



World Agroforestry Centre

TRANSFORMING LIVES AND LANDSCAPES

Restoring hope



Restoring the environment

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Agroforestry: the next 25 years



Photo by Anthony Njenga

With our many partners worldwide, we have developed the scientific basis for improved tree crop systems that provide nine basic 'family securities' required by rural households everywhere: security in food, nutrition, health, fodder, shelter, energy, water, income, and a restored environment.

Recently, I had the good fortune to glimpse the future – a place where communities applied and adapted the principles of agroforestry and are now reaping rich rewards, and teaching others to do so. The future I saw was in an unlikely place – Shinyanga region in northwestern Tanzania. Shinyanga was originally a semi-arid open acacia woodland. But by the time ICRAF began working there in 1988, it had become an overworked, overgrazed landscape with hardly a tree in sight. It was fast becoming completely desertified.

Agroforestry has come of age.

During its first 25 years, the World Agroforestry Centre has pioneered solutions to transform some of the bleakest rural areas of the developing world into productive, ecologically sound landscapes that integrate a variety of trees, food and cash crops, and livestock in sustainable farming systems.

Common wisdom has it that you can't practice agroforestry in drylands. But when scores of communities worked together with researchers and extensionists through the Hifadhi Ardhi Shinyanga (HASHI)–ICRAF Project, a vast transformation occurred in just 15 years. Using natural regeneration and rotational grazing, the woodlands were restored. Lush indigenous grasses and graceful acacia trees returned on over 350,000 ha. At that point, researchers and community members introduced a wealth of new types of useful trees, turning the common 'wisdom' on its head.

Farmers Anthony Paulo Katakwa and his wife Agnes Said now found their imaginations fired up by the possibilities of agroforestry. They first contacted the Project in 1997 to diversify their tree enterprises. Today, fruit, fodder, timber, fuelwood and medicinal trees surround their homestead, contributing to the family's nutrition, income, and health year-round. Interspersed among the maize crops on their

3 ha are fertilizer trees that can double or triple their previous yields. (As illustrated in our report *Defying the odds...* on page 8).

Woodlots for timber, fodder, fencing and fuelwood green other parts of their farm. Their fodder trees feed dairy cows contributing both to family nutrition and income. Sales of extra timber and fuelwood, plus cash-generating trees, provide other sources of income. Their rainwater-harvesting pond provides water to raise seedlings during the dry season. This small, diversified farm exemplifies what we at ICRAF call the 'family tree enterprise portfolio'. Even when a household is too far from the market to sell much produce, such enterprises provide the services and products the family needs to meet its nine family securities.

But Anthony and Agnes didn't stop there. They shared their knowledge with community members throughout the region, and grew and dispensed an amazing 90,000 seedlings in the



Anthony Katakwa (second right) and his wife Agnes Said in discussion with Dennis Garrity

last year alone! More than 1,700 other farmers have trained with them. An estimated two-thirds of these households have now begun practising agroforestry to create leafy, productive havens of their own.

Recently Anthony and Agnes started volunteer teaching two days a week in local primary schools. Today, the 17 schools they 'adopted' have become agroforestry learning centres, producing fruit, fodder, timber, honey and other bounty. School children take the seeds and seedlings home to enrich their own family farms.

Anthony and Agnes have never requested a shilling for their training or seedlings. In Anthony's words, "We want to pay back for what we've learned, because agroforestry has made our lives so much better. We want others to enjoy success too, and to give back to the land that blesses us all."

Thanks to the work of Anthony, Agnes and their neighbours, over 350,000 ha in the Shinyanga region have been rejuvenated in just a few years. From a semi-desert has grown a green mosaic of grassland and open woodlands suitable for grazing, tree culture and crops. The HASHI-ICRAF Project was recently honoured for its successes by receiving the UNDP Equator Award. This, in a place where people said "it couldn't be done."

Working trees, enriching families, communities, and the larger environment...these are the themes of this year's *Annual Report*, the themes that Shinyanga illustrates so well. .

During the next 25 years, we must expand the science that will enhance the scaling-up of such achievements to include tens of millions more poor, rural smallholders in Africa, Asia and Latin America.

We are also using agroforestry to educate future, as well as current farmers about agriculture and environment at every stage from primary to post-graduate studies (See our report *A Stitch in Time....* on page 25).

Few people realise that research on tree crops has yielded an impressive mean internal annual rate of return of 88%. We are working hard to encourage governments to build agroforestry into their development plans. And we are reaching out to the international community through the global environmental conventions. Agroforestry is a powerful means to help achieve the United Nations Millennium Development Goals of eradicating extreme poverty and hunger, and improving family health, while ensuring environmental sustainability.

Beyond research, education, and policy work, scaling-up will take concerted collective action by organised community groups. (As illustrated in our report, *Local stewardship....* on page 32). And, of course, it will take inspiring role models like Anthony and Agnes. From my travels I know they are there, in every region, indeed in every village.

I do feel that I've seen the future in Shinyanga. And it works, for us all.

Dennis Garrity
Director General

Major highlights of the year at the World Agroforestry Centre

Oct – Dec 2003

- World Agroforestry Centre (ICRAF) celebrates 25 years with an international conference on the future of agroforestry
- ICRAF projects win two Innovation Marketplace awards at the CGIAR Annual General Meeting in Nairobi
- The Canadian Minister for International Cooperation visits ICRAF
- ICRAF launches the book *A Stitch in Time – Improving Agriculture and Natural Resources Education in Africa*
- ICRAF in Nairobi organises and hosts a regional workshop on agroforestry and HIV/AIDS
- ICRAF in Nairobi organises and hosts a regional workshop on watershed management
- ICRAF wins the Outstanding Agroforestry Project award at The Philippines 1st National Agroforestry Congress.

Jan – Mar 2004

- The Regional Land Management Unit (RELMA) is fully integrated into ICRAF with ongoing funding by Sida (Swedish International Development Cooperation Agency)
- ICRAF organises a seminar on food security in the Democratic Republic of Congo
- ICRAF Zero-grazing dairy project in Rwanda wins World Bank award
- ICRAF and Kenyan Ministry of Water Resources Management launch tree-planting campaign
- ICRAF Eastern and Central Africa Regional Programme opens new country office in Ethiopia
- Media and Ambassadors Days held at ICRAF headquarters with accompanying field visits.

Apr – Jun 2004

- Millennium Ecosystems Assessment (MA) Board visits ICRAF
- ICRAF Sahel Regional Programme hosts Shea butter tree producers workshop
- First ICRAF Board meeting in India and launch of ICRAF South Asia Regional Programme
- Dr D.N. Tewari of the Indian Planning Commission and Dr Linxui Zhang of the Center for Chinese Agricultural Policy are appointed new members of the ICRAF Board of Trustees
- ICRAF's bamboo work in Kenya highlighted in *CNN World Report*
- ICRAF and Anglo-Dutch Unilever initiate a partnership for *Allanblackia* domestication
- ICRAF scientists present latest agroforestry research findings at the 1st World Congress of Agroforestry in Florida and contribute to the Orlando Declaration on Agroforestry
- Rockefeller Foundation President, Dr Gordon Conway visits ICRAF.

Jul – Sep 2004

- ICRAF and hosted institutions staff donate Ksh. 288,000 (US\$3600) to Kenya Famine Relief Fund
- President of Tigray (Ethiopia) visits ICRAF
- New ICRAF Southern Africa Regional Programme opens new office in Lilongwe, Malawi
- ICRAF organises and hosts regional workshop on agroforestry in the drylands of eastern Africa.





Zambian farm family under their Uapaca tree

Trees and families

Families are the backbone of rural community life and when they see the value of agroforestry solutions, they make them happen. The World Agroforestry Centre (ICRAF) has always overtly focused its research activities on benefiting small holders, by developing technological options they can easily implement as individuals or in groups. Options such as fertilizer trees, the domestication of indigenous fruit trees, medicinal trees, live fences and woodlots for timber and fuel are all technologies that can be readily adopted at the household level.

Agroforestry can only provide benefits at the community and environmental levels if individual families see these options as beneficial and are prepared to implement them.

The great advantage of agroforestry solutions is that they cost very little. Most of the on-farm benefits from the use of agroforestry technologies can be obtained from other sources – mineral fertilizers, dairy meal, exotic fruits or packaged medicines for instance. But agroforestry solutions require minimal cash outlay, and are therefore highly appropriate development options for poor people.



Research at the household level is important not only to refine actual technologies – but to assess their social implications. In particular, research is needed to ensure that agroforestry-based solutions are not biased against women. In fact, women can often be major beneficiaries of agroforestry options

– as shown by the examples of fertilizer trees and low-cost fruit processing in this section.

At the household level agroforestry-based solutions can have a large impact on the most vulnerable families. In Africa the scourge of HIV/AIDS has had particularly severe impacts on such families through the loss of the most productive adult family members. Agroforestry offers hope because it has lower labour requirements than annual cropping, and because of the nutritional and medicinal benefits of fruit and tree products. Agroforestry also has the ability to create long-term assets that families can rely upon during times of great need.

The uptake of agroforestry starts at the household level, and these two stories from southern Africa show how the simplicity of the technologies and their immensely practical impacts on families are inspiring rapid adoption by other families across whole nations.

Defying the odds, African farmers meet food security goals

In a region that depends on foreign food aid to feed much of its rural population, tens of thousands of subsistence farmers in southern Africa are boosting crop yields, improving the quality of their soils, and moving rapidly towards self-sufficiency and the market economy.

Despite irregular rainfall during the 2004 cropping season – and the near total absence of mineral fertilizers – farmers harvested on average 2–3 t/ha of maize, roughly four times the amount produced by neighbouring farmers.

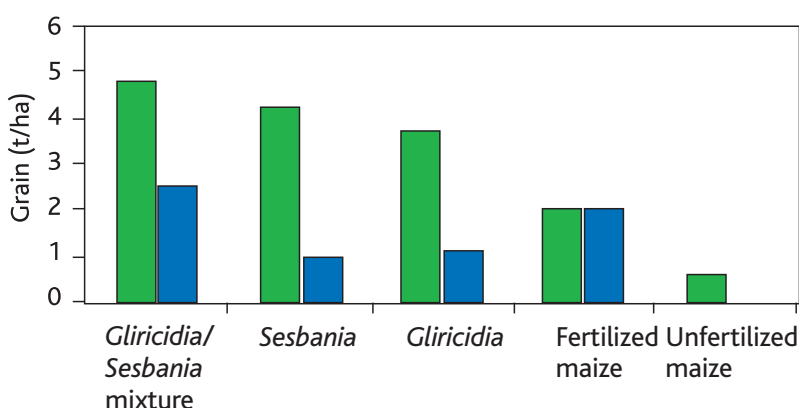
The keys to their success are ‘fertilizer trees’ – species of trees that transfer nitrogen from the air into the soil. Fertilizer trees are capable of revitalising degraded soils and helping rural communities to survive the ‘hunger months’ of November through March when food supplies run critically low.

Developed by researchers at the World Agroforestry Centre, the fertilizer tree system is quickly gaining acceptance in Kenya, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe. Since the late 1990s, when just a few hundred farmers first tested the technology, at least 100,000 maize producers have now adopted the concept.

“Our goal is to reach 12 million farmers by 2015,” says Freddie Kwesiga, an agroforester and Regional Coordinator – Southern Africa who has spearheaded research in the region since 1986. Kwesiga notes that the total number of farmers currently using fertilizer trees represents about 1.5% of the maize producers in southern Africa.

“That’s a huge number for a small research and development team, but it’s not nearly enough to help the millions of Africans in need of food.” Kwesiga is optimistic, however, that fertilizer trees will be widely used a decade from now.

“The United Nations Millennium Development Goal of cutting the number of hungry people in half by 2015 is helping to drive the use of fertilizer trees and is prompting government policymakers and international donor agencies to take note,” he says. In 2002 the Canadian International Development Agency (CIDA) provided ICRAF’s Zambezi Basin Agroforestry Project with a Canadian\$13 million grant to help it reach 400,000 farmers by 2006. The United States Agency for International Development (USAID) provided an additional US\$600,000 in 2003.



Maize yields (t/ha) after pure and mixed fallows. Kalunga, Zambia 2002–2003

In the absence of fertilizer

"It's no secret that if you want to increase African food production, you need to do something about the region's depleted soils," says Paramu Mafongoya, a soil scientist and agroforester who serves as ICRAF's Country Representative in Zambia.

Mafongoya notes that applying mineral fertilizers can easily boost the productivity of African soils. "But fertilizers are expensive and basically beyond the reach of the region's farmers," he says. Moreover, the few farmers who can actually afford to buy fertilizers rarely receive supplies on time or in sufficient quantities.

The problems of supplying bulky mineral fertilizers to millions of farmers working in countries with poor road systems, Mafongoya believes, has proved to be an insurmountable problem, especially in land-locked countries such as Malawi and Zambia where nitrogenous fertilizer can cost US\$700/t – more than five times the world price.

"The logic of the fertilizer tree concept is that it puts the job of producing fertilizer in the hands of local farmers," Mafongoya says. "Moreover, it's a one-time investment: once the trees are planted, the local community takes up the

responsibility of spreading the practices to others.

Mafongoya and Kwesiga are quick to point out that farmers can choose from a variety of fertilizer trees contained in a portfolio made available by ICRAF through national agricultural research and extension systems and



non-governmental agencies. This portfolio also includes numerous varieties of indigenous fruits, trees for timber and medicine, and fodder trees for animal feed.

"ICRAF is committed to providing farmers with an array of useful trees and shrubs that provide rural households with fruits, construction materials, fencing, fuelwood, medicine, and food. We believe – and experience has shown – that trees are pathway out of poverty and we believe that the process starts with improving soil fertility," Kwesiga says.

Such trees help farmers take severely degraded land and transform it into a productive landscape within

24 to 36 months in the rainfall conditions prevalent in southern Africa. While there is no one type of fertilizer tree that fits all situations and ecologies, demand is growing rapidly for a species known as *Gliricidia sepium*.

The 'tree of life'

Imported by ICRAF from Central America in the late 1980s, a new provenance of *Gliricidia* begins enriching the soil within 2 years of planting. By the end of 36 months it provides farmers with the equivalent of 100 kg of nitrogenous fertilizer/ha. This species performs particularly well, researchers say, in sandy soils and under the drier conditions that prevail in southern Africa.

While the amount of fertilizer that *Gliricidia* produces is equal to that provided by other fertilizer tree species, *Gliricidia* has a major advantage over its competitors: it grows back well after cutting. So long as the root system is left intact, the tree will continue to produce nitrogen for many years.

Farmers cooperating with the Project selected the *Gliricidia* used in southern Africa in 1994 and dubbed it the 'tree of life.'

Although *Gliricidia* produces nitrogen nodules below ground, it is the tree's leaves that are most valued by

farmers. The nitrogen content of the foliage ranges from 3 to 4% and provides a high quality fertilizer that is readily utilised by cereal crops. Laboratory analysis conducted at ICRAF's research station in Chipata, Zambia indicates that *Gliricidia* leaves are similar in many respects to ammonium nitrate or urea fertilizers.

Gliricidia also has the advantage of having few natural enemies and it can be grown without agrochemicals. Indeed, the beetles that attack some types of fertilizer trees, most notably *Sesbania sesban*, die when exposed to *Gliricidia*. For that reason, many of the farmers who grow *Sesbania* and other types of fertilizer trees also plant *Gliricidia* as a biological control.

ICRAF scientists anticipate that disease and pest problems will eventually overcome *Gliricidia*'s defenses and are keeping close watch. Researchers are also aware that sustained use of the trees may lead to nutrient imbalances in the soil and are therefore conducting studies to determine the need for potassium and phosphate supplementation. For now, however, the move towards large-scale adoption continues without delay.

Breaking the hard pan

According to Joyce Mulilia-Mitti, an ICRAF extension and scaling-up expert, the Centre's fertilizer tree initiative will likely reach its goal of 400,000 users by 2006. "Right now we are at about the 50% mark, but keep in mind that

as recently as 3 years ago there were only 3,500 farmers in all of southern Africa using improved agroforestry tree species," she says.

Rapid adoption, Mulilia-Mitti believes, is tied to the Project's clear strategy, an effective technology, and committed donors and partners. A large part of the Project's success, she adds, is also due to the benefits that accrue to women.

"Women are major beneficiaries of fertilizer-tree technology," she notes. For instance, because the trees add organic matter to the soil and the roots break the so-called soil hard pan – the crust that develops on the surface of degraded soils – preparing the soil for maize planting is far easier than it would be in depleted soils that are low in organic matter.

"That's a big incentive for women who are largely responsible for land preparation and crop production," she says.

Women also benefit from the fuelwood that the trees produce. Once fully established, a hectare of *Sesbania* produces on average 10 t of fuelwood each year. The majority of African families need about 3 t of fuelwood each year for cooking. Most of this wood is collected by women who carry their loads long distances from the forest.

"By growing fertilizer trees near the homestead," she says, "the need to cut and carry fuelwood is essentially eliminated and that is an enormously important labour saver for women."







Photo by Anthony Njenga

Demand is growing rapidly for Gliricidia sepium

Aiding biodiversity

Planting fertilizer trees may also have a profound impact on the region's forests.

According to the Food and Agriculture Organization of the United Nations, (FAO) Zambia – the country with the most advanced fertilizer tree programme – is losing between 200,000 and 300,000 ha of forest annually. The principal agents are agriculture and charcoal production.

"You can see the damage from just about any location," says John Lazier, a professional associated with the Project through CIDA. "Over the past 20 years, southern Africa's woodlands

have been depleted by people searching for fuelwood. Large-scale adoption of fertilizer trees and other agroforestry species could have a major impact on the region's biodiversity and allow native forest species to recover," says Lazier.

"ICRAF's work in southern Africa makes available a large suite of technological options that can overcome constraints that many experts until now had thought were basically insurmountable. These include better ways of producing timber, fuelwood, fruits and medicinal products, but most importantly they provide options for restoring soil fertility. This is a dramatic breakthrough that will have a

wide-ranging impact on the region and possibly beyond."

Indeed, according to studies conducted by the European Union-sponsored IMPALA Project (Improved Fallows in Africa), fertilizer trees annually sequester 10–20 t of carbon/ha and increase soil carbon by about 1 t/ha per annum. These amounts compare favourably to virtually any other agricultural system.

Alain Albrecht, leader of the IMPALA Project, notes that fertilizer trees not only store atmospheric carbon, a greenhouse gas responsible for global warming, but also greatly improve agricultural productivity and wood

production in farmers' fields.

Albrecht, who holds a joint appointment with ICRAF and France's Institut de recherche pour le développement (IRD) says that the trees not only sequester significant amounts of carbon when used in improved fallow systems, they prevent soil erosion, are financially attractive to poor farmers, and save labour.

"If there is a downside to the technology – and all technologies have a downside – it is that the trees tend to perform better on heavier soils and their extended use may be offset by the fact that they produce nitrous oxide emissions, which may cancel out their carbon sequestration benefits," Albrecht says.

"The principal benefits right now to farmers are improved yields and fuelwood production. However, if this technology is to be of significant benefit to the environment and to farmers who may one day earn carbon credits from their use of the trees, it will require significantly higher levels of adoption.

"That's exactly the objective we have in mind," notes Kwesiga.

"This is a technology that can be taken off the shelf, that addresses some of Africa's most important problems in an effective and sustainable way, and that we anticipate will lead to greater food security, improved health, and provide a much-needed entry point for poor people to a cash economy (see *Pathways out of poverty*).

Pathways out of poverty

In southern Africa, where agriculture and maize production are almost synonymous, thousands of farmers are diversifying their holdings as they replenish their soils with the help of nitrogen-fixing fertilizer trees. In eastern Zambia, where many farmers have been using the trees for nearly a decade to restore soil fertility, maize producers are supplementing their incomes by growing cash crops that command high prices in urban markets.

One crop that farmers find especially attractive is garlic, that can be easily dried and stored on-farm without special facilities. The retail price of garlic in Zambia is US\$5/kg, an attractive amount for farmers who until recently only grew it for home consumption.

Farmers who grow garlic for the market attribute their success to a technique known as 'biomass transfer,' a process which entails cutting and carrying nitrogen-rich leaves produced by fertilizer trees, particularly *Gliricidia*, and depositing them in garden plots at the end of the maize cropping season. Such gardens are usually located near a wetland area or in a shady environment where the soil remains moist enough to produce horticultural crops.

The end of the maize season is usually a down time for the farmers in Zambia, but the availability of the *Gliricidia* leaves allows them to grow garlic and other cash crops in quantities that bring high prices during this off-season. Leaves from fertilizer trees provide nitrogen in amounts sufficient to replenish severely depleted soils and produce not only crops for the market, but also nutritious fruits and vegetables that can prevent micronutrient malnutrition and bolster the body's immune system. In a region racked by HIV/AIDS and malaria, that is an important benefit that empowers people who lack access to drugs and food supplements to cope with their most important health problems with little outside assistance.

Women enjoy the fruits of their labour in southern Africa

ICRAF project develops the wild fruit products of the Miombo woodlands

Life at the breakfast table will never be the same again. 'Can you pass me the Mazhanje jam? Do you want some more Syzygium juice?' 'No thanks, I take some Strychnos juice instead with a cracker of Vitex jam.' These are not the latest food creations resulting from genetic modification, but products made from the fruit of indigenous trees in southern Africa. The World Agroforestry Centre (ICRAF) is helping farmers to develop a fruit tree market from the Miombo woodlands – a major ecological zone in southern Africa.

The project which is funded by the Canadian International Development Agency (CIDA), Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ), Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) and the Swedish International Development Cooperation Agency (Sida) supports farmers (mainly women) with the production, processing and marketing of indigenous fruit tree products.

"Indigenous fruit is readily available in most of southern Africa's forests and is usually collected by women and children as an additional food source for the family and to provide cash income", says Miombo Indigenous Fruit Tree Project Leader Festus Akinnifesi, an ICRAF Tree Scientist based in Malawi. "Women also sell the fruit

on the roadside and in local markets to make some extra money. They are very knowledgeable and can often tell the sweetness of the fruit by just looking at its texture."

Building on this indigenous knowledge ICRAF scientists saw potential to develop the largely informal indigenous fruit markets in southern Africa and to domesticate the species being used – turning them into real cash crops. A recent international research report estimates the annual global market for natural products at US\$45 billion with the African market remaining largely untapped. Moreover, indigenous fruit trees serve as 'food safety nets' because they produce fruit during the hungry period when there is a shortage of food between maize crops. They become even more important when such annual crops fail.

From the start of the Project in the late 1990s the ICRAF team focused on three areas: securing fruit supply by domesticating indigenous fruit trees, processing fruit, and expanding market opportunities for indigenous fruit tree products. Akinnifesi says, "We had to start from scratch: the only indigenous fruit available was collected in the forest and there was virtually no market for it, or knowledge of how to add value to the crop."

God's indigenous fruit trees

The first step was to find out if indigenous fruit trees could be cultivated. This begun with ethno-botanical surveys, explains Akinnifesi. "One of the main challenges we faced was the belief of local people that all trees are planted by God and



Training women in fruit processing, Tanzania

therefore none of the farmers was used to planting them, or even believed that this was possible. We had to foster a tree-planting culture in the villages to make cultivation of indigenous fruit trees possible. Most villagers were also not aware of the difference between female and male trees. For example, males of *Uapaca kirkiana* do not produce fruits, and for that reason most farmers would cut them down as 'barren' or 'bewitched' trees. As a result, female trees did not get pollinated and would bear little or no fruit, leading to genetic erosion."

This meant that there were not enough good quality cultivars, so the team had to go and look for the best indigenous trees in the forests of southern Africa. Farmers and villagers initially helped to select the top 20 different indigenous fruit tree species in Malawi, Tanzania,

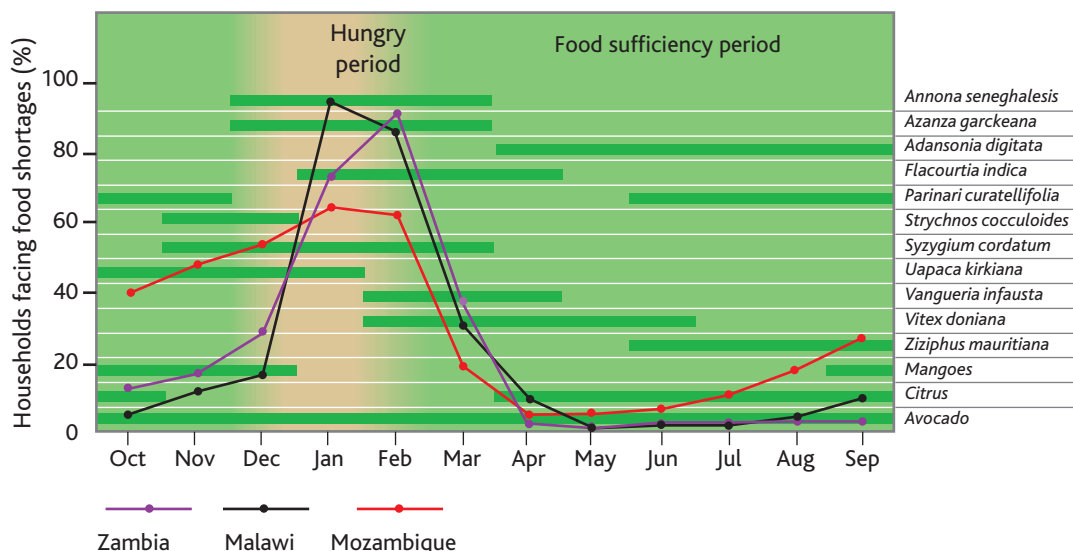
'Cultivation of trees requires a cultural change in villages as local people believe only God plants trees'

Zambia and Zimbabwe. The most-preferred trees of each species were then selected by farming communities from nearby forests, their farms and communal areas for the fresh fruit and processing markets.

Children played a key role in finding the best selections: as Akinnesi explains, "They know where to find the trees in the wild and often named trees after themselves. This made us decide to give communities the indirect intellectual property credits for their stewardship of these particular trees. We named the indigenous fruit trees after the villages or farmers that discovered and managed them. A tree found

in Nazombe, Malawi, for example, would be called ICR02NazombeMW29. In this case the ICR stands for ICRAF, 02 for 2002, MW for Malawi and 29 for the 29th superior tree identified in the country."

The most difficult step in the research was to find ways to successfully propagate selected species. There was virtually no research on methods of propagation for these wild plants until ICRAF entered the scene in the mid-1990s. The research team also had to identify what superior indigenous fruit trees should look like. This resulted in a long list including an ability to fruit early, and to produce fruit that were bigger than average and very sweet. The World Agroforestry Centre established orchards in Malawi on research stations and farms to find ways of domesticating superior selections of indigenous trees.



Many indigenous fruits crop during the hungry period in between maize harvests



Photo by Anthony Njenga

Children knew where to find the trees in the wild and often named trees after themselves

They soon found out that improving grafting and marcotting skills (techniques for cloning of selected trees) was the key to scaling-up their adoption. Grafting trainers were recruited to teach grassroots women trainers in each country in southern Africa how to propagate the species and to establish and manage nurseries. Apart from using superior planting material, the timing of grafting also turned out to be of critical importance. As Akinnifesi explains, “We found out that grafting is best done before bud break for these wild species. Grafting between February and June (Autumn in southern Africa) resulted in a 90% failure rate, while if *Uapaca kirkiana* trees were grafted between October and December the success rate was over 90%.

Jam by the spoonful

Until recently the indigenous fruit tree market has been mainly informal: women selling fruits on roadsides and in local markets. Once the production of indigenous fruit could be assured by propagating and cultivating superior trees, it was time to find out which markets to target. Market research in Malawi found out that producing fruit concentrates for industry was very promising. Fruit concentrate yields much higher prices on the market than selling the fruit per piece. For that reason the team established women’s fruit-processing groups and trained these groups to produce such products as jam, fruit juice and wine. Initially 198 grassroots women trainers from four

communities in Tanzania were trained. They in turn worked with local women’s groups and within 18 months over 2000 women were involved in processing. Within 3 years the diffusion of these innovations has resulted in over 6000 women processors becoming involved. The new indigenous fruit tree products were also a big success in the rural villages: “Women were selling jam by the spoonful on the streets”, Akinnifesi said. “Communities are excited that the luxuries of city dwellers have come to their doorsteps.”

However, success created new problems, such as storage. Most indigenous fruit trees produce a crop during only a few months in a year. Guaranteeing the quality of the fruit year-round became a challenge. Moreover, lack of

packaging materials hampered upgrading of the indigenous fruit tree products to city market standards. Co-operation with Safire, a Zimbabwe-based NGO and a private company, Tulimara (Speciality Products Ltd) provided the solution. Communities are now producing intermediate products like fruit pulp (concentrates) that are further processed and packaged by Tulimara. In addition, Safire acts as a broker by organising and training the women entrepreneurs in processing, hygiene, book-keeping and business skills. Farmers were trained in basic pulping and hygiene, and were given deep freezers in which to store their produce. And Akinnifesi already dreams about the next step: "We envision expanding the market to produce intermediate

products for the cosmetics industry like Amarula soap, Parinari oil and Baobab oil. Because that is where the real money is!" Plans are also in progress to develop high-value trees whose products can be used for medicines, oils and cosmetics.

Impact assessments have shown that the developing indigenous fruit tree industry has the potential to improve the livelihood of many farmers. Mrs Jeri of the Jerusalem Community Group in Zambia, for example, earned enough money to build a new house and buy cattle. But apart from providing income, project leader Akinnifesi stresses the importance of this project in empowering women: "Traditionally men tend to hijack the ideas and businesses of successful women but in

this case that's very difficult. The process is too complex. Compare it to cooking: a man can learn how to prepare a meal but even if he has the knowledge, a man is often slower and less skillful than a woman – and would usually prefer to do something else for a living".

The project has shown that it is not only fruit, but also a large number of other indigenous plant treasures of the Miombo woodlands that are worth preserving. Regional momentum is now building to form a large consortium dealing with the commercialisation of indigenous tree fruit products – to help spread the benefits of Vitex jam and other innovative products to wider communities in southern Africa.

Photo by Anthony Njenga



Indigenous fruit tree products

Reaching a wider audience



www.worldagroforestry.org



Trees and communities

In recent years the key role that communities play in designing and implementing local development initiatives has been emphasised by many international research and development agencies. Programmes to achieve the Millennium Development Goals on poverty reduction and food security now routinely rely on communities to be the best judges of their own needs. But the importance of community action has always been central to the implementation of agroforestry research.

Many agroforestry-based solutions have most impact at the community level – such as the development of community-owned nurseries to provide planting material and extension advice, or the role of Landcare groups in helping communities to manage their own natural resources. The role of trees in soil conservation or in protecting community water supplies is most often felt at the community level.

Communities provide the interface between central governments and individual families, and in recent years pressure from international organisations has encouraged more governments to decentralise services in the belief that the closer these get to the communities who will benefit from them, the more efficient and accountable they will be. But that is not always the case.

Through its long involvement in community action research and development, the World Agroforestry



Centre has shown which development initiatives local communities are best able to implement, and what conditions need to prevail for this implementation to be most successful.

In collaboration with the African Highlands Initiative (AHI), the World Agroforestry Centre is undertaking action research to support upland communities in eastern Africa who are seeking to manage their natural resources more effectively. In southern Africa, Centre scientists are working with Local Change Teams to rapidly scale up effective agroforestry technologies. The lessons learned from the Centre's involvement in Landcare in The Philippines are also being successfully transferred to similar initiatives elsewhere in southeast Asia and in Africa.

This section focuses on two very different types of community development based around agroforestry innovations. The cultivation of bamboo – an underutilised native product of Africa is being revitalised through the introduction of improved varieties and technologies from Asia. Exciting community development initiatives are now in progress in Kenya. A key factor in community development is also the role of skilled individuals, and the Centre has been a key player in revitalising agricultural education in Africa to make it more appropriate to the social conditions that apply in local communities. These are examples from the continuum of research for community development activities that the Centre has long championed.

A giant solution to a giant problem

Bamboo absorbs water faster than most plants and in some parts of the world is used to clean sewage. Even more importantly, it soaks up heavy metals. It is a potential answer to polluted waters in Kenya, including those of Lake Victoria whose shores are dotted with large urban centres that discharge domestic and industrial waste into its waters. It is nature's fastest-growing woody plant, with some species achieving the phenomenal growth rate of one metre a day. Its culms (poles) are the strongest, lightest natural material known to man. A square metre of flooring derived from this 'wonder plant' will sell for as much as US\$100, while in South Asia it is used to reinforce concrete and for scaffolding on skyscrapers.

No other woody plant matches bamboo's versatility in environmental conservation and commerce. It is a viable replacement for both hardwoods and softwoods. With a growth rate three times that of eucalyptus it matures in just 3 years. Thereafter, harvests are possible every second year for 4 decades.

India has almost 8 million ha of commercial bamboo that provide 60% of the country's massive paper requirements and much of its commercial timber needs. And every year, over 2 million t of edible bamboo shoots – rich in vitamins and low in carbohydrates, fats and proteins are consumed around the world, mostly in Asia.

Bamboo rhizomes anchor topsoil along steep slopes and riverbanks, very effectively

controlling erosion. Bamboo leaves, sheaves and old culms that die and fall to the ground decompose and create a thick humus layer that enriches the soil. Studies in Southeast Asia and Kenya have also shown that natural bamboo forests have excellent hydrological functions that promote soil health. Some species of bamboo absorb as much as 12 t of atmospheric carbon dioxide /ha, a valuable asset to deploy against global warming.

However, bamboo remains an untapped resource in Africa, a state of affairs that the World Agroforestry Centre (ICRAF) hopes to help remedy through a project in Kenya. The project aims to create awareness of the environmental and economic benefits of bamboo in the Lake Victoria Basin, and hopefully increase its popularity throughout eastern Africa . Interestingly, this member

of the grass family is not new to Kenya. "Kenya's water catchments were once covered in bamboo," says Chin Ong, a hydrologist working with ICRAF. "However, most of these forests have since been cleared". *Arundinaria alpina*, a species of bamboo native to Kenya, can yield as many as 20,000 culms/ha annually – with each culm growing to a height of 12 m (40 feet).

ICRAF has taken a first step towards the revival of bamboo by introducing the giant *Dendrocalamus giganteus* into selected parts of the Lake Victoria Basin, including river banks. This commercially attractive species can grow in areas traditionally used to cultivate sugar cane and coffee, thus providing an alternative or additional cash crop.

More than 800 seedlings have been distributed to farmers in



ICRAF staff inspecting giant bamboo, Thika, Kenya



Kericho, Kisii, Nandi South, Nyamira, Nyando, Siaya, and Vihiga Districts. Plans are in progress with municipal authorities to introduce bamboo for wastewater treatment in Kisumu and Kakamega. Further afield, ICRAF is also working with local authorities in Nairobi, Mwanza and several towns dotting Lake Victoria's shores.

Kenya has few privately owned commercial timber plantations. Most of the country's timber comes from small farms and government forests or is imported. However, the natural forests have been severely over-exploited with only limited replanting. Timber firms are now forced to import supplies from the Democratic Republic of Congo and Tanzania to manufacture hard and soft board. The country's leading paper manufacturer, PanPaper of Webuye, is also reportedly

using plantation softwoods to fuel its boilers and make paper pulp. With its rapid growth and high woody fibre production, bamboo could supply both these industrial needs.

At the household level, bamboo could provide a valuable source of fuelwood and charcoal. It yields more than 7,000 kilocalories /kg, equivalent to half the yield from an equivalent amount of petroleum. Some species of the plant have large thorns, making them ideal for security hedges. Others grow tall straight culms that form excellent windbreaks. And of course, edible bamboo shoots would be a nutritious addition to the family table. These shoots are mild and very crunchy and can be eaten raw or cooked. The Kenya Forestry Research Institute (KEFRI) already grows several high-quality edible varieties.

ICRAF is partnering with KEFRI and the Jomo Kenyatta University of Agriculture and Technology to lower the cost of bamboo seedlings and to increase their sprouting rate. At KEFRI-Kakamega, 20 species are being tested for agroecological suitability and to rate the performance indexes of local and exotic species. In Kibera, Kenya, ICRAF will work with the Ngong Forest Sanctuary to introduce bamboo as a more sustainable domestic fuel source for slum dwellers, in an attempt to save the dwindling forest reserves.

Through these collaborative projects, the revival and return of this multi-purpose and multi-value native plant are bound to have profound impacts on regional landscapes and livelihoods.

A Stitch in Time – sewing a brighter future for agricultural education in Africa

A Tanzanian proverb offers African farmers this bit of advice: ‘Pray for good harvests but keep on hoeing.’ And that is exactly what most smallholder farmers in Africa continue to do year in and year out – toil hard to produce the food they need to feed their families and pray that their efforts will be rewarded.

Subsistence agriculture is still the backbone of the African economy, with more than two-thirds of all Africans living in rural areas and depending entirely on agriculture and natural resources for their livelihood. That means that for more than 600 million Africans, the land – and what they can coax from it – is still their only defence against famine. Famine is often caused by just a failed rainy season or a major flood on a continent where extreme rural poverty, environmental degradation and capricious weather patterns combine to make life – even survival – more precarious than perhaps anywhere else on earth.

This situation persists despite major investment during the early years of African independence in tertiary education that focused on agriculture, forestry and animal husbandry. The question that begs to be answered is why these post-independence efforts to establish tertiary agricultural education

programmes did not generate the hoped-for improvements on the ground – for untold millions of smallholder farmers across the continent.

That is the question that the African Network for Agroforestry Education (ANAFE), with 124 partner institutions in 34 countries, set out to answer in 2002 with an in-depth study of tertiary education in natural resource management and agricultural education in 30 African countries. That study took 2 years and collected data going back a decade, culminating in a groundbreaking symposium, ‘Building Agricultural and Natural Resources Education in Africa: Quality and Relevance of Tertiary Education’, organised by ANAFE at Kenyatta University in Kenya in April 2003.

The 55 papers presented at the symposium have now been published in an important new book, *Rebuilding Africa’s Capacity for Agricultural Development: The Roles of*

Tertiary Education. And a companion document was also produced, primarily for policy-makers and managers: *A Stitch in Time – Improving Agriculture and Natural Resources Education in Africa*.

According to August Temu, who coordinates ANAFE from the headquarters of the World Agroforestry Centre in Nairobi, these publications provide a veritable manifesto for change in how agriculture is taught in African universities and training colleges. Such changes are urgently needed if Africa’s farmers and its educational institutions are to meet the many challenges of our times that include: globalisation and liberalisation of trade and markets, environmental degradation, global warming, rising rural poverty levels, rural to urban migration, and the effects of such pandemics as HIV/AIDS and malaria.

“Africa has failed to invest in agriculture,” says Temu. “Farmers are still doing things

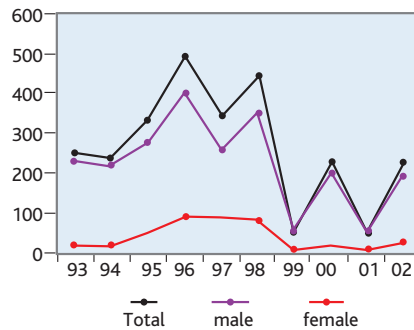


just as their parents did, functioning on the ground as if we were in the 1950s. There has been no forward movement. The smallholders have not received new skills, and so we needed to see why not."

Temu says a transformation in education is needed, but notes that it must start with a 'transformation of minds.' "The new publications and the momentum generated at ANAFE's symposium are the start of that transformation." The network has joined forces with the Forum for Agricultural Research in Africa (FARA), which in September 2004 funded an important workshop hosted by the African Union (AU) in Addis Ababa, Ethiopia.

By bringing together African and northern universities, research centres within the Consultative Group on International Agricultural Research (CGIAR), and the AU in the context of the New Partnership for African Development (NEPAD), Temu says a new initiative has emerged in a concept known as BASIC (Building Africa's Scientific and Institutional Capacity).

Temu says, "*A Stitch in Time* is a timely guideline for policy-makers seeking to right some of the wrongs and fill in the gaps that have hindered agricultural development in Africa, and built barriers separating academics, technical personnel and farmers, rather than creating communication channels to



African forestry certificates and diplomas awarded (by gender) 1993–2002

allow the free transmission of knowledge and skills among them.

In the 1970s and 1980s there was a tremendous decrease in the number of holders of technical diplomas in all areas of agriculture and natural resource management," he notes. "With the structural adjustment programmes driven by the World Bank and the International Monetary Fund (IMF), there were cutbacks to government involvement in all areas of agriculture and extension, the idea being that the private sector and non-governmental organisations would step in. That didn't happen. No one was dealing with the complexities of the integrated systems in which a single farmer might be managing, say, a few chickens, trees, maize and sorghum. There was an overall deterioration of knowledge and sharing mechanisms combined with the retrenchment of technicians.

At the same time," he says, "there was an expansion in degree-level agricultural training, pouring a lot of

graduates onto the streets". But degree-holders who were able to find scarce professional positions seldom worked at the grassroots level where they could share their knowledge and skills with those who needed them – technicians, farmers and people working in rural development. Many agricultural graduates could not find work in their field and wound up seeking employment that had nothing to do with their agricultural education and degrees.

Grounded in African reality – decolonising agricultural curricula

A Stitch in Time also highlights weaknesses in the way agriculture has been taught and in the curricula the tertiary institutions had to offer, along with ways to remedy them. The study shows that curricula in African universities have been largely adopted from the countries that once had colonies in Africa, and so university texts on agriculture were founded on an imported philosophy and policy that aimed to produce cash crops for consumption by – and processing in – those former colonising countries.

Very little attention was paid to the local needs in Africa, and little of what was taught was grounded in African reality, especially in the reality of smallholder farms on the continent, where farmers integrated and sought to manage crops, trees and livestock in



Kenyan school children tend their school nursery

complex farming systems that stressed food security through diversity.

“And yet”, says Temu, “Tree seed and tree management are almost completely absent from any curricula.”

The study also noted that the Green Revolution, that had increased agricultural productivity and food production in other parts of the world – particularly India – never fulfilled the same promises in Africa, largely because policies, institutional arrangements and capacity for knowledge management were inadequate. In addition, products from natural forests in Africa continued to be harvested and exported in raw form – as did other agricultural outputs – denying Africans the crucial income from added value that could be accrued with local processing and packaging. However, studies in agricultural development in sub-Saharan Africa have

shown that integrated systems of crops, livestock and trees on smallholder farms have served the continent well in the past and can continue to do so.

Reconstructing agricultural education – one stitch at a time

“It is time”, says Temu, “to rebuild agricultural education in Africa in a way that will turn farming into a respected and lucrative discipline that will lure the continent’s youth, rather than attract them only when all else fails and they turn to farming as a last-ditch way to survive. ANAFE has already taken a few ‘stitches in time’ to start that reconstruction process, by establishing Learning Resource Centres for farmers where young people can see for themselves which farming systems can work for them, how they can produce more with less labour, and then

add value to whatever they produce.”

Temu says Ethiopia has already begun a major transformation of its approach to agricultural education and training, by creating 15,000 farmer-training centres, each to be run by three resource persons, one responsible for crop production, one for animal production and a third for natural resource management and forestry. Temu says 45,000 Ethiopians are already being trained as resource persons. And in Uganda, he points out, the Government has developed a unified extension system that integrates all aspects of agriculture and value-addition for agricultural produce.

But are those ‘stitches in time’ enough to produce a continent-wide impetus for the transformation that the new book demands? Can they weave a new, adapted, practical and effective approach to education in natural resource management and improved agriculture across Africa?

“I am very optimistic,” says August Temu. “Our aim now is to get policy-makers and funding institutions on board and to convince them that investment is crucial to make agricultural education both useful and enticing. We did not dream this up, we have documented the problems – and the solutions.”

Reaching a wider audience



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Trees and the environment

Everyone wants environmental protection, but the environment often loses out when there are limited resources and the most pressing need is to reduce rural poverty. The World Summit on Sustainable Development in 2002 emphasised the need for new approaches to solve the increasingly urgent conflicts between these needs – for options that can provide synergistic solutions to both problems at once.

Agroforestry is increasingly being recognised as a vital means of resolving apparent contradictions between development and environment agendas. It can help provide a way out of poverty for millions – and help ameliorate the problems of desertification and climate change while contributing to watershed management and biodiversity conservation at the same time.

Research by the Centre is providing practical means to achieve such synergies between global conventions, national environmental action plans and poverty reduction strategies. Agroforestry provides practical options for small-holders to be involved in the Clean Development Mechanism (CDM) by selling carbon sequestration services to organisations seeking to meet their international carbon dioxide (CO₂) reduction obligations. It provides a means to combat desertification as well as providing alternative sources of income for the poor in arid areas. Agroforestry can ameliorate the impact of climate change on the poor because trees are less affected by weather



variations than annual crops and agroforestry can be a significant contributor to biodiversity conservation.

Research by the Centre is having considerable impact on ensuring that agroforestry does in fact live up to this potential. Unsuccessful introductions of exotic fast growing trees in the past have created environmental

problems – such as reduced runoff from water catchments or the spread of invasive species. Technologies that may be very successful at the household levels can have damaging implications at the landscape or environmental levels, and research is needed to achieve the best balance of needs.

Agroforests can provide one of the most biodiverse agricultural landscapes – with both the environmental benefits of forests and the food and income producing abilities of annual crops. One of this section's feature stories from Java shows how agroforests often provide the best-bet option to protect biodiversity that is under threat from high population and development pressures.

Our second feature story shows how agroforestry can also provide a viable option for restoring degraded environments. In highly populated rural areas of western Kenya where soil erosion has severely scarred the landscape, a new large-scale research project has begun to apply agroforestry to restore both the environment and community options.

Local stewardship – best bet for saving Java's remaining forest reserves

The survival of one of Java's last remaining biologically rich natural forests will depend as much on promoting community stewardship as it does on government conservation programmes, say scientists from the World Agroforestry Centre (ICRAF) working in the Indonesian archipelago.

Java's largest remaining block of natural forest, a reserve area of some 700 km² in the Gunung Halimun National Park and surrounding areas, is considered crucial to safeguarding drinking water supplies in nearby Jakarta. The area is under intense pressure from the combined effects of population growth and efforts to use the land for farming and government tree planting.

"The well-being of the Park's protected areas or bio-reserves depends on the ability of local farmers to make use of state-managed production forests that surround the Park," says Meine van Noordwijk, the World Agroforestry Centre's Regional Coordinator – Southeast Asia.

He feels research has demonstrated that supporting local people to plant fruit and other productive tree species in areas designated as production forests can provide the incentives villagers lost when their access to these lands was taken by the Indonesian Government in the 1970s. "Before the Suharto era, the area's production forests were

managed reasonably well by local people. If you look carefully, you can see where they planted tea, coffee and fruit trees," he says.

But, van Noordwijk fears that if steps are not taken soon to help farmers increase productivity in areas designated as production forest, and to provide legal access to the land so that they have an incentive to plant fruit trees and timber, it's unlikely that the Park's forest reserves can be maintained.

"Population pressure in Java is simply too great," he says. "Something needs to be done to give people an incentive to protect the reserve.

Incentives that lead to good stewardship," van Noordwijk adds, "are most likely to result from systematic negotiations between local communities, park managers, and local government. ICRAF," he notes, "is working with a variety of partners to identify the social and biophysical causes of conflicts arising over the Park's land tenure policies."

Non-native pine forests

Officials from the international NGO Forest Watch International and the Indonesian Institute for Forest and Environment who work closely with ICRAF think that the situation is extremely fluid.

Pine tree plantations planted during the Suharto era were recently transferred to Park jurisdiction. These plantations not only displaced native species, but are now being cut down by local people, including employees of the State Forest Company, to clear space for food crops. It only a matter of time, they say, before people start moving into the forest reserve.

"There are a number of things that can be done to reverse that situation, however," says Tree Domestication Specialist James Roshetko. "The first is to develop extension methods and technologies that will help farmers improve the productivity of both naturalised and indigenous



Marcotting to propagate valuable tree species

tree species. The second is to demonstrate how better management of trees translates into cash."

Roshetko, who holds a joint appointment with the World Agroforestry Centre and Winrock International, is testing extension methods in a project with farmers in Nangung, a sub-district of 15,000 households that borders directly on the Park's southern boundary.

"Farmers in Nangung say they don't manage their trees because they lack markets," Roshetko says, a notion seconded by Pak Kusnadi, a farm leader who teaches agroforestry to local primary school students.

Kusnadi believes that local children, most of whose families live below Indonesia's official poverty line, will need to do a better job of managing trees than their parents if they are going to increase their standard of living and protect the Park reserve areas.

The project which is financed by the United States Agency for International Development (USAID) includes training for farm leaders and NGO staff, identification of priority tree species, development of management practices that boost profits, and rapid market appraisals.

"We look at the commodity chain all the way from

production to the consumer," Roshetko says. "The objective is help farmers understand the demands of the market, avoid its pitfalls, and capitalise on its strengths."

For example, Roshetko and his colleagues are helping Pak Kusnadi's group develop strategies that maximise long-term profits. One group of Nanung farmers he notes, recently replaced less-productive spice trees with tropical fruit trees that fetch high prices in Jakarta markets.

"It will be 8 years before the new trees produce," Kusnatei says, but the farmers are willing to make the investment because they're beginning to think about the future. "It's long-term thinking", he adds, "that will save the forest".

Deal halts evictions

Questions remain, however, as to who has the right to develop the Park's production forests. Farmers claim that they are the traditional stewards of the land and had access before the Suharto regime came to power, but were never given official title. But government foresters are skeptical of the farmers' claims and are unsure if local communities can actually care for the land.

"Our intention is that local communities will soon have legal access to the land and an incentive to contribute

to its well-being, "says ICRAF Senior Forest Policy Analyst/Governance Expert in Southeast Asia Chip Fay. "What we've learned is that the interests of local people and the government's need to maintain the integrity of water catchments frequently coincide."

Fay, an expert in what is called 'negotiation support,' helps equip local communities to find common ground with powerful government agencies. For example, in the late 1990s, in Lampung Province in southern Sumatra, Fay and his colleagues helped broker an agreement that halted evictions and provided 750 families with legal access to forest production zones. The only proviso was that the farmers should plant trees that stabilise the soil and cease growing annual food crops that lead to soil erosion.

Gamal Pasya, an Indonesian Natural Resources Policy Analyst, and local government official who works with Fay adds that, "Government agencies often fail to recognise that local people have a strong tradition of caring for the land and are experts at maintaining their holdings.

There are many common-sense practices, traditional systems if you will, that people use to hold the soil in place," he says. "They may not be sophisticated, but they work



Discussing tree propagation techniques with Indonesian farmers

and are frequently better than the techniques recommended by government foresters.”

According to Pasya, who worked with local NGOs to broker the deal in Lampung, the first step in crafting an agreement is to create dialogue in order to get the parties to work together. “You have to act as an honest broker to establish trust and you have to base your efforts on the results of research,” he says.

Pasya notes that the Lampung agreement provided farmers with permission to use the land but stopped short of granting actual title, since, in this case the farmers themselves recognised that they were migrants to

the area and did not claim traditional rights. Even before the Suharto era, he says, farmers lacked clear title and recognised that they must act as stewards of the land rather than as property owners. “That’s the basis of the deal between the community and the Government.”

Fay adds that 15 similar efforts are now in progress and that he and his colleagues hope to reduce the time required to broker an agreement from the 18 months required for the Lampung settlement, to just 2 or 3 months.

“Right now we’re collaborating with the

Indonesian Institute for Forest and Environment to document the history of the land in the Halimun reserve and to reassure Park officials that tree farming is not going to have an adverse affect on the water catchment.”

Park managers, he notes, are most concerned about the planting of fruit trees in protected areas where ‘exotic species’ are prohibited. “This is a land-use restriction that seriously reduces a farmer’s economic options. Our role is to help the Park’s managers define the meaning of the term exotic species and to demonstrate that many so-called exotics were integrated into the local ecosystem



Tending a tree nursery in southern Java

long ago and thus pose little threat to biodiversity or the environment, but do offer economic returns for local people.

Local people, he says, are being encouraged, to specify the conservation methods they will use to protect the land and are asking that their areas be designated as 'conservation villages'. In return for that special classification, the farmers promise not to expand their holdings into natural forest conservation areas and to prevent unauthorised cutting in the forest reserve. "The end result," Fay says, "is that local communities will have a vested interest in increasing tree cover on the land and in acting as protectors of the forest."

Indonesian forests in decline

"The need to deepen the science of negotiation support and to scale-up its application is extremely urgent," adds Dennis Garrity, Director General of the World Agroforestry Centre. Garrity, who spent more than a decade working in Indonesia, notes that Indonesian and World Bank officials recently reported that the health of the country's forests was far worse than previously thought and that if deforestation continues at current rates, Indonesia will cease to be a major supplier of wood products.

"Perhaps more alarming", he says, "are figures that indicate few of the country's conservation areas will remain intact. What we're seeing is the rapid demise of forests that once covered 160 million km² of the Indonesia archipelago.

The need to find better means of protecting such natural forests and helping communities to make the most effective use of their production forests has never been more important."

Restoring Kenya's degraded land

ICRAF scientists launch a major project in western Kenya

The famine and atrocities in the Sudanese region of Darfur are in the news headlines every day, but a few hundred kilometres to the south another massive human disaster is unfolding. Last year, the lack of good rains caused major crop failures all over Kenya and an estimated 3 million people are facing the threat of starvation.

This no surprise in a country with such an extremely stressed ecosystem" says Lou Verchot, Lead Scientist for Climate Change and Soil Fertility with the World Agroforestry Centre (ICRAF). "There have always been droughts, but over-cropping on marginally productive land and other unsustainable farming practices make farmers very vulnerable to such natural variations as a lack of rain."

The situation in western Kenya is aggravated by a

number of other problems like overpopulation – with as many as 1600 people/km² the density is comparable to that of an average city. Inappropriate farming practices have created large areas of degraded land where erosion has stripped away fertile soil. The Katuk–Odeyo gully scarring the landscape to a depth of up to 25 m for more than 45 km is one of the most daunting examples.

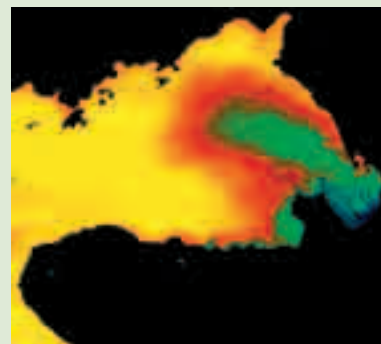
As Verchot states, "Soil erosion creates major problems. Small-scale farmers

can no longer successfully grow certain food crops and are forced to change their farming practices, but lack the knowledge and resources to do so. Compelled by necessity they continue growing the wrong crops in the wrong places causing even more damage and degraded land."

Further downstream the soil erosion creates a different problem for the fishermen of Lake Victoria. Millions of tonnes of fertile soil wash into the lake causing an explosion

Some facts on degraded land in western Kenya

- 3.2 million t of soil have washed into Lake Victoria since 1963 (equivalent to one million truckloads)
- In the Nyando river basin US\$42.7 millions worth of soil is lost every year (based on US\$12/t)
- Over 50% of the land has been abandoned due to depletion of soil nutrients
- In Kenya each year the value of soil lost due to erosion is 3 to 4 times as high as the annual income from tourism.



Nyando sediment plume (green) in Lake Victoria, Feb 2000



of water hyacinth that clogs ports. Eutrophication of the lake has destroyed the local fishing industry.

“To solve these problems, farmers in western Kenya must change their farming practices to more sustainable ways of land use” says Lou Verchot: “It’s the maize that keeps farmers in poverty: the people are not starving, but it’s a vicious cycle. The farmers make no money so they cannot invest in their land. The land degrades and productivity decreases, so they get poorer. We have to find more sustainable ways for subsistence farmers to make a living, and this is what our research is addressing.”

The Western Kenya Integrated Ecosystem Management Project, led by the Kenya Agricultural Research Institute (KARI) is looking at ways to rehabilitate large areas of degraded and abandoned land. Verchot and his team have combined field surveys and satellite imagery with advanced analytical techniques developed by two ICRAF scientists, Markus Walsh and Keith Shepherd to create maps of degraded land in the river basins of western Kenya. These maps are used to stratify the landscape into: intact, moderate, or highly degraded land in lowland, mid- or upland portions of each river basin and to help select research sites

The research team has identified nine large 100-

km² blocks of land, spread out across the landscape of western Kenya. In each block 20 focus areas each of 64 ha have been randomly selected. Activities will be carried out within each focus area. Overall the project will work with an estimated 8,000 – 12,000 households. Lessons learned from the research will be applied to other areas with severe soil erosion problems.

With an initial grant of US\$4.5 million from the Global Environment Facility (GEF) and the World Bank, the project will promote tree planting and more sustainable agricultural practices to regenerate the scarred landscape.

The sheer size and scale of the project are impressive and project leader Lou Verchot argues there is a good reason for this: “You solve large-scale problems with large-scale solutions. In the past we often focused on field-scale problems, found viable solutions for one specific location and then sought out

where these solutions could be applied elsewhere in the landscape. For example, we introduced a specific type of fertilizer tree and studied whether it would improve soil fertility, but this is not the solution for complex problems on a landscape level.

Take the example of the Nyando River basin where farming practices on the upper slopes impact farmers in lower areas. You cannot address this kind of problem with one simple solution. The project we are working on therefore starts at the landscape level, applying landscape diagnosis tools that ICRAF scientists have developed over the past 7 years.” After identifying the intervention areas the scientists will work with local farming communities to experiment with alternatives to unsustainable agriculture practices.

At the moment, most farmers grow a number of annual crops like maize, millet and

The Western Kenya Integrated Ecosystem Management Project

- Led by the Kenya Agricultural Research Institute (KARI)
- 8,000-12,000 representative households
- 180 focal areas, each of 64 ha
- Initial funding of US\$4.5 million from the Global Environment Facility (GEF) and the World Bank
- Unique impact assessment model measuring seven dimensions as diverse as biodiversity, policy and socioeconomic impact.



An aerial view of farms in western Kenya

beans. Severe soil erosion causes crops yields to be lower every year, and in severely eroded areas yields have declined by up to two-thirds. More sustainable forms of agriculture – including tree-based enterprises such as orchards and fodder plantations for livestock – are more promising in the long term. They can halt soil degradation, rehabilitate degraded areas, and thereby raise crop yields.

Trees will also contribute to reducing global warming through carbon sequestration. Trees absorb carbon as they grow and thereby reduce the amount of carbon dioxide (CO₂) in the atmosphere. One of the innovations of this project is that the scientists will explore the opportunities for farmers to sell carbon credits to countries that need to meet their national CO₂ reduction targets agreed to under the Kyoto Protocol of the Climate Change Convention.

Despite the promise of the tree-based production systems, Verchot does acknowledge that it will be difficult to change long-term farming practices overnight: “We will create demonstration sites where we will invite farmers to find out about the opportunities available. Experiences in the past have taught us that farmers understand the importance of trees and when you give them tree seedlings they will plant them. I am convinced that when we experiment directly with farmers we can jointly bring about the necessary changes. Through the diversification of regional agricultural production into fruits, fodder, timber and the selling of carbon credits we expect to see an increase in the income of farmers.”

Periodic drought is part of the natural situation in many parts of Africa, as the current situation in the region starkly reminds us, and tree-based

production systems may be less vulnerable to such climate extremes.

Trees have an important advantage in that that they improve not only soil fertility, but also soil structure and the waterholding capacity of soils. Improving overall soil quality will play an important role in maintaining the productivity of crops and fruits in dry years.

“That’s the value of this new approach,” emphasises Verchot enthusiastically. “We are restoring the ecosystem and increasing the income of subsistence farmers simultaneously. Farmers will be much better prepared for future droughts.” Although he also warns not to be over-optimistic, “The problem of degraded lands in western Kenya was created over decades, and is probably going to take decades to solve.”

Reaching a wider audience



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Major projects and key objectives

These projects and their objectives form the basis of the World Agroforestry Centre's Medium Term Plan 2005–2007. They provide a comprehensive overview of the global work of the Centre and the practical implementation of its four global cross-cutting Themes. ICRAF hosts the Alternatives to Slash and Burn (ASB) System-wide Programme, and the African Highlands Initiative (AHI) and their main projects are also included.

Theme – Land and People

Project 1 Improving rural livelihoods through integrated soil fertility management

- Develop an understanding of the nature of soil fertility problems at different scales
- Analyse impacts, synergies, and trade-offs of promising integrated soil fertility systems
- Facilitate dissemination and adoption of promising agroforestry systems to address soil fertility problems.

Project 2 Conserving soil and water for productive agricultural landscapes

- Identify the nature of the land degradation and soil erosion problem in a landscape context
- Analyse the impacts, synergies and trade-offs of agroforestry systems on conservation, water use and productivity
- Facilitate adoption of agroforestry-based soil and water conservation systems by farmers and to integrate these systems into watershed management strategies.

Project 3 Sustaining productive farming systems through improved agroforestry management

- Identify major problems and prioritise the opportunities for improve crop, livestock and integrated agricultural production or buffering capacity through management of agroforestry systems

- Understand trade-offs between productivity, resilience, and profits of integrated tree, crop and livestock systems under alternative agroforestry management practices
- Facilitate dissemination and adoption of agroforestry systems to improve crop and livestock systems.

Project 4 Reaching the poorest land users with land management interventions

- Identify the poor and other vulnerable smallholder farmers, their agroforestry needs, and their major constraints to benefiting from agroforestry
- Improve the participation of the poor and vulnerable in technology development and diffusion processes
- Promote policy and institutional change that will enhance incentives for improved land management by the poor
- Conduct monitoring and impact assessment that will inform the pro-poor research and development agenda.

Theme – Trees and Markets

Project 1 Market analysis and support to tree product enterprises

- Improve understanding of principles and practices of markets and enterprises, and to promote demand-based approaches

- Understand and publicise current and future demand, structure and performance of tree product markets and identify key policy bottlenecks
- Develop a portfolio of agroforestry tree product (AFTP) market-development projects that illustrate a range of different market levels and situations and to foster networks within key AFTP sectors for exchange of information and best practices
- Reveal and create enterprise models for marketing of new and existing tree products by small-scale farmers and entrepreneurs.

Project 2 Sustainable seed and seedling systems for sound conservation and use of genetic resources of agroforestry trees

- Better inform and mobilise actors to develop better seed systems
- Better inform and mobilise actors to develop better nursery production systems
- Facilitate actors in seed/seedling systems to provide tree germplasm with high utility to poor farmers
- Build up the knowledge base on tree species including germplasm forecasting, species characteristics and recommendation domains.

Project 3 Tree domestication with intensification and diversification of tree cultivation systems

- Rapidly and efficiently evaluate variation at species, provenance, family and clonal levels
- Undertake tree improvement research on priority fruit, medicine, timber, beverage, fodder, oil, fallow, fuelwood and live fence tree species
- Develop appropriate techniques for management and propagation of priority tree species.

Project 4 Farmer-led development and scaling-up of tree-based options

- Develop new practices with farmers and other partners, and assess their feasibility, profitability, and acceptability. Identify policy options and institutional innovations for improving household welfare
- Enable development partners to target, design, and implement successful agroforestry dissemination projects that are cost-efficient and effective
- Enhance the positive impact of agroforestry practices, minimise the negative effects, and understand their advantages and disadvantages relative to alternative practices.

Project 5 Enhanced utilisation of tree diversity at the landscape level

- Enhance the utilisation of tree species diversity at increasing scales within tropical agrarian landscapes
- Manage the intraspecific diversity of priority species by landscape-level participatory approaches
- Investigate the relationships between tree biodiversity and the stability and productivity of agricultural landscapes.

Theme – Environmental Services

Project 1 Pro-poor strategies to enhance watershed functions

- Identify and refine management principles for enhancing the contributions of agroforestry to watershed functions
- Develop and apply models to predict the effects of different landscape configurations on watershed function
- Improve incentives and cooperation between upstream and downstream communities to implement land use strategies that protect water supplies while enhancing other ecosystem services.

Project 2 Use and conservation of biological diversity in multi-functional landscapes

- Identify and refine management principles for enhancing the contributions of agroforestry to the conservation and enrichment of biodiversity in multi-functional landscapes
- Ensure agroforestry research and development contribute to goals of increasing biodiversity in priority agroecosystems
- Modify forestry and conservation policies to enhance the contribution of agroforestry to the conservation of biodiversity in working landscapes.

Project 3 Climate change mitigation and adaptation for rural development

- Identify and refine management principles for enhancing the contributions of agroforestry to buffering against climate variability
- Identify and refine management principles for reducing the contributions of agriculture to atmospheric greenhouse gas loading
- Support the design and implementation of environmental service projects aiming to promote the dual goals of rural development and carbon sequestration
- Enhance the ability of developing-country nationals to plan effectively for climate change and to engage effectively in international mechanisms for emission reduction.

Project 4 Harmonising policy for environmental stewardship and rural development

- Empower a critical mass of national and regional expertise in effective methods for multi-stakeholder assessment and negotiation support
- Empower vulnerable groups of indigenous

people who rely on agroforestry with more secure property rights

- Develop, test and disseminate policy and institutional options for agroforestry to enhance the livelihoods of smallholder farmers while meeting environmental objectives
- Empower governments in priority countries to enact changes in environmental governance that recognise the multi-functional nature of landscapes
- Contribute to the modification of international and regional conventions, agreements and action plans to better facilitate the contributions of smallholder farmers practicing agroforestry.

Theme – Strengthening Institutions

Project 1 Strengthening agricultural research institutions and systems

- Increase the number of agroforestry research projects at national institutions
- Support the development of national agroforestry research programmes.

Project 2 Strengthening the agroforestry capacity of development institutions and systems

- Ensure agroforestry knowledge products are effectively disseminated through training
- Accelerate the adoption and impact of agroforestry innovations by involving local and national institutions.

Project 3 Strengthening educational institutions and systems

- Mainstream inter-and multi-disciplinary land management approaches into tertiary education for improved productivity and conservation
- Prepare youth completing basic education with life skills by enhancing teaching methods and educational resources related to farming and agricultural enterprises.

Project 4 Fostering inter-institutional collaboration and knowledge management

- Foster collaboration and synergy among agroforestry and related institutions
- Improve the quality of service and access to agroforestry/integrated natural resource management (INRM) knowledge and products.

Alternatives to Slash and Burn (ASB) System-wide Programme

Purpose 1 Assist ASB partners to accelerate the participatory development, adaptation, and spread of technologies and land use practices that conserve biodiversity, store carbon, and maintain local environmental services, while providing attractive opportunities for poor rural households in the humid tropics to increase their income and food security.

Purpose 2 Support ASB partners' efforts to formulate and implement policy options and institutional innovations for integrated ecosystem management that encourage the adoption and sustainable management of land use alternatives in the humid tropics that reduce poverty while conserving biodiversity, carbon stocks, and other environmental services.

Purpose 3 Build sustainable operational capacity in NARS, IARCs, and other institutions for work on integrated natural resource management.

African Highlands Initiative (AHI) System-wide Programme

Purpose 1 Enable AHI partners to develop and use an integrated, participatory NRM approach to develop and adapt practical technologies and practices that improve

land use, increase returns to land and labour, arrest land and biodiversity degradation in the highlands and empower local communities to sustain these efforts.

Purpose 2 Provide support through AHI partners to local policy makers and stakeholder groups to analyse, formulate and implement improved institutional arrangements and policies that reverse land and biodiversity degradation and improve livelihoods.

Purpose 3 Strengthen the capacity of NARS, IARCs and other institutions to use integrated, participatory NRM approaches across the eco-region ensuring that efforts to improve livelihoods and land management are sustainable.



Investor support, 2003

	Unrestricted US\$ 000	Restricted US\$ 000	Total US\$ 000
Sweden	428	4,494	4,922
Canada-CIDA	1,424	1,954	3,378
European Union	–	3,199	3,199
The Netherlands	684	1,215	1,899
World Bank	1,211	550	1,761
United States of America-USAID	552	1,130	1,682
United Kingdom-DFID	–	1,046	1,046
Denmark	598	371	969
Rockefeller Foundation	–	907	907
International Fund for Agricultural Development	–	678	678
Ireland	665	–	665
Germany	257	375	632
Switzerland	364	217	581
Multidonor	–	516	516
Finland	416	11	427
Norway	277	140	417
Australia	135	264	399
Japan	230	114	344
Belgium	121	185	306
Ford Foundation	–	300	300
France	–	224	224
Spain	–	201	201
Italy	–	182	182
New Zealand	–	150	150
National Science Foundation	–	128	128
Food and Agriculture Organization of the United Nations	–	106	106
Indonesia Forest Seed Project	–	100	100
Global Environment Facility	–	95	95
Canada-IDRC	–	90	90
Peru	–	82	82
The Environmental Conservation Trust of Uganda	–	82	82
Assoc. for Strengthening Agricultural Research in East and Central Africa	–	80	80
Tinker Foundation	–	71	71
World Resources Institute	–	69	69
Kenya Agricultural Research Institute	–	60	60
Tropical Soil Biology and Fertility Programme	–	58	58
International Rice Research Institute	–	48	48
Centro Internacional de Agricultura Tropical, Colombia	–	47	47
World Fish Centre	–	46	46
Chemonics International	–	40	40
International Food Policy Research Institute	–	39	39
Farm and Agricultural Research Management (FARM) – Africa	–	36	36
Regional Land Management Unit	–	31	31
University of Wisconsin System	–	22	22
Cornell University	–	21	21
International Water Management Institute	–	21	21
Others (less than US\$ 20,000 each – see page opposite)	7	60	67
Total	7,369	19,928	27,297

Additional investors

Development Alternative Inc.
Sasakawa Foundation
Technical Centre for Agricultural and Rural Co-operation
Biodiversity Transect Monitoring Analysis in Africa
International Crops Research Institute for Semi-Arid Tropics
Foundation for Advances Studies in International Development
International Centre for Underutilized Crops-University of Southampton, UK
The Philippines
Silvoagable Agroforestry for Europe (SAFE)
The International Tropical Timber Organization
Centro Internacional de la Papa
Institut de recherche pour le développement–France
International Livestock Research Institute

Swiss Federal Institute of Technology
Uganda Forest Sector Co-ordination Secretariat
Technical Committee of the Global Water Partnership
Oxford Forestry Research Institute – UK
Centre for Development Research
Donner Foundation
Eastern and Central Africa Programme for Agricultural Policy Analysis
Indian Council for Agricultural Research
Brazil
Global Dimensions Trust
International Foundation for Sciences
Norwegian Agency for Development Cooperation
Third World Organization for Women in Science

Board statement on risk management

The Board of Trustees of the World Agroforestry Centre has responsibility for ensuring that an appropriate risk management process is in place to identify and manage major and significant risks to the achievement of the Centre's business objectives, and to ensure alignment with CGIAR principles and guidelines as adopted by all CGIAR centres. These risks include operational, financial and reputation risks that are inherent in the nature, *modus operandi* and locations of the Centre's activities. They are dynamic owing to the environment in which the Centre operates. There is potential for loss resulting from inadequate or failed internal processes or systems, human factors or external events. Risks include low impact science (and therefore irrelevance); misallocation of scientific efforts away from agreed priorities; loss of reputation for scientific excellence and integrity; business disruption and information system failure; liquidity problems; transaction processing failures; loss of assets, including information assets; failures to recruit, retain and effectively utilise qualified and experienced staff; failures in staff health and safety systems; and failures in the execution of legal, fiduciary and Centre responsibilities.

The Board has adopted a risk management policy – communicated to all staff – that includes a framework by which the Centre's management identifies, evaluates and prioritises risks and opportunities across the organisation; develops risk mitigation strategies which balance benefits with costs; monitors the implementation of these strategies; and periodically reports to the Board on results. This process will draw upon risk assessments and analysis prepared by staff of the Centre's business unit, internal auditors, Centre-commissioned external reviewers and the external auditors.

The risk assessments will also incorporate the results of collaborative risk assessments with other CGIAR Centres, System Office components, and other entities in relation to shared risks arising from jointly managed activities. The risk management framework seeks to draw upon best practices, as promoted in codes and standards promulgated in a number of CGIAR member countries. It is subject to ongoing review as part of the Centre's continuous improvement efforts.

Risk mitigation strategies include the implementation of systems of internal controls which, by their nature, are designed to manage rather than eliminate risk. The Centre endeavors to manage risk by ensuring that the appropriate infrastructure, controls, systems and people are in place throughout the organisation. Key practices employed in managing risks and opportunities include business environmental scans, clear policies and accountabilities, transaction approval frameworks, financial and management reporting, and the monitoring of metrics designed to highlight positive or negative performance of individuals and business processes across a broad range of key performance areas. The design and effectiveness of the risk management system and internal controls is subject to ongoing review by the Centre's internal audit service, which is independent of the business units, and which reports on the results of its audits directly to the Director General and to the Board through its Audit Committee.

The risk management framework is being implemented in 2004, as an integral part of the Centre's Strategy and Business Plan. The Board expects to be able to report on the implementation of this framework from 2005.



ICRAF professional staff details, June 2004

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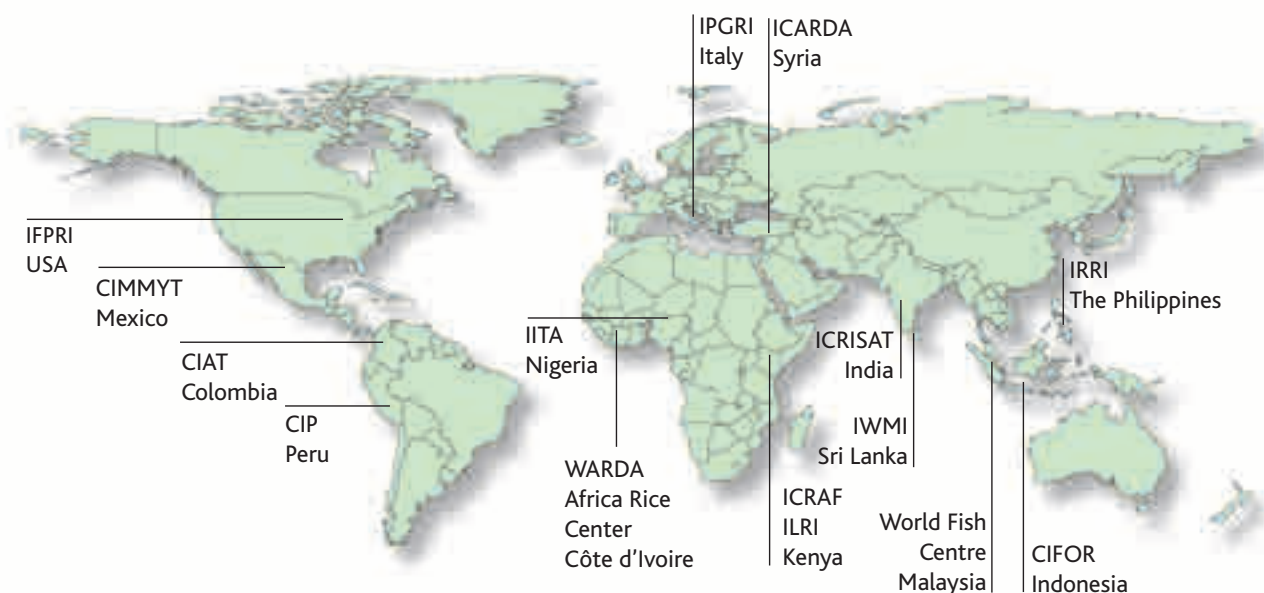
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International headquarters



The World Agroforestry Centre is one of 15 food and environmental research organisations known as the Future Harvest centres. The centres, located around the world, conduct research in partnership with farmers, scientists, and policy makers to help alleviate poverty and increase food security while protecting the natural resource base. The Future Harvest centres are principally funded through the 58 countries, private foundations, and regional and international organisations that make up the Consultative Group on International Agricultural Research (CGIAR).

In 1998 the centres supported by the CGIAR created Future Harvest as a charitable and educational organisation designed to advance the debate on how to feed the world's growing population without destroying the environment, and to catalyze action for a world with less poverty, a healthier human family, well-nourished children, and a better environment. Future Harvest reaches out to media, academics, scholars, and scientists in the world's premier peace, environment, health, population, and development research organisations, as well as to policymakers and civil society, and it enlists world-renowned leaders to speak on its behalf. Future Harvest raises awareness and support for research, promotes partnerships and sponsors on-the-ground projects that bring the results of research efforts to farmers' fields in Africa, Asia, and Latin America.

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CIFOR – Center for International Forestry Research

CIMMYT – Centro Internacional de Mejoramiento de Maíz y Trigo

CIP – Centro Internacional de la Papa

ICARDA – International Center for Agricultural Research in the Dry Areas

ICRISAT – International Crops Research Institute for the Semi-Arid Tropics

IFPRI – International Food Policy Research Institute

IITA – International Institute of Tropical Agriculture

ILRI – International Livestock Research Institute

IPGRI – International Plant Genetic Resources Institute

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