be learning from the pilot area
• Target communities and farmers’ groups are easier to supervise and motivate

The target is to reach at least 1500 farmers in 3 years using both type 2 and 3 trials. The following approaches will be used:
• Target village headmen and chiefs in selected villages
• Use organized groups, for example women’s clubs, as spring board

*Nurseries*
• Communal, individual and farmers’ training centres’ nurseries

Problems in establishing nurseries
• Water, livestock, pests, watering problems (labour), lack of commitment by some farmers

72
**Seed requirements**
The targeted number of farmers is 1500 in 3 years. Average field is 0.1 ha (or 1 ‘lima’) per farmer. Therefore, for 1500 limas, 4 million seedlings will be needed. Here, farmers prefer large plots, especially in the resettlement scheme. The required seed (200 kg) is consistent with that of Chipata South. To this we should add about 100 kg of tephrosia and 150 kg of *Cajanus cajan*.

**Beetle problem**
Currently farmers are using a cotton pesticide (Decis) to control mesoplatys. We recommend

- Planting early (November/December)—results in good plant vigour by the time of the beetle attack and the damage is not lethal to plants
- Using plant-resistant varieties
- Using biological control by introducing natural enemies
- Employing an entomologist by ICRAF for the programme
- Clean weeding of the sesbania fallows

The problems we identified and the suggested solutions (research issues) are summarized in table 9.

**Table 9: Land-use problems and suggested solutions for Katete District**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock</td>
<td>Permanent herding</td>
</tr>
<tr>
<td></td>
<td>Live fencing</td>
</tr>
<tr>
<td></td>
<td>Repellents</td>
</tr>
<tr>
<td></td>
<td>Chiefs and headmen to make rules and enforce by-laws</td>
</tr>
<tr>
<td></td>
<td>Supplementary feeding/zero grazing with improved breeds</td>
</tr>
<tr>
<td>Labour shortage</td>
<td>Intercropping</td>
</tr>
<tr>
<td></td>
<td>Direct sowing</td>
</tr>
<tr>
<td></td>
<td>Use of bare-rooted seedlings</td>
</tr>
<tr>
<td>Land scarcity</td>
<td>Use early maturing but high yielding maize. Since early maturing</td>
</tr>
<tr>
<td></td>
<td>varieties, for example GV412, are higher yielding than local maize,</td>
</tr>
<tr>
<td></td>
<td>half of the land normally put to local maize can go to improved</td>
</tr>
<tr>
<td></td>
<td>falls if such early maturing varieties are adopted.</td>
</tr>
<tr>
<td>Fire</td>
<td>Fire breaks and policies to reduce these</td>
</tr>
<tr>
<td></td>
<td>Grow sweet potatoes around the fallow plots</td>
</tr>
</tbody>
</table>

73
Incentives for extension and NGO staff

- Regular payment of monthly allowances, including delayed allowances
- Motorized transport—motorbikes, vehicles
- Protective clothing and boots
- Training—diploma and certificate courses, etc.
- Provision of stationery

Requirements for farmers’ training centres

- Overhead projector
- Slide projector
- Video camera
- Typewriter
- Radio cassette recorder
- Computer
- Television
- Funds for courses, fuel and teaching materials, including stationery

Monitoring

- ICRAF technical staff should provide guidelines and questionnaires for monitoring on-farm activities and for scheduling follow-up meetings and discussion with farmers

Group 4: Nyimba, Mambwe and Chama (valley districts)

Model of expansion

The level of the technology in the 3 districts is at the nursery to first year tree growth phase

- Select pilot camps/village based on soil degradation and willingness of farmers to participate or availability of extension personnel from NGOs or the government
- Use existing organized farmers’ groups in the camps, for example, pegging groups and women’s clubs
- Let farmers, in conjunction with camp extension officers trained in nursery technologies, select the site
• Nyimba District would like to start with 3 camps and recruit 120 farmers. They also want 3 group and 10 individual nurseries established in October/November this year. Demonstration plots should be set up at the village level and at farmers’ training centres should be encouraged. Village groups to take care of these demonstration plots (at least 1 in each village or 3 per camp) are required

• Mambwe District would like to start with 2 camps (60 farmers)

• Chama District opted for a modest start with 3 camps (50 farmers)

• For Nyimba District, a new camp will be incorporated on yearly basis depending on initial success. There should be training courses between stages of fallow development, and a study tour to Msekera Research Station and Kalunga in February and March each season.

S. sesban seed requirements
• Nyimba District requires seed to cover 40 ha, Mambwe District 24 ha, and Chama District 60 ha

Nursery requirements
• Some camps in Nyimba District need nurseries in areas with access to good water sources such as wells. LWF wells could be utilized for this (where available).

• In future, when expansion becomes necessary, seed multiplication will become inevitable and seed orchards should be planned in advance (at least 2 years before seed is to be used).

Problems in establishing improved fallows
• Livestock problems are a major concern mainly in Nyimba but not in the other 2 districts

• Mesoplatys problem: farmers to be educated on measures to control pests (see proposals under Groups 1 and 2)

• Fire: firebreaks and spot weeding the plots are highly recommended

Incentives for extension and NGO staff
• Camp officers need transport and new bicycles/motorcycles. Block extension officers need fuel, lubricants and spare parts for motorcycles and bicycles

• District officers in charge, for example of Chama Farmers’ Training Centre, require motorcycles, spares and fuel
- Vehicles for district agricultural officers require fuel and lubricants, spare parts, tyres and tubes
- One motorbike for monitoring at each block level is essential
- Allowances for block, camp and district staff should be reviewed and paid out regularly
- Motivation for farmers includes tours as already discussed for other districts above.

**Monitoring**

- Annual workshops of 2 days in the middle of the season in February and September are recommended
- Annual planning workshop in September (to plan strategies, discuss problems) is essential
- Monitoring questionnaires should be developed by ICRAF and be supplied to camp, block and district officers for follow up

**Support requirements for training farmers**

- For nursery preparation in September–October training from ICRAF staff will be supplemented with a manual on seed production and procurement, and inoculation of seedlings
- Teaching aids—video equipment/shows, posters
- Generator, slide projector and slides, still camera, flip charts required
- Stationery—chalk, box file, A4 hard-cover book, notebook, paper and pens are essential at each camp

**Training activities**

- Training trainers (30), residential courses—2 on nursery and fallow management, and 6 mobile courses have been planned each year
- Tours: Nyimba—5 times to Msekeri; Chama—twice to Msekeri; Mambwe—twice to Msekeri and 1 interdistrict tour (farmer-to-farmer)
- One international tour per year for the 3 districts should be budgeted for by ICRAF (tour to Makoka, Malawi)

**Requirements**

Teaching aids, generator, stationery, vehicle and motorcycle running and maintenance including 10 tyres and tubes per district, 3 new
motorcycles (one for each district), and a budget for staff training, residential courses for farmers (250 farmers a year) and mobile courses to cater for 400 farmers a year per district.

**Group 5: Petauke and Lundazi Districts**

*Model of expansion*
- Pilot area/village approach

*How to choose the area*
- The problem must be felt the farmers (driven by need)
- Accessibility to other areas to facilitate expansion
- Whether other relevant activities, for example by SCAFE, are already present in the area or not
- Government policy priorities, for example, if there are already pilot areas for agricultural improvement

*Target*
- 2 blocks
- 2 camps per block (4 camps)
- 30 farmers per camp
- 20 m x 20 m plots of sesbania or tephrosia improved falls and control plots (as shown in table 10)

**Table 10. Targets for scaling up in Nyimba, Chama and Lundazi Districts**

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of camps</th>
<th>No. of farmers yr⁻¹</th>
<th>Total farmers</th>
<th>Actual target yr⁻¹ (No of farmers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>30</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>30</td>
<td>180</td>
<td>300</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>30</td>
<td>240</td>
<td>540</td>
</tr>
</tbody>
</table>

*Nursery requirements*
- Each farmers’ training centre to have a seed orchard for future supply of seeds
- Interested or selected farmers to produce seed/seedlings for other farmers on commercial basis. Msekera will supply sesbania and tephrosia seed in October 1996 for each district’s requirements, but
thereafter each district should plan to produce their own seeds locally.

**Livestock problems**
- Use live fence—Ziziphus abyssinica (kankhade) or other species such as Euphorbia
- Community action—herding the animals throughout the year (chiefs to enforce legislation)

**Labour issues**
- More research on species for direct sowing—several tephrosia species and provenances to be tried
- Treat Sesbania sesban as a crop
- Intercrop in the first year

**Fire problems**
- 5-m firebreaks around improved fallow fields are recommended
- Educate farmers and seek support from local leaders (chiefs, headmen, elders, etc) on the issue and involve school children in the education campaigns

**Group 6: Chadiza**

**Mode of expansion**
- Use 3 camps as pilot areas on a village-approach basis

**Advantages of the model**
- Easy to supervise
- Mobility of staff won’t be expensive
- Easy to conduct field days
- Verification of the technology is easy

**Target**
- For the 1996/97 season we target 160 new farmers

**How to improve nursery operations**
- To use staggered system of nursery establishment; each farmer to
have their own nursery, and communal ones to be set up in each village

- Farmers' training centre nursery to be fenced and used for establishing demonstration plots
- Establishment of seed orchards at the farmers' training centre is considered a priority and as essential for future supply of quality seeds
- Networking with ICRAF staff, NGOs and farmers to share experience on improved fallow research

_Incentives for extension staff_

- Staff training, for example, training all camp extension officers on nursery techniques
- Staff tours to Msekera and other districts advanced in the technology
- Monthly allowances are essential inputs

_Farmers' training_

- Residential courses (about 600 farmers per year, 50 farmers per course each month)
- Mobile courses and field tours (at least 10 mobile courses each year covering 50 farmers per course per month)
- Drama groups in each block should be formed and supported financially to popularize extension messages on improved fallows

_Support requirements_

- Motorbikes for use by monitoring staff at the district headquarters
- Fuel and spares for the DAO's vehicle and motorcycle for personnel monitoring the progress of the technology
- Bicycles (to be given to selected block, camp, NGO and farmer leaders to popularize the technology)
- Stationery for each camp and block supervisor involved in monitoring and scaling up improved fallows
- Generator (used on mobile courses in villages) to be used at FTC
- Teaching aids
- Fencing materials for the farmers' training centre nursery
Seed requirements

- *Sesbania sesban* seed to cover 40 ha in the first year
- *Sesbania macrantha* for 40 ha
- *Tephrosia vogelii* for 40 ha
- *Cajanus cajan* for 40 ha

Problems

- Livestock—live fencing; herding of animals (see suggestions for other districts, above)
- Labour—intercropping; planting plots that are manageable with family labour (start with smaller plots, fewer treatments)
- Pests and diseases—early planting, employment of entomologists and clean weeding sesbania fallows
- Fires—construction of firebreaks; reinforcement of the law on fires by chiefs and some local leaders

Summary of issues on scaling up improved fallow research

Scaling up operations to reach nearly 4000 farm families by 1999

In planning for further expansion of on-farm participatory testing of improved fallows, very good and sensible plans were made by each district. Those districts with least experience (Nyimba, Chama, Mambwe and Petauke) proposed modest expansion whilst those with the most experience (Chipata South, Chipata North, Katete and Chadiza) were more ambitious.

Mode of expansion: community level/village approach and targeted farm families

In Chipata South, Chipata North and Katete, expansion will focus on villages (communities) representing a range of agroecological and socioeconomic conditions. This model will result in increased number of participating farmers in each village. For example, in Chiminye Village in Jerusalem camp of Chipata south, only 1 farmer, Mr Abednego Njovu, has been experimenting with improved fallows with sesbania for the last 4 years. This year the whole village expressed interest in experimenting with improved fallows. Chiminye village has at least 100 farm families of different socioeconomic backgrounds, and growing a range of crops.
The community level model has several advantages—

- It will ease logistics for nursery work, travel, farmers’ group meetings, field days and monitoring
- It will enable researchers and extensionists to evaluate improved falls across a range of farm families with different needs. There are those who would like improved falls to support cash crops such as cotton and sunflower, to grow vegetables in the dimba, for fuelwood, to reduce fertilizer use, and to grow local and hybrid maize. This range of farmers could not be accessed using the previous model where we were dealing with only 1 farmer (a biophysical evaluation of improved falls across a gradient). This approach calls for proper characterization of both biophysical conditions and socio-economic attributes of the community and its resources to establish a baseline. The use of remote sensing and ground surveys in the characterization process is recommended.
- The approach will enable the assessment of adoption and the conducting of impact studies at the community level rather than only at the plot or farm level, which is currently the case because farmers are widely spread.

**Seed requirements**

With the envisaged scaling up of operations, the Zambia/ICRAF team was asked to provide initial seed to help farmers establish nurseries for sesbania bare-rooted seedlings. The estimated amount of seed is about 700 kg of sesbania and 350 kg of tephrosia. ICRAF agreed to this request. The deadline for delivery of this seed is September 1996. Since the current plantings are of Kakamega and Chipata Dam provenances, ICRAF will provide the Kakamega provenance, together with the rhizobia specific for sesbania. It should be noted that the current provenances are susceptible to the mesoplatys beetle, and efforts to get more resistant provenances are under way.

ICRAF scientists agreed to assist some farmers in the future by sub-contracting them to set up seed orchards to reduce the expense of and dependence on imported seed. Currently, 1 kg of sesbania seed costs USD 45 or ZMK 54 000.
Monitoring of research

It was well recognized that the expanded programme is still at the research stage and is just being tested. Monitoring of random samples of farmers will be undertaken in each village and district using simple questionnaires developed by ICRAF. Such questionnaires will be used at each developmental stage of the technology, such as the nursery, land preparation, fallow establishment, fallow clearance and cropping phases.

We have developed sample questionnaires at Msekera, whose use this workshop has endorsed. ICRAF will carry out all the analysis of the data from these questionnaires and share the output with all the partners and stakeholders in improved fallow research. This would strengthen feedback and research linkages among extension, NGOs and farmers, making the research demand driven, and responding to issues raised by farmers.

To follow up on these recommendations and to implement them, the position of a nationally recruited extension officer was endorsed. This person will have the responsibility for not only implementing the recommendations, but also sending feedback to research, extension, NGOs and farmers. ICRAF was given the role of coordination, training and monitoring.

Resources

Detailed budgets from each district were presented and discussed. Participants agreed that adequate human and financial resources should be made available to ensure that the programme is properly implemented. The budget requirements for Eastern Province are close to USD 100 000 for the first year. But since ICRAF is not a donor institution, the other partners in the project—SCAFE, the Ministry of Agriculture, the Lutheran World Federation, World Vision International, the Finnish Volunteer Services and churches were asked to solicit for funding to meet this target.

Some of the institutions are waiting for this report to see how much they can contribute to ensure that improved fallow technology is widely tested in the province. For example, World Vision International agreed to support farmer-to-farmer visits at critical stages of the technology. The Lutheran World Federation agreed to establish nurseries around the wells they, together with UNICEF, have constructed in the province (see appendix 1 for memorandum of understanding signed
between ICRAF and LWF). SCAFE agreed to support a follow-up meeting in September. Overall, this session was very successful and full of promise for the future. ICRAF was mandated to solicit for and coordinate funding to support these activities.

Review of the extension manual for improved fallows with sesbania

Introduction

Extension personnel have for long been asking for information on improved fallows with sesbania, nursery techniques and seed production to support further testing of the technology. In response to those requests, Dr Freddie Kwaresa prepared a draft manual covering these topics. He sought input from the participants, hence this session. The review of the draft manual took a whole day. It was divided into working groups to review each section and a plenary session to discuss the groups’ suggestions. The issues assigned to groups were:

Group 1: Where, when and for whom do we recommend improved fallows?
Group 2: Sesbania seed production, handling and storage
Group 3: Production of sesbania seedlings
Group 4: Fallow establishment and management
Group 5: The cropping phase

The groups worked hard on the draft manual. They wrote appropriate comments on the draft text and suggested where definitions and illustrations were appropriate.

Summary of group deliberations

Group 1: Where, when and for whom do you need improved fallows?

The group suggested that the introduction be made more specific to Eastern Province, with a brief presentation of potentials and constraints of the farming systems in the area to include:

- Simple definitions and photos of natural fallows and improved fallows
- A brief case study on farmers’ experience with improved fallows.
- The local term for fallow (‘chisala’)

83
• A table containing some examples of improved fallows and providing an opportunity to the reader to contribute

Site selection
The group
• Cautioned that the technology might not work on completely degraded sites
• Recommended that the selected farmers choose areas where similar activities are already going on, for example areas with soil conservation structures, and in areas where damage by livestock in the dry season is least likely
• Suggested that tobacco growing areas be avoided to lessen the possibilities of nematode infestation on sesbania
• Recommended that sites be located where water for nurseries is available even during the dry season
• Suggested that only farmers who use grass fallows as a means of improving fertility or those that crop continuously and experience diminishing returns be selected

The group was optimistic that if the proposed site selection criteria are followed, farmers who need improved fallows technology will be identified and research will be demand driven.

How to identify farmers
• Farmers should have shown interest in soil management activities
• The selected farms should be known not to have serious labour constraints, for example female-headed farms
• Farm sizes need to be large enough to allow for fallows
• Where possible, existing groups rather than individual farmers should be used to demonstrate the technology

Extension message and methods to use
In general, the activities relating to extension of improved fallows should not be much different from other extension activities—
• Work initially with existing groups in the villages, for example village extension groups or drama groups
Most importantly, work and exchange visits with farmers who have tried the technology

84
Modus operandi

- Use group meetings, field visits (farmer-to-farmer) and drama groups
- Set up demonstration plots in strategic places, for example, near a church, school or road; train farmers on improved fallows technology.

How to coordinate activities

- Use existing SCAFE committees at the district level
- Include NGOs and farmers in these committees
- Establish similar committees at lower levels (block, camp)

How to monitor activities

- ICRAF should train extension and NGO staff in monitoring techniques
- Use a short questionnaire for individuals
- Where work is done in groups, use group review meetings or discussions

Group 2: Sesbania seed preparation, handling and storage

This group recommended that the manual should include a section on the morphology of Sesbania sesban var nubica, using pictures to show how it differs from Sesbania macrantha in seed size, seedling stages, appearance and longevity. The manual should also include

- Pictorial illustrations of the 2 sesbania species, giving distinct features of each
- Local names of the two species should be highlighted, for example Sesbania macrantha, known as ‘jerejere’ in Mambwe, and Sesbania sesban, known as ‘chigomo’ or ‘msakasase’. If possible, explain the origin of the name
- Clear descriptions of the different sub-species—for example, the S. sesban var nubica found in Eastern Province is different from var Zambeziaca found along the Zambezi River in Southern Province.
- Explanations of difficult terminology, such as ‘hydromorphic’ or ‘biomass’, and a glossary defining them
Seed production
The group recommended that the manual should suggest reliable sources of sesbania seed. They suggested that seed multiplication should be commenced at Msekera, farmers’ training centres and farmers’ fields, taking care to protect seed production orchards from contamination, to ensure purity. The manual should contain a simplified design of a seed orchard (spacing and management should be clearly depicted).

Seed collection procedures
The group felt that winnowing and seed grading procedures should be included in the manual. Emphasis should be placed on the necessity for:
- Collecting seeds from mature pods, without waiting for the pods to dehisce
- Collecting all pods from the crown
- Depending on the dryness of the pods, keeping seed in gunny bags and drying them in the sun

Storage
- Sesbania is easy to store for a long time at room temperature
- Researchers should encourage farmers to store their sesbania seed as they see fit. However, the group had reservations on the use of airtight plastic containers
- On storage chemicals, the group recommended that the manual should provide examples of the chemicals and the doses used to preserve seeds in storage, with specific reference to sesbania or comparable legume seeds.

Group 3: Production of Sesbania sesban seedlings
The group discussed nursery techniques for *S. sesban* seedling production and recommended that topics be re-organized in the draft manual. The manual should provide
- Information on inoculation of seedlings
- More explanations and illustrations of raised and sunken seed beds
- Schedules for shading and watering seedlings and the seedbed
- Information on the use of river sand for sowing and why sand is preferred
The group recommended

- Sowing seeds in rills 10 cm apart on raised nursery beds 20–30 cm high
- That the manual should focus on sesbania nursery requirements and not on kraal manure
- An illustration of the soil sieve be provided in the manual
- An illustration of the village stove and the amount of water required for, say, 1 kg of sesbania seed (that is, the water–seed ratio) to be included

They recommended that the manual explains the differences in germination rate for seeds pretreated with cold or hot water. If differences are not large enough, it should recommend only the cold water treatment.

They also recommended that the manual should specify crops that are susceptible to nematodes (such as solanaceae), and the effects of the infestation on sesbania seedling growth and development when sandy or clay soils are used.

They accepted as adequate and accurate the rest of the draft’s content on nursery techniques.

**Group 4: Fallow establishment and management**

The group raised several issues that needed to be discussed and incorporated in the final draft. These included

- Control measures for termites during the fallow phase (including a discussion on the damage caused by termites)
- Weeding and its importance and whether this should be a standard recommendation
- How to control the sesbania beetle and associated pests and diseases
- Whether to apply fertilizers when sesbania is intercropped with maize
- The merits and demerits of uprooting or not uprooting the sesbania stumps at the end of the fallow period
- The role of S. sesban fallows in controlling striga and other weeds
- Disadvantages of using seedlings that have been kept for too long in the nursery
- Important references at the end of each section
• The use of demonstration plots at farmers’ training centres, schools and strategic locations to expose the technology to a wide audience

**Group 5: Crop phase**

*Recommendation for minimum tillage*

The group discussed land preparation issues, and recommended that minimum tillage would be beneficial in fallows that have done very well. The amount of litter on the ground was considered a good indicator (litter thickness of 2 cm or more). Planting holes should be dug using a dibber or a hoe. The group also recommended that a section in the manual should cover the concept of minimum tillage.

*Where to plant the crop*

Crops should be planted along the rows of sesbania stumps, using the farmers’ row spacing of 75 cm or 90 cm.

*Advantages of planting along sesbania rows*

• Cultivation will be easier as the implement will not be disturbed by the stumps
• The soils are softer or loose in the sesbania rows
• The litter from the fallow will be earthed up to the maize ridge at cultivation time
• The method would be in line with the existing farming practices

*Category of farmers*

There are 3 main categories of farmers in Eastern Province:

a) Those who plant on flat, even land with good fallows—mostly in the valley districts (Mambwa and Chama). For land preparation, they should follow the minimum tillage practice

b) Hand hoe users on the plateau. These should not re-ridge during initial land preparation, but should sow straight and ridge later during first weeding. Those who planted fallows on ridges should use the existing ridges for crop cultivation.

c) Ox-plough users. For this category, ploughing depth should follow the usual recommendations.
Weeding
• Stick to the standard weeding pattern that farmers follow. This will control sesbania regenerating in fallows
• Regeneration can be used for establishing new fallows, as already reported from several districts

Recommendations for transplanting wildings (regeneration)
• Use hoes and dig up to 10 cm deep
• Use wildings from field borders, or
• Leave small plot (2 m x 2 m) inside main fallow plot for supply of seedlings at planting time. This will act as a small natural nursery

Soil conservation
• Farmers will get maximum benefit if they follow soil conservation measures

Crop rotation
• A cereal should be planted in the first year—preferably a hybrid—to enhance the performance of the fallows
• Planting legumes in the first year should be discouraged
• Crops that are sensitive to nematodes, such as tobacco and tomatoes should be avoided
• After the first year, the farmer should follow the normal (recommended) rotational practices

Duration of fallow benefits (residual effects)
Benefits last longer on medium to heavy soils than on lighter, soils and will vary depending on the following:
• How well the fallow performed—i.e., the amount of litter it produced
• The crops planted and how they are rotated
• The amount of rainfall (with sufficient rainfall, continuous maize cropping for 4 years after a 2-year fallow has consistently given improved yields way above the control plots every year).
• Soil type

89
Sustainability issues

- Fallows should be set up in rotation plots to sustain production (called rotational fallow management)

Researchers and extension staff should be on alert to check on deficiencies of other elements such as phosphorus and potassium.

Field visits

Madzimoyo RCZ agroforestry demonstrations

The first trials we visited were those by the Reformed Church of Zambia at Madzimoyo, about 15 km from Msekera Research Station. Their agriculture programme is run by the Madzimoyo Agriculture Team (MAT), comprising 2 project managers, a farm manager and a development facilitator.

The church has set up a central demonstration area that currently has 24 plots (22 m x 18 m) for soil improvement using tephrosia, sesbania, velvet beans, sunhemp and pigeon pea, and 9 for pasture (grasses and legumes).

The project is currently working with 1500 small-scale farmers, 10 of whom are testing S. sesban improved fallows.

We were taken around the trials by the project manager. The visits aroused several interesting questions and comments mainly on improved fallows with sesbania, ranging from the establishment of the fallows to the cropping phase. For example, some visitors wanted to know

- Whether sesbania regenerates during the cropping phase
- Why sesbania plants are closely spaced, at 1 m x 1 m
- Which provenances of sesbania were being recommended for the farmers to use
- Whether sesbania could be propagated vegetatively
- Whether it was necessary to root-prune sesbania in the nursery

Msekera Research Station

We visited

- The species screening trial. The participants observed the various
species being evaluated for 1- and 2-year improved fallows. The species used were *Sesbania sesban*, *Tephrosia vogelii*, *Cajanus cajan* and *Sesbania macrantha*

- Trials to determine the effect of various combinations of *Sesbania sesban* and forage legumes on biomass production and subsequent maize yield
- Screening trials of various species for 3-year fallows. The species were *Sesbania sesban*, *Senna siamea*, *Flemingia mycrophylla*, *Gliricidia sepium* and *Luecaena leucocephala*
- A provenance trial of *Sesbania sesban*
- Trials of various types of *S. Sesban* nurseries (sunken and raised beds)

Commenting on crops performance following the sesbania fallows, several participants observed that maize yields on sesbania plots were just as good as those on plots that had received the recommended amount of fertilizer. Others were convinced that maize grown on plots that had sesbania fallows showed more vigorous growth than that on fertilized or control plots. The participants were quick to notice the differences in soil physical properties. Some noticed that the soil in the fallows was darker in colour and appeared to be looser and softer.

At the end of the field tour most participants were convinced that *Sesbania sesban* can restore soil fertility. What they were not sure of was whether the results they saw on station could be replicated on farmers’ fields, and hence their eagerness to see similar trials on farms. Some of the issues that came up during the station visit included

- The problem of the *Sesbania sesban* leaf defoliating beetle, *Mesoplatys ochroptera* and other pests such as the *Ootheca* spp
- The problem of seed supply to meet the nationwide demand for *Sesbania sesban* and *Tephrosia vogelii*
- The issue of technical back-up, particularly for nursery techniques
- Nematodes and the calorific value of sesbania woodfuel

**Farm visits**

The group proceeded to Jerusalem and Kalunga in Chipata South District to see some on-farm trials. These included researcher-designed, researcher-managed trials (type 1), researcher-designed, farmer-managed trials (type 2), and farmer-designed, farmer-managed trials (type 3).
They visited 6 farmers: Mr Abednego Njovu, Mr Michael Jere, Mr Pepulani Nthani, Miss Martha Daka, Mr Lyson Daka and Ms Jennifer Zulu.

The participants dwelt mainly on issues relating to the farmers’ perception of the S. sesban improved fallow technology, management of the fallows, and the performance of the crop after the fallows.

At Mr Abednego’s field, the maize was deep green, similar to the control that had fertilizer applied at the recommended rate. This impressed the participants. The farmer informed the participants that he had used some of the sesbania that regenerated naturally to plant another improved fallow field of about 0.40 ha. They observed similar innovations at all the other fields they visited.

Some of the questions posed to the farmers included:

- Did the farmers plant the maize in the rows where sesbania had been stumped?
- Did they find the maize yield following the sesbania fallows satisfactory?
- Were their neighbours copying their improved fallow technology? If not, why?

The tour ended with nearly all the participants fully convinced that the technology was not only working on the station but also on the farmers’ fields.

Closing remarks and recommendations

The workshop was closed on Friday, 26 March 1996 by Mr Christopher Chimfwembe, the principal agricultural officer for Eastern Province, who reiterated the need to strengthen linkages among research, extension, NGOs and farmers. He urged the organizers and the workshop participants to start implementing the recommendations made during the workshop and thanked the donors for funding the workshop.

Mr Botha, the farmers’ representative, thanked the organizers for inviting farmers to participate in such a workshop where their fate was being decided. He said he had thoroughly enjoyed participating in the
workshop and had learnt a great deal, which he would implement during the year.

**Farewell remarks**

*Drs Peter Cooper, ICRAF, Nairobi*

I have to leave before the end of this workshop because of commitments in Nairobi. I would have preferred to stay here longer. This has been an intensive meeting. After these days of hard work, the field visits will be a good break. I have been impressed by the hard work and punctuality—I felt embarrassed when I came in 1 minute late. I would like to congratulate the workshop for the realistic targets set for expansion of sesbania fallows. There remains much work to be done, but I wish you all the best in your efforts to disseminate the technology.

On the manual, I am used to reviewing scientific manuscripts where mainly commas and decimal points are corrected, and the contents are hardly touched upon. Here the participants did a thorough job of reviewing the draft sesbania manual, coming up with lots of criticisms and useful comments. Thank you very much.

**Wrap-up remarks**

*Drs Freddie Kwesiga, ICRAF, Msekera*

It is not easy to wrap up exciting deliberations of a 1-week workshop in 15 minutes. However, what I will do is to highlight some of the important issues that each participant should remember. These are

1. **Seed.** The total request of 1 tonne of seed in this first year is a big challenge. We should be able to get it and distribute it to you by October 1996 to prepare nurseries for the 1996/97 season.

2. **We should all refer to the farmers participating in improved fallows as ‘farmers’, not ‘ICRAF farmers’ or ‘SCAFE farmers’. This workshop has given all of us the chance to help farmers in Eastern Province achieve self-sufficiency in food production using sesbania and other improved fallow options.**

3. **Coordination.** The ICRAF team is already over-stretched. ICRAF will appoint a full-time specialist to coordinate the activities on dissemination of improved fallow technology. In the meantime, Mr
Donald Phiri is responsible for issues concerning sesbania. All the groups are to liaise with him for the time being, but the districts will coordinate linkages and the exchange of reports with ICRAF through Mr Phiri.

4. Research issues. Need for further research has been pointed out here. This research will continue as researchers receive feedback information from the field. The agricultural sector investment programme (ASIP) stresses that research issues need to originate from extension, NGOs and farmers. Come up with ideas for research and pass them on to us at Msekeri for possible solutions.

5. Consultative workshop. Our plan is to have 2 workshops—one in February/March, and a planning one in September/October every year. However, we invite you to come up with suggestions on the form, frequency and period of the year when these should be convened.

6. Information dissemination. The extension manual on improved fallows will be prepared soon. Dr Cooper says he has never before seen a workshop with such thorough criticism and comments. ICRAF will use this as a model for planning dissemination activities of other technologies in other countries. We propose to set up steering committees at provincial and at district levels.

7. Publications. We need your suggestions. Do you want a quarterly, biannual or annual newsletter? It is not possible to have a monthly newsletter at present, but we need your feedback on this.

8. Exchange of annual reports. Who is interested in the ICRAF reports? Should we distribute the reports through the PAO, the ministry headquarters at Mulungushi House in Lusaka and Mount Mukulu, or at the district level? These reports are available to districts, NGOs and farmers that want them. Please give us feedback.

Vote of thanks

Mr Sax Botha, farmer, Kalonje village

ICRAF has been spreading the message about improved fallows with sesbania to farmers through the extension system and NGOs. I believe the outcome of the strengthened research-farmer linkages will ulti-
mately benefit the farmer. The field visits helped me to understand the practical aspects of the technology that I had previously not understood. At Madzimoyo we saw fallows and pastures, at Msokera sesbania fallows and pastures, green manures and a nursery. At Kalunga FTC we saw the improved fallows with sesbania and the problems caused by leaf-defoliating beetles.

This technology is new to Eastern Province: all we knew about soil fertility improvement was the use of chemical fertilizers. Now the fertilizers are too expensive for us. Relief maize has further contributed to our inability to face the reality of the fertilizer problem. We have resorted to food for work instead of aiming at self-reliance.

I would like to give the following recommendations:

- Extension officers should be well versed in the knowledge on alternative technologies to be able to help the farmers
- ICRAF and SCAFE should continue inviting farmers to seminars such as this
- Tours, courses and T-shirts should be used as incentives
- Seeds should be made available immediately to camp extension staff for immediate distribution to farmers who are interested in setting up nurseries for improved fallows

**Major recommendations of the workshop**

1. **Scaling up strategies.** A village or community level approach was endorsed as the mechanism for scaling up. Efforts to disseminate the improved fallow technology should be concentrated in selected pilot target areas to best utilize the limited resources. Within these target areas, nurseries, demonstration plots and seed orchards should be concentrated in such areas to assess their impact. Once an area is covered, information should be disseminated through regular extension channels—farmers' group meetings, field days, training courses and extension staff visits. Local leaders and schools should be especially targeted.

2. **Training materials.** The sesbania manual was top priority. The workshop participants urged ICRAF to try and produce this manual in time for the preparations for the 1996/97 season. The
Uthenga Bulletin should be fully supported and utilized in disseminating information on improved fallows.

3. **Seed production.** A strategy for the establishment of seed production stands in priority areas should be formulated. Meanwhile, all those involved in the dissemination of improved the fallow technology should make maximum use of the seed collection possibilities in existing fallow stages in on-farm trials. ICRAF should make seed available from Msekera and other suitable sources.

4. **Research–extension–NGO–farmer linkages.** Efforts to strengthen these linkages should be continued through steering committees, regular meetings, joint field visits and exchange of reports.
   - **Steering committees** on improved fallow technology should comprise representatives of NGOs, extension services, farmers’ groups and individual farmers dealing with the technology at district and lower levels.
   - **Follow-up meetings.** 2 meetings per year should be held to follow-up on technology development and dissemination. One should be held in March and the other in September to coincide with regular SCAFE review and planning meetings. All organizations involved (such as the LWF, WVI, churches, and so on) should be represented in such meetings.
   - **Exchange of reports.** Research and extension departments and NGOs should inculcate a practice of routinely distributing their reports to each other. Recipients should give feedback about the reports.

5. **Sesbania pests:** ICRAF should focus on solving the problems of the mesoplatys beetle and nematodes. Resistant species and provenances should be bulked in seed orchards.

6. **Incentives for extension officers.** General working conditions of extension officers, particularly at camp and block levels, should be improved. The officers need to be provided with adequate transport, including regular supplies of spares, fuel and monthly subsistence allowances, which should be paid on time. Training should be better organized so that acknowledged courses can lead to promotions.
Concluding remarks

Mr C Chimfwembe, PAO

I thank you all very much for your active participation. We need to interact more. By interacting, commenting and criticizing in this kind of forum we remove the sense of fear of higher authority. We have not been coordinating much with NGOs in the past. We have been housed in the same building with World Vision, but they had never been to the provincial agriculture office until I went to them out of personal interest to ask what they were doing in the province. The missing linkages have been identified by this workshop. So when you go back to your districts, sit together, plan together, cooperate and coordinate activities. Exchange your reports.

We have been here for 1 week, and now it is time to go back to our stations and give feedback about our deliberations here.

Most meetings are about understanding between people. Now, we have to see how best we can plan work programmes together, including planning for the recommended biannual meetings. We have agreed that these meetings will take place in September and March. We should go back to our stations, prepare our reports and make arrangements on time, without too many reminders.

The few researchers here cannot reach all the camps. We shall have to disseminate the research findings they have provided here to our farmers. It is we, the extension officers, who will disseminate the information to farmers. We can identify farmers’ problems and bring them to the attention of the researchers. Do not let these researchers sit idle at Msekeria; knock on their doors and ask them for extension messages. Farmers used to complain that fertilizer was a problem, but now we have some alternatives.

Let us work as a team, meditate on farmers’ problems and develop the solutions together. Research done in isolation will only be understood by the researchers. But by working together with the extension personnel and farmers, who are part and parcel of the solution-seeking process, we shall all understand and appreciate the technology development and transfer processes.

Travel home in peace, and once again thank you very much.
References


Appendix 1

Memorandum of understanding between the Lutheran World Federation and the International Centre for Research in agroforestry

Memorandum of agreement between the International Centre for Research in Agroforestry, Msekera Research Station, Chipata, and the Lutheran World Federation (RCDM).

By this agreement the International Centre for Research in Agroforestry agrees to supply technical advice, seeds and visits of inspection to ensure proper management and the Lutheran World Federation agrees to provide sites for tree nurseries and to manage the planting and care of such nurseries and also to arrange the distribution of seedlings to farmers with follow up advice on management.

This agreement shall remain in force for as long as is agreeable to the parties involved, but if 1 party wishes to withdraw it should give suitable notice of at least 3 months to the other party.

Signed
(Principal Scientist/Project Leader)

Signed
(Project Coordinator, RCDM)
Lutheran World Federation

Date:
Appendix 2

Groups for reviewing the sesbania manual

Group 1. Where, when and for whom do you need improved fallows?

Thomas Raussen, FSRT, Msekera
PJ Nyrenda, Chipata North
M Mukelebai, NAIS, Eastern Province
TA Mbuzi, Chipata South
John Lungu, World Vision, Tamanda
S Chikamwe, Chipata North
P Chisenga, Baptist Church, Chipata
A Lamminaho, Finnish Volunteer Services, Chipata
P Chikasa, SADC/ICRAF, Chalimbana
PM Dhaka, Chadiza
Melwin Siwale, Petauke
SZ Ziwa, Nyimba
D Mukelabi, RCZ
L Nkhoma World Vision
GNK Simaila, Chadiza
S Minae, ICRAF Malawi

Group 2. Seed production, collection and storage

John K Chanda, Nyimba District
PM Zulu, Chadiza District
L Miti, Petauke
IB Phiri, Chipata
MC Kapuka, Eastern Province
A Mwanza, Katete
R Chintu SADC/ICRAF, Chalimbana
Mrs HM Mvula, Chipata South
A-L Raunio, SCAFÉ, Eastern Province

Group 3. Nursery techniques

AN Chirwa, Chipata North
G Pelekani, Chipata South
S Botha, Chipata South
S Simute, Chipata
Group 4. Improved fallows phase

DN Ngugi, ICRAF, Malawi
LK Mutale, Chama District
MP Zulu, Chipata South
OS Tembo, World Vision, Khovu CDP
LM Nyendwa, Mambwe District
AZ Phiri, Katete FTC
LD Phiri, RCZ, Madzmoyo
PH Sohati, FSRT, Msekeru
CL Phiri, SCAFE, Eastern Province

Group 5. Crop phase

Peter Cooper, ICRAF, Nairobi
Kenneth Linyunga, ICRAF, Msekeru
RA Chikubi, Chipata South
I Banda, Chipata South
L Banda, Chipata South
T Banda, Chipata South
E Sakala, Chipata North
John Bateson, SCAFE, Central Province
MN Tembo, Eastern Province
Freddie Kwesiga, ICRAF