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CONCEPT PAPER

SUPPORT FOR TECHNOLOGY TRANSFER TO  
NGOS AND PVOS PROMOTING FORESTRY AND AGROFORESTRY IN AFRICA

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## I. SUMMARY AND INTRODUCTION

### A. Definitions

NGO refers in this paper to nongovernment, nonprofit organizations promoting tree planting and management in Africa. NGOs include both indigenous African organizations and international private voluntary organizations (PVOs). Thus PVOs are a subset of NGOs. Forestry here refers to the planting, maintenance, and use of trees and shrubs by farmers, landless people, and communities. The term forestry as used here includes agroforestry, but it is broader than the strict definitions of that term, since many of the uses of trees being promoted by NGOs in Africa do not meet those definitions. In places this paper uses the terms "forestry and agroforestry" together. Likewise, the terms "NGOs and PVOs" are sometimes presented together. In both cases this is because some readers may be used to seeing these as mutually exclusive terms. Technologies is used in this paper to mean the physical, social, and economic methods used to promote forestry.

### B. Basis of this Paper

This concept paper was commissioned by the Office of Forestry, Environment and Natural Resources in AID's Bureau for Science and Technology (S&T/FENR). Information was developed in three ways: (1) structured interviews conducted in the United States, Sudan, Kenya, Niger, Senegal, and Mali with some 68 officials of NGOs, PVOs, Agriculture Research Organizations, Development Assistance Organizations, and African government officials, (2) workshops in Kenya, Niger, and Senegal in which all these categories of personnel participated to discuss needs, what works, and what could and should be done to support transfer of technologies to field agents of NGO and PVO projects, and (3) study of published literature and of unpublished reports within AID and within the PVOs and NGOs. Persons interviewed and workshop participants are listed in Appendix A.

The observations and conclusions in this concept paper report the expressions of the interviewees and workshop participants. These have been sorted into a framework of necessary and sufficient conditions for forestry technology transfer, in order to develop the concept for an AID activity that would help to meet the technology transfer need of NGO and PVO projects at modest cost. The specific activities suggested were articulated by the PVO, NGO, and USAID personnel in Africa. Some nontechnical personnel in PVO offices at the national level do not feel that improvement in forestry technical capability is a priority need of their organizations.

C. Role of NGOs in Development Assistance for Forestry in Africa

In Africa, much of the most effective work to promote use of trees by farmers is occurring in development projects organized by NGOs. (The term NGOs includes PVOs). Numerous USAID projects with forestry components are being managed or assisted by CARE, World Vision, Catholic Relief Services, VITA, Save the Children, Africare, and other NGOs. A study initiated by AID's Africa Bureau is investigating projects that have been clearly beneficial to small farmers in Africa, and many of these, such as the Majja Valley windbreak project organized by CARE, will be NGO projects with a strong forestry component.

In most such projects, government forestry and agriculture agencies cooperate with the NGOs, providing technical information and materials and in many places providing the field personnel who are in direct contact with farmers. NGOs bring to these projects their superior abilities to: (1) organize and motivate community participation, (2) marshal funding from foreign sources, (3) apply funds, equipment, and personnel quickly to resolve logistical, technical, and social constraints on progress. In addition to these abilities, the NGOs bring enthusiasm -- a can-do attitude -- to development assistance projects.

Applying these strengths, NGO managed projects in African countries are transferring forestry technologies to farmers. Multipurpose shade trees in house compounds, nursery establishment and operation, and living fences are succeeding in many projects. However, opportunities to use NGO strengths to full advantage are being missed where NGO field personnel are not thoroughly familiar with improved forestry (including agroforestry) technologies.

D. Need for Technology Transfer to NGO Project Personnel and Availability of Improved Technologies

Foresters and agronomy field agents on NGO-managed projects who have a limited repertoire of forestry or agroforestry technologies from which to choose must use substantial time and resources on trial and error searches for solutions to technical problems. The process is satisfying when solutions are found, but it is often inefficient and unnecessarily risky when the same or similar problems have already been solved in another time or place. The repertoire of technologies is limited for several reasons:

- o field level personnel on NGO projects are often young, enthusiastic, and energetic people who have not yet had broad experience or extensive technical training;

- o forestry and agroforestry technologies developed in Africa have mainly been intended for government owned forests or large commercial plantations;
- o agricultural development in Africa has generally neglected the role of trees and shrubs other than commodity plantation crops such as coffee and tea, so agroforestry technologies truly ready for low-risk extension to farmers are extremely limited; and
- o how-to descriptions of existing potentially useful techniques for farmer's or villager's use and management of trees or shrubs are generally unavailable.

Improved forestry technologies are available from several sources. In past decades, foresters and agronomists have solved many of the same technical problems that constrain current projects. Useful descriptions of some of these solutions are to be found in the poorly organized archives of government agencies. Other useful experience could be captured by detailed interviews of experienced technical personnel still in government service or in retirement.

The international agricultural research organizations active in Africa, such as IITA, ILCA, and ICRISAT, have only recently begun to address uses of tree and shrubs. Within five to ten years improved agroforestry technologies may be ready for release. Meanwhile, alley cropping methods suitable for humid lowland areas have been developed at IITA, and technical materials potentially useful for the crop and livestock components of agroforestry systems are already available. However, the international organizations, including ICRAF, do not have a strong mandate to transfer technologies to persons implementing operational development projects. Rather they release technologies to national agricultural research organizations.

National agricultural research organizations have generally lagged in attention to trees and shrubs, but ICRAF is now promoting agroforestry to national organizations through the AFRENA network, and IITA is taking steps to resuscitate the Alley Cropping Network. If these efforts succeed, research organizations may be potential agroforestry technology sources for NGOs within the next decade.

Organizations in other regions of the world are another potential source. CATIE in Costa Rica is developing agroforestry materials and techniques of potential use in parts of Africa. Foresters in India have for decades been describing techniques for planting and maintaining multi-purpose trees in difficult environments. Many techniques

developed in the U.S., such as clonal propagation, improving nursery production, fertilizing trees, inoculating with microorganisms, and managing natural resource information, are potentially useful to NGO projects in Africa. Australia and New Zealand have tested tree and shrub germplasm suitable for arid and saline soils, and have demonstrated direct seeding techniques for forestry species.

However, the technology sources with greatest potential utility for NGOs in Africa are the recent and current development projects promoting the use of trees, particularly in agroforestry applications, by farmers in Africa. NGO personnel widely believe that they are laboring to reinvent techniques recently or simultaneously invented by other NGO technicians in the same or nearby countries. The methods being reinvented include: organizing and operating nurseries, using trees and shrubs in farming and live stock systems, training extension workers, matching species and provenances to socioeconomic needs and site conditions, planting tree seeds directly in the field, protecting young trees from livestock, droughts and pests, and developing financial conditions that enable farmers to adopt resource-conserving practices.

#### E. Existing Technology Transfer Mechanisms are not Sufficient

Numerous mechanisms already exist that support transfer of forestry and related technologies to implementers of development projects in Africa. Workshops, training programs, reports, books, journals, manuals, newsletters, and networking activities related to forestry, and the technical support personnel within some NGOs are all helping to develop some of the necessary conditions for technology transfer. The Forestry Support Program sponsored by AID/S&T was one of the most frequently cited sources for networking information. However, no organization is working to assure that the sufficient conditions are created. As a result successes in transferring improved methods from the sources to field agents on NGO projects occur sporadically, when the sufficient conditions happen to occur.

Of the several sources of relevant technologies, the one least exploited is the potential for project to project transfers. Managers of projects implementing technologies seldom consider dissemination of the techniques they invent or adapt to agents of other projects to be a priority task. Some NGO consortia, and a few networks have been set up partly for this purpose. Their NGO to NGO technology transfer accomplishments have been few, partly because the consortia managers have other priorities for their meager resources, partly because the typical network manager's mandate is to help create necessary, but not necessarily sufficient, technology transfer conditions.

## F. An AID Activity to Enhance Technology Transfer to NGOs

AID could help to create the necessary and sufficient conditions for needed transfer of forestry/agroforestry technologies to personnel of NGO forestry projects. The following features characterize a concept developed from observations and suggestions made by NGO and AID personnel.

Technology transfer facilitators: Positions can be created for technology transfer facilitators. These would be individuals who thoroughly understand what the necessary and sufficient conditions are for effective technology transfer. They would serve as brokers, advocates, and managers of technology transfer. They would be responsible to facilitate creation of those conditions.

Washington position: In Washington, a facilitator would work with officials of AID and other organizations to modify the design of development projects that have forestry/agroforestry components in order to make explicit arrangements for transfer of technologies developed to other projects. He or she would also facilitate the transfer of technologies among global regions, e.g. from U.S. nurseries to the NGO developers of nurseries in Africa, from projects in Latin America to projects in India. The number of transfers initiated by the facilitator would be limited to those which could be followed up adequately to assure that sufficient conditions for success are created. Finally, the facilitator working from Washington would train, monitor and provide technical and managerial support to a dispersed team of facilitators in the field.

African positions: In selected African locations, facilitators would work under the auspices of USAID missions or REDSOs to create necessary conditions complementary to those already being created by existing programs. At the same time, they would monitor and advocate adjustments to development projects and to institutional programs, so that sufficient conditions for effective technology transfer would occur by design and not only by chance.

Specific activities: The dispersed technology facilitators could immediately begin several activities, while gradually building the rapport and linkages needed to effectively monitor and advocate technology transfer. Depending on needs and opportunities in the specific locations, activities could include:

- o A forestry techniques journal, providing how-to descriptions of agroforestry, social forestry, and nursery techniques used by NGO managed projects.
- o Targeted workshops, seminars, and consultancies. The facilitator could serve training

programs of other organizations to advocate and facilitate follow up. With the Washington based facilitator helping to marshal funding he or she could occasionally organize and sponsor workshops. Such activities would be limited to the number which could be adequately monitored and followed up.

- o Work to build African organizations' ability to transfer technologies. The facilitator could help to organize and make accessible the information buried in archives of government agencies. He or she could train NGO personnel to use expert systems techniques to document and disseminate the undocumented lessons learned, problem solving strategies, and rules of thumb now known only by the most experienced foresters and agronomists in Africa.
  
- o Build information management systems and communication links to make existing networks more effective. A pilot project organized by the Industry Council for Development has helped NGO consortia organizations in Mali and Niger to install PC computer based information management systems. These are enthusiastically received, do not seem to need more than about two months of technical assistance, and appear to have great potential to strengthen the organizations' ability to facilitate technology transfer for their member NGOs.

Phased development: The AID support for technology transfer to NGOs could be designed to increase gradually from a single position to a modest program funded either centrally or with a combination of Bureau, Mission, and REDSO support. It would start with designation of an individual position in the Technical Resources Office of the Africa Bureau, or in the Forestry Support Program sponsored by the Bureau of Science and Technology. That person could begin almost immediately to facilitate technology transfer, but would develop and operate a flexible plan so that the activities would be modified in accordance with needs expressed by the Missions and REDSOs and needs and opportunities revealed by the current NRM priority country assessments. Some role might also be given the Nitrogen Fixing Tree Association (NFTA), which currently produces a "Technical Notes" series.

The positions for technology transfer facilitators in African countries would be staffed by host country nationals or by expatriates already located in the countries. Using a phased approach, one such individual could be recruited, trained, and supported to meet the needs of a particular country. Later, as the value of the concept is proven and as

funding is developed, additional people can be recruited to work at national or regional levels.

The institutional arrangements and initial activities would depend on the country and the facilitator's initial expertise. For example:

- o In Sudan, the facilitator could be a resident expatriate with forestry and information management skills, who would work with a Forestry Department counterpart. The technology transfer support work might begin by organizing the information archives of that department and related departments to make them accessible and useful to both NGO and Forestry Department field agents.
- o In Kenya, the facilitator could be a Kenyan with technical writing and journalism skills, who would work from the agricultural college at Egerton. His or her work might include production of a technical journal that would include detailed how-to descriptions of techniques demonstrated in recent or current development projects, columns in which college faculty, forestry department technicians, or other sources answer field agents' technical queries, and similar problem oriented features. (Such a journal is distributed now within the Kenyan Forestry Department, but may be discontinued when its expatriate producer leaves.) The facilitator could also promote use of the college's agroforestry demonstration center (established under the USAID-sponsored KREP program) for hands-on training for NGO field agents.
- o In Niger an expatriate with social forestry experience could work with a local counterpart at GAP, the NGO umbrella organization. Initial work could include further development and use of the information management system installed by the Industry Development Council pilot project, and communication assistance to forestry department and NGO personnel who have been workshop trainees but who do not implement technologies learned because follow up was not planned.

Early results: The program concept described here could begin soon to facilitate effective and needed technology transfer to personnel on projects managed by NGOs, who have a demonstrated ability to adapt technology innovations to local conditions and to transfer the technologies on to farmers. At

modest cost it could complement other NRM activities to build on existing technical and institutional accomplishments. Thus it could produce tangible results earlier than many of the necessarily long-term efforts to develop agroforestry and still other natural resource management technologies for Africa. Measurable achievements should be apparent within two years.

## II. THE CASE FOR FORESTRY TECHNOLOGY TRANSFER TO NGOS

PVOs and NGOs manage over one fourth of the AID-sponsored tree planting activities in Africa, and both AID's forestry investment and its use of NGOs as providers of technical assistance are expected to become even more important as AID implements its natural resource management plan for Sub-Saharan Africa. Thus the effectiveness of the NGO agroforestry work will be a significant determinant of AID's success in Africa.

Trees are part of many traditional farming systems in Africa, and in many African farming situations trees help to necessary to sustain farm productivity. But rapidly expanding human populations, increases in numbers of livestock, changing economic conditions, destructive farming and grazing practices, and inappropriate conversion of marginal lands to agricultural production have resulted in degradation of natural resources. Widespread consequences include soil erosion, soil fertility loss, scarcity of fuelwood, fodder and other tree and shrub products, and loss of vegetative cover that exacerbates desertification. New methods -- both fundamentally new agroforestry techniques and marginal improvements in existing technologies -- are needed to make tree planting and maintenance an attractive and profitable activity for farmers.

Forestry/agroforestry as an assistance activity aimed at farmers is still in a very early stage of development. It is far behind the technical sophistication of agricultural assistance. NGO development interventions involving trees are often projects to develop community-level tree nurseries and to distribute seedlings to farmers. Many of the NGO projects also attempt to assist farmers with information on how to use the trees, and some projects send extension agents onto the farms to provide information on where and how to plant and maintain the trees in relation to other crops or livestock. Some NGOs have begun to develop information on how tree products can be used and marketed.

These interventions seem very appropriate for sustaining the natural resource base of farms, and some analyses indicate that agroforestry interventions are economically justifiable. However, whether agroforestry technologies promoted by AID projects will be sustained by the intended beneficiaries, and whether spontaneous technology diffusion will begin, will depend on whether they meet the farmers' criteria of affordability, profitability, and risk aversion.

Spontaneous diffusion of introduced techniques for farm use of trees can occur, if the methods are clearly profitable. In the colonial era, the spontaneous spread of farming systems that used tree species to produce commodities such as coffee and tea was probably aided by favorable government policies

and strong commercial organization. Use of the neem tree, introduced from South Asia and encouraged by forestry officials, has been widely accepted by farmers and urban dwellers alike. More recently, planting eucalyptus trees to produce poles has become popular in Kenya and some other countries, and some farmers who use large quantities of fuel for crop drying and other processing activities are maintaining fuel woodlots.

Examples of such spontaneous diffusion of tree use by farmers are few, however. This is partly because agroforestry interventions have only recently begun to be a common assistance activity. But it also appears that many technologies being promoted are not in fact technically viable, much less affordable or profitable.

For example, Australian acacias known to grow relatively well under semi-arid conditions were distributed on a pilot scale in Niger in spite of high costs of seedling production in centralized nurseries. But many of these trees have been dying 3 to 4 years after planting. The solution now being proposed is to use native species grown in village nurseries, since naturally regenerating native trees live longer than 4 years, and village nurseries are less expensive. But these may die too, since the cause of the mortality may be use of root-constraining plastic bags in both central and village nurseries.

Thus, if agroforestry interventions are to be as effective as seems to be expected in AID/Africa Bureau's natural resources sector strategy, technology development must occur and the technologies must be transferred to the people who promote agroforestry to African farmers.

### III. THE OPPORTUNITY FOR AN AID ACTIVITY

If the above argument that technology transfer is necessary is accepted, then several questions arise for AID's consideration in determining whether to sponsor an activity designed specifically to enhance agroforestry technology transfer:

1) Have agroforestry technologies been developed and is development continuing?

Yes. Techniques relevant to solution of many agroforestry problems have already been developed and are to be found in published technical reports, in unpublished reports located in the archives of forestry and agriculture agencies, and in the personal knowledge of expert farmers, foresters, and agriculturalists. Other techniques and some technology systems ("technical packages") are now being developed by implementers of development assistance projects -- many of whom are working on PVO and NGO managed projects. Still others are being developed by local government forestry and agriculture departments and by national and international research organizations. USAID is one of the principal sponsors of all these technology development activities.

2) Is adequate transfer from the technology developers to the NGO/PVO promoters of agroforestry already occurring?

No. Some important technology transfer is occurring, but it is too slow and sporadic to support (1) the level of effectiveness AID seeks for the NGO managed interventions or (2) the productivity and sustainability goals envisioned in AID's natural resource sector strategy for Africa. This is evidenced by promotion of technologies for which profitability and sustainability are highly doubtful, by the failure to use improved technologies that already exist, and by NGO personnel at widespread sites having frequently to reinvent solutions to problems that have already been solved elsewhere.

3) Why is adequate technology transfer not occurring?

In spite of development assistance agency activities calling attention to agroforestry technologies and training opportunities, and in spite of numerous networking activities among the NGOs working in Africa, most of the necessary conditions for

successful technology transfer are not being met. The next section of this report uses the necessary conditions concept (developed by the Office of Technology Assessment's 1984 study of technologies to sustain tropical forests) to organize description of the needs of NGOs, the shortcomings of current mechanisms with which agroforestry technologies are transferred, and the inferences regarding an AID activity to enhance technology transfer.

4) Are NGOs likely to develop adequate technology transfer without intervention from AID or other donors?

No. In several African countries, umbrella organizations and consortia have been established to coordinate and serve the NGO organizations. Some of these, such as KENGO in Kenya, concentrate heavily on social forestry and are providing important technical training services. However, these organizations are not adequately facilitating technology transfer, partly because most have not made this a high priority, and partly because the potential technology sources are doing very little to use these organizations for outreach.

Most of the agroforestry technology development is being done by the NGOs, forestry departments, and other technology implementers. The great strength of these organizations, especially the NGOs, is their ability to concentrate on pragmatic work at the community level. A consequence of this focus is that their staff tend to be 100 percent occupied with solving pragmatic day-to-day problems of their own projects. They are not predisposed to invest their limited resources in transferring technologies to other organizations.

Some international PVOs, such as CARE, have staff who work to assure the technical quality of numerous projects, rather than focussing on individual projects. These PVOs too, however, are occupied with the project approach to development, and their staff necessarily focus on their own organization's projects. Decisions about how much to invest in networking seem to be based largely on what benefits they perceive for their organization and its projects. CARE provides important contributions to coordinating activities. However, having less to gain from networking than the weaker NGOs, the large international organizations seem unlikely to invest substantially in such activities from their overhead funds or from funds designated for site-specific projects.

5) Should technology transfer networks be organized on a national, multi-country, or an ecology-zone basis?

On a national and multi-country basis. Agroforestry technology development, technology transfers, and extension agent training for several ecological zones can effectively be handled by a single organization, so long as the need to sort out technologies by their ecological requirements is accommodated in the design of the program.\* Thus organization of technology transfer networks separately for each major ecological zone is not necessary, except to the extent that attention to such zonal groups is needed to relate to technology development institutions and networks that are organized on this basis.

The relationships among government organizations, NGOs, and development assistance agencies vary greatly from one country to another. Thus a different structure is needed for each country's agroforestry technology transfer network.

The agroforestry activities of NGOs and their needs for technologies are similar across countries. Thus an AID activity organized to provide technical information and assistance to one country's technology transfer network could increase efficiency by expanding its service to other countries.

6) Who should be the targets for agroforestry technology transfer activities in Sub-Saharan Africa.

Both NGO personnel and government extension staff should be the targets. Many reports discussing the important role of NGOs in Africa give the impression that personnel of these organizations are the principal extension agents for agroforestry technologies. In person, however, most NGO staff are quick to point out that the people actually working directly with farmers are most commonly government extension agents. In most cases, the NGOs have an intermediary, enabling role in development assistance interventions. They receive community requests for assistance; develop project proposals

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\* The Kenya Renewable Energy Development Program sponsored by USAID effectively developed and transferred agroforestry technologies for six different ecological zones. The agroforestry information network being developed for NGOs by the Industrial Development Council sorts information by ecological zone readily.

and plans; secure financing and government approval for the projects; manage projects, including procurement and distribution of inputs and technical assistance; and assist with or carry out evaluations and reporting functions. In a minority of cases, people in the direct employ of NGOs are the extension agents working directly with farmers. Most of these personnel rely on government foresters and agronomists for most of the technical information which they extend to the farmers and for solutions to the technical problems that arise. In only a few cases do the NGO personnel work independently of government forestry and agriculture personnel.

7) How can NGO's best serve the technology transfer process?

In each of the three workshops conducted for this study, NGO representatives and development assistance agency officials agreed that a technology transfer program should not be targeted solely at NGOs. However, in many countries PVOs/NGOs manage the most effective development assistance projects involving agroforestry, and are the primary proponents of hands-on, person-to-person technology transfer. Thus NGOs are often in a good position to serve as facilitators of technology transfer.

In some countries, such as Senegal, agroforestry is not clearly a high priority for either the forestry or agriculture bureaucracies. In those countries, the NGO inter- and intra- organization networks may provide the best technology transfer channels to reach extension agents at the field level. In other countries, such as Sudan, the best role for NGOs may be to work within a program organized by the government's forestry department. In still other countries, such as Kenya, a university may be in the best position to serve as the center of a technology transfer network serving both NGOs and government agencies.

#### IV. THE NECESSARY AND SUFFICIENT CONDITIONS FOR SUCCESSFUL TECHNOLOGY TRANSFER

The necessary and sufficient conditions for successful transfer of technologies to promoters of farm forestry in Africa are discussed below.

##### Condition 1: Knowledgeable people at source end of the transfer.

For a technology transfer to be effective, the technology should be thoroughly understood by articulate people at the source end. It is not sufficient to know that something worked. It is also necessary that the technology developers, or someone else involved at the source end of the transfer, should understand why the technology works and what its limits are.

The alternative is to proceed slowly, abandoning technologies that fail to work at the new site as they did at the source site. This trial and error method has worked for centuries in the diffusion of new crops and farming methods. With spontaneous diffusion, farmers who can afford risk are innovators. However, development assistance projects typically seek to accelerate technology diffusion by motivating normally risk-averse farmers to accept a new crop or practice. Where an NGO promotes a forestry technology without understanding why it worked at the source end, the likelihood of failure is greater. Farmers may be encouraged to take risks they can ill afford. And when the error part of trial and error occurs, farmers may become unwilling to participate in the next innovation to be introduced.

Scientists at international organizations working on agroforestry in Africa, such as ICRAF, IITA, ILCA, and ICRISAT, are keenly aware of their responsibility to avoid placing farmers at risk. Therefore they are careful to develop a thorough knowledge base before they promote a technology package for extension. In fact these organizations are so cautious that they have as yet not been an important source of agroforestry technologies used by NGO projects in Africa. The international organizations transfer their technical materials and information to national research organizations and programs. There the technologies are tested and adapted for local conditions and released for extension to implementing organizations if and when the knowledge is adequate. However the priority of agroforestry in the national agricultural research organizations has been so low that technology development in agroforestry through these channels has been stalled.

This bottleneck is beginning to be addressed with more aggressive promotion of research networks. ICRAF is

organizing the AFRENA program, and IITA is developing activities to promote the Alley Cropping Network more aggressively. Eventually, these agroforestry research networks could become important technology sources, but they are not designed to be technology transfer networks.

In the nearer term, NGO and government forestry department staff perceive that the best potential sources for technology transfers are the practical experiences of current projects where implementers are "learning what works". This presents two problems: how to develop adequate knowledge at the source end on why demonstrated techniques work, and how to bring that knowledge into an effective technology transfer process.

Generally, forestry and agroforestry project implementers are so fully occupied using trial and error to overcome logistic, administrative, and social problems, that they have little time or inclination to investigate why a technique worked. The great strength NGO personnel bring to this process is their "can do" attitude toward the myriad problems they face. This attitude predisposes them to move on to the next problem rather than to reflect on why a particular solution to the last one was effective. The result is lots of technology development, but a very inefficient development process as people make similar mistakes while reinventing the same solutions over and over in different places.

In at least one case, a successful technology developed through pragmatic field experience -- the renowned Neem tree windbreaks implemented by a CARE project at a semi-arid location in Niger -- is being investigated. Fields in the near lee of the windbreaks show substantially higher yields than fields further away. But are a disproportionate share of the near lee fields owned by farmers who use additional yield-enhancing techniques? The windbreak effect on the field crops has not been offset by competition from the neem tree roots for nutrients or water. But is this because the unusual soil moisture situation in this valley has inhibited lateral development of tree roots that would occur on drier soils?

This windbreak technology can become an important source for technology transfer. However, CARE is properly investigating why the technology worked before intensively promoting it as a technology transfer source. Fortunately, CARE has been able to get support for studies of its successful project. Unfortunately, this development of knowledge on why an agroforestry technique worked is a rare, perhaps unique, case.

An additional constraint on development of adequate knowledge of why pragmatic experiences are successful is the substantial difficulty of designing investigations that will reveal causes of events that were not set up as experiments from the outset. This problem has vexed evaluation of the

Neem tree windbreaks in Niger. Development officers in AID and other agencies who have training in science are properly skeptical of interventions based on guesswork about why the technology works\*.

Workshop participants and interviewees concurred that it would be unrealistic to expect NGO staff or government extension agents to regularly develop detailed knowledge on why technologies applied on their projects work. In fact they seldom have time or motivation to write detailed reports on how a technology was done.

Successful technologies are reported by NGO staff, but the reports are typically sent up through the NGO bureaucracies to satisfy administrative needs. Thus they do not move laterally and seldom include the how-to detail needed to make them valuable additions to the organizations' technical memories. Exceptions to this pattern exist, however, which indicate the potential for strengthening NGO projects as technology transfer sources.

In the stronger international PVOs working in Africa, such as CARE, Catholic Relief Services, and Save the Children, verbal and written reports of successful technical innovations are sometimes noted at the country, region, or headquarters levels by staff who have sufficient technical knowledge to recognize potential importance to the organization's other projects.

For example, a CARE project in Kenya developed techniques for using wood ashes and plastic mulch to control termite damage in tree nurseries. This technology may be important, since the alternative is use of pesticides dangerous to nursery personnel. CARE has technical experts in its regional and headquarters offices with authority and ability to develop more knowledge of this technology, including further testing and written technical reports. The method is likely eventually to be transferred to other CARE projects through internal workshops. However it seems unlikely to be transferred out to other NGOs, except perhaps by a slow excepteter

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\* This study encountered development officers very skeptical of proposals to promote planting *Acacia albida* trees in crop fields. The evidence that this tree species enhances soil fertility and crop yields in traditional farming systems is convincing. But if people who design interventions to promote *Acacia albida* planting know too little about why trees in traditional systems have the observed effects, then they must guess about (or fail to consider) such matters as where to place trees in fields.

diffusion process as people who work on CARE managed projects eventually move to jobs with other organizations\*.

An AID-sponsored technology transfer activity could encourage development of sufficient knowledge at the technology source end in several ways. These include:

- o Identifying important technical innovations within current AID-sponsored and other agroforestry projects, and encouraging the implementing agencies to investigate these and prepare how-to descriptions of them.
- o Where the reason why a technology works is not clear, promoting scientific investigation and description by local experts. This could include development of funding sources for the investigation and perhaps identification of biometricians to assist with research design.
- o Sponsoring or finding sponsors for programs that would reward technology developers for time spent preparing how-to descriptions. For example a technical journal that could send a journalist to project sites, call attention to a organization's expertise, give first authorship to the on-site technician, and pay a modest honorarium to the technician would probably be able to get participation from project implementers in spite of their being busy with solution of the next problem.

Condition 2: Capable people at the receiving end of the transfer.

This report is addressing the transfer of technologies to field workers on NGO managed projects. The ultimate recipients are, of course, farmers. But here we are concerned with the capability of the NGO personnel at the field level and the government extension agents through whom most of them promote technologies to farmers.

Expatriates hired as agriculture or forestry project staff by international PVOs typically have B.S. degrees in forestry or agriculture, and many have had Peace Corps experience. Some have master's degree training. Indigenous NGO field staff on the same projects, and the government personnel with whom they work, typically have had secondary

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\* This is not to suggest that CARE has any policy to hold its technologies closely. Indeed, CARE is investing considerable effort to prepare a manual written by its agroforestry expert, Louise Buck, for extension to other organizations.

school and one or more years of agriculture technical training. A few have two or more years of forestry technical training. Since agroforestry is so poorly developed as an academic field, neither the foresters nor the agronomists have had much school work that focussed directly on techniques for maintaining trees on the same land as crops or livestock. But most are capable of screening plant-based technologies to match them to local growing conditions.

Much agroforestry promotion is done by missionary programs that focus on more general community development activities. The project personnel, both expatriates and locals, often have had their technical training in health care, community development, or other fields than forestry and agriculture. Some have had substantial agriculture or horticulture experiences and self-instruction, but those who lack appropriate technical backgrounds are likely to use up funds, resources, or farmers' good will with technologies that are not ecologically suitable to site conditions. Often these missionary staff have important insights into the social factors that affect how a technology must be presented be acceptable on a community or individual farm level.

Thus an AID-sponsored technology transfer activity serving PVOs/NGOs should study its target technology receivers carefully to determine what general training is needed as a prerequisite to their successful choice and adaptation of agroforestry technologies. It is also necessary to be skeptical about expatriates' opinions that government extension agents, nursery managers, or farmers will not be capable of managing technologies which seem more sophisticated than current practices. Such opinions may turn out to be prejudices and may prevent potentially successful technology transfers. For example, the attitude that government forestry personnel cannot manage soil nutrient testing and use of complete fertilizers in agroforestry projects should be scrutinized.

### Condition 3: Maximization of direct person-to-person contacts.

Nearly all the workshop participants and interviewees in this study stated that technology transfer is much more effective when person-to-person contacts are the main channel. Print or other media alone seldom suffice for effective transfer of technical "packages", such as alley-cropping or improved nursery operation. However, media materials are essential in the person-to-person technology transfer process, first to help users choose the technology to be transferred, then to provide technical memory for the person-to-person process, then to aid problem solving and follow-up communication as the technology is being adapted and implemented.

This does not mean that no transfer takes place without person-to-person contact. NGO personnel and forestry extension agents report that illustrated how-to pamphlets or other media alone do occasionally suffice to transfer a straightforward technique -- e.g. an illustrated pamphlet describing a new tillage technique, or information distributed through a technical newsletter on how to treat seed of a particular species be prepared by a source who is capable and motivated to produce sufficiently clear and complete information. And the receiver must be a very capable extension agent with adequate time and resources for innovation.

Many informants for this study cited Fred Weber's book\* as the best example of useful media. Yet they often declared that they would not attempt many of the useful-seeming techniques described in that book without some person-to-person support on how to decide whether a particular technique would be appropriate, how to get inputs (such as seeds), and what problem solving methods to use in adapting a technique (such as water harvesting) to site-specific socio-economic and physical conditions.

An apparent barrier to successful technology transfer is that the people who participate in workshops or who read and clearly understand the how-to media do not physically use the technologies. That is, foresters and extension agents in Africa seldom touch shovels. The name of Fred Weber came up in this context too, as he is cited as one of the few teachers of agroforestry technology in Africa who has been able to charm or bully trainees into handling shovels. The "hands-on fieldwork" in most workshops and short courses comprises tours to passively observe what supervised laborers have accomplished.

One interviewee, an agroforester in West Africa, has been sponsored for participation in five workshops and training courses outside his country over the past decade. None of them entailed actual hands-on experience with a technology. None of them helped him to get the necessary inputs for the technologies that were promoted. None provided for follow-up visits to his country by persons who had experience with the promoted technologies. None has led to him extending any innovations to the people with whom he works.

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\*Weber, Fred R. and Carol Stoney. 1986. Reforestation in Arid Lands. Vita Publications, Arlington, VA. Many field personnel working on NGO projects in Africa do not yet have a copy of this important fundamental manual. It costs \$11.75 (including surface mail shipping).

An AID-sponsored technology transfer activity could seek to maximize effective person-to-person contact for technology transfer by:

- o Promoting inter-project visits among field-level technical personnel of projects with similar biophysical or socioeconomic problems. Where possible, such visits should be temporary assignments that encourage hands-on experience, rather than study tours that encourage passive observation. Such visits are likely to be a distraction to the host agency, so the technology transfer program must try to develop motivations, such as exchange programs or identification of a technology learner who can also be a technology teacher.
- o Limiting sponsorship of workshops and training programs to those which are sure to meet criteria of hands-on experience, follow-up communication between trainees and trainers, and assistance to trainees for acquisition of necessary inputs to put the promoted technologies to use.

Condition 4: The technologies must be adapted to conditions at user's end.

This condition means that the person-to-person contact between knowledgeable source and capable recipient takes place either at the recipient's site, or where conditions are essentially identical -- or at least the transfer facilitator must effectively encourage follow up communication as the adaptation proceeds.

NGO informants at field level, country office level, and headquarters level all indicated that they disregard many of the technologies brought to their attention, because they doubt their own ability to adapt the methods without an easily accessible source for follow up advice as problems are encountered. Several people cited examples of consultants who had visited field sites once, and had made suggestions for technical improvements that seemed sensible, such as the use of particular tree species, use of inoculates, and nursery watering systems. However, the experts had not been available for follow up help a year or more later when attempts to implement the suggestions encountered unforeseen problems.

Farmers in Africa are too often encouraged to invest their time and land in technologies that have not been adapted to local conditions. For example, some NGOs are promoting woodlots, field border trees, within-field trees, and house compound trees without any reference to growth or survival data

from environments with growing conditions similar to the project sites.

Much data that could be useful for making technology adaptation decisions does exist in technical literature from other places with similar environments and, reportedly, in the archives of the African countries' forestry departments, agriculture departments, and academic institutions. For example, most countries have long histories of species trials, but data are usually buried in unpublished and unindexed reports in departmental archives.

Another example, foresters and agronomists have coped for decades with pest outbreaks that occur cyclically, such as the recent locust and rat population explosions in the Sahelian countries. Unfortunately the strategies they develop and report on tend to be lost between cycles. Historical data, both published and unpublished are not practically available to agroforestry project implementers in Africa who have no time for "fishing expedition" searches of disorganized data sources.

Many African and expatriate foresters and agricultural experts have developed solutions to problems which they no longer work on. The "rules of thumb" and pragmatic problem solving approaches developed over decades of experience are often lost when experts retire or are promoted without effectively passing on their knowledge. A new method -- called "expert systems" -- that uses debriefing techniques, decision tree data organization, and computer data storage capabilities has been developed in Europe and in the U.S. to capture and make more available the specialized knowledge developed through decades of practical experience.

The expert systems method seems to hold great potential to accelerate technology adaptation in Africa. For example, many of our informants noted that direct sowing of tree seeds will necessary if agroforestry is to become inexpensive enough to be practically available on the scale it is needed. Many are aware that direct seeding is used to establish hedges of *Leucaena* and other species in high rainfall areas of Asia. But the technique is not attempted by NGO technology implementers in the drier regions Africa, because they have no knowledge of earlier experience. Meanwhile, Robert Fishwick, who developed successful methods for direct seeding of neem in West Africa decades ago, has taken his expert knowledge into retirement in England.

An AID sponsored technology transfer activity could help NGO technology recipients to adapt technologies to local conditions by:

- o Sponsoring and/or encouraging follow up visits by technology source persons to sites where transferred technologies are being implemented.

- o Developing computer data bases and data access programs that would allow technology recipients to search efficiently for reports of technology adaptation experiences under site conditions similar to their own.
- o Promoting organization, indexing, and institution of search services to improve access to forestry, agriculture department, and academic department archives.
- o Promoting experimental use and subsequent evaluation of the expert systems method for making the knowledge of the most experienced foresters and agriculturalists more widely and more permanently available.

Condition 5: Participation of a facilitator who understands the technology transfer process, the market for the technology and its products, and the constraints and opportunities affecting the other actors.

Numerous networking resources already exist to facilitate technology transfer to the PVOs/NGOs promoting agroforestry in Africa. Most of the organizations have an in-house network for technical information, consultants, and support. Some, such as CARE in East Africa, have a hierarchy of technical personnel, so that technical information not available at the country office level can be sought first from forestry experts at a regional office and then, if necessary, at the headquarters level. Others, such as Lutheran World Relief in Senegal, have recently begun to institute regional agroforestry experts to backstop the field level personnel. Some of the larger PVOs have staff who have had foreign technical training and who maintain links with their American or European universities. Others, such as the Friends in Kenya, have University-trained agronomists who can refer information needs informally to the (local) Universities where they studied.

As noted above, most PVOs and NGOs are in regular communication with the extension networks of the countries they work in. For example, in Senegal CRS, CWS, and Africare cited the following government services as sources for technical information: Agents Techniques de Eaux et Forets (ATEF), Ingenieurs Techniques des Eaux et Forets (ITEF), Centre National de Recherches Forestieres (CNRF), Direction du Reboisement et de la Conservation des Sols (DRCS), Centre de Developpement Horticole (CDH), Ecole Nationale d'Horticulture (ENH), Centre de Recherches Agricoles de Bambey (CRA), Projet Agroforestier de Reboisement de la Sone Centre-Est (PARCE), Projet Agroforestier de Conservation des Sols et Des Eaux (APFOCSE), Centre d'Entrainement aux Techniques Agricoles de

Developpement (CETAD), and Projet de Reboisement Communautaire dans le Bassin Arachidier (PRECOBA).

Several countries have one or more "umbrella" NGO organizations that consider facilitating communication among PVOs to be one of their objectives. These include organizations that serve all types of NGOs, such as GAP in Niger, organizations that focus on a particular sector, such as KENGO in Kenya with its focus on renewable energy, and organizations that serve a particular subset of the NGO community, such as the Ecumenical Working Group on Africa, which groups various church-related development organizations to coordinate planning goals.

The PVOs that have volunteers from agencies such as Peace Corps, AFVP (French), and CECI (Canadian), can tap the technical support networks of those agencies for information, documentation, or consultants. International programs, such as CILSS occasionally loan staff or provide consultants to assist NGOs with project design or technical problems.

Some NGOs, both local and international, serve as clearing houses for published information. Examples are ENDA in Senegal which sells french language documents on development-related subjects, and Winrock International in the United States, which sells numerous technical documents. Winrock International, like VITA, can also answer requests for situation-specific technical information.

American and European universities, usually with support from bilateral assistance agencies, provide technical information to PVOs directly or through various consortia. Examples include the Joint PVO-University Rural Development Center in the U.S., and the linking programs of Brot fur die Welt in Germany.

Numerous international organizations use newsletters or targeted occasional mailings that call attention to technology transfer sources, training opportunities, etc. Examples include the international research organizations, such as ICRAF, IITA, ILCA, and ICRISAT, which send newsletters that call attention to training programs and technical documents; the UNDP-affiliated Tree Project based in New York, the CTFT information bulletin, "Bois de Feu", the F/FRED project based in Thailand, the Nitrogen Fixing Tree Association based in Hawaii, the Environmental Liaison Centre based in Nairobi, OXFAM, and the AID-sponsored Forestry Support Program based in Washington. Various missionary groups also include information about technology sources and training opportunities in their nontechnical newsletters and mailed announcements. Information from these organization's international announcements and newsletters often is used for in-country newsletters published by the NGO/PVO umbrella organizations.

In spite of all these resources, linking, and network efforts, agroforestry technology transfer is greatly constrained. The reason is that none of the organizations provides technology transfer facilitators who have thoroughly investigated the technology transfer process and whose job is to find specific technology transfer opportunities and to follow through to assure that constraints are resolved and all the necessary conditions are met. Such facilitators exist in several agricultural research networks (e.g. in IITA and ILCA, for example), and these provide one of the models from which the necessity of such facilitators was deduced. The other model of successful technology transfer is the non-subsidized private sectors in both industry and agriculture, where private firms rely on in-house or freelance brokers and salesmen to carry out the facilitator role.

Facilitator positions (usually with other names but with the facilitator function) are beginning to be instituted for agroforestry research networks, such as the AFRENA program at ICRAF, the AID-sponsored FFRED project based in Thailand, and NFTA program based in Hawaii. But these research networks do not recognize the implementation programs of NGOs as primary sources of technology innovation, or as the intended recipients of the technology transfers they facilitate. Rather they serve to two-way transfers among researchers and (mostly) one-way transfers between researchers and government extension services.

To have a significant impact beyond the results already being gained by the networking activities of numerous organizations in communication with the NGOs in Africa, an AID technology transfer activity would need to include one or more full time positions for persons who understand the technology transfer process and whose job is to promote creation of all the necessary conditions for technology transfer, and to follow specific transfer opportunities, monitoring for the necessary conditions and intervene as advocate for the intended technology recipients when the conditions are not being met.

Condition 6: Involvement of users and transfer agents in choosing the technologies to be transferred and in planning the transfer process.

Nearly all the interviewees and workshop participants in this study emphasized that technology transfer works best when it is tailored for the specific needs of the recipients, and that only the recipients fully understand their specific needs. Development organization personnel, especially those working with NGOs, have become convinced of the need for participant planning to involve farmers in selection of technologies and in planning agricultural interventions. The same necessity exists to involve field-level extension agents in technology transfer efforts where they are the target

recipients. With the exception of in-house technical backstopping provided by the strongest PVOs, however, technology transfer planning seldom includes continuing participation by field level NGO staff and the government extension agents with whom they work.

The stronger NGOs have in-house technical personnel who screen information that comes through the many technical, partially technical, and general interest media that come to the country level offices. Those who are thoroughly familiar with the technical needs of field level personnel on their projects try to find time and resources to match technology sources to appropriate recipients in their projects. These technical personnel have many other programming and administrative responsibilities, however, and often are unable to thoroughly review all the materials received at their offices. The smaller NGOs lack technically trained personnel at the country office level, and so have little ability to screen all the literature they receive. Several of the NGO personnel working at the country level showed us shelves of development literature -- journals, books, magazines, newsletters, pamphlets, project reports -- that comprised their technical libraries but that were seldom used because nobody with the ability to screen the information for potential utility had the time to do so.

The study for this report included contacts at four levels of the NGOs: headquarters level (in the U.S.), multi-country region level, country office level, and field agent level. We found perceptions of technology needs to be similar among technically trained personnel, but very different between the development generalists in country offices and the individuals working at the field level. Generally, country office personnel felt that the field people had adequate access to technologies. Some felt their people needed more training in methods to motivate and manage farmer and community participation in project activities, but very few perceived lack of technology transfer as a significant constraint on effectiveness of their projects.

Among the technically trained personnel, the perceptions were quite different. The need for training and technology transfer to strengthen social, cultural, and project management skills was recognized at all levels, but so was the need for more effective biophysical technologies. Personnel with technical expertise in agroforestry working at the headquarters, regional, or country level, usually view their in-house technology transfer procedures as adequately organized to serve their own projects. Some noted that their in-house technology transfer programs were underfunded and understaffed, but they recognized those constraints as a normal NGO working condition.

Personnel working at the field level in the NGOs, even the stronger ones, seemed less satisfied with their

organization's technology transfer or technical backstopping procedures. They particularly noted that the pressures to reach project objectives leave little time to follow leads on new technologies. In the stronger organizations, in-house procedures facilitate procurement of seeds and other technical materials effectively, but field level people in the smaller NGOs perceive technical procurement as a major constraint on their effectiveness. In both the stronger and smaller organizations, field personnel reported that they try to invent solutions to the technical problems they encounter, rather than seeking help. This seems to stem partly from the "can-do" attitude mentioned earlier, and low expectations of their organizations' abilities to provide technically appropriate information on a timely basis.

The well managed international PVOs showed us minutes of management meetings in which field level personnel did identify their technology needs, such as rat control in nurseries. Usually suggested solutions are put forth by other meeting attendees and the query does not go further before those have been tried\*. This is appropriate given the effort that must be made to get more information from the presently disorganized technology data sources, but the narrowness of the initial search for technical options does lead to mistakes being made that have been made often before.

Thus, to be most effective, an AID technology transfer program should focus a substantial part of its effort on identification of opportunities for transfers in which the NGO personnel at the field level, and the government extension agents with whom they work, are able to participate actively in early stages of the technology choice and planning of the technology transfer process. This need not be limited to activities that respond to particular technical problems being encountered. It could also involve organizing data sources, such as forestry department archives or NGO technical media collections, in ways that facilitate ready access to technical material.

NGO and government extension personnel are more likely to use technical information systems that have been designed and implemented with their participation. This principle has been followed in development of the Industry Council for

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\*Circulating the notes of such meetings has a networking effect, however, as outside persons sometimes have suggestions to offer. During our visit to Khartoum, AID forester Tahir Qadri was preparing a technical note to CARE foresters on the use of chemicals to repel insects, mammals, and birds that eat tree seeds being used in direct seeding trials. Mr. Qadri had not been directly queried, but he routinely reviews CARE meeting notes on forestry and he happened to be familiar with solutions to this technical problem.

Development's project to develop data bases to support NGO agroforestry work in Mali and Niger, and seems to be responsible for that project's immediate success in Mali.

(The project was just beginning in Niger during our visit, but NGOs in that country were already optimistic about its importance to them.)

To be fully effective, however, an AID technology transfer activity should not assume that the NGO personnel will fully recognize their technology needs. Just as a peasant farmer on a highly weathered soil must be taught to recognize her crops' need for micronutrient fertilizers before she will want that technology, the extension agent may not recognize the need for technologies that have not been demonstrated locally.

Thus, the technology transfer facilitator must sometimes be a salesman, helping the NGO recipients and the government personnel with whom they work to recognize their technology needs.

Condition 7: Self-interests of all parties involved (sources, transfer agents, facilitators, end users) are identified and satisfied.

The self-interests of technology users, which in this case refers to the field-level personnel of the NGOs and the government extension agents with whom they work, will be identified and satisfied if they are adequately involved in planning the technology transfer, as discussed above. However, the technology sources and transfer agents (instructors, writers, editors, outreach personnel in NGOs and in schools and research institutions) are often completely occupied with responsibilities other than transferring technologies to NGO personnel outside their own organizations.

For example, forestry technical personnel in CARE must meet project and programming objectives which relate directly to the criteria for success specified within CARE and by organizations such as AID that provide funds to CARE for agroforestry activities. They are willing to take some time to participate in NGO consortia activities in Mali, and provide essential services to the coordination meetings of forestry project personnel in Sudan. But they do not seem to view these activities as meeting their personal needs or CARE's needs. Thus CARE personnel can hardly be expected to step up their efforts to transfer the technologies they develop to potential users outside their own organization, unless such transfer activities are funded separately or made a specific objective of adequately funded development activities. So far as we were able to determine, the site-specific forestry and agroforestry projects funded by AID and other development assistance donors in Africa have not

routinely included objectives or funding line items related to transfer of technologies beyond the boundaries of the project.

An AID activity to support technology transfer should track agroforestry project planning in Africa and should intervene at appropriate times to advocate that planners include specific objectives and identify adequate funds for project or program personnel to act as technology sources to NGO personnel or government extension service personnel who are working on or designing projects for similar conditions in other areas. Project planners will need to be sold on this idea, since it is not common practice now.

The self-interests of development assistance personnel, including those who can be technology transfer sources or agents and those who manage the employment and assignments of such experts, are largely determined by evaluation criteria for the projects or programs on which they work. Thus the AID technology transfer activity needs to encourage recognition during evaluations of technology source and agent activities that do not directly support on-site accomplishments, or that may be outside the current mandate of the organizations that are developing technologies. For example, the ICRAF, ILCA, and IITA personnel interviewed for this study indicated that transferring technologies to NGO personnel or to government extension personnel is not in those organizations' mandates. For this to change, someone must actively advocate the change.

Condition 8: The role of each participant should be defined early in the technology transfer process, and each participant should understand the steps that occur previous to and subsequent to his or her involvement.

To be effective on a more than sporadic basis, technology transfer needs to be planned. This may seem obvious, but in fact it is seldom done. Many technology using organizations are participating in technology transfer attempts by sending their personnel to workshops and training courses, by passing technical information and materials to the field level, and by using expert consultants. Many other organizations are organizing and sponsoring workshops and training courses (such as IITA's alley cropping symposium), distributing practical information (such as ICRAF's book on multipurpose tree seed sources), identifying and funding expert consultants for project design, evaluation, and problem solving (such as the Forestry Support Program arranged consultations). Still other organizations are serving technology transfer by producing detailed materials on technical topics (such as IITA's publications on alley cropping), and by distributing technical materials (such as Operation Double Harvest's "Winstrip" seedling containers and simple drip irrigation systems).

But, these organizations are all contributing pieces. Few of them seems to be planning or managing the technology transfer process from beginning to end. Yet the benefits of planning are readily apparent. Dr. James Ball, an FAO expert helping to develop the extension capabilities of Sudan's forestry department, explained a simple technique that greatly enhanced the likelihood of workshops and short courses being useful. Participants are required to write plans on how they will implement the technologies learned before they depart their duty post for the workshop, again during the workshop, and a third time after their return. Operation Double Harvest has thoroughly planned the diffusion of its improved nursery technologies through church-related programs in several African countries, and the early response indicates a very rapid acceptance of these fundamental changes in technique. The Industry Council for Development's thoroughly planned introduction of computerized data base systems to NGO consortia also has been very rapidly put to use.

The importance of each participant fully understanding all the technology transfer steps subsequent to his or her involvement is apparent from the consultations, workshops, and short courses that fail to effect significant changes in technology use. Often the cause of failure is that the technology receivers or the transfer agents (e.g. instructors), or the technology sources did not recognize the importance of maintaining close communication during the technology adaptation period.

The AID technology transfer activity could advocate and assist in the preparation of written plans for technology transfer, and could advocate and facilitate the thorough briefing of all transfer process participants.

Condition 9: Demonstrations in physical, social, and financial environments that are similar to actual conditions where the recipient is expected to apply the technology.

Many of the NGO and government agency informants for this study expressed their unwillingness to place farmers at risk by encouraging them to invest in experiments with unproven or unadapted technologies. Personnel of even the best funded NGOs feel that experimentation is not compatible with their objectives, even if farmer participants understand the risks or can be insured for lost time or resources. Thus most said they greatly prefer technology transfer experiences that include demonstration of the technology in physical, social, and financial situations similar to their project conditions. This partly explains why the NGO personnel see other NGO projects and forestry or agriculture line agency projects as sources of technology generally preferable to research institutions.

To help satisfy this condition, an AID activity could strongly advocate development assistance strategies that develop and provide continuing support for country-level demonstrations of previously unproven or unadapted agroforestry technologies. Because such demonstrations should not place farmers at risk and are outside the usual objectives of NGOs, they can probably best be implemented under auspices of government development agencies or academic institutions. An example is the highly effective demonstration programs implemented at the six ecozone based Agroforestry/Energy Centers established by the AID-sponsored Kenya Renewable Energy Development Project (KREDP). This program, developed to support both technology development and technology transfer, found ecological and socioeconomic conditions so different in various parts of a single country that six demonstration centers were needed.

An AID activity with more modest funding than the KREDP has had might promote the development of similar, but fewer, centers in one or more other countries. Such centers could demonstrate social, financial and partial ecological suitability of technologies, and the wider range of ecological adaptability could be demonstrated by visits and participation in hands-on work at the appropriate centers in Kenya.

Condition 10: Initial identification of resources sufficient to support the technology transfer process through until it is self-supporting.

Technology transfer may occur without this condition being met, if the technology transfer facilitator stays with the transfer process for its entire duration and is an effective salesperson to find further resources when the process stalls. However, AID and other development assistance agencies have learned the danger of basing a program or project on the continuing availability of an individual. Too often career or personal circumstances interrupt and personality-based projects must be abandoned. This is a reservation several of our informants expressed about the smaller NGOs in African countries, and it should be heeded in development of an AID activity to facilitate agroforestry technology transfer.

This condition indicates the time frame necessary for the plan advocated in the discussion of condition 8, above. A technology transfer process becomes self supporting when cost of continued contact among the receiver, the agents, and the source persons becomes relatively low, and the receiving organization's appreciation of the value of continued contact becomes relatively high.

The technology transfer process can become self-supporting in a single year for straight-forward techniques, such as use of specific chemicals for pest control

in nurseries. The transfer process for technologies less directly related to immediate operations, such as the ICD's computer data bases for NGOs, are likely to need subsidized technical consultations for several years.

Technology transfers may also have to be supported through several years if they involve adaptation to physical or socioeconomic conditions that are very different from conditions at the technology source. An example would be transfer of aerial seeding technologies from the Southern U.S. to Africa. The need for a method of direct sowing tree and shrub seeds on the open woodland areas of Africa is widely recognized. Aerial seeding technologies are well developed in the Southern United States and in New Zealand. However, transfer of the aerial seeding technology would involve substantial adaptations, as the African environments have very different drought, fire, and grazing stresses. A less "high tech" approach to direct seeding has been demonstrated in Senegal. Acacia albida seeds are fed to livestock; the animals are kept in the place to be seeded for a few days and then carefully kept out of that area while the seedlings are emerging and becoming established. While the method has been demonstrated, it would need considerable adaptation to be widely useful in Africa. Neither method is being transferred to the areas that need direct seeding, apparently because the transfer process would need subsidies that have not been available.

It might be expected that technology transfers which necessitate a considerable period of subsidy for adaptations should be supported as research. However, neither forestry nor agriculture research organizations have shown much interest in adaptation of agroforestry techniques, perhaps because such research does too little to advance science. Thus other sources than research funding are apparently needed for the adaptation aspect of technology transfers.

The AID technology transfer activity can help to meet this condition by supporting specific technology transfers or developments of technology transfer capabilities only when sufficient continuing funding can be foreseen. This implies that a substantial portion of the time invested in such an AID technology transfer activity would be used to identify funding sources and to sell the concept of continuing support for technology transfer.

## V. AN AID PROGRAM TO ENHANCE TRANSFER OF FORESTRY TECHNOLOGIES TO NGOs AND PVOs IN AFRICA

An AID program to enhance technology transfer could adopt one or more of three approaches:

1) To contribute to technology transfer opportunities by promoting and sometimes sponsoring activities such as workshops, training courses, consultancies in response to NGO requests, and regular publication of an agroforestry technique journal (patterned on Tree Planters' Notes or Leucaena Research Reports).

2) To build NGOs', and host government agencies' capabilities to facilitate technology transfer, by promoting and sometimes sponsoring information organization activities, such as the Industry Council for Development's method for development of computerized data bases in the national offices of NGO umbrella organizations.

3) To promote comprehensive planning for technology transfers, by selling the need for such plans to officers in AID, in NGOs, and in research organizations, by helping to develop such plans, by sponsoring critical parts of them, by monitoring their implementation, and in some cases by serving as a technology transfer facilitator.

This study's assessment of needs and opportunities for agroforestry technology transfer in Africa indicates that all three of the above approaches are needed. An AID activity taking the first approach could be able to document an impressive list of accomplishments within the first year. Specific activities could be chosen to complement, rather than duplicate, already existing network and information exchange activities. However, our evaluation of current activities in Africa suggests that this approach alone would be insufficient, and it cannot be assumed that some other organizations will create the necessary and sufficient conditions for significant acceleration of technology transfer.

The technical journal, for example, would publish illustrated how-to descriptions of technologies and techniques that work, and perhaps notes on techniques that do not work. Such articles would come more often from pragmatic technology implementers than from scientists in research organizations. Several of our NGO informants suggested that such information is now scarce and such a journal would be a welcome addition to the networking activities already occurring. They noted, however, that personnel in their own organizations would have little incentive to prepare the needed articles for such a journal. This problem could be solved. The AID activity could employ one or more technical journalists to visit agroforestry projects and prepare the articles. However,

such a journal would be expensive, and so it seems unlikely that it, or other discrete transfer activities of which it is an example, would continue after the AID program was finished.

The second approach would also yield documentable results in the first year. It could be supported as a part of the NRM project with technical support from some already established field service organization, like the Forestry Support Program. If this were the only approach used for the technology transfer activity, it could be implemented on a staged basis, as the Industry Council for Development project in Mali and Niger has been. This method seems more likely than the first to result in sustained improvements in NGO access to technology sources for agroforestry.

For example, a start could be made in Sudan where one long-term person with technical skills in information management could work from the Forestry Department, which does a better job of coordinating NGO agroforestry activities than do most countries' governments. Substantial forestry and agriculture archives exist in Sudan that could be made into an important technology source for agroforestry if the database techniques were used to make the information they contain readily available, and if their use were adequately promoted.

After proving its utility for organizing information that exists locally, the project could begin to bring in and organize information from outside the country, such as the databases that should become available on diskette from ICRAF, and the "how-to" database being developed for agroforestry in Mali. It could also use short-term consultants to experiment with the "Expert Systems" technique for making widely available the heuristics and rules of thumb known by the country's most experienced foresters and agriculturalists. Such a project would need an adequate budget for short term technical assistance and for operating and networking activities\*.

The third approach seems most likely to result in substantial improvement in the present situation of chaotic and inefficient technology transfer. It might be less likely to have substantial achievements within a single year, though it could be structured to quickly demonstrate the importance

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\*Short term technical assistance could be needed, for example, to screen techniques described in archival material for validity. Discussing the archival material left from colonial times, an experienced PVO director in Sudan confirmed that the disorganized archives contain information of great value that could save many research dollars and prevent many mistakes in adaptation of technologies. However, he cautioned, they also contain some incorrect or unfounded information that could be misleading.

of comprehensive planning for technology transfer by becoming involved in some transfer activity already underway, such as the ODH distribution of improved nursery materials through church-related organizations.

This approach would entail employment (or reassignment) of a technology transfer facilitator who is experienced in agroforestry and who understands and is committed to developing all the necessary and sufficient conditions for successful technology transfer. The budget could be modest, since the individual would act mainly as an advocate to convince existing (or beginning) AID projects to plan for and invest in technology transfer. The facilitator's budget could probably be limited to salary, clerical support, and travel costs, but the travel budget should be substantial. This activity could be based in the FSP, or with the NRM project.

If sufficient funds can be made available, an AID activity that incorporates all three of the above approaches would be most desirable. For example, a comprehensive program could include:

- o A Nairobi or Dakar based technical journalist with a budget to produce an agroforestry journal that would publish "how-to" reports on technologies that have been demonstrated to work in Africa.
- o Contracted technical assistance services to take over the ICD program in West Africa. Or, if other donors are recruited for that activity as ICD phases out this year, then contracted services to implement a similar program in East Africa.
- o Contracted technical assistance services to organize the forestry and agriculture information already existing in one or more countries.
- o A Washington-based technology transfer facilitator to manage the African-based activities and to act as an advocate for investment in comprehensively planned technology transfers.

APPENDIX A

## APPENDIX A

### PERSONS INTERVIEWED

The following persons were interviewed to collect information for conceptualization of an AID activity to enhance forestry technology transfer to NGOs and PVOs in Africa. Those marked with asterisks were in-depth interviews of one to two hours. These were open-ended interviews, though for all the in-depth interviews in Africa, a the same questionnaire was used. The persons whose names are not marked by an astrisk were briefer contacts regarding more specific queries.

Jimoh Omo Fadaka* African NGOs Environment Network Kenya	Louise Buck* CARE Mali
Olu Karib* Africare Niger	Steve Dennison CARE Niger
Caroline Harington Africare Senegal	John Miskall* CARE Sudan
Walter Williams* Africare Senegal	Steve Wallace* CARE Sudan
Joe Tavarez* Africare Senegal	Tom Alcedo* CARE Sudan
Bob Wilson Africare USA	Leigh Heart CARE Sudan
Christopher Davies* Bellereive Foundation Kenya	John Michael Kramer* CARE USA
Paul Cambell* CARE Mali	Charles Tapp CARE USA
Sandy Laumark* CARE Mali	Rudy Ramp CARE USA

Jorg Schaeffer\*  
CARITAS  
Niger

Edward W. Sulzberger  
CGIAR  
USA

Helen L. Vukasin  
CODEL Environment & Development  
Program  
USA

Mora Conroy\*  
CONCERN  
Sudan

John Maina\*  
Catholic Releif Services  
Kenya

Nigel Ede\*  
Catholic Relief Services  
Kenya

Samba Fall\*  
Catholic Relief Services  
Senegal

Peter Gallagher\*  
Catholic Relief Services  
Senegal

Awa Seck\*  
Catholic Relief Services  
Senegal

Carolyn Mutamba\*  
Catholic Relief Services-USCC  
Kenya

Makhone Mbaye\*  
Church World Service  
Senegal

John Wilkinson\*  
Church World Service  
Senegal

Peter O'Manahny\*  
Concern  
Sudan

Kristin Cashman  
Consultant to ILCA  
USA

Hezekiah Gitata\*  
Consultant to  
development projects  
Kenya

Peter Freeman  
Consulting Geographer  
USA

Silvanal Comino  
Cornell University  
USA

Jossa Beye\*  
Environment Liaison  
Centre  
Kenya

Ian McDonald\*  
Euro Action Acord  
Sudan

James Ball\*  
FAO  
Sudan

Tapio Niemi\*  
Finnish Aid  
Sudan

Edward Karch  
Forestry Consultant  
to USAID  
USA

Mat Gamser  
Forestry Consultant  
to AID in Africa  
USA

Greg Minnick  
Forestry consultant  
to USAID/Niger  
Niger

Juan Seve\*  
Forestry consultant to USAID/Niger  
Niger

William R. Casey  
Former U.S. Ambassador to Niger  
Niger

Zablon Isaal Malenge  
Friends International Centre  
Assessment Kenya

Van Den Beldt\*  
ICRISAT Sahelian Center

M. Le Boulanger\*  
Industry Council for Development  
Mali

Walter Simon  
Industry Council for Development  
USA

S.A. Shaw\*  
International Tree Crops Institute  
Project USA

Elizabeth Obel\*  
KENGO  
Project Kenya

Stephen Karekezi\*  
Tree Project Kenya

Achoka Awori\*  
KENCO  
Kenya Niger

Davinder Lamba\*  
Mazingera Institute  
Kenya

Keith W. Russel  
Agricultural Library  
USA

Leroy Duval\*  
US Forest Service/FSP  
USA

Jidraph Kimura\*  
National Council of  
Churches  
Kenya

David Shear  
ORT  
USA

Kathy Parker  
Office of Technology  
USA

Bruce Burwell  
Peace Corps Niger USA

Idrissa Daonda\*  
Projet Tapis Vert  
Niger

R.D. Williams\*  
Southern Baptist  
Mission  
Niger

Hamza Jaffer\*  
Sudan Renewable Energy  
Sudan

Jaffer Al Meri\*  
Sudan Renewable Energy  
Sudan

William Booth KENGO  
USA

Sue Bratz\*  
UNDP

Tom Geary\*  
US Forest Service/FSP  
USA

Tim Resch\*  
National US Forest  
Service/FSP  
USA

Emy Simmons\*  
USAID/Mali  
Mali

Dennis Johnson\*  
Fore t Service/FSP  
Sudan

S. Tahir Qadri\*  
USAID/Sudan  
USA

Dwight Baker  
USAID/Kenya  
Kenya

Gene Lewton\*  
World Gospel Mission  
Kenya

Peter Hazelwood\*  
World Resources Institute  
USA

Nigel Ede  
Catholic Relief  
Services  
Kenya

Jim Salego\*  
World Vision  
Kenya

#### WORKSHOPS

Three workshops were convened to discuss forestry technology transfer needs, opportunities, and constraints. In Kenya, Dr. Amare Getahun chaired a one day workshop held at ICRAF on June 26. Bruce Ross served as facilitator and Nancy Diamond was recorder. None of the workshop participants had yet been interviewed in depth for this study, so the session began with short statements by each participant regarding his or her perspective on the needs and constraints on transfer of forestry technologies to field agents of NGO managed projects. Thereafter the workshop discussion followed the structure provided by an early draft of the necessary and sufficient conditions concept. Workshop participation included:

James Allego	- World Vision International
Achoka Awori	- Kengo in Nairobi
Louise Buck	- CARE
Noel Chavangi	- KWDP
Cheryl Danley	- Ford Foundation
Nancy Diamond	- University of California, Berekley
Amare Getahun	- E/DI
Susan Minae	- ICRAF
Eva Muller	- Natural resources and community development consultant
Keith Openshaw	- EIA
Dianne Rockham	- Ford Foundation
Bruce Ross	- E/DI
Sara Scheir	- ICRAF
Nate Simmons	- E/DI
Ramesh Thampy	- Action Aid
James Wabone	- World Vision International
Robert Zimmerman	- Swiss Development Cooperation

In Senegal, a half day workshop was held on June 30, 1987. The meeting, which was conducted in French Language, was held at the office of Africa Consultants International (ACI). Lillian Baer of ACI chaired the meeting and Gary Engleberg served as facilitator. ACI staff prepared the record and Engleberg and Baer prepared on analysis of the meeting after it was concluded. The participants in the Senegal meeting had been interviewed in depth during the two weeks preceding the meeting, so workshop was organized to build on the ideas that came from those interviews. In Senegal we were successful in getting from each of three NGOs, Church World Services, Africare, and Catholic Relief Services, perspectives from three levels: field agent, technical backstop officer, and NGO administrator. The following were workshop participants:

Lillian Baer	- Africa Consultant International
Gary Engleberg	- Africa Consultant International
Jack Shea	- Peace Corps APCD/Forestry
Abdou Sarr	- Oxfam GB
Joe Tavarez	- Africare
John Wilkinson	- Church World Services
Greg Youngstrom	- Church World Services

In Niger, a half day workshop was hosted on July 6, 1987 by Dr. Juan Seve of the AID-sponsored FLUP project at the Niger Forestry Department. Bruce Ross acted as facilitator. The participants had not been interviewed before the workshop, so the proceeding was as in Nairobi, with each participant presenting their perspective from personal experience in the first hour and discussion of need, opportunities, and constraints in the next two hours. Participants included:

Ide Bana	- Forestry Department of Niger
David Blaine	- Peace Corps
Francis Le Boulenge	- Industry Council for Development and Groupement des Aides Privees
Issoufou Boureima	- Forestry Department of Niger
Steve Dennison	- CARE
Samaila Ille Kulou	- Forestry Department of Niger
Dennis Panther	- USAID/Niger
Bruce Ross	- E/DI
Juan Seve	- Forestry consultant to USAID/Niger

AGENCY FOR INTERNATIONAL DEVELOPMENT  
WASHINGTON, D.C. 20523

MAR 02 1988

MEMORANDUM

TO: Mission Agricultural Development Offices (ADOs)  
Concerned with Natural Resources/Agroforestry Projects

FROM: Kenneth A. Prussner, Chief *K. Prussner*  
Agriculture and Rural  
Development Division  
Office of Technical Resources (AFR/TR/ARD)  
Bureau for Africa  
and  
John D. Sullivan, Director *John D. Sullivan*  
Office of Forestry, Environment and  
Natural Resources (S&T/FENR)  
Bureau for Science and Technology

SUBJECT: Agroforestry Technology Transfer for PVOs and NGOs  
Working in Africa

Two copies of a recent report dealing with agroforestry technology transfer for PVOs and NGOs working in Africa are attached for your information and use in connection with your ongoing or future project work in natural resources and agroforestry.

The report was prepared through an IQC Work Order by S&T/FENR to complement other studies dealing with PVO needs in connection with natural resources that are being carried out by the Africa Bureau as part of the new Natural Resources Management Support project (NRMS).

The most important conclusion of the present report is that much of the agroforestry work being done by African PVOs is largely based on local practical experience, and upon adaption of that experience; in other words, field projects in agroforestry are learning by doing.

While traditional tree intercropping practices have a long history among farmers, the emergence of agroforestry as a serious formal scientific discipline is a very recent phenomenon, and is, in fact, still very much evolving. National agricultural research institutions and international agricultural research centers are in most cases only now beginning to investigate agroforestry technologies. Very little formally and thoroughly researched information is yet available on agroforestry technologies.

One recommendation made by the present report that we wish to bring to your attention is the report's call for increased sharing and transfer of the practical experiences gained at different agroforestry project sites among different projects and among PVO/NGO organizations. In countries where numerous agroforestry project activities are being carried out, development results can be improved in the near-to-medium term by doing a better job of transferring experiences among different field sites, among different implementing PVOs/NGOs and other organizations, and among different projects, agencies and donors within each country.

Attachment:

1. Concept Paper: "Support for Technology Transfer to NGOs and PVOs Promoting Forestry and Agroforestry in Africa."