The Prunus Tribune

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A quarterly publication of the Eastern and Central Africa Region of the World Agroforestry Centre

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improving the traditional Malian parklands systems

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# Taking stock and charting the way forward

Focus on the drylands of eastern and central Africa

SPECIAL ISSUE

## IN THIS ISSUE





## Understanding the challenges facing eastern and central Africa's drylands

Welcome to the third edition of your informative magazine, The Prunus Tribune. This special edition has a particular focus on the drylands of eastern and central Africa (ECA). The articles covered in this issue are the outcome of presentations and deliberations of a drylands workshop convened in September 2004 at The World Agroforestry Centre (ICRAF). Many of the presentations made during the workshop underscored that; interventions in the drylands need a more holistic approach that combines many facets of development. This includes but not limited to agroforestry, livestock improvement, soil and water conservation and management among others.

It is our hope that the outcome of the workshop will provide a more comprehensive understanding of the magnitude of challenges facing the region's drylands. These lands hold a lot of potential for the region as they are home to large human and animal population as well as diverse natural resources.

In this issue, we highlight articles on dryland agroforestry management strategies that include how tree/crop interactions change as the tree matures. There is also a captivating article on cattle management amidst the challenges prevailing in the drylands. On the section of ICRAF-ECA's work in drylands, there is an article on the Centre's experiences in Machakos while pioneering the practice of integrating trees into croplands. As a key highlight, this issue incorporates an article on rainwater harvesting for drylands agroforestry. These are just but some of the captivating articles in this edition.

*– Editor*



## Potential of agroforestry in addressing challenges facing the drylands of the ECA region

It is my pleasure to welcome you all to the third edition of our flagship publication, The Prunus Tribune. This is a special edition, which is dedicated to issues relating to the drylands of eastern and central Africa. Our drylands have not received much attention in terms of research and development relative to the better-watered highlands. In light of increasing poverty in these lands, there is urgent need to focus more on ways of stemming the tide of droughts and famines.

ICRAF recently organized a drylands workshop, which brought together partner organizations and individuals working on natural resource management in the drylands of Sub-Saharan Africa. The main thrust of this important meeting was to chart a niche for agroforestry in the dryland development programs of countries in the region. The meeting was also called upon to develop a framework and plan of action for ICRAF's collaborative programme in the ECA region. This is timely given the renewed focus on the drylands by governments and their development partners in addressing poverty and degradation of natural resources in the drylands and the is widespread recognition of the role of agroforestry in meeting these needs.

During the workshop that was attended by 80 participants, stakeholders shared experiences on emerging issues in agroforestry research and development, reviewed case studies for scaling up options, assessed main lessons that have been learnt, and initiated the development of country and regional strategies that will advance the impacts of agroforestry in the region's drylands. Remarkable progress was in this endeavor.

It is my hope that this special edition of The Prunus Tribune will provide you with useful insights on the potential of agroforestry to address the enormous challenges facing the drylands of the ECA region. We would be glad to receive your feedback on the magazine.

Dr Bashir Jama
Regional Coordinator
ICRAF-ECA Programme

# Agroforestry holds opportunity for drylands - says Ugandan Minister

BY ABDALLAH KASSIM

The Ugandan government has put in place policies and institutions to support agroforestry as one of the options for improving farm productivity

Uganda Government has identified agroforestry as one of the solutions to its dryland's problems. The Minister of State for Animal Industry, Hon. Mary Mugyenyi made the declaration in Nairobi while delivering a speech at the drylands workshop organized by ICRAF in September 2004 whose theme was "The Science and Practice of Agroforestry in the Arid and Semiarid Lands of Eastern and Central Africa: Charting the Way Forward." The Minister said that her government has put in place policies and institutions to support agroforestry as one of the options for improving farm productivity. This is expected to reduce poverty through increased family incomes and bring solutions to the numerous environmental problems.

Hon. Mugyenyi reiterated her government's commitment in addressing the drylands problems by signing the United Nations Convention to Combat Desertification (UNCCD) in 1994 whose goal is to mitigate the effects of drought. Uganda has also formulated a National Action Programme (NAP) to combat desertification with the aim of mainstreaming dryland issues into Uganda's Poverty Eradication Action Plan (PEAP). This will be done by ensuring that strategic planning takes into account sustainable development issues with focus on poverty alleviation, food security and sustainable management of natural resources.

The Uganda Government believes that fruit trees have a potential in the drylands. This was well noted in the Minister's remarks when she said that there was need to encourage establishment and management of fruit trees by setting up tree nurseries, establishing woodlots and orchards in the districts' schools. For this to happen we need to strongly collaborate with ICRAF. On this, ICRAF provided 5000 scions of improved mango varieties in early 2004. This has been used to improve local varieties and establish multiplication and training orchards in Uganda. The Minister also stated that agroforestry should address the livestock sector

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*Photo: Abdallah Kassim*

*Participants who attended the regional dryland workshop at ICRAF*

## Agroforestry holds opportunity for drylands

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Photo: Abdallah Kassim

*Dr Bashir Jama (right) chats with Hon. Mary Mugyenyi (left), Minister for livestock-Uganda*

and soil and water conservation in the drylands as these have a big potential in improving farmers' livelihoods.

"I have discussed this matter with my colleague, the Minister of Water, Lands and Environment and we would like ICRAF to share with us skills of land mapping, determining the production potential of soil and new affordable water harvesting technology. A formal request will be coming soon," said the Minister.

The Minister acknowledged ICRAF-ECA for organizing the workshop, which she said was important for Uganda as a country whose agriculture is based largely on natural resources, including the drylands for its livestock production. ■

For more information on ICRAF Uganda's Programme, contact: Dr. Willy Kakuru at w.kakuru@cgiar.org

# Plant indigenous trees in Kenya's degraded lands — KEFRI Director

BY ABDALLAH KASSIM

While addressing the delegates at the regional workshop on dryland agroforestry in eastern and central Africa, Dr Paul Konuche, the KEFRI Director, said there is need to intensify tree planting in degraded areas using indigenous species, which are well adapted to the prevailing conditions in those localities. An example is *Melia volkensii,* an indigenous tree that provides high quality timber and fodder in eastern Kenya. He called for the promotion of sustainable forest management in areas with woodlands and bush-lands. He urged the countries in the region to collaborate closely in tackling the environmental problems facing their drylands. One such problem is the invasive weed, *Prosopsis juliflora* that now covers large areas of the drylands of Kenya, Ethiopia and Sudan.

Dr Konuche noted that although Kenya has a low forest cover (about 1.7 % of the total land area) the area under woodlands, bush-lands and wooded grasslands (which are mainly found in arid and semiarid areas), comprise slightly over 60 percent of the total country land area. The dryland woody vegetation is rich in biodiversity and support tourism, which is one of Kenya's top three leading foreign exchange earners. Forests and woodlands in drylands also provide forage for livestock, especially during the dry season. They also supply construction materials and marketable commodities such as charcoal and fuel wood, gums and resins, aloe products, medicines, frankincense and honey. With the exception of charcoal and fuelwood, the rest of the resources are all underutilized.

The Director appealed for the diversification of income generating activities through the development and commercialization of non-timber forest products in the region, which he said would go a long way in addressing poverty and unemployment in the drylands. An immediate opportunity is the gums and resins and we could learn a lot from Sudan which dominates in the trade with a 60% share of the world market. At the same time, he urged the regional research organizations, government agencies and their institutions to strengthen their technology development and extension services, which he said would enable the public access such innovations easily.

He urged scientists working in agroforestry and agriculture to create stronger linkages among research and extension institutions and other relevant sectors in drylands such as forest, agriculture, livestock and water sectors.

The Director appreciated the agroforestry research and developement partnership between ICRAFand KEFRI spanning over twenty years. Some of the projects jointly implemented include the Dryland Agroforestry Research Project (DARP) in Machakos District, and the regional Agroforestry Research Networks for Africa (AFRENA). He looks foward for a renewed regional initiative on dryland agroforestry. ■

DRYLAND AGROFORESTRY MANAGEMENT SYSTEMS

# The Mt. Kenya region experience

BY CATHERINE W MUTHURI

Phenomenal population increase in Kenya has resulted in the increasing shortage of arable land for agriculture, especially in Mt Kenya region. Deforestation for agriculture and related land uses, and the high human in-migration from high potential areas to marginal lands has put a heavy burden on the available arable land.

There is a need to address the land management systems in the Mount Kenya region and agroforestry has been identified as one of the available options to save the already worsening situation. For instance, *Grevillea robusta,* a tree introduced by migrant small-scale farmers and which is widely grown in Naro-Moru, has increased the tree cover, supply of fuel wood, provided protection against strong winds and increased water infiltration to the soil in the area. However, this has led to competition for water between trees and crops resulting in reduction in crop yields in the area.

To address this concern two deciduous trees species, *Alnus acuminata* and *Paulownia fortunei,* considered less competitive with crops compared to G. robusta, were investigated. This was aimed at reducing the demand for the already limited water supplies. The effect of each tree species on the growth and yield of maize was evaluated and the impact of the different tree leafing phenologies on soil water balance identified.

On leafing phenology, Paulownia commenced leaf fall in May and was leafless between June and early September. Alnus shed some of its leaves in the dry season between August and October. Grevillea did not shed any leaves. During the 2001-2002 short rains, the average maize yields ranged from 1.3 to 1.5 tonnes per ha. Intercropped with Alnus, Grevillea and Paulownia, yields declined by 15.4%, 15.6% and 1.02% respectively, indicating that Paulownia was the least competitive of the three.

Five-year simulated water balance studies as a percentage of the total rainfall in agroforestry systems with Alnus, Paulownia and Grevillea were carried out. The simulations indicate that a substantial proportion of water balance was attributable to water uptake by the crop and tree, soil evaporation and drainage compared to interception losses and runoff. The study indicates too that altering leaf phenology from evergreen through semi-deciduous, generally decreased water uptake and interception losses for all the three species, while water uptake, drainage, evaporation and runoff were increased.

The study concludes that A. acuminata and P. fortunei are suitable for the semi-arid areas and so can provide possible alternatives to Grevillea. In addition, P. fortunei was least competitive with maize in the region. The lower water use by P. fortunei should also increase stream flow compared to G. robusta. Modelling studies using the WaNuLCAS (Water, Nutrient and Light Capture in Agroforestry Systems) model, suggested that leafing phenology may be one of the most important tree attributes.

The suggested way forward is that long-term studies are required to determine how the tree/crop interactions change as the trees mature. In addition, plot studies should be extended to look at the whole watershed. Comparisons of the trees under study with other popular fast growing trees like Eucalyptus/indigenous species should also be investigated. In addition, agroforestry systems using vegetable crops popularly grown in the study sites should be assessed. Finally, the database for the WaNuLCAS model, which was used for this study, needs to be improved. ■

Photo: Chin Ong

*Leafless paulownia*

Photo: Chin Ong

*Green-leaf paulownia*

The writer is the chairlady of Botany Department at the Jomo Kenyatta University of Agriculture and Technology, Thika.

DRYLAND AGROFORESTRY MANAGEMENT SYSTEMS

# The ARIDSAK Experience

BY JACKSON MULATYA

The Agroforestry for Integrated Development in Semiarid Areas of Kenya (ARIDSAK) project started in 1977 as a collaborative venture between Kenya Forestry Research Institute (KEFRI), Kenya Agricultural Research Institute (KARI) and the Belgian Technical Cooperation Agency. The project operates in Makueni and Kajiado districts, semi-arid areas that receive rainfall of between 400-600 mm. ARIDSAK develops and disseminates appropriate agroforestry technologies for pastoralists and farmers.

The project has experimented with intercropping trees with maize, beans and pulses. Maize yields (Fig. 1) were similar with or without intercropping with trees, indicating that the trees were a bonus to the system. Vegetable farming using drip-irrigation has been introduced, together with high-value fruit trees such as citrus, lemon, Annona, avocado, *Sclerocarrya birrea* (Marula tree), papaya and mango. Also intercropping of maize with timber trees (*Melia volkensii, Senna siamea, Acacia polyacantha, Melia azedarach, Grevillea robusta,* and *Commiphora baluensis)* has been experimented.

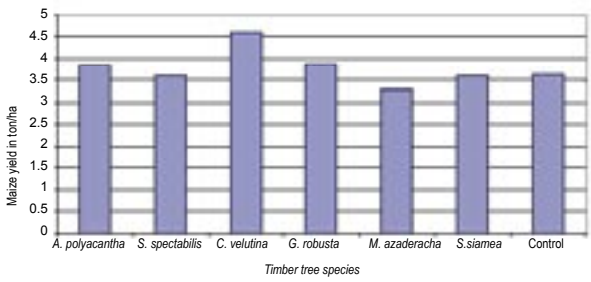


*Fig 1. Maize yields intercropped with various tree species at Kibwezi, Kenya.*

In addition, enterprise development through commercialisation of farm activities for better income generation possibilities has been promoted. Farmers are trained in proper farm planning, record keeping, processing and utilisation of products. In terms of marketing of farm produce, farmers have been urged to seek both local and national markets, thus creating marketing networks for better impacts. ARIDSAK has been instrumental in the creation of 40 private tree nurseries.

The development of profitable business enterprises based on agroforestry products has been one of the main achievements of the ARIDSAK project. ■

The writer, Dr Jackson Mulatya, is a scientist working with KEFRI.
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# Efforts to improve the desert

BY ANDRE F. VAN ROOYEN, ICRISAT BULAWAYO, ZIMBABWE

Photo: ECA library

*Vegetable production in the drylands for improved rural livelihoods and food security.*

The Desert Margins Programme (DMP) is a collaborative initiative among nine African countries, funded by the Global Environmental Facility (GEF). The goal is to improve rural livelihoods and food security of smallholders in Africa's desert margins, through arresting land degradation and conserving biodiversity.

Most of the 120 million people in these countries depend on rain-fed agriculture and natural rangelands for their survival. The loss of biodiversity is particularly critical in these very dry areas, which receives about 200-600 mm rainfall annually, as their ecosystems are less likely to recover once they become seriously damaged.

The Desert Margins Programme aims at understanding the ecosystem dynamics with regard to loss of biodiversity, and the development of strategies for conservation, restoration and sustainable use of the degraded agro-ecosystems. It also works to enhance capacity of target populations towards alternative livelihoods. All activities need sound policy guidelines for sustainable resource use to be formulated, adopted and implemented in the affected areas.

The project has achieved results concerning impact of crop/livestock systems in Zimbabwe, Namibia's land resettlement scheme, local level monitoring system, policy and impact on natural resources in Botswana, and sharing of technological information on increase in cropland and rangeland degradation and the impact of crop/livestock systems in Zimbabwe.

Countries involved in the DMP initiative are Burkina Faso, Botswana, Mali, Niger, Senegal, Namibia, Zimbabwe, South Africa and Kenya. ■

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# Dairy goats generate wealth

## *FARM Africa* project improves goat productivity in the drylands

BY C O AHUYA

Photo: Abdallah Kassim

*In the harsh drylands conditions, the goat is able to browse and survive*

There are 9.7 million goats in Kenya's drylands. Over 90% of these goats are indigenous, and contribute 30% of the total red meat consumed in the country. Despite their importance to the livestock industry and the national economy, goats have been largely ignored in research and development programmes.

*FARM-Africa's approach is to use farmer groups as service providers for breed improvement, marketing, lobbying and advocacy, training and extension.*

The advantage of goats lies in the fact that they mature fast, enabling farmers to quickly build-up stocks. They are also known for their ability to do well in harsh conditions such as those prevailing in the arid and semi-arid areas, with water and feed shortages, extreme temperature variability and difficult terrain.

Food and Agricultural Research Management-Africa (FARM-Africa) is an international NGO. It started operations in Kenya in 1987, and has been widely involved in work aimed at developing the smallholder goat industry.

FARM-Africa's approach is to use farmer groups as service providers for breed improvement, marketing, lobbying and advocacy, training and extension. The organisation has contributed about 100,000 (mainly crossbred) dairy goats to the key production areas of the drylands. More than a hundred buck stations for cross-breeding with local goats have been set up, with more than 35,000 buck services provided. During the project time, the value of goats has greatly increased from US$20 to US$100 currently. The survival rates at weaning are now estimated at 94%. Other benefits that have been realized include increased growth rates, manure production, improved capacity of farmer groups to obtain the right breed for rearing and enhanced access to animal health care by poor farmers.

The success of this programme may be in part due to the fact that a goat-based enterprise requires relatively little start-up financial resources. Fodder trees and shrubs can improve the productivity and incomes from the goat enterprises. Towards this, FARM Africa is collaborating with ICRAF in several projects in Kenya. ■

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# Soil and water management: solution for dryland agriculture?

BY GEORGE E. OKWACH

Soil and water management are the key issues in dryland conservation. These areas suffer from inadequate and unreliable water supply due to low and erratic rainfall, and high evaporation rates. Problems of poor soils as well as inappropriate land use and land management systems such as continuous cropping without adequate replenishment of nutrients, removal of crop residues for livestock feeds, inappropriate tillage and cultivation of steep slopes without terracing, cannot be ignored either.

Photo: Kimunya Mugo

*Drip irrigation system...a success story in the drylands*

However, much effort has been put in place to reverse the degradation trend in the dryland areas over the last few years. Interventions worth mentioning are terracing, water harvesting, drip irrigation for vegetable production, application of agroforestry, and management of soil fertility and conservation tillage. These have, over the past few years, made positive impact on the drylands, and led to reduced risk of crop failure, improvement of household nutrition and health, and increased consumer welfare.

Drip irrigation, one of the interventions promoted, is a system where tubes deliver water slowly and directly to each plant. Its advantage lies in the great reduction of the water needed for growing vegetables. When a farmer applies this type of irrigation, there is little presence of weeds to control, since almost all the water goes directly to the planted crop compared to other forms of irrigation. Apart from vegetable farming, drip irrigation can also be used in fruit-tree farming.

Conservation tillage is another beneficial system that can help save enormous amounts of water that would otherwise be lost through runoff. In a system comprising of tied ridging with stover mulch, for instance, the runoff is estimated at just 3.1%, with 156 mm of soil moisture stored. This is an improvement over the conventional ox-plough system, where about 43% of water is lost to runoff and only 66 mm of soil moisture is stored.

Agroforestry systems in arid settings, such as barrier hedges, can be used for reducing runoff and increasing infiltration. Trees can be used to stabilize terraces and other soil conservation structures, while tree litter and pruning can be used for increasing soil organic matter content, aggregate stability and resistance to erosion; this helps in improving soil fertility. Trees also reduce wind erosion. 'Fertiliser trees' (agroforestry trees that help replenish soil nutrients) such as *Gliricidia sepium* can also help in rejuvenating soil fertility in degraded soils. ■

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# Pioneering Agroforestry in the Drylands: Root Management in Dryland Agroforestry

BY CHIN ONG

Photo: Bashir Jama

*Melia volkensii can aid drought-proof farming systems in drylands*

The ICRAF Research Station at Machakos, which started in 1990 and closed down in 2000, was the pioneer dryland agroforestry centre in Kenya. The station, established to extend the practice of integrating trees into croplands, was used to test the rationale that there would be increased productivity via better use of light, water and nutrients; mimic ecosystem functions (e.g. improved microclimate); and better capture of belowground resources.

Among the major highlights of research findings at the station was the fact that annual crops are unable to utilise water and nutrients fully, with more than half being lost as evaporation. The roots of crops and trees overlap, competing for resources. It was also noted that local trees such as *Melia Volkensii* can aid 'drought-proof' farming systems in the drylands.

Tree pruning was seen as one of the most viable methods of addressing land productivity in the drylands. Key findings on root pruning indicate that while tree productivity was affected by 20 to 30%, crop production was not affected. Tree roots need to be pruned once every two years. Surprisingly enough, tree pruning was relatively easy to undertake for women. In tree pruning, the 'safety net' role of the tree root is not compromised. A question that emerged, and which needs further research, was whether root pruning would decrease nitrogen fixation by nodules.

The tree root system can compensate for the pruning of lateral roots. When all lateral roots are pruned on one side of the tree rows, water uptake by the tree remained the same, compensated by the increased flow from remaining root system.

Mixed intercropping with trees such as Gliricidia has been identified as an alternative to alley cropping, with encouraging results being reported from Malawi. Mixed intercropping is more beneficial than alley cropping because of the resulting better complementarities and minimal competition. Improved maize yield during drought was attributed to less nitrogen leaching and higher nitrogen uptake.

Although root pruning is a technology that holds a lot of promise, adoption by small-scale farmers has been slow because the concept of below-ground management is still new to them. We are testing adoption of root pruning in Kenya with KEFRI and in Kabale, south-western Uganda. Although mixed intercropping is labour-intensive it is being increasingly adopted in Malawi and the dry zone around Lake Victoria Basin in Kenya. ■

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# New ICRAF Initiatives for Enhancing Rural Development in the Drylands

Photo: Bashir Jama

*A well managed improved mango tree can yield up to 300 fruits per season.*

## Combating Prosopis in Kenya: light at the end of the tunnel

BY ABDI ZEILA, BASHIR JAMA AND ANNAH NJUI

In collaboration with the Arid Lands Resources Management Project (ALRMP II) in the Office of the President, the World Agroforestry Centre (ICRAF) has initiated a two-year pilot project *Agroforestry for Livelihoods Improvement in the Drylands (ALID)*. The project will be implemented in the three dryland districts Baringo, Garrisa and Tana-River, starting January 2005.

ALID has two main objectives:

1. Management of *Prosopis juliflora*, i.e. introducing useful approaches to managing the problems caused by prosopis, as well as training local communities on potential utilisation of the weed.
2. Fruit tree based enterprise development, i.e. commercialization of high-value fruit tree species through enhancing production, value-adding processes and marketing. Initial focus will be on mango and guava, including access to improved mango and guava germplasm, both from within and outside the eastern Africa region.

Depending on the experiences of the inception phase, the project may later be up-scaled and out-scaled to other districts that are within the mandate area of ALRMP II and with similar environment in the east and central Africa region. ■

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## The Tigray Agroforestry Initiative in Ethiopia – land rehabilitation through vegetative cover in the drylands

BY ELIAS EYASU, FRANK PLACE, BASHIR JAMA AND ANNAH NJUI

The Tigray Regional State covers about 50,000 $km^2$ across northern Ethiopia and has around 3.6 million people. Almost the whole region is classified as dry. Serious deforestation and subsequent soil erosion has led to recurrent droughts, poverty and food insecurity.

To conquer the situation, the regional state has been active in constructing hillside closures and woodlots for natural regeneration. Hundreds of thousands of hectares of cultivated fields are also treated with stone bunds and terraces. The next step in rehabilitating the Tigrian landscape would be to increase the vegetative cover, for example, through agroforestry practices. The existence of conservation structures offers particular opportunities to plant high-value trees for fruit, fodder, watershed protection, and fuelwood. The existence of small-scale ponds at individual backyards is an added advantage for bucket-irrigated fruit and fodder production.

Cognizant of the agroforestry potential and the need for its expansion, the Tigray Region Food Security Co-ordination Office approached ICRAF to help implement the agroforestry activities. The following areas were identified where ICRAF could enhance impact:

- Supply and introduction of improved germplasm for high value fruits, fodder and timber trees
- Training and exchange visits for local leaders, development agents and farmers
- Up-scaling of technologies at watershed level, and
- Impact assessment, monitoring and evaluation.

A project proposal was formulated and financial assistance has been obtained from the European Union. ■

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# Economic importance of Acacia trees in Africa

BY SHAUKAT A. ABDULRAZAK

Photo: R Labelle

There are several tree species worldwide whose economic value has never been fully exploited, the acacia tree is one of them. With more than 800 species globally, it dominates the tree vegetation in drylands of sub-Saharan Africa. This article presents the uses of the indigenous species of acacia in Sub-Saharan Africa, which include *A. seyal, A. nilotica, A. mellifera, A. senegal, A. xanthoploea, A, reficience, A. nubica, A. tortilis* and *A. brevispica*.

## Food

The acacia tree is capable of providing man with most of his domestic and industrial needs, for example food products. The Turkana people make porridge from the pods of *A. tortilis* after extracting the seeds, while the Masaai eat the immature seeds. The seeds of *A. senegal* and tender pods and shoots of *A. nilotica* are dried and preserved for use as vegetables. Similarly, the gum collected from *A. mellifera* from injured stems is edible and loved by rangelands children.

## Acacia as feed for livestock

The tree provides food for livestock as well. Its foliage and fruits are important browse, and are eaten green as well as dry. Depending on age, season and type of acacia, one tree yields about 4-6 kg dry leaf and 10-12 kg pods per year. The nutrient content is variable between species, and also affected by soil, parts of the plant and maturity. The crude protein content ranges between 13 and 24%. Digestibility of about 46% has been reported.

Also the bark is eaten by livestock, and is probably together with the foliage and fruits a major feed resource during the dry season. The bark is rich in both macro and micro-minerals. Interestingly, iron, copper and selenium concentration is very high and above the recommended levels for livestock. Work is ongoing examining the bioavailability of the minerals.

Acacia forages contain moderate to high levels of polyphenolic compounds, which have been recognised as anti-nutritional factors. Due to these compounds, their use in livestock might be limited to certain levels, especially in cut and carry systems.

## Fuel

In developing countries, fuelwood is the most widely used source of energy, contributing to the destruction of environment as it takes time before those trees are replaced. The faster growth and coppicing behaviour, with large caloric value makes many acacia species suitable for fire wood and charcoal.

Photo: P Nair

The merits of fuel production, however, do not apply to all species. While *A. seyal* produces good dense firewood, *A. xanthophloea* for instance produce gum, which results in a thick black far like deposits when burnt, while charcoal made from *A. nilotica* emits sparks, although it has a higher caloric value of about 4,500kcal/kg. Generally, they are important sources of rural energy as both firewood and charcoal. In Sudan, it is reported that pieces of *A. seyal* are used to make a fragrant fire over which women perfume themselves.

## Timber

Timber industry is a most viable investment currently affected by the decreases of wood supply. However, acacia gives hope to this industry with several of its trees producing timber. Wood from acacia is used to make furniture in many areas of Kenya. *A. tortilis* is harvested for poles used for fencing, house construction and farm implements. Hard and durable wood from *A. nilotica* is attractive for art and craft.

## Medicinal value

Dried powdered bark of *A. tortilis* is used as a disinfectant on wounds and is anti-helmintic. The stem is used against asthma, and the seeds for treating colds, diarrhoea, jaundice and headache. It is reported that the bark decoction of *A. mellifera* is used for treating stomachaches, pneumonia, malaria and syphilis. The roots and the powdered bark of *A. xanthoploea* have been known to have a prophylactic effect against malaria.

## Gum production and apiculture

Another product from Acacia trees is gum, which exudes from the duct of inner bark when tapped in the hot season. Tapping is started when trees are 4-5 years with annual yield of 240 g and 530 g for young and older tree respectively.

Apiculture does well in areas where Acacia trees dominate. Bees seek the nectar from flowers of *A. senegal* and *A. mellifera*, while the scent from *A. xanthoploea* attracts the bees and produce excellent honey. Baringo District, Rift Valley of Kenya is well known for its good quality acacia honey.

## Dye products and pesticide

The inner bark of *A. nilotica* contains about 20% tannin, which is used for tanning and dyeing leather black. Extracts from barks, leaves and pods are used for dyeing cotton, silk and leather. Extract from *A. tortilis* has been used as powerful molluscide and algaecide. Chemicals in the bark of *A. seyal* are successfully used to kill freshwater snails that carry bilharzias parasite and algae in fishponds with no detrimental effect on fish.

Acacia tree has many other services it provides such as, shade provision, fencing, sand dune stabilization, prevention of soil erosion, some species also have the ability to fix nitrogen and improve fertility.

The economic importance of Acacia trees is enormous and the benefits are yet to be fully exploited. For example, with the increasing trend of nomads shifting towards settling life, there is a need to address the issue of food both for them and for their livestock. Acacia already exist in these areas and could contribute substantially in improving living standards of the dryland communities.■

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# Livestock – Agroforestry Interactions in Dryland Management

BY AICHI KITALYI

Photo: Aichi Kitalyi

*Cattle in Kajiado browsing on an indigenous tree species* Maerua angolensis*—the main source of livestock feed*

The growing rate of natural resource base degradation in the Arid and Semi-arid lands (ASALs) of sub-Saharan Africa and the increasing poverty and vulnerability is a major challenge not only for the region but also the larger international community. Yet these areas are inhabited by many people and contribute well to the national economies. For example, in Kenya, livestock from the ASALs constitutes 50% of the total national herd. They provide livelihood for the drylands inhabitants, which are 36% of the total population, and contribute with about 67% of the total red meat in the country.

Ironically, these areas have the lowest development indicators and the incidence of poverty is highest, with over 60% of the population in these areas living below poverty line.

In the past, livestock, and especially goats, have borne the brunt of most blame as the main cause of natural resource degradation and desertification in the ASALs. However, recent studies and analyses put the blame more on the disintegration of the pastoral systems. Traditionally, rangelands productivity and environment conservation was sustained through seasonal movements on the basis of availability of the key resources - forage and water. This essential practice has broken in many areas of the ASALs.

Recent work also suggests high chances of success where a combination of local knowledge of traditional management systems and improved technologies are employed. One such case is the ICRAF – HASHI project in Shinyanga, Tanzania, where a traditional land management practice was combined with agroforestry science to reclaim land and improve livestock production. The traditional system of protecting grazing reserves for dry season grazing, so called 'Ngitili', was enriched with soil fertility improvement tree species and improved grass and legume species to broaden and increase the livestock feed resource base. Although the main purpose of the 'Ngitili' was for natural regeneration, it could form a basis for introducing other technologies such as soil and water conservation techniques and high value crop/tree species.

This practice is not unique to Shinyanga, as most pastoral communities maintain grazing reserves: the Maasai of Tanzania call it 'olalili', the Turkana of Kenya call it 'amare', the Afar of Ethiopia refers to it as 'deso', while the Borana call it 'kello'.

One important issue is the fact that these traditional natural

Photo: Aichi Kitabyi

*Shinyanga cattles browsing the* Azanza garckean

management systems are based on local knowledge, which has evolved over generations of living in harsh and unpredictable environment. The unfortunate part is that this knowledge capital is at a critical threshold as it is now threatened by various factors such as:

- population growth
- breakdown of social institutions responsible for natural resource management
- recurring and debilitating droughts
- human conflicts and insecurity
- encroachment of grazing lands for non-livestock and
- poor and/or undefined land tenure polices.

Intensification of livestock-agroforestry interactions could probably be rated as the most viable option in addressing livestock management in ASALs. The livestock population is diverse with cattle, goats, sheep, camels and donkeys, and they require diverse feed resources. The woody species have been recorded to provide 30 and 80% of the feed for grazers and browsers, respectively. This fact is highly acknowledged by the local communities. For example, in West Pokot of Kenya, Balanites aegyptiaca, Terminalia brownii, Kigelia africana, Grewia bicolour, Zizyphus mucronata and Acacia tortilis are among the useful tree species cherished by the Pokot community for fodder, food and medicine. The Maasai pastoral community of Kenya is reported to recognise over 150 forage tree and shrub species in their rangelands of high value for livestock feed. Tree/shrub forages are of higher protein and mineral contents, thus supplementing the low quality herbaceous forages. In addition to providing fodder, trees and shrubs in rangelands contribute to improved soil fertility, improved nutrient and water cycle and pleasant environment.

These multiple functions of woody species in the drylands have not been adequately tapped and much more could be done to contribute to the war against poverty and hunger in these areas. This requires investment in research and development, and some priority areas include:

- Identification and domestication of useful tree species in different areas in the drylands
- Supporting community based strategies such as the Ngitili and assessing their impacts on land rehabilitation and on livelihoods
- Developing and disseminating methods to control the spread of invasive weeds such as Prosopis species

ICRAF's past work on forage trees had emphasis on a few species of fodder trees such as; Calliandra calothyrsus and leucaena species. In a recent dryland management workshop, stakeholders identified the need to widen the range of species to farmers. As mentioned above, the ASALs will benefit greatly from research and development in livestock-agroforestry interaction. Some of those issues can be addressed in the proposed dryland agroforestry initiative now going on within the ICRAF ECA region. ■

Photo: Abdallah Kassim

*Goats from the region are highly preferred by the Middle East market and therefore good source of foreign currency.*

# Learning from the SAHEL-Malian parklands

BY AMADOU NIANG AND BOCARY KAYA

In the semi-arid lowlands of Sahel, the climate is characterized by unpredictable rainfall, up to nine months dry seasons and temperatures reaching lethal levels of +50° C. As in many other parts of Africa, the soils are constantly being depleted by leaching, erosion and continuous cropping, while the populations are growing. Life is a year-long quest for food security. To help revegetate these lands, ICRAF is supporting and improving the traditional Malian parkland system.

Bocary Kaya

*Sorghum grain yields after a two-year coppicing fallow in the Sahel (Kg/ha)*

The Malian parklands system is made up of trees scattered in the farmlands. The most common species are *Parkia biglobosa* (néré), *Vitellaria paradoxa* (karité), *Adansonia digitata* (baobab), *Tamarindus indica* (tamarind), *Acacia albida* (balanzan) and *Borassus*

# Rainwater Harvesting: improving lives in the semi-arid areas of Tanzania

BY NUHU HATIBU

## The Problem

Small-holders who live in tropical semi-arid areas have to cope with frequent negative impacts on livelihoods such as food shortages and economic losses. This is as a result of drought, soil erosion or flooding. Statistics show that over the past 100 years, floods have caused about 38% of all declared disasters in Tanzania, while droughts caused 33%. Often, the floods and droughts occurred in the same semi-arid area, and in the same season. The problem is that only a small fraction of the rainwater reaches and remains in the soil long enough to be useful. Up to 70% of the rainfall can be "lost" as runoff that causes erosion and flooding downstream. Both floods and droughts and their detrimental consequences result from wastage of valuable rainwater. A clear win-win solution is to convert the runoff that causes erosion or flooding into soil-moisture that is critically needed for crop and pasture growth in the semi-arid areas. This is what Rain Water Harvesting (RWH) is all about.

*aethiopium*. The natural stands vary from woody savannas in the south to bushes and steppes in the north. The trees provides diverse services and products, such as fuel, timber, fodder, protection and even soil fertility replenishment through long fallow phases wherever still possible. However, because of the combined effects of frequent droughts, over-exploitation and ageing of trees, the availability of many species is declining rapidly and some are under threat of disappearance.

The baobab tree (*Adansonia digitata*) is maybe the most dominant species of the Sahel not only because of its size but also its importance for people. Almost no part is unused. From the bark is made ropes and the fruit pulp is eaten, rich in vitamin C. Perhaps most important, in much of the Sahel and particularly in Mali, the leaves of baobab form the staple vegetable - eaten daily as sauces with cereal-based meals. Growing in the wild and on farmland, the baobab has become so heavily exploited that its natural regeneration is at risk.

Fodder shortage is a serious constraint in the long dry seasons. The traditional lopping of indigenous tree species such as *Pterocarpus erinaceus* and *P. lucens* has become so severe that also here the natural regeneration is endangered. Fodder banks, an agroforestry innovation promoted by ICRAF can certainly contribute to both improving animal production and preserving the biodiversity.

The declining soil fertility is a major limitation for agricultural production and economic growth in the region. Thus, agroforestry-based soil fertility management approaches such as biomass transfer and improved fallow technologies would be very useful and are now being developed. Recent on-station studies show that the yield of sorghum can be increased at least twice by seven to ten months long fallows of *Sesbania sesban* and other species.

Thanks to live-fencing, farmers can grow vegetables in dry season without having to invest time in rebuilding fences as the traditional method using dead branches requires. The impact of these gardens on family economy is enormous. For example can the selling of only three lettuce plants pay one meal for a family of five. The species *Zizyphus mauritiana* that have thorns but also produce fruits is promoted, and improved varieties have been introduced to enhance uptake of the technology.

There are numerous of more examples of how agroforestry products play a great role in Sahelian peoples' lives as food and medicines. The importance of shea butter from *Vitellaria paradoxa* (karité), 'soumballa' from *Parkia biglobosa* (néré), and tamarind from *Tamarindus indica* are also well documented.

There is certainly a lot to learn form the traditional Malian parklands systems. And it appears that innovative agroforestry practices can help turn some of the negative trends around. Therefore, ICRAF and its partners has selected these parklands as a priority land use system to promote in this region, and are currently implementing village and community based conservation activities.

With *Zizyphus mauritiana*, live fences can also produce fruit. High yielding Indian cultivars such as Seb, Umran and Gola starts bear fruit after only six months, and the fruits are ten times the size of the local types. ■

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Whilst policy makers recognized the consequences of water shortage in semi-arid areas, they had not recognized the importance of runoff. Policies and programmes were for a long period dominated by two contradicting perceptions. Firstly, that the only solution to livelihood problems in the drought prone semi-arid areas was drought-resistant crops. Secondly, that the solution to soil erosion was safe disposal of the "hazardous" runoff away from crop and range lands. This led to soil and water conservation programmes that focused on water disposal in areas where agriculture and livelihoods are affected more by shortage of water than anything else.

***Continued on next page ▸***

*Photo: Alex Oduor*

*A farmer in Machakos in Kenya points to her rectangular shaped runoff collection tank for irrigation*

Photo: Alex Oduor

*Peter Kiio stands by his plastic-lined runoff collection point for irrigation in Machakos, Kenya*

◂ *Continued on next page*

## The Action

The Soil-Water Management Research Group (SWMRG) was started in 1991 at the Sokoine University of Agriculture (SUA), to find ways of increasing the productivity of rainwater in semi-arid areas. The Group has been supported mainly by DFID and SUA. Other organizations that have assisted it are IDRC, NORAD, EU-DG6 and Sida. Furthermore, SWMRG has sustained collaboration with researchers from other organizations, notably the University of Newcastle in the United Kingdom.

The work described here focused on four main aspects, implemented concurrently:

- Intensive and extensive participatory work of learning from farmers' practice of exploiting natural concentration of runoff in local depressions and valleys
- Indigenous Knowledge (IK) on bio-physical, technical, social and economic aspects of RWH was collected and collated, from six districts
- Use of the IK, in collaboration with local stakeholders, to design and implement on-farm experimentation, modeling and participatory GIS work to develop a sound scientific understanding of the farmers' practice so as to be able to describe with confidence the benefits of the system
- Development of Knowledge Sharing Products (KSPs) that target stakeholders such as individual households, community, local change agents, and policy makers and planners at both local and national governments
- Communication with stakeholders through media, seminars, workshops, training courses and distribution of KSPs, designed to:
  - Raise awareness about policy, planning, and extension needs for supporting rainwater harvesting for agriculture, and
  - Improve the technical knowledge and skills of extension and farmers on RWH systems.

The most innovative aspect of the SWMRG is that, although it is university based, it has focused on action research in full collaboration with local stakeholders. Furthermore, it has sustained public relations approach that keeps relevant stakeholders at all levels well informed of the research and its findings.

## Outcomes and road to impact

The efforts sustained by SWMRG and its partners over 12 years have significantly influenced policy. RWH is now a common feature in the development plans of several district councils and NGOs. In 1997, the Agricultural and Livestock Development Policy contained six policy statements on drought resistant crops and none on soil-water management on croplands. By 2001, the Agricultural Sector Development Strategy recognized integrated soil-water management including rainwater harvesting as the solution to the drought problems of semi-arid areas. In March 2003, when inaugurating the national water policy, the President of Tanzania announced that rainwater harvesting was the first among four priority areas of focus in national water resource management.

## Conclusion

The change in perception, policy and strategies towards rainfall runoff has been nothing short of remarkable. There is now a real demand for the rainwater harvesting technology. SWMRG and its partners are continuing to work on the subject, especially to develop institutional arrangements for ensuring that there is social and environmental equity in the capture and use of the scarce rainwater resource. ■

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# Taking Stock and Charting the Way Forward

BY ABDI ZEILA AND ANNAH NJUI

Arid and semiarid lands form the largest land reserves available in most of the eastern and central African countries. Indeed, between 30 and 80% of the total landmasses of Kenya, Ethiopia, Tanzania and Uganda are classified as arid and semiarid lands (ASALs). In addition, a significant portion of Rwanda is also dryland. These are areas with low and unreliable rainfall. Droughts and famine are also common.

Agroforestry is now increasingly being recognised as a viable option for mitigating land degradation and desertification. In determining the specific roles of agroforestry in sustainable dryland development, ICRAF's Eastern and Central Africa Regional Program called a stakeholders' workshop on "The Science and Practice of Agroforestry in the Drylands: Charting the Way Forward", which was held at ICRAF Headquarters, Nairobi, between 1st and 3rd September 2004. Over 80 participants from Kenya, Uganda, Tanzania, Ethiopia, Mali and Zimbabwe attended, representing a broad spectrum of institutions (both public, private and research) working in the drylands of the region.

The goal of the workshop was "improved natural resource management through agroforestry for wealth creation, sound land management and sustainable livelihoods in the drylands of eastern and central Africa." The workshop was aimed at exposing the stakeholders to the variety of agroforestry options in the quest for sustainable socio-economic development in the drylands.

While opening the workshop, the ICRAF ECA Regional Coordinator, identified the key challenges facing the region as combating poverty and food insecurity; mitigating land degradation; improving water supply and water use efficiency; improving market linkages; building partnerships and diversifying the options open to dryland communities. He reiterated the importance of drylands to the national economies, saying that the war against poverty in the region's countries will either be won or lost in the drylands.

The stakeholders identified and prioritised four broad areas (thematic areas) for interventions, where the science and practice of agroforestry was seen as an approach that could be used to reverse the tide of poverty and degradation of ASAL resources.

These four areas were:
- Disseminating options for improving livelihoods;
- Rehabilitation of degraded lands and mitigating degradation;
- Reducing pressure and contributing to the conservation of natural forests, woodlands, reserved areas (national parks and game reserves), and other biodiversity and ecological 'hotspots' through domestication of trees and shrubs in the landscape;
- Building capacity and strengthening institutions.

Additionally, several crosscutting issues were identified:
- Water harvesting and management;
- Land tenure and property rights;
- Improved access to markets;
- HIV/AIDS and gender mainstreaming;
- Monitoring and evaluation and impact assessment.

Through the application of agroforestry-based sustainable land and natural resource management approaches, it is expected that there would be:

- Reduced dryland degradation through decreased resource-dependence as a result of improved livelihoods and mitigation of degradation through innovative strategies such as agroforestry;
- Enhanced capacity of national dryland management institutions to incorporate low-cost and effective approaches such as agroforestry in their resource management programmes ;
- Improved environmental quality and enhancement of the living standards of dryland communities through practising sustainable socio-economic development strategies;
- National agencies capacity to utilise innovative resource planning/management and decision support tools such as remote sensing and geographic information systems (GIS) for targeted interventions will be enhanced;
- Improved access by communities residing in the drylands to information beneficial to them.

The stakeholders agreed that a consortium approach would be the most appropriate implementation framework for implementing the resolutions of the workshop. It was resolved that all key players in drylands development (research, education, policy and development) would be involved in this effort. The consortium would also benefit from strong and committed private sector participation. Policy makers would also be engaged for greater and sustainable impacts.

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# in the next issue...

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How ICRAF is helping in achieving the Millennium Development Goals...

How TOFNET is advancing agroforestry technologies and practices in the eastern and central Africa region

Photo: Malesu Maimbo

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