



# Integrated farming enhances rainwater and soil productivity

Broad stretches of the rain-starved Volta Basin in West Africa could reap the benefits of an innovative land-use system that is already helping farmers in semi-desert areas of Niger to sustain healthy soil and healthy crops.

■ Research Highlight #4



CGIAR Challenge Program on  
**WATER & FOOD**



Broad stretches of the rain-starved Volta Basin in West Africa could reap the benefits of an innovative land-use system that is already helping farmers in semi-desert areas of Niger to sustain healthy soil and healthy crops – and even to diversify into higher value produce.

Named the Sahelian Eco-Farm (SEF), the system was developed by scientists and farmers at the Sahelian Center of the International Crops

Research Institute for the Semi-Arid Tropics (ICRISAT), in Niger. It has been shown to significantly improve the efficiency with which rainwater and soil nutrients are used by crops and retained in the soil, even in periods of extreme water scarcity.



*The degraded soil of Ziga, Burkina Faso*



## ■ The Sahelian Eco Farm concept

A typical SEF comprises a blend of traditional and introduced components selected to work in harmony. An important multi-purpose component is *Acacia cole*, an Australian species of leguminous tree whose roots fix atmospheric nitrogen and whose leaves remain green during the dry period. Hedges of this species are planted to enrich the soil and improve its fertility, and also to act as wind-breaks. Branches pruned from the hedges serve as firewood and mulch, its seeds as poultry feed.

Earth bunds are built in a half-moon shape to create micro-catchments, collecting run-off water and protecting the soil against erosion. High-value trees such as the domesticated Indian variety of *Ziziphus mauritiana* (or 'Pomme

du Sahel') are planted inside these 'demi-lunes'. This variety produces fruits ten times bigger than those of the indigenous tree. Its leaves can be used for forage and mulch and the pruned branches for firewood.

A perennial grass such as *Andropogon gayanus* is planted on the earth bunds to strengthen them. Annual crops such as millet and cowpea are each planted in half or a third of the field in rotation each year.

The results are impressive: increased water use efficiency and soil fertility, drought mitigation, reduced soil erosion, more and better animal feed during the dry season, higher incomes and more diverse sources of income, spreading risk.



Cowpea and sorghum crops after two years on the Navrongo SEF site, Ghana.

Photo: ICRISAT.

## ■ Development and adaptation

The SEF has now been selected for further development and adaptation as part of the CGIAR Challenge Program for Water and Food (CPWF) project, "Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin."

The SEF has now been selected for further development and adaptation between soil, water, crop and nutrient management. In partnership with farmers, it is using the knowledge gained from these studies to develop 'integrated technology options' – solutions that use a systems perspective for improving water and nutrient use efficiencies while increasing crop productivity. It will also adapt the solutions as necessary for use in different locations.

Development and adaptation

The SEF has now been selected for further development and adaptation as part of the CGIAR Challenge Program for Water and Food (CPWF) project, "Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin."

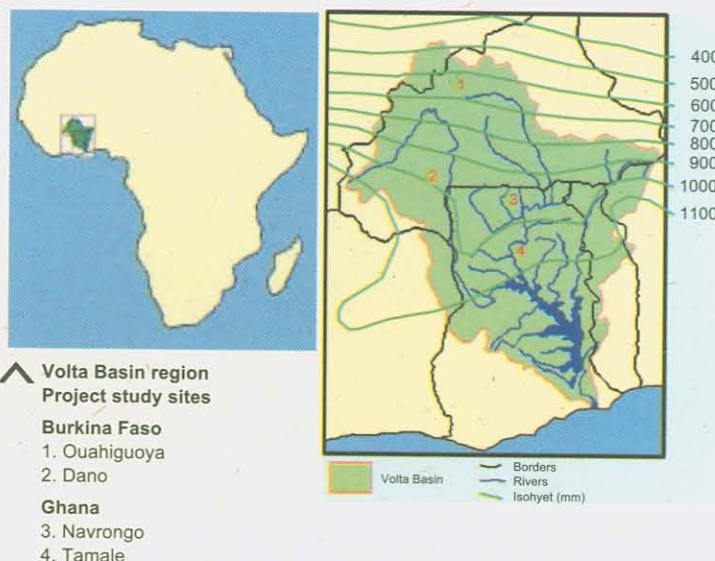
The SEF has now been selected for further development and adaptation between soil, water, crop and nutrient management. In partnership with farmers, it is using the knowledge gained from these studies to develop 'integrated technology options' – solutions that use a systems perspective for improving water and nutrient use efficiencies while increasing crop productivity. It will also adapt the solutions as necessary for use in different locations.

The idea is to simultaneously address the main problems faced by farmers across the Sahelian region – declining soil fertility, dry-season feed shortages and insufficient and poorly distributed rainfall – and ultimately, to reduce poverty by improving their food security and incomes.

The SEF was a clear choice for further development in this context. It has as its basis an integrated approach to land management in which an entire farming system is designed with a view to making best use of the properties of local rainfall, soil and geography, together with those of selected crops and other plants. Its design is successful because it also takes into account – and optimizes – the interactions between these elements. See box.

Since the project was started in 2004, CPWF work on the SEF concept has focused on gaining greater understanding of how it works and adapting it for use elsewhere. So far a total of 35 new SEF trials have been established in countries outside Niger: 33 in Northern Ghana, divided between the districts of Navrongo and Tamale, and two more in Burkina Faso.

As yet, only preliminary results are available from the pilots, but for the adaptations under trial, farmers are exploring the use of common cereal crops such as millet, sorghum and maize as the base crop, to establish their suitability in various agro-ecological zones.







◀ Comparison of sorghum crops with and without the Zai method.

## ■ Integrated production system

The project team is also investigating the potential for a number of other high value tree crops for inclusion in the system (in addition to *Ziziphus mauritania* and *Acacia coleii*, described in box). Analysis of the data is not yet complete, but the responses of participating farmers in Ghana and Burkina Faso to the SEF suggest that they are delighted at the prospect of a diversified and integrated production system that addresses most of their problems.

While the SEF is in many ways a self-contained concept, it has great potential for integration with other promising technologies, such as conservation tillage, conservation agriculture, micro-dose fertilization (involving the application of small quantities of fertilizers at the plantbase) and the 'Zai' method of planting in water-retaining pockets. Trials of these techniques are also under way across more than 30 sites in the Volta Basin.



CGIAR Challenge Program on  
**WATER & FOOD**

### Challenge Program on Water and Food Secretariat

P.O.Box 2075, Colombo, Sri Lanka  
Tel: +94-11-2787404, 2784080 Fax: +94-11-2786854  
Email: [cpsecretariat@waterforfood.org](mailto:cpsecretariat@waterforfood.org)  
Web: [www.waterandfood.org](http://www.waterandfood.org)

## Contacts

**Project leader:** Dr Ramadjita Tabo  
Deputy Director and Regional Coordinator  
Desert Margins Program  
ICRISAT, BP 12404 Niamey, Niger  
Tel: +227-722626/722529/Fax: +227-734329  
Email: [r.tabo@cgiar.org](mailto:r.tabo@cgiar.org)

Further research will identify market opportunities that can provide incentives for the adoption of the technologies. Modelling and Geographical Information Systems (GIS) applications will be used to target technologies and assess their impact. The successful pilots will be scaled up and out across the region.

## ■ Project information

Project title: Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin

## ■ Partner organizations

- The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) (coordinating institution)
- Savanna Agricultural Research Institute (SARI), Ghana
- Centre National de la Recherche Scientifique et Technologique (CNRST), Burkina Faso
- Centro Internacional de Agricultura Tropical (CIAT)
- Tropical Soil Biology Fertility Institute of CIAT (TSBF-CIAT)
- The United Nations University-Institute for Natural Resources in Africa (UNU-INRA)
- The Semi-Arid Food Grain Research and development (SAFGRAD)
- The Center for Development Research (ZEF)