Facilitating the wider use of agroforestry for development in Southern Africa

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Southern Africa is one of six eco-regions in which the International Centre for Research in Agroforestry (ICRAF) currently operates. Work in this region started in Malawi, Tanzania, Zambia, and Zimbabwe between 1986 and 1987 with efforts to diagnose farming-system constraints and to design agroforestry interventions. These countries are located within the savannah woodland eco-zone, or *miombo*, which is characterised by one rainy season, receiving 700–1400 mm of rainfall annually and a long dry season from May to October. An upland plateau ranging in altitude from 600 to 1200 m dominates the region. The soils, predominantly ferralsols, acrisols, and nitosols according to FAO classifications, are generally poor in nutrients. Mixed farming is dominant in the region, with crops and livestock being integrated only very loosely in traditional systems. The degree of cropping and livestock keeping varies depending according to ethnic background and the availability of natural grazing land, the latter having declined in recent decades because of population growth. Maize is the most important staple crop throughout the region, and its production and prices are often dictated more by politics than economics, especially as the urban electorate becomes increasingly influential. Cassava, sweet potato, sorghum, millet, and various grain legumes are other important subsistence crops. Food insecurity is common in the region, and is underscored by a several-fold increase in maize imports in most countries over the past decade. Access to safe drinking water, basic health services, and markets is critical in most rural areas.

Key farming-system constraints that have been identified are all associated with widespread and advancing degradation of the natural resource base and accelerated deforestation. Caused principally by increasing human populations, both have led to a widespread decline in soil fertility, increased soil erosion, and shortages of fuelwood and seasonal fodder, to mention only the most severe effects felt on-farm. Continuous cultivation of maize exacerbates the depletion of soil fertility, with nitrogen being particularly critical for good production in most parts of the region. Research started in 1987 to develop agroforestry technologies to address these problems. Project sites were gradually established in Shinyanga and Tabora in Tanzania, Zomba in Malawi, Chipata in Zambia, and Harare in Zimbabwe. Since 1997, ICRAF has been breaking new ground as a research centre in Southern Africa by getting more proactively involved in development. This engagement seeks primarily to accelerate the impact of agroforestry in the region.

This paper reports on the process and outcomes of research-driven technology development and how it has recently evolved into a more client-driven process. This shift looks promising as a way to reach large numbers of particularly poor households, a disadvantaged group that is of top priority to ICRAF. Agroforestry technologies that are now available have great potential to improve the livelihoods of many in the region. This paper first assesses development trends in Southern Africa and describes agroforestry options addressing farmers' constraints. The problems and successes ICRAF has experienced in facilitating the wider use of agroforestry in the region are a further focus, so that lessons learned can be shared with a wider audience. The paper highlights the role of agroforestry as a learning tool in helping local communities to become more capable of developing technological and other kinds of innovations.

Development trends in southern Africa and agroforestry opportunities

For the purposes of this paper, the Southern African region is the area similar to that covered by the original Southern Africa Development Community (SADC), with 11 member countries: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe. These countries cover an area of 6, 823, 490 km^2 and have a total population of slightly over 142 million. Only small proportions of land are classified as arable, ranging from as little as 1 per cent for Namibia to a maximum of 18 per cent for Malawi. Populations are therefore exerting considerable pressure on available arable land, with maximum densities in rural areas reaching as many as 350 persons per km^2 in southern parts of Malawi. Population growth rates have fallen well below 3 per cent recently (see Table 1), mostly an effect of the AIDS pandemic, but are still large enough to trigger further significant population increases over the next 20 years. Some key development indicators of the five countries where ICRAF currently operates in Southern Africa are summarised in Table 1. Assuming for Mozambique, where no data are available, that 60 per cent of the total population is below the poverty line, this would mean that 44 million people currently live in absolute poverty in these five countries. If the average household size across the region is six persons, this would translate into an approximate total of 14.67 million poor households.

The overall goal in widening the use of agroforestry in the region is to make an impact on people's livelihoods, in particular on food security and poverty, and to reverse the progressive degradation of the natural resource base. Since socio-political, economic, and environmental conditions govern any large-scale use of agroforestry, and these also change constantly, it is important to predict likely future trends so that the best agroforestry interventions can be identified and innovations developed together with farmers in good time. This was done in a regional strategic planning exercise that ICRAF facilitated in early 1999, where major institutional stakeholders were represented.

Table 1: Some development indicators for selected countries in Southern Africa (compiled from <http://www.odci.gov/cia>)

Indicator	Tanzania	Zambia	Malawi	Mozambique	Zimbabwe
Total population (m)*	31.27	9.66	10.00	19.12	11.16
Population growth rate (%)*	2.14	2.12	1.57	2.54	1.02
Life expectancy at birth (yrs)*	46.17	36.96	36.30	45.89	38.86
Literacy (% total pop.)†	67.8	78.2	56.4	40.1	85.0
GDP per capita (US$)‡	730	880	940	900	2400
Contribution of agriculture to total GDP (%)§	56	23	45	35	28
Population below poverty line (%)¶	51.1	86.0	54.0	No data	25.5
UNDP human poverty index (%) (rank)ll	29.8 (54)	38.4 (64)	42.2 (72)	49.5 (79)	29.2 (53)

* 1999 estimates
† Aged 15 years and over who can read and write, 1995 estimates
‡ Purchasing power parity, 1998 estimates
§ 1995 estimates for Malawi, 1996 estimates for Tanzania and Mozambique, 1997 estimates for Zambia and Zimbabwe
¶ 1991 estimates for Tanzania, Malawi, and Zimbabwe, 1993 estimates for Zambia
ll 1997 data published in the UNDP Human Development Report 1999

Table 2: Predicted future development trends in Southern Africa and possible opportunities for agroforestry

Development trends	Opportunities for agroforestry
Socio-political	
• Disintegration of the extended family and loss of traditional values • Wider access to information • Increased urbanisation • Declining social status of farming • Decentralisation of decision making and advancing democratisation • Change of demographic structure and declining overall productivity in communities because of AIDS • Regional political integration	• More land becoming available in areas of urban drift • Peri-urban and urban agroforestry production for niche markets • Empowerment of grassroots institutions that drive the scaling up of agroforestry use • Increased accountability of local institutions • Easier adoption of gender- and age-neutral agroforestry technologies
Economic	
• Increased poverty and widening of gap between rich and poor • Decline of real incomes and continued devaluation of local currencies • Continued dependency on external aid • Increased privatisation • Regional economic integration with South Africa emerging as dominant player	• Increased private investment into processing and marketing of agroforestry products • Emerging cottage industries and adding of value to products at local level • Growing markets for 'green' products in urban areas • Increased demand for substitution of expensive external agricultural inputs such as fertiliser and feed
Environmental	
• Increased deforestation • Decline in biodiversity • Soil and water degradation • More pronounced fluctuations in seasonal rainfall (droughts and floods)	• Stabilisation of overall natural resource base through agroforestry • Conservation of economically important indigenous trees through domestication and marketing • Stabilisation of land-use systems through diversification and ecological buffering (trees as risk buffers)

Table 2 summarises the results of this workshop and highlights future opportunities for agroforestry in the region.

Developing agroforestry technology options

ICRAF's research agenda in Southern Africa focuses on replenishing soil fertility, producing fuelwood and fodder, and evaluating suitable tree germplasm, including the domestication of fruit trees indigenous to the *miombo* woodland. The research effort first diagnosed farmers' priority problems, then followed up with on-station and on-farm research. By 1997, approximately 5000 farmers were participating in on-farm research in the four countries where ICRAF has project offices.

The main agroforestry technologies developed were improved fallows, mixing of coppicing trees with crops, annual relay cropping of trees, fodder banks, rotational woodlots, and planting of indigenous fruit trees. These options, now used by large numbers of farming families, are described briefly below.

Improved fallows

A piece of land is dedicated to fallowing with nitrogen-fixing tree species for a minimum of two growing seasons. During at least one season, trees take up the entire field and no crops can be planted. The tree most successfully used is *Sesbania sesban*, but farmers also plant *Tephrosia vogelii,* both species being native to Africa. The main objective is to achieve household food security in staple foods, most importantly maize, in situations where land availability is not severely limited (population densities <60 persons/km^2).

The technology aims to replenish soil fertility, in particular nitrogen, with little or no external inputs such as fertilisers, resulting again in significantly increased maize yields after two years of fallowing. Farmers have intensified improved fallows by intercropping during the first year while the trees are being established. The main requirements of the technology are the availability of land, high demand for labour, availability of enough water to establish the trees successfully, and the need to protect the improved fallows during the dry season from fires and free-ranging livestock (the latter being less of a problem for *Tephrosia*). When large areas are planted to one tree species, insect pests may become a problem; this is already occurring in some places with the *Mesoplatys* beetle on *Sesbania*. (For a more detailed description of improved fallows using *Sesbania*, see Kwesiga and Beniest 1998.)

Mixing coppicing trees and crops

Nitrogen-fixing trees that can tolerate continuous cutting back, such as *Gliricidia sepium* from Central America, are mixed in and grown with crops in the field. Trees are coppiced in such way that they do not interfere with the crop, yet large amounts of cut biomass can be recycled as green manure over many years. The main objective is to achieve household food security in staple foods in situations where the availability of land is severely limited, such as in parts of southern Malawi where population densities are over 100 persons/km^2.

The technology aims at replenishing soil fertility, in particular nitrogen, with little or no external inputs such as fertilisers being required, resulting again in significantly increased maize yields, usually three years after tree planting. After this time, and provided that the trees are managed rigorously, the technology has been shown to perform well for at least eight years without any need for fallowing the land.

One limitation is that a three-year waiting period is needed before trees reach their full biomass productivity and benefits become tangible. Furthermore, a considerable amount of labour may be required for tree management, but farmers appreciate that trees for coppicing need to be established only once and can then be used for many years. Farmers are obliged to manage trees well at all times during the cropping season so that tree and crop competition is minimised. Another constraint for wider use of the technology in the region is the limited availability of tree seed, especially for *Gliricidia*, but farmers will gradually overcome this constraint as they increasingly propagate this from stem cuttings. Livestock do not browse fresh *Gliricidia* leaves, and therefore trees need little protection during the dry season. (For a more detailed description of mixed cropping of *Gliricidia* and maize see Ikerra *et al.* 1999.)

Annual relay cropping of trees

Nitrogen-fixing trees are planted into a field at a time when crops have already been well established. Trees such as *Sesbania sesban* and *Sesbania macrantha* are first raised in nurseries, then bare-rooted seedlings are transplanted into the field. Species such as *Tephrosia vogelii* or *Crotolaria* spp. are sown directly under a canopy of established crops. The trees thrive mostly on residual moisture and develop their full canopy only after the crop is harvested. As farmers prepare land for the next season, they clear-cut trees and incorporate the biomass into the soil, and then repeat the cycle. Trees must thus be replanted every year.

As with coppicing, the main objective is to replenish soil fertility and achieve household food security in land-scarce farming systems. The main limitation of the technology is that farmers must depend on late rainfall for trees to become well established. In very dry years, there is a high risk that trees will produce little biomass and hence have little effect on crop yield. Labour needed every year for establishing the trees could be another constraint, although less labour is needed for species that are sown directly. Yield increases are less dramatic than with the former two technologies, because the trees produce less biomass.

Trees that are browsed, such as *Sesbania*, need to be protected during the dry season in areas where livestock grazing is not regulated. (For a more detailed description of relay cropping with *Tephrosia* see Böhringer *et al.* 1999b.)

Fodder banks

A fodder bank is a small, well-protected, and intensively managed plot of trees that is cut continuously for feeding livestock. Species with high nutritional value are preferred such as *Leucaena* spp., *Calliandra calothyrsus*, and *Acacia angustissima*. Tree spacing may be as close as 1 x 0.5m, but it may be wider where fodder banks are intensified by planting fodder grasses such as napier between tree rows. Fodder banks are usually planted close to the place where livestock are kept in order to minimise the amount of labour for carrying the fodder. Many smallholder dairy farmers are currently using this technology, but it also has potential for milk goats and, possibly, other livestock (see also Wambugu *et al.* 2001 and in this collection).

The main objective of fodder banks is to increase the income of smallholder dairy farmers by substituting the fodder for expensive, purchased feed concentrates and by increasing overall milk yield, especially during the dry season, when fodder from natural grazing sources becomes extremely scarce. Access to markets for milk is a precondition for the technology to be profitable, and hence farms in a peri-urban setting have a comparative advantage. Trees can be cut just one year after planting, reach their full potential in the second year, and then be continuously harvested for many years. Processing and storing the tree fodder on-farm offers considerable opportunity for adding value.

The main limitations of the technology are the labour needed to establish the trees well in the first year, and the need for solid fencing throughout to protect them from roaming livestock. Major constraints in the region are that improved dairy animals are scarce and generally unavailable, and that small-scale farmers who want to buy animals lack access to loans.

Rotational woodlots

Rotational woodlots are normally small plots of trees (0.04–0.5 ha), which are well-protected, particularly during the first two years after they are planted. Tree species planted by farmers are Australian acacias (*A. crassicarpa, A. julifera, A. leptocarpa*), native acacias such as *A. polyacantha*, neem (*Azadirachta indica*), and *Senna siamea*. Trees are usually planted 2 x 2 m apart, and farmers often use the spaces in-between for intercropping with a crop such as maize during the first two years that the trees are growing. In the third and fourth years, when trees have reached a height beyond the reach of livestock, and intercropping has to cease because of the shade created by them, animals are allowed to enter for grazing. Trees are clear-cut in year four or later, after which soil fertility is also restored where nitrogen-fixing acacias were planted.

The main objectives with rotational woodlots are to make households self-sufficient in wood for fuel and construction, and to provide some additional income through the sale of wood. Rotations of four to five years are possible where land is less limited and farmers can allow at least two years of fallowing. Where land is scarce, farmers have adapted the technology to boundary plantings. The technology has the potential to produce 60–80 tonnes/ha of dry wood five years after planting compared with an average productivity of natural *miombo* of approximately 32 tonnes/ha (Ramadhani *et al.* in press). It may thus offer an economic alternative to ongoing deforestation of the *miombo*, particularly in areas where fuelwood is in high demand for activities such as curing tobacco.

The main limitations of rotational woodlots are the long period (four to five years) farmers have to wait for the technology to provide wood products, the high labour costs during the first year of establishment (including for protection), and the lack of water for nurseries in drier areas such as in Tanzania, where it has particularly large potential in the heavily deforested Shinyanga and Tabora regions. Furthermore, an extreme scarcity of tree seed for Australian acacias inhibits wider spread of the technology. (For a more detailed description on rotational woodlots see Ramadhani *et al.* in press.)

Planting indigenous fruit trees

Individual fruit trees are planted as boundaries along field edges, on contours, or around homesteads. They are usually well protected and looked after, with some occasional watering needed during the first dry season after transplanting. Farmers' priority species from the *miombo* are *Uapaca kirkiana, Sclerocarya birrea, Strychnos cuccloides, Parinari curatellifolia, Vangueria infausta,* and *Azanza garckeana,* all highly valued for their nutritious fruit.

The main objective of planting indigenous fruit trees is to safeguard the nutritional security of the family, in particular children, since all indigenous fruits are high in sugars, vitamins, and minerals, and many trees are in fruit during the seasons when people often go hungry.

They also provide farming families with income through the sale of fresh fruit, a potential that could be further developed by promoting processing and marketing. Another objective is to conserve biodiversity of the dwindling *miombo* tree resources. The true merits of planting indigenous fruit trees still need to be determined through researching the markets and product development.

The main limitation now is lack of knowledge on the best propagation techniques. Research on the best methods for on-farm planting is still in its infancy, but some success in germinating seed and in vegetatively propagating the plants has been made, especially with marcotting (a propagation technique involving inducing roots to grow on a small branch while it is still attached to the larger tree). If the time to first fruiting of these species could be reduced to well below five years, the economics of planting on a larger scale would certainly be improved.

Linking agroforestry innovations to development

Since 1992, on-farm research has become the main vehicle for assessing the biophysical and economic performance of these technologies, with farmers gradually taking over the design and management of trials in their fields. By the 1996–7 season, approximately 5000 farmers participated in this kind of research across the four countries, most of the testing being on improved fallows in Zambia (Kwesiga *et al.* 1999). On-farm experiments are usually characterised by intensive farmer–ICRAF interaction, and individual farmers are supported with information, training, and technical visits. Researchers provide a lot of this support during field visits for data collection.

Here, the support given to individual farmers could be considered as the minimum incentive necessary for making agroforestry technologies adoptable in the first place. Such incentives are expected with agroforestry, which is classified as a preventive innovation (Rogers 1995), meaning that the time from tree planting until tangible benefits accrue is relatively long. For instance, significantly increased maize yields after a two-year fallowing with *Sesbania* in on-farm trials created a lot of enthusiasm among peer farmers, which again triggered a large demand for the technology in Eastern Province of Zambia (Kwesiga *et al.* 1999). This highlights the fact that disseminating these agroforestry technologies has now evolved into a more client-driven process. But this change occurred only after a good number of first-time testers demonstrated the benefits in their fields to their peers, who could see the results for themselves.

The number of farmers across the four countries who are using the new agroforestry technologies outside on-farm research arrangements with ICRAF indicates the demand – they totalled approximately 30,000 in the 1999–2000 season, of whom more than 40 per cent were women.

Approaches to accelerating impact: agroforestry as a learning tool

Scaling out through partners

To achieve impact, our main strategy focuses on working through existing government, non-government, and development organisations and farmer groups. This scaling out aims to influence partner organisations and their policies through networking, lobbying, and collaboration (Scarborough *et al.* 1997) so that we can achieve our goal of catalysing a client-driven wider use of agroforestry technologies in order to improve rural livelihoods in the region significantly. Partner and ICRAF contributions in Southern Africa in this scaling out vary considerably (see Table 3), but this diversity is needed to involve mainstream development agents. The institutional and managerial set-up of government and non-government agents is distinct. The former is commonly more hierarchical with top-down planning and implementation, while the latter tends to have better grassroots participation yet is often weak in integrating development efforts systematically into existing structures and hence in providing impact beyond project areas.

In collaborating with such contrasting partners, we want to compare successes and failures and assess transaction costs in partnership, which should lead to a better understanding of which are the most effective ways of scaling out agroforestry. At the same time, we hope that hybrid diffusion systems may emerge (Rogers 1995) that will successfully combine existing technology transfer by national extension services with participatory, decentralised innovation processes happening locally. This implies that parts of our collaboration must interact with farmer groups, which gives us an opportunity for direct client consultation. Thus the quality of our core services (provision of information, knowledge, tree seed, and capacity building) can continuously improve through feedback from farmers. ICRAF's overall role in Southern Africa is therefore one of a facilitator between government research-extension services, which continue to operate

Table 3: ICRAF's operational modes with partners in Southern Africa

Partner	Partner contribution	ICRAF contribution*
Government	• Infrastructure • Executive power • Personnel • Tax rebates	• Germplasm • Scientific knowledge • Networking • Capacity building • *Operational funds*
NGOs	• Grassroots-level organisation • Personnel • Operational funds • Practical feedback	• Germplasm • Science/knowledge • Networking • Capacity building • *Institution building* • *Empowerment*
Farmer groups	• Land • Time • Labour • Indigenous knowledge	• Germplasm • Science/knowledge • Networking • Capacity building • *Compensation* • *Organisational support* • *Empowerment*

* ICRAF contributions in italics are those that need to be provided in addition to the core services (germplasm, science and knowledge, networking, and capacity building) to make collaboration more effective.

largely on the linear model of technology transfer and local, decentralised extension processes of participatory technology development. Furthermore, a dialogue between participatory technology development actors and formal extension and research institutions is also facilitated, providing opportunities for feeding research hypotheses from the grassroots level into the formal research set-up.

At present, we are collaborating with 572 partners in the four core countries, comprising government agencies (36), development projects (16), NGOs and grassroots organisations (26), farmer groups (485), and the private sector (9). We have extended our activities into Mozambique through the Danish International Development Agency (DANIDA), the German Gesellschaft für Technische Zusammenarbeit (GTZ), and World Vision International. In South Africa, we have conducted joint training activities in former homelands with the Danish Cooperation for Environment and Development (DANCED) in Mpumalanga and with the Finnish International Development Agency (FINNIDA) in Northern Province.

The main instrument for collaboration in these four countries is open, informal, biannual 'networkshops', which ICRAF facilitates. In these workshops, representatives from partner organisations and farmers together plan and review the implementation of agroforestry activities. A series of 'networkshops' were used to develop detailed operational plans until March 2001 and strategic options beyond (Böhringer *et al.* 1999a). Six main operational objectives were identified as necessary for overcoming common drawbacks:

- increasing the awareness of stakeholders, including farmers;
- strengthening the capacity of farmers and extension agents;
- amplifying the availability of germplasm at the grassroots;
- improving partnership and co-operation among stakeholders;
- supporting the marketing of tree products;
- institutionalising participatory approaches and methods for innovation development and extension.

ICRAF has given the first four points much attention since it first engaged in development in Southern Africa in 1997. They are action oriented and seek to prepare a platform that will help broaden the impact of agroforestry in the region. The first one is to overcome the limited awareness that stakeholders have, including farmers, of agroforestry potential and benefits. Awareness is increased by using common dissemination tools such as holding field days (reaching on average 2500 farmers, about half of whom are women), in each of the four countries every year, and producing and distributing agroforestry extension materials (leaflets, manuals, cartoons, posters, radio programmes, and videos) and regional and national newsletters.

Grassroots capacity can be strengthened by helping farmers to form groups, facilitating direct farmer-to-farmer training in villages, training farmer trainers who will lead community-based extension, and providing technology-related skills training on topics such as how to manage nurseries and trees. We have found that this 'farmer first' approach to capacity building is efficient. Farmer-to-farmer training, for instance, costs on average approximately US$2.50 per farmer trained, lasting usually three to four days in villages. In comparison, a one-week residential training course costs on average between US$20 and US$30 per farmer. One trained farmer typically reaches up to ten other farmers during the first season after training in agroforestry.

Supporting decentralised grassroots-level germplasm production and building supply networks help to address the problem of restricted availability of germplasm, mainly tree seed. Here, the projections until the end of year 2001 are that ICRAF will help to establish 800 farmer seed-multiplication plots and over 6000 farmer nurseries (Böhringer *et al.* 1999a). Partnership and co-operation among stakeholders can be improved through the scaling-out process described earlier.

Our facilitation role in marketing tree products is a more recent one, as we appreciate more and more the need to improve links between small-scale farmers and markets. Thus, the development of innovations and the use of new technologies are ultimately driven by consumer demand. This is particularly true for technologies for which generating income is an important objective, such as cultivating indigenous fruit trees or fodder banks. In promoting indigenous fruit in particular, the need to assess market demand and consumer preferences is immediate; therefore, links need to be established between producers and markets. Building these links must start before large numbers of trees planted start bearing fruit. Here, experience from the tree-crop sector is particularly valuable, and ICRAF in Southern Africa collaborates closely with a GTZ-funded regional project, 'Integration of Tree Crops into Farming Systems'. This project has put into place in Kenya a successful model for exotic fruits such as mango, papaya, and cashew. It integrates product development, processing, capacity building of farmers, and farmer-to-farmer extension in a holistic way (Van Eckert 1997). The challenge for the years to come is to adapt this approach for indigenous fruit to Southern Africa and to draw more private partnerships into the network, particularly from South Africa, where markets are well developed.

Pilot development projects: understanding impact under real-world conditions

Keeping our goal in mind we need to ask: how much of the technology developed by research actually reaches the farming world through the technology-transfer approach? This approach still predominates in extension services in the region. Technology transfer produced remarkable impacts during the Green Revolution in parts of Asia, largely by limiting its focus to interventions that targeted homogeneous cropping systems with large geographic spread such as irrigated rice; but it has failed to show similar impact for the large majority of smallholder farming systems elsewhere.

In Southern Africa, biophysical conditions are more marginal and socio-cultural settings more variable, which calls for the development of diverse and often complex agricultural systems that meet farmers' multiple needs. These complex and diverse technology innovations are best developed locally. Only continuous farmer experimentation and adaptation *in situ* will make them feasible and profitable to farming communities at large – the ultimate clients of research and development services.

This calls for a better understanding of the complex interdependencies among the major biophysical, economic, social, and cultural factors that come into play at a larger community or even watershed scale, so that the process of agroforestry innovation, development, and extension can be conceptualised for wider scaling up. Communities drive this process, and technical options are primarily perceived as learning tools that bring about social change. Only to a lesser extent are they seen as linear vehicles for increasing adoption rates of technical 'solutions' *per se*.

ICRAF therefore considers that establishing pilot development projects is an important link between research and development. In them, hypotheses in natural resource management and agroforestry development can be tested together with communities. Results can be assessed in a participatory way and documented more holistically at a landscape level. We are currently selecting and designing at least one pilot project with partners and communities in every core country. In Malawi, three communities have been involved in a watershed near Zomba since 1998. Our working hypothesis there is that agroforestry makes conservation farming on the steep slopes more profitable and catalyses the effective conservation of soil and watershed in the community.

The approach we follow is to facilitate community dialogue based on the principles of adult education and 'critical consciousness'; that is, the process of reflection and action needed for a community to improve itself (Freire 1969). The approach starts with training for transformation; community action follows, with conserving fields and establishing farmer nurseries; village monitoring, and planning workshops then follow on. Such cycles of community reflection and action are repeated and are gradually expected to increase community capacity to higher levels so that development becomes sustainable.

Already, after two years, work in this pilot development project has given us some crucial insights into researcher–farmer communications, gender–wealth relationships, and community organisation. Outside experts tend to oversimplify scientific information, while farmers are asking for comprehensive and scientific explanations for natural processes to be given in their own language and in terminology based on indigenous knowledge.

Annual household incomes in the area range from as little as US$80 to US$500, yet villagers clearly distinguish four wealth tiers. Peer communication happens mainly within these four wealth tiers and a gender aspect in communications cross-cuts them, meaning, for instance, that women within the same wealth group communicate most readily with each other, and then with women in different wealth groups, but rarely with men, and vice versa. Organisation of groups follows a similar pattern.

The challenge will be to draw in more women, who head 46 per cent of all households in the area, and more of the poorest, but who have little means to participate in ICRAF-facilitated activities as they are too busy with their own household problems and cannot risk trying out innovations. Here, community soil and watershed conservation is thought to provide an excellent tool for facilitating social change, as its effectiveness relies on being all-inclusive, which means that the wealthier members in the community have to find ways to assist the poorer ones with conserving their fields so that everyone in the watershed can benefit. Our strategy for scaling up such pilot development projects is to help make direct farmer-to-farmer links within and across countries in the region. To do this, we work with projects such as those of Oxfam GB in the Mulanje area in Malawi, which has similar objectives and uses approaches like those in our pilot development project.

Monitoring and evaluation: a key element in the learning process

The focus of our work over the past three seasons has been on getting agroforestry action initiated with multiple partners. Activities have largely been driven by demand and supported by a very limited number of ICRAF staff in Southern Africa. Therefore, our monitoring and evaluation (M&E) efforts so far have had to concentrate on measuring outputs quantitatively using conventional methods such as questionnaires and record sheets, for example, to characterise households or to capture information about farmer nurseries. These efforts have been project driven, and little dialogue has taken place so far on what M&E means to different stakeholders, including farmers, how it can be approached together, and how it can be used as a central learning tool within our network. However, as people add value to information obtained from monitoring, we must find answers to important questions about who is evaluating, why, and for whom (Guijt *et al.* 1998).

This kind of dialogue should lead to more participatory methods being used in M&E. It would also necessitate finding a common language for communicating among farmers, scientists, project administrators, fieldworkers, donors, and others, so that agreement can be reached on who wants to evaluate what, with whom, and how. We envisage, therefore, a practical approach to M&E, which could be founded on three pillars: farmer self-M&E, external (conventional) M&E by development agents, and village impact assessment workshops in selected representative communities. With all three pillars, stakeholders would participate in identifying impact indicators and the design, implementation, and analysis of common M&E tools. Triangulation among results from these three approaches should be a more transparent, accurate, and cost-effective way to reflect successes and failures of our work and to advance our learning (Guijt *et al.* 1998).

Still, the main way in which participation can add value should be that it builds grassroots capacity in situation analysis and that it empowers people to reflect on actions in a structured way before new activities are planned and implemented (Freire 1969). ICRAF wants to catalyse this process, with the main aim being to use participatory M&E as a tool for planning and learning within our network. This would also elevate M&E from an internal project operational output to a developmental output with larger benefits to the public. Dialogue has been initiated since the 1999–2000 season with a series of village workshops, followed by a 'networkshop' focusing on M&E. The objective was to understand farmers' own concepts of M&E and priorities better, and to identify key indicators for joint assessment. This process has just begun, and first experiences will be evaluated in another 'networkshop'.

Some lessons and preliminary conclusions

Getting the right partnerships

After three years of engagement in development in Southern Africa, ICRAF has reached out to a considerably larger number of farmers compared with earlier forms of on-farm research. This has been achieved mainly through networking and through scaling out agroforestry to an increasing number of partners and collaborators in the region. Partnerships have now become so numerous that the costs of handling them stretch ICRAF's limited resources and capacities to the maximum. Therefore, it is now time to analyse partnerships and identify the efficient ones that contribute substantially to our reaching our goal. For example, a number of partners such as NGOs and bilateral development projects are willing to dedicate some of their resources to agroforestry, while others are not, yet they all want our continued support.

Special cases are government partners in all countries, who have scarcely any operational funds at their disposal. The large amounts of funds that government partners put forward for field activities are usually allocated to paying staff allowances, which are meant to supplement very low government salaries. Such staff allowances may typically total more than 60 per cent of overall costs for a planned joint activity. This raises questions about the appropriateness of scaling out under such conditions. While we appreciate the importance of government extension services in providing a national institutional umbrella, their role needs to be redefined. They should move from their current poor delivery of services to a role of facilitating and coordinating services – and this ideally with minimum overhead costs. Yet, currently, government facilitation for local development agents and grassroots movements remains marginal in most cases, while vertical integration of these development efforts into national strategies and institutions hardly exists.

This lack also explains to some extent why a fragmented multitude of multilateral and bilateral development projects, NGOs, and charities, most of them financed externally, are largely driving local development in Southern Africa today. This situation cannot be sustainable in the long run. ICRAF's role as a facilitator is therefore seen to be a limited and temporary one, since national institutions should naturally take over this role. Whether this changeover succeeds will also depend on policies that favour the decentralised development of innovation and demand-driven delivery of services to smallholder farmers. The latter will probably need more public and private partnerships in the region to become effective.

The timeframe for agroforestry impact

Another experience with scaling out is that, aside from pilot development projects, it allows ICRAF only limited direct assessment of impact in the communities. Partners' capacities in M&E are overall weak, and the need for M&E is often dictated by external donors, who very seldom put natural resource management or agroforestry high on their agenda. An assessment of the overall effect of scaling out on the actual impact of agroforestry thus becomes very difficult, if not impossible. Still, we are reaching as many as 10 per cent of households with agroforestry in a given area in a relatively short time. But this achievement also depends on the combined effort and resources that partners and ICRAF spend.

Such a reach conforms well to results from other diffusion studies reporting that 'innovators' typically account for 2–3 per cent of the total number of members of a given social system and 'early adopters' 12.5 per cent (Rogers 1995). However, agroforestry needs special consideration, because innovation–decision periods of two or three years are common. This is the period that elapses between acquiring awareness and knowledge about the potential of a technology and its actual use or adoption. The earliest it will happen in agroforestry is when tangible benefits accrue from trees for the first time. It is therefore far too early to predict the likely outcome of continued scaling out or, if more project resources were available to ICRAF, of scaling up agroforestry in the region (Scarborough *et al.* 1997). Either strategy, or both combined, should eventually lead to a 'take-off stage' in technology use, where as many as 30 per cent of the households are reached (Rogers 1995).

For now, we consider bridging the decision–innovation time period of two to three years to be crucial, which means that our main efforts are focused on steering the current first generation of agroforestry users towards success. The numbers should greatly increase in Malawi, Tanzania, Zambia, and Zimbabwe after the 2000–01 season.

Farmers as key agents of change

Our collaboration with large numbers of farmer groups and communities often entails involving limited numbers of farmer representatives for specific activities, after which they should act as agents of change in their home areas. Here, we experience again and again how important and yet difficult is the proper selection of farmers. Our partners select the farmers to represent their communities in joint activities such as field days or farmer-to-farmer training. Later, when we interact with the communities concerned more closely, we often learn that the roles, responsibilities, and privileges of persons who were selected to represent groups or whole communities were not discussed openly, and that little agreement was reached on the selection criteria to be used. Indications are that the personal criteria of extension agents also often govern farmer selection.

Farmer 'representatives' selected on such a basis are likely to act only with great difficulty as agents of change in their home communities. They experience 'social levelling', meaning they lose influence and become ordinary farmers again within a short time instead of evolving into leaders. It is, therefore, of utmost importance that farmer representatives be selected with a true mandate from their communities, and endorsed by traditional leaders. This process may take lengthy facilitation and negotiation, but we learn that this is time well spent in order to avoid unwelcome social disruptions during a period of change that is difficult anyway as innovations are introduced into the community.

Addressing the special needs of women

Getting the right gender balance in our work has proved more difficult than originally anticipated. Part of this problem is inherent in partner institutions, with, for instance, fewer than 3 per cent of extension staff working directly with farmers in the region being women. Without involving more qualified women, especially where impact is to take place, it appears unlikely that gender barriers in communications can be easily overcome, or much progress made in increasing the use of agroforestry among the large numbers of female-headed households in the region. One way in which ICRAF tries to overcome this discrepancy is by ensuring that at least half of those who participate in any joint activity must be women. This is one of the few conditions that we place on collaborating partners. With this condition, we hope gradually to build grassroots women's capacity, so that this marginalised group can eventually gain more influence in ongoing decentralisation processes in the region.

Agroforestry – first and foremost a learning tool

In summarising our work to date, the most important lesson is that agroforestry, because of its inherent complexity and diversity, emerges as a central learning tool in building local capacity to develop innovations. Secondly, agroforestry offers farmers technology options that can significantly contribute to improved livelihoods. We particularly see a great need for many dispersed local innovation centres to emerge, which should then be linked horizontally to achieve wider impact. This calls for some new thinking within ICRAF and other international agricultural research centres that have promoted a research paradigm focused on developing models with the widest possible applications based on simplifying the complex, separating the connected, and standardising the diverse. It appears unlikely that models for agroforestry development can be constructed in a similar way, as the variability of the biophysical and socio-cultural settings of smallholder farmers is very great in the real world. However, pilot development projects have been shown to be crucial, because they provide ICRAF in Southern Africa with opportunities to learn, even as we develop innovations, about what can happen at a wider landscape or watershed level. This enhances our own understanding of critical factors that can lead to success – or failure – in our efforts to facilitate development in the region through agroforestry.

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