

- Nomadic herders will be close partners in the development process; agreements between them and farmers will be reached to ensure buy-in from all land users.
- A range of distinct ethnic groups will be deliberately included.
- Women will have major roles to address the gender equity gap.
- Testing will span a range of ecological conditions across the Sahel.

Execution and management

The phase I project will be executed by the ICRISAT-Niamey team in Niger that developed these tree-crop-livestock systems, in a participatory, partnership mode as described earlier. ICRISAT scientists have acquired deep understanding of the Sahel environment and socio-economic situation over the 20-year history of this station's existence.

Technical assistance for this phase I project will be provided by the University of California at Davis. These universities bring expertise in dry zone crop management and fruit-tree management, respectively.

More information about these partners is in Appendix 1.

Duration and budget

Phase I will take three years with an option for no-extra-cost extension for an additional year (to guard against possible disruption from unexpectedly severe drought). The required phase I project budget is US\$3.5 million.

Conclusion

For Africa to escape its ongoing tragedy of poverty and land degradation, new farming systems that rebuild the soil while increasing incomes are essential. Tree-crop-livestock systems hold the key. Most work on this topic has been focused on the humid forest belt, but our research has found that these systems hold great potential for the drylands too—the special focus of this proposal. Our approach is holistic, combining the sustainability principles of integrated tree-crop-livestock management with the economic principles of market-driven development.

Our approach squarely addresses the NEPAD Pillars as articulated in the Comprehensive Africa Agriculture Development Programme (CAADP), which emphasizes sustainable land management, trade-related capacity for market access, increasing food supplies, and agricultural research and technology dissemination. It also addresses the global commitments of the Millennium Development Goals to eradicate extreme poverty and hunger, empower women, ensure environmental sustainability and develop global partnerships for development.

We believe this project can lead to major change to reduce hunger and poverty in the Sahel, one of the poorest and longest-suffering areas of Africa.

Appendix 1. About the Partners, and Related Proposals

(The International Crops Research Institute for the Semi-Arid Tropics) ICRISAT is one of 15 international agricultural research centers across the developing world supported by the Consultative Group on International Agricultural Research (CGIAR). ICRISAT's Niamey station in Niger is strategically situated in the heart of the Sahel. With additional support from the Government of Finland, the Israeli Center for International Cooperation (MASHAV), USAID's Africa Bureau, and USAID/WARP, ICRISAT-Niamey developed the three tree-crop-livestock systems discussed here, along with a range of supporting services such as tree nurseries, mother nurseries, seed multiplication, and training facilities. ICRISAT-Niamey will play a central role in the phase I project, especially in the areas of research, tree and seed multiplication, and training.

While ICRISAT's expertise is integrating the technologies and components of the tree-crop-livestock system, ICRAF, ILRI, and AVRDC will contribute in their areas of expertise. Other partners will include the NARS and CORAF, as well as NGOs active in the region.

The University of California at Davis is a leader in fruit tree management in the USA, and has deep international experience. Its expertise and knowledge base will be valuable in strategic planning, problem diagnosis, and training.

TCC Group, formerly known as the Conservation Company is a US-based firm which assists nonprofit organizations in developing customized strategies involving corporate social responsibility and engaging communities, especially involving partnerships among corporations, private foundations and the public sector. It also assists in the development of a corporate alliance to involve US companies in the project, and in training local agribusinesses and helping them develop partnerships to provide market outlets for the produce generated from the new tree-crop-livestock systems.

This proposal links to another that ICRISAT and partners have submitted to USAID-GDA to formally develop marketing mechanisms and build private sector collaboration to expand exports of agricultural products from the Sahel. This project would contribute to the GDA-supported Sustainable Tree Crop Program and its Corporate Alliance.

Also, as a result of close collaboration of ICRISAT with the Corporate Council on Africa's WAIBL program, marketing efforts are underway as a followup to a highly successful Agriculture Workshop held at ICRISAT-Niamey in early February of this year.

ICRISAT's commitment to the tree-crop-livestock system approach is further evidenced by our submission of a Sahelian Eco-farm proposal to the NEPAD-G8 mechanism. That proposal focuses largely on building broad partnerships with national and regional NARS and networks, and capacity-building. If successful, that proposal would strongly complement the dissemination effort proposed herein.



Transforming Agriculture in the Sahel Through Tree-Crop-Livestock Systems

Helping Fulfill the NEPAD and Millennium Development Goals in Dry Africa

A Concept Note

Draft for discussion – 22 April 2005

International Crops Research Institute for the Semi-Arid Tropics¹



dissemination. It also fits directly within the UN Millennium Development Goals to eradicate extreme poverty and hunger, empower women, ensure environmental sustainability and develop global partnerships for development.

The first phase described here will require three years and a budget of US\$3.5 million.

Introduction

The Sahel stretches more than 6,000 km across the breadth of Africa along the southern edge of the Sahara desert, and about 600 km from north to south. The traditional cropping system in this zone is based on two coarse grains, millet and sorghum, often intercropped with cowpeas. Cash crops such as groundnuts, cotton and sesame are widely grown on the southern (wetter) end of this zone. Ruminants are important to traditional livelihoods, raised on rangelands and on crop residues.

These Sahelian agro-pastoral systems are low in productivity due to limited rainfall, inherently poor soils and severe human-induced land degradation. Reliance on mono-cropping of low-value crops combined with low yields, crop failures due to droughts and pests, and a high population growth rate are perpetuating poverty and land degradation. About 80% of the population (some 200 million people) derives its income from agriculture and related activities.

ICRISAT research at its station near Niamey, Niger has identified many of the physical causes of land degradation, and promising solutions.

In this concept note we propose a phase I study to lay the foundation for disseminating tree-crop-livestock production and land-rehabilitation systems across the Sahel.

Integrated tree-crop-livestock production systems

The three systems are: the Sahelian Eco-Farm, the Dryland Fruit Tree system, and the Bioreclamation of Degraded Lands system.

Brief descriptions and pictures of these three systems follow.

1. The Sahelian Eco-Farm

The Sahelian Eco-Farm is based on one or two tree species interspersed with two to three annual crops grown in rotation. This tree-crop combination reduces water and wind erosion; increases soil fertility (which in turn leads to higher responsiveness from modern crop varieties); provides food,

Executive Summary

Current dryland production systems of the Sahel are unsustainable, causing land degradation and poverty. The ICRISAT-Niamey research station in Niger has developed three promising tree-crop-livestock land management systems for the Sahel: the Sahelian Eco-Farm (SEF), the Dryland Fruit Tree (DFT) system, and the Bioreclamation of Degraded Lands (BDL) system. These tree-crop-livestock systems deliver markedly higher farm incomes while increasing food production, enhancing food security, increasing labor opportunities, improving soil fertility, and generating important additional products such as fuelwood and fodder.

This document proposes a three-year first phase of a project to establish the methods and infrastructure for a participatory and speedy mass dissemination of these three systems, through the support of USAID's food-for-work program or other appropriate mechanism. The mass dissemination program will plant hundreds of thousands of hectares with these new tree-crop-livestock systems over a 15-year period.

Food-for-work has had major impact in reforestation efforts, and this concept note proposes an innovative credit dimension that rewards farmers for long-term care of tree-crop-livestock systems. The project will be executed by ICRISAT-Niamey with technical support from UC Davis, and with administration of the funding and credit mechanisms by partners to be determined in the course of this study.

The outputs of the work proposed herein squarely address the NEPAD Pillars as articulated in the Comprehensive Africa Agriculture Development Programme (CAADP), which emphasizes sustainable land management, trade-related capacity for market access, increasing food supplies, and agricultural research and technology

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Sahelian Eco-Farm. Annual crops such as millet are interspersed between rows of nitrogen-fixing 'fertilizer trees'. Tree rows are perpendicular to the slope of the field so that runoff collects in earth bands and is funneled to high-value fruit trees (see photos in next section).

fodder and fuelwood; generates considerably higher revenues and profits; diversifies production options to hedge against transient droughts; and absorbs more labor, more evenly spread over the yearly calendar.

A working model has been in field trials for three years now. Research at ICRISAT-Niamey continues to identify more tree and crop species best suited to this eco-zone and land management system. High-value products are sought that can raise farmers' incomes substantially to reduce poverty and reward the better land care that the system provides.

Trees showing promise so far include *Acacia tumida*, a so-called 'fertilizer tree' producing mulch, root biomass, atmospherically-fixed nitrogen, firewood, and protein-rich seeds for poultry feed. Pomme du Sahel—the domesticated *Ziziphus mauritiana* tree—provides tasty and nourishing fruit that can be dried and sold; it also produces forage and firewood (more about this tree in the next section). Additional fruit trees under investigation are sweet tamarind, *Saba senegalensis* and pomegranates. Annual crops such as millet (shown below), sorghum, dual-purpose cowpeas, roselle, groundnuts, sesame, corn, various pulses, and more are grown between the trees.

2. The Dryland Fruit Tree System

The DFT a variation of the SEF based on rainfed fruit trees (instead of or complemented by fertilizer trees) integrated with high-value annual crops. Trees are planted widely apart (determined by soil properties and average annual rainfall) inside micro-catchments that are joined by earth bands. A live hedge of *A. tumida* trees (excellent for soil nitrogen, mulch and seeds for chicken feed) and a dry fence surrounds the field. Potential annual crops are dual-purpose cowpeas, dryland watermelons, calabash, groundnuts, sesame and more. Pomme du Sahel is currently the main fruit tree, but other fruit trees such as sweet tamarind, pomegranates and *Saba senegalensis* can also be added



Dryland Fruit Tree system (above) and closeup of a three-year old Pomme du Sahel tree (left). Notice the water-harvesting soil bands, cowpea intercropping, and fertility-increasing litter mulching at the base of the trees.

3. Bioreclamation of Degraded Lands System

Gum arabic is an especially drought-tolerant, hardy tree that can grow on extremely poor soils—rehabilitating them in the process, while yielding a commercially valuable product. Current research at ICRISAT-Niamey is identifying high gum-yielding *Acacia senegal* trees and methods for vegetatively-propagating the best trees. The selected varieties will be planted in commercial systems to be established on degraded lands.



*Certain high-yielding gum arabic trees (*Acacia senegal*) can yield 4-5 times more than normal trees; research can find out whether this characteristic is inherent and can be transferred through grafting. Inset: closeup of gum globule.*

Extra-hardy annuals such as local leafy vegetables, medicinal plants and forage plants are planted between the gum arabic trees to provide quick income until *Acacia senegal* and other trees are old enough to yield economic products.

Goal

Combat poverty and dryland degradation in the Sahel through the mass introduction of sustainable, remunerative, integrated tree-crop-livestock systems.

Phase I objectives

Phase I will be carried out in two countries-Burkina Faso and Niger.

1. Develop partnerships, mechanisms and modalities for mass dissemination of three tree-crop-livestock systems to pave the way for mass dissemination of these systems
2. Develop the physical infrastructure (nurseries, seed multiplication systems, training materials etc) needed for the up-scaling of these systems
3. Train and prepare a core cadre of field operators in participatory methods and management of dissemination, seed multiplication and farmer training.
4. Establish demonstration plots of the three tree-crop-livestock systems in diverse locations within the Sahel
5. Conduct research to optimize these systems and to solve problems encountered in farmers' fields
6. Develop market outlets for the products of the new systems
7. Develop a master plan for the large-scale dissemination of these systems in preparation for the follow-up project

Phase I activities

1. Partnership-building

One financing option to consider, among others, is an innovative application of USAID's Food-for-Peace program (described in more depth later). With assistance from the TCC Group, we will explore public/private/NGO partnership models to identify the optimal approaches and mechanisms.

Partnerships will also be built with national research programs of the two countries, and with NGOs and farmers' groups (also elaborated later).

2. Tree and seed multiplication facilities

The phase II program (subsequent to this phase I) will require the annual production of millions of tree seedlings. The fruit trees and most likely also the gum arabic trees will need to be grafted. To set the stage for this, mother nurseries will be established in different locations to supply seeds, cuttings and scions and to train personnel.

Phase I will also introduce new high-yielding, high-quality varieties of annual field crops. These will be propagated together with traditional leafy vegetables and medicinal plants as well as native forage species. Seeds of these leafy vegetables, medicinal plants, and native forage species will be produced in a central seed multiplication facility for each of the two countries.

Initially the nurseries and seed multiplication facilities will be owned and operated by the phase I project on a non-profit, break-even basis. As the implementation phase progresses they will be transferred to private sector entities after carefully assessing their capabilities. They will be mostly run by women. They will be trained in nursery methods with emphasis on grafting.

3. Training

The new production systems will require training and technical backup for farmers. The first step is to train the trainers. Phase I project technicians will be trained on a range of subjects such as agronomy, silviculture, fruiticulture, soil and water management, economics, and participatory development. These phase I technical staff will subsequently train farmers. Training materials (mostly illustrated) will be created for all agricultural (including nursery) activities. The use of rural radio for extension and marketing will also be explored.

4. Establishment of demonstration plots

Demonstration plots of the three systems will be established at the beginning of the phase I project in selected study areas. These plots will be planted in fields of innovative and leading farmers who serve as role models for the general farming population. The demonstration plots will help farmers visualize and gain understanding and comfort with these novel systems, and learn how they are established and managed.

5. Research

All three tree-crop-livestock systems were devised and refined through research. Research will continue to be critical to further adapt and improve these systems, including benefiting from farmer feedback and experimentation. Research will also address any socio-economic problems that arise.

6. Marketing

The sale of large volumes of high-value food products produced through tree-crop-livestock systems will require special marketing arrangements. Some of the products such as fruit will require processing for conservation or for transformation.

A regional and international market survey for these products will be carried out and both exporters and importers of the various products will be identified. The potential regional and international market volume will be

assessed for each product. The economics of these systems, especially their impact on poverty alleviation will be assessed and models developed.

7. Development of a Master Plan for dissemination

All the studies carried out through activities 1-6 will provide the information needed for the production of a Master Plan for large-scale dissemination of these systems. The Master Plan will be developed in consultation with government and regional agencies. Modalities for the dissemination program will be elaborated, target areas and populations will be identified, management mechanisms will be defined and an infrastructure will be put in place for the up-scaling of the project.

A unique 'food-for-work' approach

We propose a new approach to 'food-for-work', as one financing option for this phase I project. Traditionally, food has been paid through this program on a daily basis for work performed. This approach was successful in a wide range of public works initiatives such as well-digging, construction of public buildings, the construction of terraces on farmland, and the planting of forestry trees. Additionally, some of the grains/commodities were sold in internal markets by the implementing organizations to fund their operations.

The use of food as a means of direct payment for land reclamation and agricultural tree planting does not always succeed, though. This is because some of these systems, especially those involving orchard trees and other cultivated species, require continued skilled maintenance for years following planting. Since the workers do not acquire a long-term stake in the outputs of these programs if they are only paid for each day's work, the trees are often not maintained after the project ends. Neglected young trees are soon destroyed by animals or harvested for fuel wood by the poor.

Successful 'food-for-work' projects have provided longer-term incentives. For example, a REST project in Tigray, Ethiopia in which ICRISAT/IPALAC participated, ensured that farmers had rights to the timber from trees they cared for, and the grass and grazing areas between trees. That project has rehabilitated more than 50,000 hectares of degraded hillsides in 10 years, planting more than 1 million trees per year.

In the present project, we propose to use the grain as a source of credit for loans to farmers. Farmers will start reimbursing the loans four to five years after planting the tree-crop systems, ie, at the time when those systems begin yielding profits. Since the future profits provide the means to pay back the loans, they will have an incentive to continue to care for the trees within tree-crop-livestock systems that also provide a range of other food, fodder and income needs. The authorities may even choose to forgive a significant portion of the loan to farmers who kept and tended their systems. This could be an additional, powerful incentive.

Principles and modalities of land-user participation

The phase I project will be based on new modalities of participatory development, customized for each of the tree-crop-livestock systems.

- Village and inter-village committees will be established to monitor and authorize the credit/support transactions involved.