Management and utilization of dryland forests in Sub-Saharan Africa: the role of agroforestry

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Abstract

The future of drylands forests lies on enhancing people's participation in the utilization and conservation of its natural resources. Strategies to adapt to drought and prevent land degradation need to also meet the expressed food security, income generation, risk management, and social objectives (including gender and equity considerations) of the rural poor and built from knowledge capital and expectations of local communities. Agroforestry can contribute significantly in mitigating degradation of dryland forest resources by providing various products and services. There are many promising agroforestry technologies now finding applications in the drylands of Sub-Saharan (SSA). Examples include fodder and soil fertility improving trees in cropping systems as well fruit and medicinal trees that generate income. Enhancing impacts of agroforestry technologies requires continuous development and dissemination of innovations, coupled with research and development efforts that improve policies and strengthen institutional delivery capacities.

1. Introduction

Forests are an important natural resource in the drylands of Sub-Saharan Africa (SSA) providing critical environmental, economic, social and cultural functions. Forests and forestry in Africa, however, face a number of problems, including a rapid decline in forest cover, loss of biological diversity and a variety of unsustainable uses that cast uncertainty on the future flow of goods and services (FAO, 2003). Some of the driving factors of these problems include increasing food insecurity, inappropriate land use practices, poor market access, declining rainfall and absence of local institutional arrangements for resource management by the community.

Some manifestations of these problems include the expansion of agriculture and livestock production into forests, and extraction of charcoal, fuelwood and wood for carving. In some regions, poor governance, including land tenure problems, and civil wars are confounding factors. Frequent droughts complicate the issue further. For instance, the average rainfall across the Sahel has diminished by 30% since the 1970's. The causes of this are not known but global warming is a strong probability.

There are intimate links between agriculture, poverty, and human-induced dry land degradation. Millions of people are estimated to live in dry areas at risk of desertification. About 70% have incomes below US$ 2.0 per day and the majority is involved in agriculture including pastoralism. It is increasingly recognized that mitigating degradation of dryland ecosystems is essentially a people and development problem. This requires focusing activities on both human-induced land degradation and drought.

Dryland forests in SSA are an important source of a variety of non-wood forest products (NWFPs) such as gums and resins, honey and beeswax, medicinal and aromatic plants, dying and tanning materials and bamboo. In some situations, NWFPs account for a significant share of household income. This is an area with great-undeveloped potential for improving incomes for many people without degrading the dryland forest resources. At present, gums,

resins and honey are probably the NWFP that are marketed most from the drylands. But even with these, much needs to be done to build capacity of producers and entrepreneurs in improving quality of products and marketing chains. Medicinals and aromatic plants are used considerably for domestic purposes (both human and livestock). This is, however, an area that is largely untapped for external markets. The exception perhaps is Ethiopia where there is both considerable internal use and sale of products of *Boswelia* species.

The extraction of fuelwood and charcoal is a major driver of dryland forests degradation. These products are at the same time an important source of income for many poor in the drylands. Most of the trees currently used for theses products are indigenous hardwoods e.g. *Acacia* and *Terminalia* species. Extraction of hardwoods for woodcarving has further exacerbated the problem. Many species in drylands are getting ecologically degraded as a result of these activities. To mitigate these problems, comprehensive land and resource use policies in the dryland are needed in many countries. At present, many countries lack resource maps that can help determine the extent of degradation.

There is, indeed, strong evidence that empowering the local communities in the management and ownership of the forest helps achieve the twin objectives of conservation and development (McNeely and Scherr, 2002). Agroforestry initiatives can contribute by increasing access to tree products and services on farm. There are many agroforestry systems in practice and a good example is the parklands systems – a traditional agroforestry system with scattered trees in croplands found throughout the Sahel. Parklands are constituted of about 50 species and genera, but only around 20 are considered as the most important ones. According to the species and locations, densities range from 3 to 50 trees per hectare. Parklands are also important sources of food and nutritional security, producing fruits, oils, leaves, nuts and spices that are main components of the diet. Trees also supply fuelwood for domestic use and feed for livestock and are a source of additional income. They reduce wind erosion, during the 9 months of annual drought, and also water erosion during the cropping season. These systems demonstrate the importance of multipurpose, woody, often leguminous trees and shrubs in low-input farming systems.

ICRAF and its partners have, over the last 25 years developed and documented various agroforestry technologies that focus on increasing farm productivity, food security, and diversified incomes for improved livelihoods. These are described in several publications including some specific to the drylands (Rocheleau et al., 1988; Boffa, 1999; Franzel et al., 2002). In this paper, we highlight some of the key options for the drylands and what is needed to enhance their impacts of development and conservation of dryland forests. With respect to the scope of the paper, this introduction section is followed by some of the key agroforestry technologies in the drylands. Following this is a section outlining the key practical challenges faced by farmers in tree planting in the drylands that draws on the experiences of a development project in eastern Kenya. A section on what are the key emerging issues needed to be considered in order to enhance the impact of agroforestry practices in the drylands follows. The final section highlights the way forward including research, development and policy implications.

2. Agroforestry Options in Drylands

There are many options include in practice, with the key ones being:

- ***Trees in crop fields - Parklands systems***

Some of the common dryland tree species used in parkland systems include *Vitellaria paradoxa, Faidherbia albida, Hyphaene thebaica, Balanites aegyptiaca, Sclerocarya birrea, Parkia biglobosa* and *Acacia raddiana.* Regeneration of many these species in an environment of free grazing and declining seed pool is poor and is threatening the sustainability of these age-old systems. Regeneration and rehabilitation techniques of the aging traditional parklands systems, which increase vegetation cover and enrich agroforestry biodiversity, are much needed.

- ***Windbreaks and Live fences***

Trees as windbreaks and live hedges cut down dramatically on wind, water and soil erosion, and improve soil structure and fertility. Many species are used for both purposes. For example, in the drylands of Meru in eastern Kenya, most farmers' plant *Euphorbia tirucalli* as live fence for farm protection and are increasingly realising its importance as a windbreak when left to grow tall. They have reported that crops yield more in protected sites. As a result farmers are now planting windbreaks consisting of three lines made of *Eucalyptus sp, Shinus molle* and *Leucaena sp*. In some transitionally less dryland areas, *Grevillea robusta* is very popular among farmers planted for both timber and windbreak functions.

Live hedges protect fodder and vegetable gardens from free grazing livestock. Depending on the species, live hedges also provide by-products such as gum and fruits that can be sold or used by the household. Some of the most successful fences are made up of a combination of species such as *Ziziphus mauritiana, Acacia nilotica, A. senegal, Bauhinia rufescens* and *Lawsonia.* In its second year after planting, fruit production from a 200 m fence of *Z. mauritiana* was estimated to be worth US $ 100 in Mali. Vegetables grown in the enclosures include the giant baobab that, through management practices, has can be reduced to a dwarf tree. Live fences free up the labour time used in collecting material and recurrently constructing "dead" fences (option initially used to prevent destruction of valuable cash crops from livestock), thus enabling farmers to increase the area under high-value crops. A key challenge with living fences is their potential to precipitate conflicts between individual fencing plots and the community, which is used to free grazing.

- *Woodlots:* Various species are used for woodlots including many fast growing Australian acacias. These species grow well even on degraded laterite soils for biomass energy while rehabilitating degraded soils through leaf droppings and root development. In Tanzania, ICRAF and its partners are evaluating the extent to which the plating of these acacias (e.g., *Acacia cracicarpa*) on-farm can mitigate degradation of the miombo woodlands that is under pressure for fuelwood from the tobacco industry.

- *Soil and water conservation*: Planting trees on terraces for soil and water conservation is an important function in drylands. The trees, however, must provide additional products beyond soil and water conservation. In Meru District of eastern Kenya, terrace planting

of trees has increased after farmers realized that boundary planting was not very successful if the trees are not weeded. Since farmers use oxen for ploughing they are not keen to plant trees on cropland as this affects ploughing. However following the successful demonstration to farmers of the importance of weeding, farmers are also adopting woodlots and orchards on farm. The trees are initially intercropped with food crops so as to encourage weeding.

- ***High value trees on farms in various niches***

This mainly includes trees used for production of timber, fodder and fruits (indigenous and exotics):

- *Timber production*: Few dryland species are finding their way into the formal markets for timber. The exception in Kenya is *Melia volkensii* - a fast growing indigenous dryland hardwood found in eastern Kenya, and also the drylands of Tanzania and Ethiopia. It provides both good timber and fodder. Woodlots of *Melia* (and other species such as *Eucalyptus*) are common and often more preferred for boundary in order to reduce competition with crops. Wide-scale planting of M*elia* has, for a long time, limited by its hard and difficult to germinate seeds. Because of its high fodder value, livestock helped overcome germination problems once it passed through their rumen systems. Researchers have now developed an appropriate technology that overcomes germination problems. This technology needs to be improved to make it practical for farmers and nursery operators. There is also need to collect and conserve the genetic diversity of this species.

- *Fodder species:* A wide range of species, both exotic and indigenous are promoted and planted by farmers, and some examples of promising exotic species include *Leucaena sp, Gliricidia sepium, Callliandra and Morus alba.* A challenge to guard against is some of the species becoming weeds. An example of this is *Prosopsis juliflora* initially a very good fodder but has now become an ecological disaster in the ASALs of northern Kenya and Ethiopia. More effort needs to be put into the development and promotion of indigenous fodder species.

- *Fruit trees*: Fruit trees function as a major source of income and nutrition for farmers in the drylands. Both exotic and indigenous fruit trees have potential. Mangoes, citrus and papaya are some of the popular fruit plants in the drylands. Grafted mangoes are particularly in high demand in the drylands of Kenya (Njenga et.al., 2000). Production of the fruits is improved through water harvesting techniques (micro- catchments) and irrigation schemes. Indigenous fruits such as *Tamarindus indica* and *Adansonia digitata* are also widely used by the rural people living in the drylands. However *Sclerocarya birrea* (marula) that occurs widely in the drylands of Kenya is rarely used presumably for lack of knowledge on its many uses including commercial liquor. It is evident that there is greater scope for improving both the production and marketing of these species to provide more incomes and improved livelihoods in the drylands. A key challenge here is getting farmers to organize and collectively market their produce.

- ***Non-wood forest products***

Trees with medicinal value (for human and Livestock) are increasingly being planted on farm particularly around homesteads. Some examples from eastern Kenya include *Azadirachta indica* (the neem tree) and *Shinus molle*. Honey is another NWFPs on farms. There is some good progress with honey production in Kenya where improved bee hives (Langstroths) are being introduced by various NGO in close partnership with the private sector (Africa Now, 2002).

Practical challenges facing farmers in drylands

Several practical challenges regarding tree planting in drylands drawn from the work of Meru Dryland Farming Project (MDFP) in eastern Kenya include:

- *Unavailability of seed and seedlings of some trees.* As a consequence, farmers with tree nurseries raise a narrow range of tree species. This is because nurseries have to be kept small due to inadequate water supply and therefore only-easy-to market species are produced. To deal with this, MDFP has been promoting small domestic nurseries and mobile nurseries. The mobile nurseries involve the delivery of seedling from a major central nursery to a community-selected site at the onset of rains. The seedlings continue being cared for on the site as they are being sold to farmers at a slightly marked up price.
- *Land tenure*. Trees are seen as fairly permanent investment and farmers are not ready to plant them in farms they are not sure whether they will ultimately own. This has adversely affected adoption of tree planting in several areas.
- *Youth involvement*. In some areas, participation of youths in agroforestry is low, as their parents are not keen to allocate them pieces of land while they are still alive. Even in cases where the youths have been allocated land they are still reluctant to plant trees because they reckon their parents could relocate them to other parts of the farm in future and hence loose their trees. The problem may persist as long as the old man is still alive even though his son already has a family of his own.
- Belief that trees will not grow in the drylands unless they are watered. “If only we had water, we would plant so many trees”. Experiences of this project, however, indicate that that it is more of the right species and planting methods rather than lack of water.
- Narrow range of timber trees that can do well in the drylands
- Demand on the planted trees outweighs the supply, hence the trees are destroyed before maturity

3. Enhancing impact: What is needed

To enhance and sustain impact, a holistic approach that combines technologies and production systems with improving access to markets, policy incentives and empowerment of local communities is essential. Within these broad considerations, the key issues are:

- *Appropriate technologies (agroforestry and others)* - promotion of agroforestry options should be tied to other economically beneficial activities that address the expressed need for food security, income generation, risk management, and social objectives of the rural poor and built from knowledge capital and expectations of local communities. For

example, linking fodder trees to dairy goats, fuel wood trees to a fuelwood conservation programme (in our improved stove programme, farmers are recognizing the need to use dry rather than wet firewood. As a result of this, farmers in Meru district of Kenya are now planting fuelwood trees and constructing fuel wood drying racks). Fruit trees such as mangoes and papaya to fruit marketing programme and natural woodlots conservation to a beekeeping programme. Emphasis should not be on technologies per se. Even when this is so, complementary technologies that enhance the use of each other should always be promoted. An example is water harvesting techniques that can boost the production of trees, crops and livestock during the dry periods.

- *Institutional and organizational innovations* - even when there have been technical solutions that met client perceived needs, bottlenecks for implementation often existed at institutional and policy-making levels. Institutional and organizational innovations and property rights arrangements need to be devised with community input, in order to create innovations that ensure adequate incentives for individuals to participate in resource investment and management, including that of collective resources, as well as catalyze their wide adoption.

- *Scaling up impact* - past efforts have tended to be piecemeal and scattered without consideration of the potential and need for scaling up. For example, few countries have planning framework to cope with land degradation as an inter-sectoral development issue. Research on dryland resource use (including forests) needs to be integrated and coordinated with development efforts through consortium approach. These more holistic efforts need to be focused in carefully chosen pilot areas to produce development models that can be replicated through development investments in similar ecoregional niches.

- *Improving access to markets* – a stronger link with the private sector is needed to help farmers go beyond subsistence production. Markets are a major bottleneck in the drylands. There are many products that farmers and pastoralists can sell including NWFPs. More research and development efforts need to go into the marketing and sustainable management of dryland trees with NWFPs.

- *Capacity building* - most countries have inadequate planning frameworks to deal with land degradation as an inter-sector development issue and, something that is essential for mitigation the many causes of drylands resource degradation. There is need to foster a closer interchange of the different sectors involved in agricultural land use, e.g., crop, forestry, agroforestry and livestock. There is also a need to increase the capacity of land users and institutions to formulate their own location-specific solutions through efforts in capacity building. Research on knowledge, information, and communication flows amongst all levels of organizations is essential. At farmer's levels, practical extension guidelines are needed, for instance, for training nursery operators on propagation of *Melia volkensii*. This will increase availability of trees seedlings of difficult-to-germinate species

- *Involve the community* - carry out ethno-botanic survey with communities using both local and external experts. More people will appreciate the importance of tree species found in

their area. This will encourage protection of these species even as farmers' open new areas to cultivation. Also, carry out demonstration on tree planting with communities. For example the demonstration carried by Meru Dryland Farming Project in eastern Kenya with farmer groups in schools and church compounds have effectively highlighted both the right species and appropriate planting methods. This has, indeed, increased the demand for and survival of trees planted on-farm. Demonstration of use of trees (e.g. cooking and tasting of *Moringa oleifera* vegetables and medicinal trees) has also increased there planting.

- *Learning from the past* - a thorough understanding of the reasons why resource-poor land users do not adopt appropriate technologies is required. It is also hypothesized that critical bottlenecks exist at the institutional and policy maker levels. A holistic approach will ensure that all stakeholders participate in the planning and implementation of the research and efforts to prevent and reverse degradation of dryland forest resources. The Meru Dryland Farming Project uses one such approach that involves many stakeholders (including farmers) and integrates the planning, implementation, monitoring, monitoring and implementation of its dryland agricultural project (SOS Sahel, 2002).

- *Mainstreaming gender* – in rural development, women's role in forest and tree resource cultivation, management, use, marketing and sharing of benefits that accrue have not received the full attention of planners, administrators and extension agents. Strategies need to be mainstreamed to reach women, learn about their unique needs, and motivate them to take part and ensure that they receive the benefits of dryland forestry programs. Doing this is a long process and has to be learnt and implemented progressively. This in turn requires policies and institutional systems that support program-level work. (Kabutha, C. 2002).

- *Taking into consideration impacts of HIV/AIDS* – the pandemic must be considered in any discussion on Africa. There is evidence that the pandemic will threaten social welfare and economic life of many of the continent's inhabitants. The impacts of HIV/AIDS can be many and varied. Rural farm households are generally vulnerable to poverty and distress because of their limited resources. Households in drylands are particularly vulnerable because environmental conditions already impose severe constraints. Key research and development questions for dryland forestry program and HIV/AIDS are: What are their contribution to management of the pandemic? What household response factors should be considered in the design of projects, in order to ensure that projects provide appropriate support to farm households? Can programs be designed in ways that serve a range of agendas such as research or productivity agendas as well as broader social health and welfare support?

- *Climate Change* - the links between climate risk, especially drought, agricultural production and intensification, land degradation, and dryland forest need to be understood. Assuming that the predictions of the drylands getting drier with global warming, more emphasis needs to be improved water management and enhanced use efficiency.

4. Way forward

Agroforestry can make significant contribution to a comprehensive dryland forests resource management systems, something apparently lacking in many countries in SSA. Four areas are deemed necessary to the success of such systems and they include:

(i) Community-based negotiation systems over resource use that focuses on land tenure, economic and policy development.

(ii) Develop technical innovations, including production systems such as water harvesting techniques, that improve farmer and community-based natural resource management planning, production and marketing initiatives.

(iii) Disseminate innovations to a wide range of target audiences and building capacity to utilize the products in areas beyond the initial benchmark sites.

(iv) Improve tools for assessing and monitoring the effect of land use practices, including agroforestry, and for supporting decision on sustainable management of dryland forest resources. At present, there is lack of rapid, reliable, and cost-effective methods to quantify and monitor the extent and severity of dryland forest resources degradation.

(v) Synthesis of promising and successful technological and methodological based innovations found effective to reduce or revert degradation of dryland forests.

In summary, the future of drylands forests lies on enhancing people's participation in the utilization and conservation of its natural resources. Strategies to adapt to drought and prevent land degradation need to also meet the expressed need for food security, income generation, risk management, and social objectives of the rural poor and built from knowledge capital and expectations of local communities. Both strategic and applied research are needed to unravel the complex causal factors of drylands forests degradation, both climatic and human-induced, and formulate and pilot appropriate technical and policy solutions. This can be done through methodology development and modeling, as well as through action-oriented participatory research, technical backstopping, knowledge sharing, and capacity-building activities in representative pilot areas. Inter-regional cooperation and collaboration would also be an important component and holds promise to add much to the success of these efforts. There is potential for increased impact from transfer of information, technologies, and experiences through inter-regional cooperation and collaboration, something that is indeed essential for natural resource management options such as agroforestry that tend to be site and location specific.

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