FOREST LANDSCAPE AFRICA

MSB International Forestry Workshop

(Forest 2011)

Afforestation in Africa:

Constraints and Opportunities

5 – 10 December 2011

Nairobi, KENYA

SYNTHESIS REPORT

EXECUTIVE SUMMARY

This Report is a synthesis of the findings resulting from the '*MSB International Forestry Workshop: afforestation in Africa - constraints and opportunities*' Workshop held at the World Agroforestry Centre in Nairobi on the 5-8th December 2011. It was attended by forestry institutes from 11 African countries (Botswana, Burkina Faso, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mozambique, Nigeria, Tanzania and Uganda). In addition, representatives from the Royal Botanic Gardens, Kew, ICRAF, FAO, Forest & Landscape Denmark, UNEP, DFID and others attended.

Net deforestation is still occurring in all of the African countries represented at the meeting. Mozambique has the highest forest cover remaining (50%), Kenya has the lowest (6%). Forest cover, in terms of actual area, is being removed fastest in Nigeria (410,000 hectares per annum), Tanzania (403,000 ha) and Mozambique (217,000 ha). As a proportion of what remains, forest is being removed most rapidly in Nigeria (-3.7%), Uganda (-2.6%) and Ghana (-2.1%). Kenya (-0.3%) and Madagascar (-0.4%) have the lowest deforestation rates.

On average Government tree seed centres and forestry institutes supply 40 tonnes of seeds of 558 species and 398 million seedlings per annum. The majority of seeds and seedlings supplied by public sector forestry organisations are of exotic species. However, all of the forestry institutions present at the workshop also supply indigenous tree seeds and seedlings, albeit in lower amounts than exotics.

All of the Governments represented at the meeting have national policy in place that supports afforestation activities, and all have afforestation programmes that involve communities in participatory management. In addition, many have decentralised models, with public-private partnerships forming important parts of their portfolios. Most of the participating organisations outsource some of the services and products they provide. Botswana, Burkina Faso, Kenya, Malawi and Kenya reported on a growing demand for indigenous species, particularly in agroforestry and habitat restoration. Ghana and Mozambique said that there was currently little demand for indigenous species in their countries. Botswana, Burkina Faso, Ethiopia, Kenya, Malawi and Kenya reported on existing or future activities in the context of climate change, carbon offsets and REDD+. Biodiversity is an explicit component of afforestation policy in Botswana, Burkina Faso, Ethiopia, Kenya and Tanzania.

The strengths of the national forestry institutions that participated in the workshop include: technical skills in plantation forestry with fast growing exotics; strong knowledge of the collection, processing, storage and use of a wide range of indigenous species; and good knowledge of seed sources, local conditions, ecosystem services provided by trees, and the wants and needs of local people. All of the institutions felt that their technical networks and the information exchange they provide is strength. Institutions like ICRAF and the MSB were cited as useful providers of technical support and information, enabling innovation. All of the participating institutions were sources of high quality seed compared with much of the seed available from the private and civil (NGO) sectors (see 'Threats' below).

Many of the participating organisations identified policy and regulatory weaknesses in areas such as sustainable management of forest resources; fire management; land use planning;

domestication/ commercialisation of indigenous species; seed quality; and importation of seeds. Collectively the participating institutes felt that forestry is generally regarded as a low priority by governments. Structural issues and lack of joined up thinking were cited as weaknesses in some government departments. Staff retention and skill shortages are a problem in many government forestry institutes, linked to lack of funding, poor salaries and limited political support. It was acknowledged that Government institutions often have poor understanding of value chains and markets. Finally, a number of research area weaknesses were identified.

All of the participants cited increasing public and political awareness of the importance of sustainable natural resource management as creating an opportunity for afforestation activities. Ecosystem services, climate change, carbon capture, biodiversity offsets and sustainable livelihoods all present opportunities. All of the institutions saw the opportunities afforded by the decentralisation of forestry services. Decentralised tree seed centres, extension services and the participation of the private sector were all seen as an opportunity to scale up and reach more communities and individuals. All of the participants felt that the technical consortium proposed by this workshop, built on decades of bilateral relationships, created a major opportunity in a number of technical areas. The Consortium was also seen as an opportunity to better engage with policy makers and donors, and to greatly scale up afforestation activities.

Lack of continuity, leadership and long term thinking were cited as major threats to forestry in Africa. Donor faddism was included as a challenge in this context. Natural resource management has not been in vogue amongst donors or Governments in Africa for the past 20 years. Forestry is a long term enterprise, and needs long term and sustained support. Many felt that the contribution of forestry was still undervalued by local decision makers and by donors. All felt that Government natural resources management and development policies were frequently not joined up. Policies are fragmented and incoherent. The continued degradation of forest genetic resources was seen as a consequence of poor policy but also poor implementation. Many participants felt that markets are distorted by external organisations (especially NGOs) that are not interested in long term effects and

sustainability. Lack of innovation and poor seed quality were also seen as challenges affecting afforestation and seed/seedling markets.

The plenary sessions of the workshop concentrated on the opportunities afforded by the establishment of a mutually supportive technical consortium – tentatively named 'Forest Landscape Africa' that would include a range of facilitating/support organisations with complementary expertise, and an array of delivery organisations who could put trees back in to the landscape. Next steps were agreed.

I-SYNTHESIS REPORT

STRENGTHS AND WEAKNESSES OF PUBLIC SECTOR FORESTRY IN WEST, EAST AND SOUTHERN AFRICA

Background

The Royal Botanic Garden, Kew's Millennium Seed Bank has been working with Government Tree Seed Centres and Forestry institutes in sub-Saharan Africa since 2000. The Millennium Seed Bank Project (2000-2010) had two main aims: to bank 10% of the world's wild plant species; and to build seed conservation capacity worldwide. During this project, seeds from more than 8500 African wild species were banked from 10 African countries (Botswana, Burkina Faso, Egypt, Kenya, Madagascar, Malawi, Mali, Namibia, South Africa and Tanzania). In addition, £4.068 million was spent on building seed conservation capacity in Africa, 7 countries were equipped and their facilities improved; and 163 people were trained, including 10 PhDs.

From 2003-2006, Kew's Millennium Seed Bank led and managed the Darwin Initiative Research Exercise on Community Tree Seeds (DIRECTS) project. This project, a consortium of forestry institutions in 16 African countries, investigated seed physiology and provided training for the longer term conservation of community tree seeds in sub-Saharan Africa. Seeds of more than 60 identified important tree species have been studied and species information exchanged among partners. The project has involved over 80 scientists in the network, who have been trained to conduct seed research. One of the main information outputs was the production of >20 seed leaflets for key species; these are freely available on the web (see http://sl.life.ku.dk/English/outreach_publications/reports/seed_leaflets.aspx).

Building on the successes and momentum of the past, Kew's Millennium Seed Bank Partnership (MSBP) – a technical network of 120 institutions in 50 countries – has developed a business case for the next 10 years (2010-2020). The Partnership has two main aims:

1. To secure seed from 25% of the world's plant species in safe storage by 2020, and;

2. To enable the sustainable use of plant diversity in agriculture, horticulture, forestry and habitat restoration.

It is in the context of developing the second target, above that the Millennium Seed Bank convened a meeting of MSBP and DIRECTS forestry partners to carry out an analysis of the current status of public sector forestry in Africa and to chart a way forward.

The meeting, entitled 'MSB International Forestry Workshop: afforestation in Africa - constraints and opportunities' was held at the World Agroforestry Centre on the 5-8th December 2011. It was attended by forestry institutes from 11 African countries (Botswana, Burkina Faso, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mozambique, Nigeria, Tanzania and Uganda). In addition, representatives from the Royal Botanic Gardens, Kew, ICRAF, FAO, Forest & Landscape Denmark, UNEP, DFID and others attended. See Annex 1 for a full list of participants.

The participants in the workshop have been guided for the preparation of their country reports to be sent prior to the meeting and for their presentations at the workshop three months later. To ensure uniformity in gathering relevant information, each country reported on the drivers for re/afforestation effort in-country, the scale and range of reforestation activities in-country, the constraints and opportunities in the re/afforestation sector in-country, the partnerships they got in implementing their re/afforestation programmes, and also the drivers for current and future policy for these programmes in the respective countries. We suggested collating in a table technical detailed data on seeds, germination issues, seedlings, quantities and qualities, needs and sources of main tree species (including natives and exotics) used in re/afforestation in the countries. It was as well, important to get their thoughts and conclusions on the implications of those achievements on species conservation and management and on people livelihoods. We also requested in the reports, future activities and the next steps they think are required for enhancing and delivering effective reforestation programmes, using more native tree species. Based on these reports, each participant in the meeting was then given a 20 minutes opportunity to talk about the forestry situation in their country and to respond to the audience's questions. The latter part of the meeting was then spent in plenary, discussing common issues and charting a way forward. The main findings of the workshop are synthesised in the following section, with much greater detail covered in Tables 1-3.

Synthesis of workshop findings

Trends in deforestation

Figures on deforestation in the African countries represented at the meeting were presented by both national forestry institutes and by FAO.

According to FAO's figures, of the participating countries, Mozambique has the most forest cover remaining (39,022,000 hectares) followed by Tanzania (33,428,000 ha), Madagascar (12,553,000 ha), Ethiopia (12,296,000 ha), Botswana (11,351,000 ha), Nigeria (9,041,000 ha), Burkina Faso (5,649,000 ha), Ghana (4,940,000 ha), Kenya (3,467,000 ha), Malawi (3,237,000 ha) and Uganda (2,988,000 ha). In percentage terms Mozambique again has the highest forest cover (50% of its land area), followed by Tanzania (38%), Malawi (34%), Ghana (22%), Madagascar (22%), Burkina Faso (21%), Botswana (20%), Uganda (15%), Ethiopia (11%), Nigeria (10%) and Kenya (6%).

Net deforestation is taking place in all the countries represented at the meeting. Forest cover, in terms of actual area, is being removed fastest in Nigeria (410,000 hectares per annum), Tanzania (403,000 ha) and Mozambique (217,000 ha). As a proportion of what remains, forest is being removed most rapidly in Nigeria (-3.7%), Uganda (-2.6%) and Ghana (-2.1%). Kenya (-0.3%) and Madagascar (-0.4%) have the lowest deforestation rates.

Perceptions of rates of deforestation differed amongst participants compared to the FAO figures. This may partly be due to different definitions of forest, and different methods employed for measuring its disappearance. Delegates from Burkina Faso and Ghana presented deforestation figures that were higher than those of FAO; delegates from Kenya and Nigeria produced figures in agreement with FAO; and delegates from Tanzania presented figures significantly lower than those of FAO. Other delegates did not produce deforestation figures.

Afforestation capability

All the public sector forestry institutions represented at the meeting produce significant numbers of seeds and seedlings on an annual basis.

Seeds collected generally fall in the 4-8 tonnes per annum range. Tanzania is the exception, collecting up to 12 tonnes per annum. Seeds are supplied in similar amounts, usually with a small proportion of seed being carried over and held as stock. On average, the forestry institutes in the 11 countries supply 40 tonnes of seed per annum.

Production of seedlings varies enormously amongst the partners from 50,000 per annum in Botswana to 140 million in Tanzania. On average, the forestry institutes in the 11 countries supply 398 million seedlings of 558 species per annum.

In all of the participating countries, the majority of seeds and seedlings supplied by public sector forestry organisations are of exotic species. Tanzania is an exception in that 65% of the species it supplies by number are indigenous species (although only 35% by weight). The main exotic taxa supplied to users are *Pinus*, *Eucalyptus*, *Casuarina*, *Grevillea*, *Acacia* (usually Australian), *Gmelina*, *Leucena*, *Azardirachta* and *Tectona*[1].

All of the forestry institutions present at the workshop also supply indigenous tree seeds and seedlings although in lower amounts than exotics. On average, the participating forestry institutions routinely provide 38 species, although the numbers range from 20 to 200 species depending on the institution. Between them, Millennium Seed Bank partners have expertise in the collection, processing, germination and storage of around 120 indigenous tree and shrub species, providing ample opportunity for broadening species portfolios in agroforestry and catchment restoration for example.

The policy context

[1] It is worth noting that many of these species have invasive and/or allelopathic properties when planted in the wrong place.

All of the Governments represented at the meeting have national policy in place that supports afforestation activities. These policies are reflected in national schemes in all of the countries that provided information on afforestation policy: Botswana (National Tree Planting Day); Burkina Faso (Village Wood Programme); Ethiopia (Forest development, conservation and utilization Proclamation 542/2007); Ghana (National Forest Plantation Development Programme); Kenya (Kenya Constitution 10% target)Mozambique (National Plantation Programme 2005); Nigeria (National Afforestation Programme); Tanzania (2002 National Forest Programme) and Uganda (National Forest Plan). Perhaps the most ambitious national scheme is that of Kenya. In Kenya's new Constitution, every farmer is required to plant 10% of their land with trees.

All of the countries that reported on afforestation policy have afforestation programmes that involve communities in participatory management. Examples of engagement with schools include the Forestry Conservation Botswana funding scheme (supported by the Government of Botswana and USAID) and Kenya's 'adopt a tree' scheme. Examples of working at the village community level include Burkina Faso's Village Wood Programme involving 8000 villages and 8000 forests, and Uganda's Community Tree Planting Fund. Schemes aimed at farmers include Kenya's Farm Forestry Field Schools, Uganda's Farm Income Enhancement and Forestry Conservation Project and Saw Log Production Grant Scheme, and Ghana's Modified Taungya System.

Many of the participating forestry institutions have decentralised models with public-private partnerships forming important parts of their portfolios. Government seed and seedling suppliers in Madagascar, Tanzania and Uganda are semi-autonomous and are able to raise and reinvest their own revenue: all have networks of nurseries and extension services. In countries like Nigeria and Ethiopia afforestation activities are implemented at the state level. Most of the participating organisations outsource some of the products and services they provide. The Kenya Forestry Service, for example, buys 80 million seedlings a year from private nurseries, many of them owned by communities and small scale entrepreneurs/farmers. Other examples include Uganda's Saw Log Production Grant Scheme and Farm Income Enhancement and Forestry Conservation Project. The Government forestry institutes in Mozambique, Ethiopia, Ghana, Kenya and Uganda work on plantation establishment and management in partnership with private companies. Malawi's Forestry Research Institute works with LaFarge on habitat restoration.

Botswana, Burkina Faso, Kenya, Malawi and Kenya reported on a growing demand for indigenous species, particularly in agroforestry and habitat restoration. Ghana and Mozambique said that there was currently little demand for indigenous species in their countries.

Botswana, Burkina Faso, Ethiopia, Kenya, Malawi and Kenya reported on existing or future activities in the context of climate change, carbon offsets and REDD+. Biodiversity is an explicit component of afforestation policy in Botswana, Burkina Faso, Ethiopia, Kenya and Tanzania.

Strengths of public sector forestry in Africa

Collectively the forestry institutes and tree seed centres felt that they had strong technical skills in plantation forestry based on a long track record working with fast growing exotic species. At the other end of the afforestation spectrum, the Millennium Seed Bank partner organisations (Botswana, Burkina Faso, Kenya, Madagascar, Malawi and Tanzania) have strong knowledge of the collection, processing, storage and use of a wide range of indigenous species. All the institutions thought that they had good knowledge of seed sources, local conditions, ecosystem services provided by trees and the wants and needs of local communities. Infrastructures are generally good, and well established over a long period thanks to the long term nature of public sector institutions. All the institutions felt that technical networks and the information exchange they engender is a strength. Institutions like ICRAF and the MSB were cited as useful providers of technical support and information, enabling innovation.

Individual partners in the network identified key strengths as: high quality seed sources (Kenya, Tanzania, Uganda); production of plants (all); working with local communities (all); training of local producers (Burkina, Kenya, Uganda); participatory forest management (Ethiopia, Tanzania); watershed/watercourse protection and rehabilitation (Ethiopia, Kenya, Tanzania); working with industry in plantation forestry (Ghana, Mozambique, Uganda); trials and improvement of indigenous species (Ghana, Kenya, Malawi, Tanzania); development of technologies for sustainable management of natural forests and biodiversity (Ghana); and carbon offset projects (Kenya).

Kenya, Tanzania and Uganda forestry services all felt that being semi-autonomous was a strength, as it resulted in reduced political pressure and influence from other parts of Government, the opportunity to raise and mobilise resources, and the ability to engage with all sectors, including local communities, commercial companies and the development sector.

All the participating institutions were sources of high quality seed compared to much of the seed available from the private and civil (NGO) sectors (see ‘Threats’ below).

Weaknesses of public sector forestry in Africa

Many of the participating organisations identified policy and regulatory weaknesses in areas such as domestication/commercialisation of indigenous species (Botswana); fire

management (Burkina); sustainable management of forest resources (Burkina); land use planning (Ethiopia); seed quality (Kenya); and importation of seeds (Uganda).

Collectively the participating institutes felt that forestry is generally regarded as a low priority by governments. The contribution of forests and forestry to GDP is invariably underestimated, and funding for research on forest genetic resources comes a very poor second to agriculture. Forestry education is weak, and rarely features in tertiary education curricula. Either as a cause or consequence, connections and access to policy makers and funding is generally weak, and the capacity to attract funding is poor.

Forestry departments are, in some cases, embedded in large Ministries with other, larger departments, such as Agriculture, Environment or Tourism (e.g. Ethiopia) leading to 'poor cousin' status. Forestry departments and tree seed centres don't always work together, and information dissemination channels are weak, linked to the collapse or erosion of extension services. Community engagement is often poor as a result.

Staff retention is poor in many government forestry institutes, linked to lack of funding, poor salaries and limited support. Skill shortages in key technical areas are often the result (e.g. Nigeria). In one case it was said that there are 'lots of people at desks with degrees' but a lack of technical staff at lower levels. Some key technical skills, e.g. tree breeders are missing in some countries (e.g. Uganda). Facilities (seed centres, nurseries etc.) were felt to be poor in some countries (e.g. Ghana, Nigeria, Uganda).

Government forestry departments are generally poor at enforcing laws and regulations due to lack of capacity. This has led to the erosion of *in situ* seed sources (e.g. Ghana). Weakness in natural resource management capacity of forest genetic resources *in situ* (e.g. forest reserves) was identified in several institutions (e.g. Burkina Faso, Ghana, Nigeria). This lack of security in forest plantations and reserves puts off private investors (Nigeria).

It was acknowledged that Government institutions often have poor understanding of value chains and markets. For example, predicting market demand is often difficult, and nursery managers often don't have good business skills. Government nursery managers are happier sticking with what they know (fast-growing exotics). As a whole, Government tree seed centres mainly produce exotic species, which are not always appropriate (e.g. Ethiopia, Ghana). The view was expressed that Government institutions are generally risk averse and not competitive in the market place.

Research weaknesses include: a lack of economic analysis of the relative performance of indigenous tree species; genotype/environment interactions; the importance of local provenances; phenology data for indigenous species; optimal storage conditions for indigenous trees; propagation protocols for some indigenous trees; growth and yield data

for estimation of annual allowable cut; no cover or deforestation data for some forest reserves.

Opportunities for public sector forestry in Africa

All of the participants cited increasing public and political awareness of the importance of sustainable natural resource management as creating an opportunity for afforestation activities. Ecosystem services, climate change, carbon capture, biodiversity offsets and sustainable livelihoods all present opportunities for new afforestation partnerships with government, NGOs, the multilaterals, the private sector and others.

Government policies and large scale schemes supported by donors are creating new markets and opportunities, for example: the Kenyan constitutional 10% farmland policy; Botswana district afforestation scheme; the National Forest Plantation Development Programme and others (Ghana); the Mau catchment restoration in Kenya; the Adopt a Tree schools programme in Kenya; the Mozambique Plantation Programme; Nigeria's National Afforestation Programme; and a range of schemes in Uganda such as the Farm Income Enhancement and Forestry Conservation Project.

All of the institutions saw the opportunities afforded by the decentralisation. Decentralised tree seed centres, extension services, local enterprises and the participation of the private sector were all seen as an opportunity to scale up and reach more communities and individuals. Afforestation is seen as a means to improve people's lives through income generation and to improve ecosystem services (fuel, timber, food etc.) at the same time taking pressure off natural vegetation. The caveat is that certification related to quality and sustainability is necessary not only for international markets but also for local markets.

All of the participants felt that the technical consortium proposed by this workshop, built on decades of bilateral relationships, created a major opportunity in a number of technical areas: in the use of new techniques, such as potential vegetation mapping; exchange of information on indigenous knowledge and use; the use of biotechnology for growing difficult species (e.g. through micropropagation); new knowledge developed on domestication; and exchange of seeds and materials.

The Consortium was also seen as an opportunity to better engage with policy makers and donors, and to greatly scale up afforestation activities.

All felt that identification of an increasing range of forest products for an increasing range of purposes will drive demand for trees (e.g. food, fuel, construction, carbon, biodiversity offsets). Indigenous species, in particular, were believed to be an untapped resource with enormous potential value (if they can be marketed properly – see 'Threats' below). The value and opportunity afforded by entrepreneurial training was also mentioned.

Threats to public sector forestry in Africa

Lack of continuity, leadership and long term thinking were cited as major threats to afforestation in Africa. Donor faddism was included as a challenge in this context. Natural resource management has not been in vogue amongst donors or Governments in Africa for the past 20 years. Forestry is a long term enterprise, and needs long term and sustained support. Many felt that the contribution of forestry was still undervalued by local decision makers and by donors. Banks do not finance forestry establishment. It is thought to be too risky and the repayment period too long (Uganda).

Corruption in the public sector was identified by some countries as the major threat to *in situ* forest management. Incessant encroachment in forest reserves and illegal logging were specific threats mentioned (Nigeria, Uganda). Loss of seed sources is one direct consequence that undermines afforestation activities. The deforestation drivers are well known and understood: increasing population; demand for fuelwood; land conversion; fires; desertification, climate change; lack of regulation and enforcement; the predominance of the (unsustainable) informal economy, and so on. All the participating organisations felt that Government policy had not got to grips with tackling these causes of deforestation.

All felt that Government natural resources management and development policies were frequently not joined up. Policies are fragmented and incoherent.

Many of the public sector forestry institutes that attended the workshop felt that donor funded projects supporting NGOs can compromise and undermine the development of seed/seedling supply enterprises. It was felt that markets are often distorted by external organisations (especially NGOs) that are not interested in long term effects and sustainability. Free distribution by Governments and NGOs distorts the market and is a major challenge in some countries. Unpredictable markets (e.g. Moringa, Bixa, Jatropha etc.) were cited as creating unrealistic expectations and creating boom and bust conditions that undermine innovation.

Without Government regulation or support, it was felt that there would continue to be an over dependence on what customers already know (i.e. fast growing exotics). Customers are often unwilling to buy indigenous species (e.g. Mozambique) even though better adapted, fast growing indigenous species are available.

Some participants reported that there seemed to be a lack of understanding by customers that quality seed is a better investment. Seed quality issues were identified as a major challenge. Many privately owned tree nurseries do not attach importance to quality (e.g. Uganda) and, without regulation, this undermines the market for seeds and seedlings. Exotic invasive species, previously promoted as agroforestry species (e.g. *Prosopis juliflora*), were identified as major challenges in some countries.

Conclusions

The analysis carried out above has highlighted many of the strengths and weaknesses of public sector forestry in Africa. The plenary sessions of the workshop concentrated on the opportunities – particularly the opportunities afforded by the establishment of a mutually supportive technical consortium that would include a range of facilitating/support organisations with complementary expertise, and an array of delivery organisations who could put trees back in to the landscape.

A tentative name for this consortium is 'Forest Landscape Africa', and the consortium – in the first instance - will comprise the following partners:

Facilitating organisations providing technical support and coordination: World Agroforestry Centre (technical areas: agroforestry, seed sources, provenance, appropriate species, seed supply systems, capacity building); Forest and Landscape Denmark (appropriate species, seed supply systems, capacity building); Kew's Millennium Seed Bank Partnership (seed quality, collecting, processing, germination, storage, diversity, capacity building); Food and Agriculture Organisation (impacts on landscape, evaluation, monitoring, assurance, capacity building); United Nations Environment Programme (links to development sector, policy makers and policy advice).

Delivery organisations carrying out afforestation on the ground: forestry research institutes, forestry departments and national tree seed centres from 12 African countries: Botswana, Burkina Faso, Ethiopia, Ghana, Kenya, Madagascar, Mali, Malawi, Mozambique, Nigeria, Tanzania and Uganda.

The Forest Landscape Africa consortium will deliver the following:

- Large scale tree planting on the ground. On average, each of our delivery organisations produces 7 tonnes of seed and 24.5 million seedlings per annum.
- A diverse range of tree species appropriate to place and purpose, including more than 550 indigenous tree species appropriate to carbon and biodiversity offsets, REDD+ and catchment restoration.
- Public-private seed supply systems maximising benefits to communities and livelihoods.
- A long term approach, from seed to tree to product to market.

- The highest quality assurance, based on world leading scientific knowledge, from seeds and seedlings through to resilient landscapes.

- An established track record in agroforestry, utility forestry and habitat restoration.

Next steps for the establishment of this consortium were discussed, and outlined as follows:

1. Produce a Synthesis of the findings of the workshop for circulation to policy makers and other stakeholders (this document) (Kew lead, February 2012).

2. Synthesise vision and capability of the Forest Landscape Africa consortium into a Prospectus to present to sponsors. (Facilitating partners, February 2012)

3. Project ideas, concepts and proposals developed by delivery partners at local, national and regional level. (Delivery partners, February 2012)

4. Write up the Proceedings of the meeting and publish as a report (Kew, August 2012).

5. Follow up workshop presenting vision and concepts/proposals to policy makers, sponsors, donors and supporters (September 2012).

II- COUNTRIES' TREE SEED AND BIODIVERSITY CENTRES' REPORTS:

1-BOTSWANA

2-BURKINA FASO

3-ETHIOPIA

4-GHANA

5-KENYA

6-MADAGASCAR

7-MALAWI

8-MALI

9-MOZAMBIQUE

10-NIGERIA

11-TANZANIA

12-UGANDA

TOWARDS AFFORESTATION AND LIVELIHOODS IMPROVEMENT: MSB-UPP CONTRIBUTION IN BOTSWANA

Dr. Kebadire K. Mogotsi and Dr. Samodimo Ngwako
Department of Crop Science and Production
Botswana College of Agriculture (BCA)
Gaborone, Botswana

Abstract

Botswana is a semi-arid country that exposes natural sources especially plants to stress. The stress is translated into high level poverty among communities that live in the marginal lands of the country. Additional source of stress are land degradation, deforestation, overgrazing, bush encroachment that impact negatively on the fragile and vegetation of Botswana. In an effort to promote afforest/reforest in the country, the government has established an annual national tree planting day (NTPD) issuing 50 000 tree seedlings to free tree seedlings to the communities annually and sells the rest at highly subsidized price. The country is still bear. It is possible that this is either not understood, Batswana are not yet able to plant tree especially indigenous trees, there is lack of skill and knowledge in afforestation or people do not know the benefits of planting trees and/or conservation. Although not strictly working with trees, MSBP-UPP Botswana since 2003 has been among other things working with communities collecting and conserving seeds of indigenous plant species, establishing indigenous plants gardens as demonstration or research plots and building capacity in all areas of conservation for utilization. School gardens are also established to enhance teaching and learning of science, agriculture and environmental science. Forty-three plant species have been propagated in the gardens. The number of plant species growing in the gardens is higher (up to 52) as additional species are naturally occurring and are being conserved. The MSBP has collected and conserved over 700 plant species since 2003 and UPP 108 since 2008. Twenty six species are being propagated through seeds and cuttings in the communities and at BCA. Other funders and partners are participating in the project. These include Forestery Conservation Botswana Fund between Botswana and the USA, Sida/SLU and numerous local institutions. Product development in the communities has shown that conservation for utilization is working in Botswana.

Keywords: afforestation, communities, livelihoods, conservation

Introduction

Botswana is endowed with a vast land of approximately 581,730 km^2. Up to 488,654 km^2 (84%) is covered by the dry savanna or the Kgalagadi (Kalahari) desert. In the northwest, the Okavango river drains inland from Angola to create 17 000 km^2 of wetlands, (the Okavango Delta). The ecosystem also consists of the sand dunes in the south to south west, sparse grasslands, and mophane (*Colophospemun mopane*) woodlands in the north and *Acacia* species across the country to the Makgadikgadi and Nxai saltpans. This translates to a very fragile ecosystem that carries about 3,000 plant species, 164 mammalian, 157 reptiles, 550 birds species, a large numbers of insects. Most of the fauna depend on the flora as source food thus first classical pressure on the plant resources.

The people of Botswana, especially those living in marginal regions of the country have derived livelihoods from these indigenous resources, especially plant based resources as hunting is prohibited. As agricultural production intensified over the years, the country has experienced high levels of land degradation, deforestation, overgrazing, bush encroachment. Research and development on how to reverse the situation, domestication and cultivation of indigenous plant species to create resources tenure is limited. This has led to a number of challenges such as:

- lack of policy on domestication, cultivation and conservation of indigenous plant species
- lack knowledge and information on the proper use of the components of the plant (medicinal/nutritional or even poisonous parts of plants), domestication, cultivation and conservation
- over-exploitation and unsustainable harvesting
- lack of market and marketing (packaging, viability, storage/shelf-life) for those collected from the wild

Drivers for Afforestation in Botswana

Government role in afforestation

The government provides tree seedlings at subsidized prices to the public to support afforestation program. The aim is to encourage Batswana to plant indigenous trees to combat desertification and mitigate the impacts of global warming. An annual national tree planting day (NTPD) addition has been established by issuing free tree seedlings to the communities to promote reforestation. The NTPD issues about 50 000 tree seedlings to the public annually.
The National Tress Seed Center (NTSC) is charged with providing about 150 kg tree seeds of high physiological and genetic quality to the government tree nurseries and the public each year. Other major projects that have contributed to afforestation include Botswana Range Inventory and Monitoring Project (BRIMP), Indigenous Vegetation Project (IVP); Okavango Delta Management Plan (vegetation component)t, Community Forestry Development Project (CFDP), Forest Protection and Development Project (FPDP). The Millennium Seed Bank Project (MSBP)

and Useful Plant Project (UPP) have also been providing input in reforestation/afforestation in the country.

Role of Selected partnership in implementing afforestation

Propagation and cultivation of Botswana of indigenous species has been spearheaded by local non-governmental organizations such as Thusana Lefatsheng (TL) and Veld Product Research and Development (VPR&D). These largely supported from external funding. The Millennium Seed Bank Project (MSBP1) - Useful Plant Project (UPP) and partners have intensified the process and currently over forty different plant species have been planted in the initial communities gardens/orchards for research and demonstration of the potential for domestication and commercialization of indigenous plant species.

MSBP – contributing to the health and survival of Botswana plant species through seed conservation and strengthening of Botswana seed conservation capacity. MSB1, partners included but not limited to Royal Botanic Gardens, (**RBG**), Kew, Ministry of Agriculture, National Plant Genetic Resources Center (**NPGC**), Ministry Environment Wildlife and Tourism (National Tree Seed Centre (**NTSC**), the National Herbarium an Botanical Garden (**NHBG)** and other stakeholders.

UPP - *improving the welfare of poor communities and safeguarding useful important plants from extinction in Botswana.* UPP 1 partners included Royal Botanic Gardens, (**RBG**), Botswana College of Agriculture, Ministry Environment Wildlife and Tourism (Department of Forestry and Range Resources; National Tree Seed Centre (**NTSC** and District Forestry Offices). Other partners are Forestry Conservation Botswana Fund, University of Botswana (Office of Research), National Food Technology Research Center, and Swedish University of Agricultural Sciences. The most important partners are the local communities whose efforts in afforestation are tightly bound to their livelihoods.

Constraints and Opportunities in afforestation

Although the country may have a wide range of plant (trees) resources for afforestation, the areas where MSBP-UPP partner communities are, are not suitable for most tree species that are recommended for afforestation (fast growing), due to extreme temperatures, poor soil fertility and persistent droughts. *Sclerocarrya birrea, Adansonia digitata*, *Schinziophyton rautenenii,* Colophospermum *mopane, Berchemia discolor, Elaeodendron transvaalense*, *Cassia abbreviata*, and Strychnos *coculeoides* have performed very poorly in the Kalahari where winter temperatures are extreme (very cold and dry winter and very hot and dry summer) and very poor fertility. However this region is endowed with some high value non wood rangeland products such as *Tylosema esculentum*, *Citrullus lunatus, Ximenia caffra, Grewia flavescence* and *Kalaharituber pfeilli*. Some either trail/ need support, form symbiotic relations with shrubs (savanna woodland) or highly tolerant to stress due to their morphological and physiological development. Therefore, these would need the support of slow growing species. Therefore in the dry and difficult ecosystem of Botswana, afforestation is not only about woody plant system but also the companion plants and other microorganisms.

UPP activities therefore include (1) identifying plant species useful to local communities and value adding/ product development. Value addition/product development include a) formulation of poultry feed using three plant products compared to commercial feed. b) cold press oil extraction, c) sun drying of the Kalagadi truffles, (2) collecting seeds and *ex-situ* conservation, (3) plant propagation, seedling production and nursery management for income generation, (4) establishment of community gardens (5) investigating the photochemistry & eco-physiology of selected plants (6) schools project to enhance teaching and learning of science, agriculture and environmental education modules in basic education.

In addition the conservation needs, abundance of the species, knowledge of the species, proximity to the area of abundance and needs to improve livelihoods are taken into account.

Policy development on emerging crops

During the agricultural sector review consultations, all stakeholders consulted indicated that 'government should promote the cultivation of veld products with the view to diversify livelihood sources for rural communities'. The Ministry of Agriculture has therefore being challenged to lead the policy development on new and emerging crops. The current agricultural policy is encouraging communities in the different ecosystems to utilize the indigenous plant resources in the respective regions. This therefore is a new partnership in afforestation program in Botswana.

Results/ Achievements

MSBP – Botswana has contributed to the health and survival of Botswana plant species through seed conservation and strengthening Botswana seed conservation capacity. Over 10% of Botswana indigenous plant species have been collected and conserved in Botswana and the UK. UPP has collected and conserved 108. Some have been prioritised for cultivation and domestication by communities. Areas of achievements include but limited to:

1. **Priority useful plant species identified and information made available:** working with communities, the following have been prioritized and cultivated in the community gardens. The benefits have started showing.

Table 1: Selected plant species for planting, and product development in the communities

Plant Resources	Part Used	Use
Tylosema esculentum	Seeds, leaves and tuber	Food, medicine, environmental services
Citrullus lunatus	Fruit, seeds	Food, medicine, environmental services
Ximenia caffra	Fruits, leaves, stem, seeds	Food, environmental services
Grewia flavescence	Fruits, stem	Food, environmental services
Kalaharituber pfeilli	fruiting body	Food, medicine, environmental services
Cassia abbreviate	Bark, leaves, roots,	Medicine, environmental services
Elaeodendron transvaalense	Bark, stem, and leaves	Medicine , environmental services
Stomatostema monterroae	Fruits & tuberous roots	Food, medicine, environmental services
Myrothamnus flabellifolius	Leaves and twigs	Medicine, food, environmental services
Sclerocarrya birrea	Fruits , barks, stem, seed, pulp	Food, medicine, environmental services
Cucumis africanus	Fruits	Food, environmental services
Strychnos coculeoides	Fruits, stem	Food, environmental services
Adansonia digitata	Fruits, stem, leaves, seeds	Food, fodder, medicine, cosmetics
Schinziophyton rautenenii	Fruits, barks and twigs, stem, seeds	Food, fuel, medicine, environmental services
Colophospemum mopane	Stem and twigs	Firewood, animal feed, environmental services

2. Propagation of species

Communities have been collecting more useful plant species for conservation and planting in the gardens. The following have been propagated by cuttings or seeds; *Acacia nilotica, Grewia flavescence, Grewia bicolour, Acacia mellifera, Rhus tenuinervis, Vangueria infausta, Olea europaea, Ximenia caffra, Sclerocarrya birrea, Strychnos madagascariensis, Bridellia mollis, Leucaena lucocephala, Elaedendron transvaalense, Grewia flavascence, Strychnos spinosa, Tylosemma esculentum, Azanza garkeana, Jatropha carcus, Mimusops ziyheri, Grewia villosa, Phileneptera violacea, Abrus precatorius, Stomatostemma monterroae, Adansonia digitata, Bauhinia petersiana, Ziziphus mucronata.*

3. Quality of plant material identified, improved and adopted

Three basic poultry diets have been formulated using *Imbrasia belina* (Westood), *Tylosema esculantum* (Burchell) Schreiber and *Vigna subterranean* (L) Verdic) as protein source on growth and laying performance of Tswana hens. A study on purification of the proteins is underway for poultry feed formulation. This will validate the results.

4. **School Activities:** Enhancing learning in science, environmental education and agriculture for grade 5 pupils. The pupils are also involved in seed collection expeditions and exchange visits.

Discussions

All partners have been proactive in the implementation of the afforestation for livelihoods improvement. The project has also attracted both local and international partners to implement biodiversity and plant conservation learning. The government of Botswana is highly supportive initiative as part of the poverty eradication efforts. These activities include local and international students attachments, national tree planting flora, Botswana government policy initiatives (Vision 2016), launching of the 2010 International Year of Biodiversity and provision of information on plant resources of Botswana.

Communities have expressed their commitment in participating in the UPP activities and plant conservation for livelihood improvement, knowledge development and sharing in indigenous plant resources. These include collection, selection, propagation, cultivation and management of plant resources and facilities. The communities defined their needs that could be met by conservation and sustainable use of plant resources and therefore eager to conserve these. This is demonstrated by the ability of the communities to prepare and submit project proposals to other funders.

The communities are implementing projects that they have initiated and mobilized financial resources for them. These have been funded by both local and international funders and are:

- Cultivation of multipurpose trees using saline water in Tsetseng, that will largely be developing an interactive sustainable indigenous plants conservation & utilization strategy and establishing and operating a Learning Resource Centers (LRC)
- Value addition and cultivation of indigenous plant resources (Tylosema esculentum, Grewia flavescence, Ximenia caffra, Citrullus lunatus & Kalahari desert truffles (Kalaharituber pfeilli) in Tsetseng. The objectives were expressed as i) community capacity building in values adding of indigenous plant resources, ii) establishment of conservation areas and maps for Tylosema esculentum, Grewia flavescence, Ximenia caffra, Citrullus lunatus & Kalahari desert truffles (Kalaharituber pfeilli) iii) Value/ and processing of Tylosema esculentum, Grewia flavescence, Ximenia caffra, Citrullus lunatus & Kalahari desert truffles (Kalaharituber pfeilli) at the source (cottage industry) and marketing.
- Cultivation and value addition of medicinal plants in Pilikwe (Tswapong) with the objectives to developing interactive sustainable indigenous plants conservation and utilisation strategy (for community 2), establishing and operating a Learning Resource Centers (LRC), value adding/processing and marketing of medicinal plants. These will not only contribute to plant conservation but to the overall Botswana government strategies on diversification of the economy, poverty eradication strategy and improved livelihoods for communities in the marginal areas of the country.

- Increasing community awareness and utilization of indigenous grains to improve nutrition security and livelihoods in Botswana and Namibia (*Tylosema esculantum* (Burchell) Schreiber) funded by Sida.

Research and development of the Botswana College of Agriculture and partners has been enhanced by the UPP. Both undergraduate and graduate students have been involved as well as students from other institutions have conducted thesis research at UPP sites. The BCA outreach program and in-service training has been greatly influenced useful plants.

Challenges

The following have remained to be challenges for the project and communities:

- Lack of markets for the products produced by the communities due to lack of policy framework on indigenous plant species;
- UPP team (professionals) working on part-time basis in the project;
- Lack of knowledge on cultivation of indigenous plants by communities;
- Harsh environmental conditions (cold winter, high temperatures, low rainfall, strong winds); and
- Human illness and diseases that sometimes delay project activities implementation.

Future Activities

Future UPP activities in Botswana are:

- Expansion of existing gardens and integration of new ones so that, more useful plants can be grown in these gardens for the benefit of the communities. In this case the communities will have to sustain themselves in the near future from the products derived from the gardens. This will also provide options for scaling up. For example, some communities are eager to venture into ecotourism using the unique flora of their regions.
- In school gardens, exotic species have been planted and also the schools are involved in the planting of vegetable crops and this will help the school in future in terms of sustaining themselves instead of buying fruits and vegetables for the shops.
- UPP will continue seed collection in Botswana and produce more seedlings for planting in community gardens and to donate during tree planting days around the country.
- Collaborations with local and international institutions on conservation and propagation of indigenous plants will continue.
- Research areas will include insect diversity, development of propagation protocols, selection of prolific plant species, physiological study (stress tolerance, resource capture and carbon fixation), products development protocols, chemical/phytochemical composition of indigenous plant species for afforestation and livelihoods.

Acknowledgements

The UPP Botswana would like to thank BCA management for support and hosting the project. VPR&D, NTSC, Department of Forestry and Range Resources provided some seeds and

seedlings for planting in the gardens. The Department of Environmental Affairs (Ministry of Environment Wildlife and Tourism) conducted the 2010 International Year of Biodiversity at Tsetseng and re-emphasized the objectives of the project. Sida through SLU has adopted Tylosema esculantum (Burchell) Schreiber. The MSBP-Botswana team assisted in seed collection on behalf of UPP and in collaboration with UPP. Kew staff of both MSBP and UPP also provided unlimited support. The UPP-Botswana wishes to express gratitude to these.

References

Heath A. and Heath, R. (2009). Field Guide to the Plants of Northern Botswana. Kew Publishing, RBG. Kew

IUCN (2000). Medicinal Plant Conservation Newsletter (Vol 6). Medicinal Plant Specialist Group of the IUCN Species Survival Commission. Jackson, J.C., Duodu, K. G., Holse, M., Lima de Faria, M. D., Jordaan, D., Chingwaru, W., Hansen, A., Cencic, A., Kandawa-Schultz, M., Mpotokwane, S. M., Chimwamurombe, P. de Kock, H. L. and Minnaar, A. (2010). The Morama Bean (*Tylosema esculentum*): A Potential Crop for Southern Africa. In: Stephen Taylor, editor: *Advances in Food and Nutrition Research*, Vol. 61, Burlington: Academic Press, 2010, pp. 187-246.

Kawanga, V. (2008). *Cassia abbreviata*. In Schemelzer, G.H and Gurib-FakimA. (edits) PROTA 11 (1). Medicinal Plants. Wageningen, Netherlands

Lambert, D. H., Ryden, P. A. and Esikuiri, E.E. (2005). Capitalizing on the Bio economic value of multi-purpose medicinal plants for rehabilitation of drylands in Sub Saaran Africa. Global Environmental Facility. World Bank, Washington DC, USA.

Tibe, O., Modise, D. M.& Mogotsi, K. K.(2007). Potential for domestication and commercialization of *Hoodia* and *Opuntia* species in Botswana. African Journal of Biotechnology Vol. 7 (9), pp. 1199-1203.

Roodt, V. (1998). Trees and Shrubs of the Okavango Delta. Meidcinal Uses and Nutritive Value, Botswana. Shell, RSA.

Smith, P. (2009) http://www.kew.org/msbp

van der Walt, L. (2004). *Artemisia afra* Jacq. ex Willd. Kirstenbosch National Botanical Garden. South African National Biodiversity Institute.

Van Wyk, B. and van Wyk P. (2007). Field Guide to trees of Southern Africa. Stuik Publishers, South Africa.

BURKINA FASO REFORESTATION PROGRAMME: CONSTRAINTS AND OPPORTUNITIES

[*Programme De Reboisement Du Burkina Faso: Contraintes Et Opportunites*]

Dr. Sibidou Sina
Centre National de Semences Forestieres (CNSF)
Ouaguadougou, Burkina Faso

And

Mr. Adama Doulkom
Direction des Forets (DIFOR), Ministry of Environnent
Ouaguadougou, Burkina Faso

ABSTRACT

Burkina Faso has been suffering a continuing degradation of natural resources for decades, due to both the adverse effects of climate change and the negative effects of human impact (such as uncontrolled land clearing, overgrazing, uncontrolled logging, and bush fires). After the great droughts of the 1970s, Burkina's Forestry Policy was defined by the promotion of reforestation and afforestation, and sustainably meeting people's needs for forest products. Since then, a progressively increasing importance has been placed on national tree planting and reforestation campaigns. As a result, nearly 90 million seedlings have been planted between 1996 and 2010. Burkina Faso's governmental reforestation programmes range from industrial and state plantations through to collective community, family, and individual plantations, using increasingly well-adapted local species. Consequently, this has helped improve the production techniques, collections and genetic diversity of the native species used. One of the priorities of the government policy of restoring degraded lands and implementing reforestation programmes is to involve rural communities, NGOs and socio-professional groups. The involvement of these groups has considerably increased the production capacity of the CNSF (with vital MSB support) to reach on average, three tons of seeds of tree and herbaceous species per annum. Despite such success, the survival rate of seedlings in the field remained medium to low. This prompted the development of a new reforestation strategy, to maintain seedlings until their establishment success. Furthermore, local communities and decentralised local administrations now play an important role in the implementation of reforestation campaigns.

RESUME

Le Burkina Faso est confronté depuis plusieurs décennies à une dégradation continue de ses ressources naturelles, sous les effets néfastes de péjorations climatiques et d'actions

anthropiques (défrichement incontrôlés, surpâturage, coupes anarchiques, feux de brousse). La grande sécheresse des années 1970 a marqué un tournant important dans la politique forestière du pays avec la promotion des reboisements en vue de reconstituer le couvert végétal en diminution et de satisfaire durablement les besoins des populations en produits forestiers. Depuis lors, on assiste d'année en année, à un engouement croissant des différentes couches sociales pour les plantations d'arbres au cours des campagnes nationales de reforestation. Ainsi entre 1996 et 2010, près de 90 millions de plants ont été mis en terre. Dans le même temps, les approches en matière de reboisement ont connu des évolutions majeures allant des plantations industrielles réalisées par l'Etat en passant par les plantations collectives, familiales et individuelles, utilisant de plus en plus d'espèces locales dont les techniques de production, la sylviculture, la physiologie et l'amélioration génétique sont de mieux en mieux maitrisées. Considérée comme l'une des priorités de la politique gouvernementale, la préservation des ressources naturelles et la restauration du couvert forestier impliquent la participation de plus en plus active des différentes couches socio-professionnelles du pays. C'est ainsi que les capacités en production de plants et de plantation se sont considérablement accrues avec notamment la mobilisation annuelle de 3 tonnes de semences d'espèces ligneuses et herbacées en moyenne par le CNSF soutenu par le MSBP. Malgré ces acquis, il ressort des évaluations que les taux de réussite des plantations sont demeurés moyens à faibles en raison d'un certain nombre d'insuffisances récurrentes. Cette situation a amené le gouvernement du Burkina Faso à élaborer une stratégie de production de plants et un cadre directeur pour la mis en œuvre des campagnes de reboisement. En outre, avec l'avènement de la décentralisation, les collectivités territoriales jouent un rôle de plus en plus important dans la réussite des campagnes de reboisement d'autant plus que l'essentiel des terres à reboiser fait partie de leur domaine foncier.

Introduction

Au Burkina Faso, les activités de reboisement ont commencé en 1967 avec le Programme Global de Développement des Communautés Rurales (PGDCR) dans les régions. Ces activités ont été soutenues avec le lancement la même année de « la fête de l'arbre », marquée par une distribution gratuite des plants aux communautés par les Services Forestiers et les Organisations Paysannes de Développement pour la mise en place de plantations aux abords des grandes voies, dans les places publiques et les écoles.

La prise de conscience sur la problématique de la désertification s'est réellement opérée suite aux sécheresses consécutives des années 1970 qui ont engendré une rupture de l'équilibre des écosystèmes, du fait de la dégradation des ressources naturelles. Comme réponse à cette crise écologique, une politique de plantations à grande échelle d'espèces exotiques telles Eucalyptus camaldulensis, Cassia siamea, Azadirachta indica, Gmelina arborea a été développée, et souvent en substitution des espèces locales considérées alors comme peu productives.

Réalisées sans l'implication des populations, ces plantations n'ont pas permis de freiner le processus de désertification qui, au fil du temps s'est étendue à l'ensemble du territoire. Cette situation est la conséquence de la perte des habitats engendrée par les activités agricoles et pastorales et les changements climatiques. En effet, le pays perd chaque année plus de 110 000 ha de formations forestières.

Au plan floristique, des investigations réalisées au niveau des différentes zones écologiques mettent en évidence 62 espèces menacées sur l'ensemble du Burkina Faso (annexe 1) se répartissant comme suit :

- 20 espèces dans la zone sahélienne
- 33 espèces dans la zone nord-soudanienne
- 31 dans la zone sud-soudanienne.

Ces menaces sur les formations végétales ont engendré une dynamique négative avec un accroissement de plus de 32 % de zones à tendance négative entre 1992 et 2000 donnant ainsi un taux d'ensemble de plus de 43% de zones dégradées au Burkina Faso en 2000 (fig. 1).

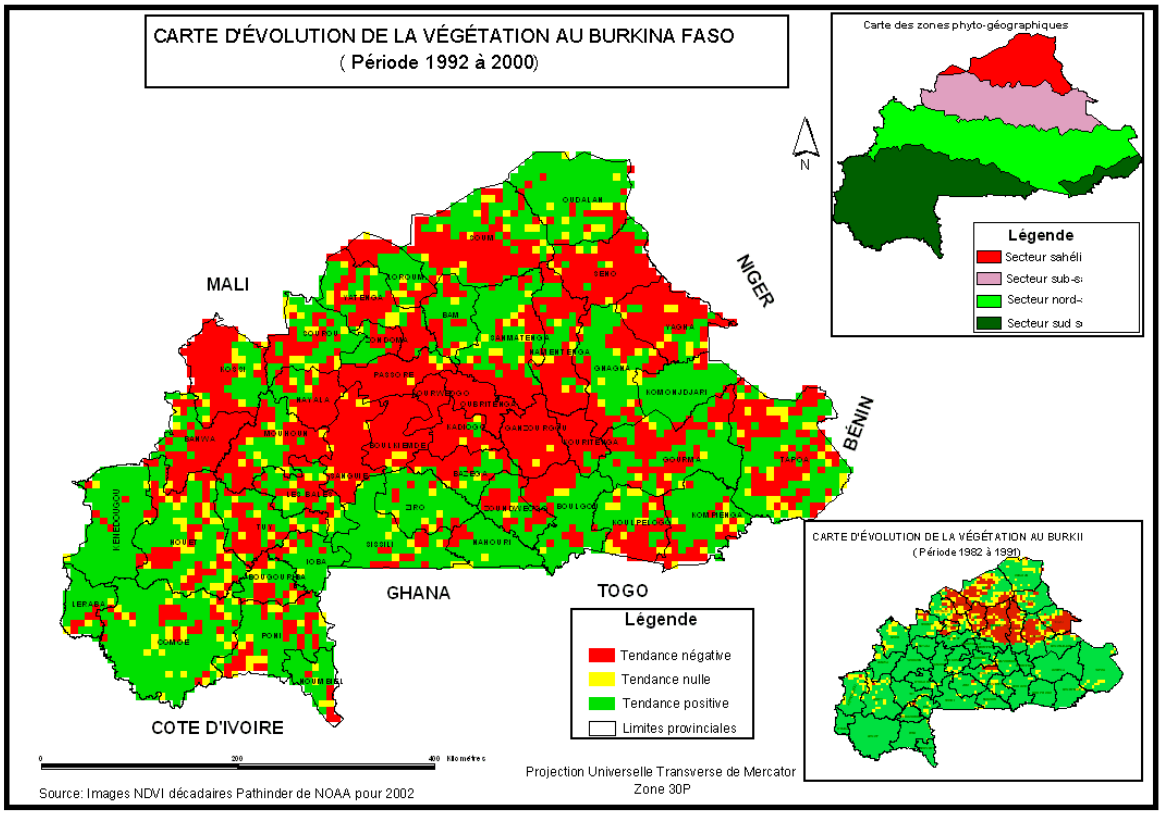


Fig. 1 : Evolution des formations végétales du Burkina Faso entre 1992 et 2000

La persistance du phénomène de désertification a conduit à la prise d'une série de mesures dont la création en 1976 d'un Ministère en charge de l'Environnement et la formulation à partir de 1978 de programmes de reboisement villageois avec la participation des populations, qui ont connu des améliorations successives en adéquation avec les cadres d'orientation stratégiques et politiques en cours, notamment la Politique Forestière Nationale de 1998, le Cadre Stratégique de Lutte contre la Pauvreté, le processus de décentralisation en cours, la stratégie de politique de Développement Rural Décentralisé.

Pour la mise en œuvre des programmes, plusieurs projets de reboisement ont été exécutés dans l'objectif de réduire la régression des superficies forestières résultant principalement des défrichements non contrôlés, de la pratique des feux de brousse et de l'utilisation du bois comme principale source d'énergie.

La majorité des plantations a été réalisée avec l'appui financier de la Coopération bilatérale (Suisse, Allemagne, Pays Bas, France,…) et multilatérale (PNUD, FAO, Banques,…)

Une liste exhaustive des projets intervenant la reforestation est présentée à l'annexe 2.

Les différents programmes et projets d'appui à la reforestation au Burkina ont bénéficié des semences produites par le CNSF qui, annuellement met à la disposition des acteurs, en moyenne trois (3) tonnes de semences forestières ligneuses et herbacées à multiples vocations : alimentaires, médicinales, fourragères, restauration des zones dégradées, génération de revenus, etc.

Quant au choix des espèces prioritairement retenues pour le reboisement, la conservation et la recherche, trois critères essentiels sont pris en compte:

- l'intérêt pour les populations
- la valeur socio-économique
- le niveau de menace

L'annexe 3 présente la liste des espèces utilisées dans le reboisement selon le niveau de priorité en fonction des régions écologiques du pays.

Contexte

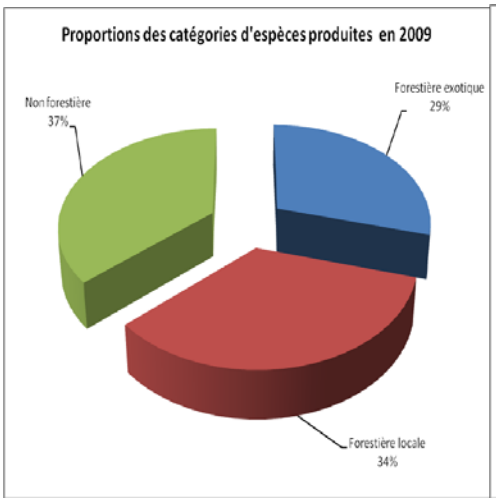
La politique du Burkina Faso en matière de reforestation et de conservation traduit une volonté des autorités gouvernementales à inverser la tendance de dégradation.

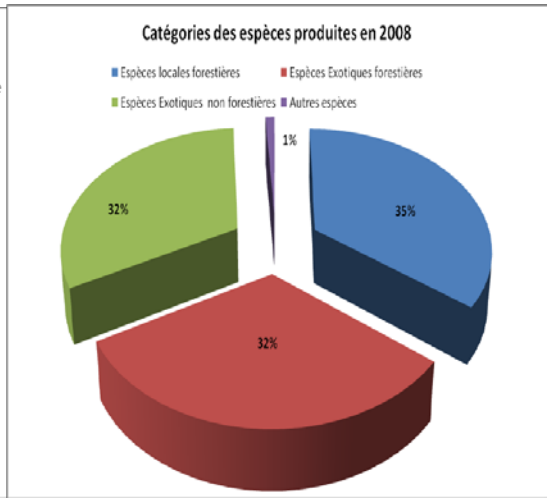
En effet, le pays qui est signataire de la convention de Rio sur la Diversité Biologique, s'est doté depuis plusieurs années d'instruments juridiques permettant d'assurer la gestion durable et la conservation des ressources biologiques. C'est ainsi que le plan stratégique de mise en œuvre de la convention a été élaboré. En outre, dans le cadre de sa politique d'ensemble sur l'environnement le Code Forestier a vu le jour avant de connaître une relecture ces dernières

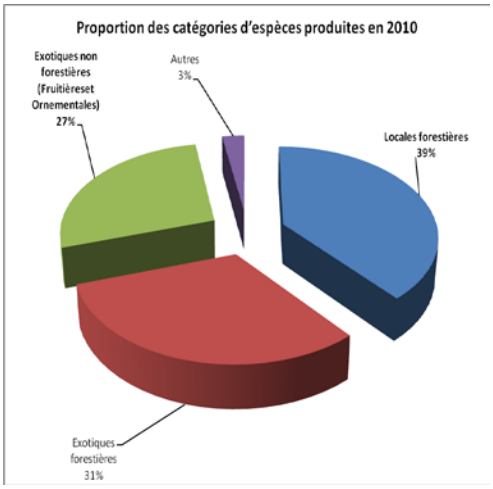
semaines au niveau de l'Assemblée Nationale afin d'assurer une plus grande efficacité dans la conservation des ressources forestières.

Une autre volonté affichée par le gouvernement réside dans la recherche d'une meilleure gestion des aires classées qui constituent des réservoirs importants de biodiversité. Le Burkina Faso est l'un des rares pays en Afrique sub-saharienne à expérimenter ce mode de gestion qui consiste à confier la gestion de certaines aires classées pendant une période déterminée et selon un cahier de charges. La durée de la concession qui était de 10 ans en 1996, est passée à 20 ans à partir de 2006. Les 3 figures ci-dessous indiquent que la part des espèces locales en 2008, 2009 et 2010 se situe entre 32 % et 39%.

Proportion d'espèces locales et exotiques







Opportunités et contraintes

Les résultats obtenus ces dernières années indiquent les points positifs suivants :

- la disponibilité d'une large gamme de semences forestières de qualité améliorée ;
- l'accroissement du nombre d'espèces locales en plantation mieux adaptées aux conditions écologiques des différentes zones du pays ;
- l'implication de plus en plus forte des différents acteurs du développement dans les efforts de reforestation à travers le pays.

En termes de contraintes, on notera les principaux points suivants :

- La question de la protection des plantations contre la divagation des animaux qui constitue la principale cause de la mortalité des plants ;
- la question de la sécurisation foncière qui n'incite pas les planteurs à s'investir convenablement dans les actions de reboisement ;
- l'inexistence des espaces de conservation prévu par le code général des collectivités, et l'insuffisance de terres à consacrer aux bosquets de Maire ou de Jeunesse dans certaines communes ;
- l'insuffisance des moyens financiers, matériels et humains au niveau des services forestiers qui constitue une entrave aux activités de suivi , d'encadrement et d'appui technique aux acteurs ;
- la faible capacité technique des agents et des producteurs en matière de production, plantation, protection des plants et suivi évaluation des opérations de reboisement;
- l'improvisation des actions de reboisement due à l'absence de planification ;
- l'urbanisation croissante des centres urbains, entrainant la disparition de nombreux boisements.

Partenariat

En dehors des partenaires techniques et financiers bilatéraux et multilatéraux, on note une grande diversité d'intervenant dans l'activité de production de plants et de reboisement. En effet, l'activité est exercée par :

- des pépiniéristes publics et privés qui produisent les plants pour les besoins de reboisement à diverses fins. Les pépiniéristes privés contribuent selon les statistiques à plus de 70 % de la production totale annuelle en plants ;
- des institutions de recherche comme le CNSF et le CNRST qui génèrent des données sur la domestication des espèces locales ;
- des structures de formation universitaire (université de Ouagadougou) et professionnelle telle que l'Ecole Nationale des Eaux et Forêts qui assurent la formation scientifique et technique en matière de sylviculture et d'amélioration génétique ;
- des structures d'encadrement et d'appui comme les directions régionales des eaux et forêts dont le rôle est d'accompagner les producteurs et de coordonner le suivi sur le terrain ;
- les projets et programmes de développement ainsi que des ONG et Associations qui accompagnent également sur le terrain les producteurs ;

- des fournisseurs d'intrants tels les pots plastiques, les produits phytosanitaires, indispensables pour une bonne production de plants en pépinière.

Les différents utilisateurs de plants : qu'il s'agisse des tradipraticiens, des planteurs et paysans forestiers ou des collectivités territoriales, ils sont tous conscients de la précarité de la ressource qu'il faut entretenir pour la satisfaction de la demande actuelle en produits forestiers et pour garantir le devenir des générations futures. A cet effet, ils produisent et/ou plantent chaque année sur des espaces réservés (jardins de plantes médicinales, différents types de bosquets, …).

En plus du concours « Meilleures réalisations forestières », des actions promotionnelles sont régulièrement organisées dans les différentes régions du pays par les autorités publiques pour motiver les producteurs et les collectivités territoriales à mieux s'investir dans la reconstitution du couvert forestier.

Résultats

Les campagnes de reboisement entreprises depuis des décennies ont permis l'atteinte de résultats forts encourageants, en matière de protection, de conservation et de gestion durable des ressources naturelles, ainsi que dans le cadre de la lutte contre la pauvreté à travers des activités génératrices de revenus.

- Les principales activités couramment menées lors des campagnes sont :
- La sensibilisation des populations sur la nécessité de la reforestation ;
- La formation des producteurs et des agents aux différentes techniques en matière de reforestation ;
- La production des plants ;
- La plantation et la protection des plants ;
- L'organisation de concours et de cérémonie de lancement.

Les ménages, les groupements associatifs, les ONG, les projets, les institutions nationales et internationales constituent les principaux acteurs des campagnes de reboisement.

Depuis l'année 2000, les appuis techniques et financiers du MSBP au CNSF ont permis d'élargir la gamme des espèces utilisées pour la reforestation et la conservation. Un accent particulier a été mis sur les espèces herbacées qui constituent d'excellents fourrages et interviennent dans la lutte contre la désertification par la restauration des zones dégradées en réponse aux effets du changement climatique. Ainsi à ce jour, plus de 7000 spécimens de 110 familles, 824 genres et 813 espèces représentant environ 80% de la flore locale actuellement répertoriée, ont été mobilisées.(voir annexe 4).

Pour une maîtrise de l'utilisation des semences destinées à la production de plants, des activités de recherche sur des espèces locales pour lesquelles des données n'existaient pas, ont été développées. Les recherches ont porté entre autres sur les caractéristiques de germination et de conservation d'un certain nombre d'espèces parmi lesquelles: *Spondias mombin, Raphia sudanica, Cola cordilfolia, Pterocarpus lucens, Sclerocarya birrea, Ximenia americana, Cochlospermum planchonii, Vitex doniana, Vitex chrysocarpa, Pentadesma butyracea and*

Strychnos innocua, Parinari curatellifolia, Zanthoxylum zanthoxyloïde, Entada sudanica, Terminalia mollis et Spermacoce stachydea, prakia biglobosa.

En outre, en complément des efforts de conservation, le reboisement constitue l'une des principales armes de lutte contre la dégradation accélérée des ressources forestières. Ainsi de 1996 à 2010, près de 90 millions de plants ont été mis en terre sur une superficie évaluée à 144 000 ha. (Voir tableau1 et figure1 ci-dessous)

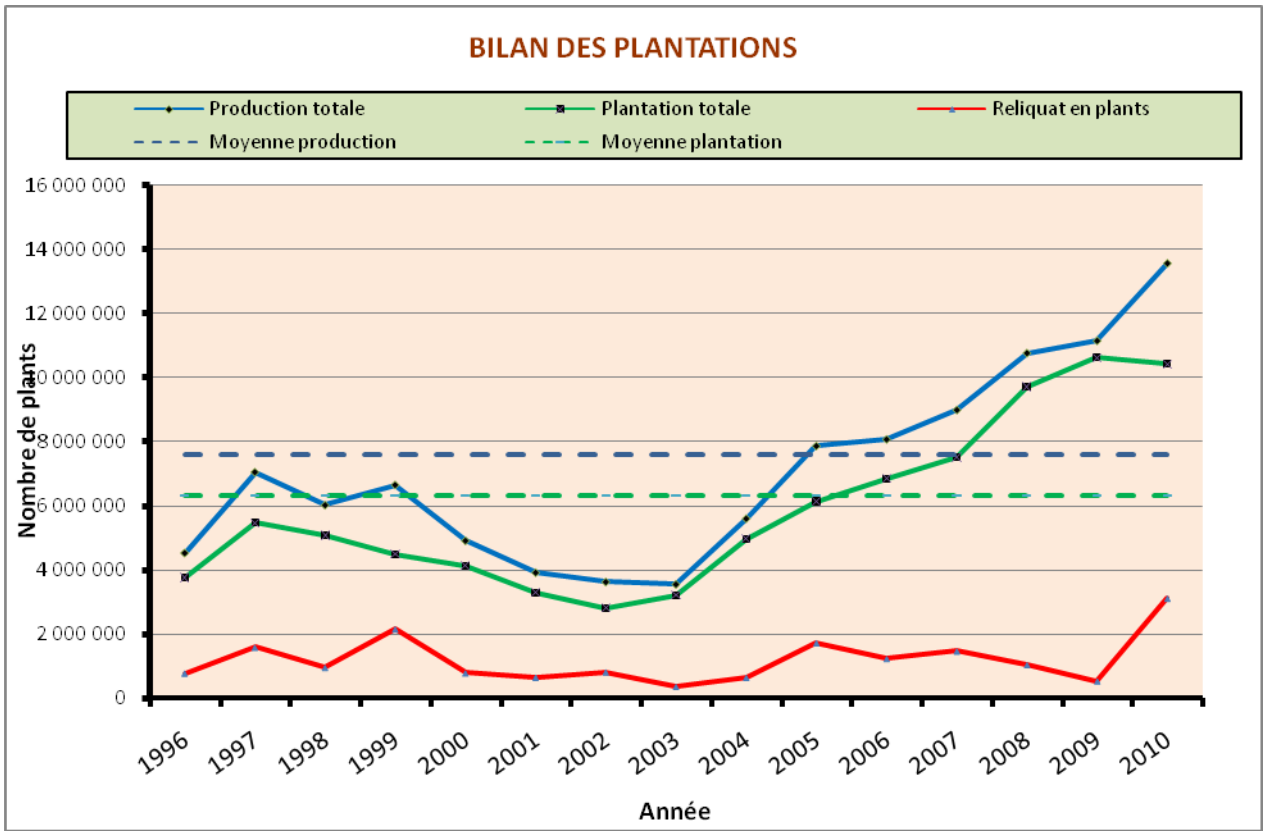
Par ailleurs de nombreuses actions ont été entreprises à l'échelle nationale pour inverser la tendance de dégradation du couvert végétal. Parmi celles-ci on peut retenir :

- le programme Bois de village,
- 8 000 villages, 8 000 forêts,
- un département, une forêt,
- l'opération 65/15,
- les reboisement réalise dans le cadre de Programmes et projets d'aménagement forestier ou à composante gestion durable des ressources forestières (Projet d'Appui à la Gestion participative des Ressources Naturelles dans la Région des Hauts – Bassins (PAGREN), Projet de Gestion durable des Ressources Forestières dans les Régions du Sud - Ouest, du Centre - Est et de l'Est (PROGEREF), le Programme de Lutte Contre l'Ensablement dans le Bassins du fleuve Niger : Composante du Burkina Faso (PLCE / BN), le Projet de Gestion participative et durable des forêts classées dans la Province de la Comoé, le Projet d'Accès au Services Energétiques (PASE) / Composante Biomasse énergie, le programme d'action nationale d'adaptation à la variabilité et aux changements climatiques (PANA), le plan national de lutte contre la désertification (PAN-LCD).

Tableau1 : Etat de la production de plants et des plantations de 1996 à 2010

Année	Nombre pépinières fonctionnelles	Prévisions plants	Production totale de plants	Nombre total de plants mis en terre	Superficie totale plantée (ha)	longueur des haies-vives et brise-vents plantée (km)
1996	-	3 750 000	**4 515 354**	3753194	6 004,0	0,0
1997	1 408	6 500 000	**7 032 750**	5462018	14 046,0	0,0
1998	-	6 000 000	**6 006 747**	5068943	6 331,0	596,0
1999	1 654	6 612 700	**6 637 580**	4493249	7 519,0	415,0
2000	1 051	3 730 306	**4 897 715**	4131141	5 670,0	753,0
2001	641	4 626 825	**3 904 207**	3273208	2 919,0	138,0
2002	1 051	4 094 262	**3 612 621**	2812485	4 736,0	548,0
2003	857	3 289 400	**3 536 996**	3194889	5 952,0	681,0
2004	1 015	4 040 355	**5 584 109**	4956668	6 382,0	568,0
2005	1 155	7 112 303	**7 848 407**	6132433	9 582,0	498,0
2006	1 147	6 527 410	**8 056 610**	6837811	13 026,4	1 663,0
2007	1 322	7 214 723	**8 969 781**	7514820	14 306,0	734,0

2008	1 755	9 384 970	**10 742 459**	9712762	20 105,5	1 468,1
2009	1 903	9 916 405	**11 127 250**	10382273	18 322,0	1 446,0
2010	1 593	9 250 600	**13 539 288**	10428812	9 668,0	1 081,0
total	**16 552**	**92 050 259**	**106 011 874**	**88 154 706**	**144 569,0**	**10 589,2**



Discussion

L'analyse des résultats quantitatifs et qualitatifs de la production de plants pour le reboisement de 2008 à 2010 indique un niveau d'utilisation des espèces locales assez intéressant. Il convient toutefois de constater que ce niveau qui situe autour de 35% est très bas par rapport à la disponibilité de semences d'espèces locales au niveau de la banque de graines du CNSF. En effet, près de 90% des espèces produites sont locales. Ceci traduit une sous utilisation des espèces locales dont l'intérêt est pourtant souvent reconnu en termes d'adaptation. Cette situation peut s'expliquer par plusieurs facteurs dont une maîtrise insuffisante des techniques de production d'un certain nombre d'espèces, une méconnaissance de l'existence et des avantages de ces espèces en relation avec une faible sensibilisation des acteurs de la production de plants et des utilisateurs.

La nécessité de développer une stratégie efficace de conservation et d'utilisation de ces espèces locales requiert un plus grand intérêt en matière de recherche et une plus grande sensibilisation à l'endroit des producteurs, des diverses ONG et associations et même des techniciens du ministère en charge des forêts.

Pour mieux promouvoir l'utilisation des espèces locales, il est important que le ministère en charge des forêts, à travers le CNSF et la direction des forêts, puissent développer des projets pilotes en milieu réel en partenariat avec les communautés, mettant clairement en évidence l'intérêt et l'impact des boisements d'espèces locales.

Si théoriquement près de 90 millions de plants ont été mis en terre sur une superficie estimée à 145 000 ha entre 1996 et 2010, il reste que dans la réalité, les faibles taux de survie de ces plants anéantissent tous les efforts financiers et matériels déployés. Cette situation s'explique à la fois par :

- la mauvaise organisation des campagnes de reboisement qui s'apparentaient à des foires au cours desquelles les plants étaient utilisés sans précaution,
- l'absence de suivi des plants mis en terre, les espaces boisés étant considérés comme des propriétés des agents forestiers, les différentes acteurs n'étant pas associées au processus à la base;
- la divagation des animaux dont le broutement de jeunes plants laisse peu de chance de survie auxdits plants.

Il convient toutefois de remarquer que l'approche participative adoptée par le ministère en charge des forêts ainsi que le développement ces trois dernières années de la nouvelle stratégie qui met en avant les groupes organisés, les collectivités territoriales et les individus, donne des résultats encourageants se traduisant par : taux de survie dépassant 60% dans les plantations, accroissement de l'utilisation de plants d'espèces locales. Cette tendance, si elle se poursuit, permettra à la fois de valoriser nos espèces, de restaurer de nombreuses zones dégradées et d'améliorer la production agroforestière.

Perspectives

Pour donner un souffle nouveau aux actions de reboisement en vue d'accroître la qualité et la durabilité des réalisations, les orientations pour les futures campagnes de reboisement tiennent compte du processus de la décentralisation, en vue de permettre une gestion décentralisée des ressources forestières.

Pour l'atteinte de cet objectif, il est nécessaire qu'un accent particulier soit mis sur le renforcement des compétences des collectivités territoriales en matière de production de plants et de reboisement.

Il s'agira d'inciter les conseils régionaux et communaux à saisir l'opportunité des campagnes de reforestation pour réaliser leurs activités en matière d'environnement et de gestion des ressources naturelles comme prévu dans le Code Général des Collectivités Territoriales.

Pour ce faire des dispositions s'imposent à court moyen et long terme.

A court terme, il s'agira de l'implication et de la responsabilisation des conseils régionaux et municipaux à la gestion des ressources naturelles en général et aux actions de reboisement en particulier dans leurs territoires.

Cela pourrait consister à :

- Sensibiliser les conseils municipaux et surtout les commissions « environnement et développement local » par des conférences, des projections de films suivis de débats sur la nécessité de prendre en main la gestion des ressources forestières de leur territoire ;

- Inciter les conseils municipaux à développer au niveau de chaque commune un tissu relationnel entre les principaux acteurs impliqués dans la gestion des ressources forestières (pépiniéristes, jardiniers, planteurs, sponsors, projets, ONG, associations, leaders, services publiques concernés etc.);

- Apuyer les conseils municipaux à organiser des rencontres de concertation avec tous les acteurs en vue de s'accorder et de planifier des actions prioritaires en matière de reforestation dans la commune. Par exemple : en attendant l'élaboration et la mise en œuvre des plans communaux de développement PCD (volet ressources forestières) les collectivités territoriales pourront canaliser tous les efforts de reforestation de leurs acteurs vers des sites idoines qu'elles auront identifiés et dont elles pourront protéger et entretenir (embellissement des routes et lieux publics, bosquet, espace vert, parc communal, espace de conservation) ;

- Inciter et appuyer la formation des membres des conseils municipaux et surtout les commissions « environnement et développement local » sur les différentes techniques en matière de reforestation ;

- Encourager les initiatives des communes par l'organisation de concours sur les meilleures réalisations en matière de gestion des ressources forestières et inciter les communes à participer à ces concours initiés à leur endroit.

A moyen et long terme, il sera question de contribuer à l'élaboration des plans communaux de développement PCD (volet ressources forestières) entamée avec l'appui de certains projets dont le Programme National de Gestion des Terroirs, et d'acompagner les collectivités territoriales pour la mise en œuvre de ces PCD. Pour ce faire les objectifs spécifiques suivants pourront être poursuivis :

- Contribuer à l'élaboration et à l'adoption des PCD ou autres plans de gestion des ressources forestières des collectivités territoriales ;

- Elaborer et la diffuser un guide méthodologique pour la création et la gestion des aires de conservation ;

- Elaborer et vulgariser des fiches techniques en matière de reforestation à l'endroit des techniciens ;

- Renforcer les capacités techniques des collectivités territoriales en matière de gestion des ressources forestières ;

- Appuyer le transfert de la gestion des ressources forestières aux collectivités territoriales ;

- Appuyer l'aménagement et à la gestion des ressources forestières transférées au profit des collectivités territoriales.

La mise en œuvre de ces perspectives nécessite la mobilisation d'importantes ressources que l'Etat seul ne saurait supporter sans le concours des partenaires techniques et financiers.

Le cycle des activités liées à l'organisation et a l'exécution d'une campagne nationale de reboisement devra respecter le schéma de la figure 2 ci-dessous.

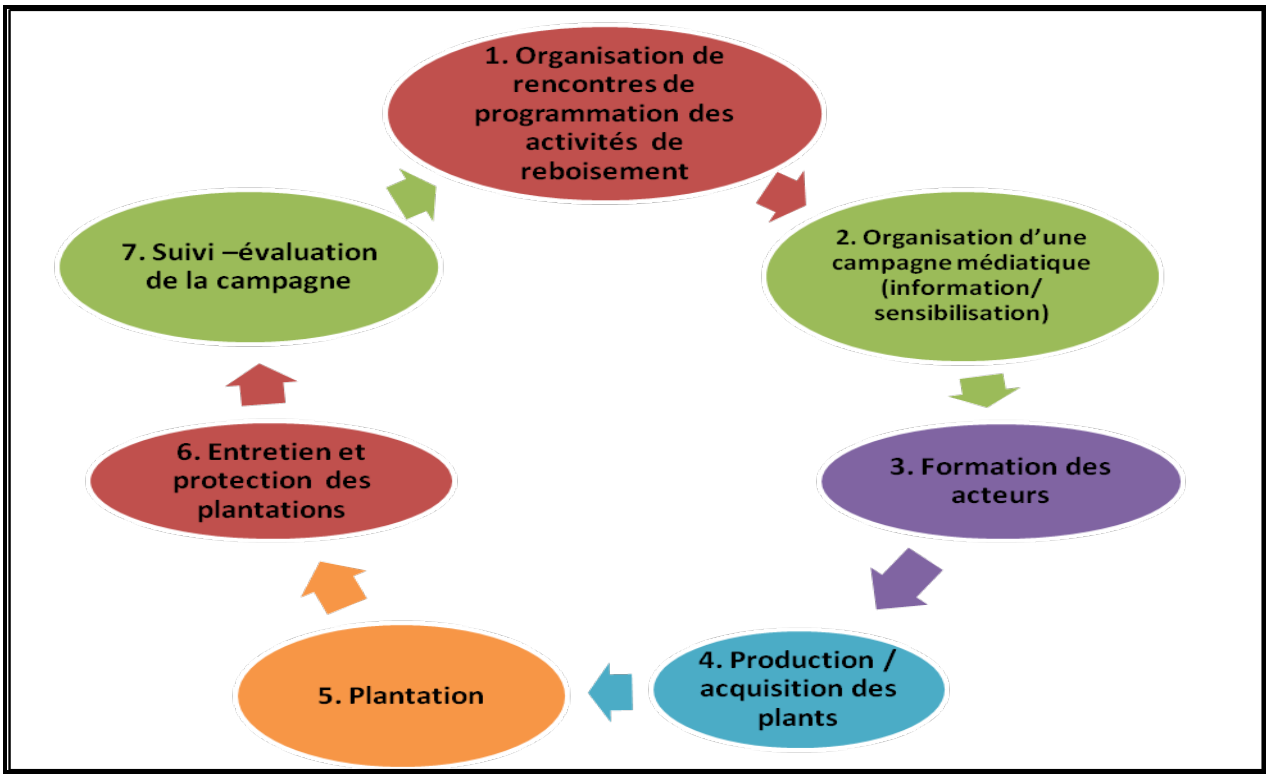


Figure 2 : Cycle des activités liées à l'organisation et à l'exécution d'une campagne nationale de reforestation

Références bibliographiques

Durand J-R & Lévèque C. 1980: Flore et faune aquatiques de l'Afrique sahélo-soudanienne. Tome I, Ed. Paris.

Guinko S. (1984). Végétation et fore du Burkina Faso. Thèse de Doctorat d'Etat ès sciences naturelles. Université de Bordeaux III, 2 tomes.

Hahn-Hadjali K. (1998). Les groupements végétaux des savanes du Sud- Est du Burkina Faso (l'Afrique de l'Ouest). Etude for. Vég. Burkina Faso, 3: 3 - 79.

Hien M. (2001). Etude des déplacements des éléphants, lien avec leur alimentation et la disponibilité alimentaire dans le ranch de gibier de Nazinga, province du Nahouri, Burkina Faso. Thèse unique, univ. Ouaga.

Lebrun JP, Toutain B, Gaston A & Boudet G. (1991). Catalogues des plantes vasculaires du Burkina Faso. IEMVT, France.

Mace, G.M., Cramer, W., Díaz, S., Faith, D.P., Larigauderie, A., Le Prestre, P. (2010). Biodiversity targets after 2010. *Current Opinion in Environmental Sustainability, 2,* 3-8.

Mbayngone E. (2008). Flore et végétation de la réserve partielle de faune de Pama, sud est du Burkina Faso. Thèse Unique, Univ. Ouaga.

Millogo-Rasolodimby, J. (2001). L'homme, le climat et les ressources alimentaires végétales en période de crises de subsistance au cours du 20^{e} siècle au Burkina Faso. Thèse de Doctorat d'Etat. Université de Ouagadougou, Burkina Faso. 248p

Nacoulma-Ouédraogo O. G., (1996). Plantes médicinales et pratiques médicinales traditionnelles au Burkina Faso, cas du plateau central. Thèse, université de Ouagadougou,

Burkina Faso, 261 p.

Ouédraogo A. (2006). Diversité et dynamique de la végétation ligneuse de la partie orientale du Burkina Faso. Thèse de doctorat, Univ. Ouagadougou.

Ouédraogo O. (2009). Phytosociologie, dynamique et productivité de la végétation du Parc National d'Arly (Sud-Est du Burkina Faso) Thèse Unique, Univ. Ouaga.

Ouoba P. (2006). Flore et végétation de la forêt classée de Niangoloko, Sud-Ouest du Burkina Faso. Thèse de doctorat, Université de Ouagadougou.

Rapport d'activités du CNSF, (2008, 2009, 20010)

Rapport d'activités MSBP/ CNSF, (2006 - 2010)

Taïta P. (1997). Contribution à l'étude de la fore et de végétation de la réserve de la Biosphère de la mare aux hippopotames (Bala, Ouest du Burkina Faso), Thèse de Doctorat de Troisième cycle, Université de Ouagadougou.

Thiombiano A. (2005). Les Combretaceae du Burkina Faso: taxonomie, écologie, dynamique et régénération des espèces. Thèse de Doctorat d'Etat, Univ. Ouaga

Thiombiano A. & Kampmann D. (eds.), 2010. Atlas de la biodiversité de l'Afrique de l'Ouest, Tome II : Burkina Faso. Ouagadougou et Frankfurt/Main, 581 p, ISBN 978-3-981-3933-1-6.

Thiombiano A., Doukom A., Diébré R., C. Honadia, & M. Savadogo (2011).Importance, état et dynamique de la biodiversité foresti-redans un contexte de variabilité et de changement climatique. Communication à forum national sur la diversité biologique et les forêts, Ouagadougou, 13-17 avril 2011, 14pp.

THE MSBP: CONTRIBUTION TO BURKINA FASO FLORA'S CONSERVATION AND AFFORESTATION

Dr. Sibidou Sina
Centre National de Semences Forestieres (CNSF)
Ouagadougou, Burkina Faso

Centre National de Semences Forestières

MSB International Forestry workshop
Nairobi, 5-10 December 2011

THE MSBP: CONTRIBUTION TO BURKINA FASO FLORA'S CONSERVATION AND AFFORESTATION

Dr Sibidou Sina , Director CNSF - Burkina Faso (sibsina@fasonet.bf)

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

INTRODUCTION

- The population of Burkina Faso is estimated at 14 millions inhabitants with an annual growth of 3.1%.
- Economy mainly based on agriculture and livestocks' keeping
- Significant rainfall deficit and a fragile environment
- Forests cover a total area of 7 millions ha and the annual losses are estimated to 100.000 ha. This decline in forest areas is mainly due to **deforestation** associated with the **expansion of farmlands**. More than 80% of the population are farmers and about 97% of these people depend on forest resources for energy supply. This type of energy production and consumption is a major factor of pressure on natural resources, which, in addition to climate change, is increasing the erosion of the natural ecosystems.

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

INTRODUCTION

Like other countries in the Sahelian zone of Africa, Burkina Faso is facing the combined effects of natural and anthropogenic factors which are increasing pressures on the natural resources.

Major actions among which plantation programs are undertaken to deal with the encroaching desertification. However, the results are still distrustful for several reasons among which, the difficulties to maintain the planted seedlings alive and also the difficulties to identify the suitable species to use for planting.

The success of afforestation programs requires the availability of seeds of adapted species and a good understanding of the physiology of plant materials used.

In Burkina, the afforestation program is managed by the Department of Forest under the Ministry of Environment and Sustainable Development. CNSF is a key partner in the implementation of the program.

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

CNSF: PARTNER OF MSBP IN BURKINA FASO

- **Creation:** 1983 following the dramatic drought seasons of the years 70s.
- **Main goal:** Provide seeds of improved genetic and physiological quality, in sufficient quantity to support national afforestation program.
- **Activities carried out:**

- Research on sylviculture, ecology, seed technology, genetic improvement of native species
- Seeds Colleting and seedlings production in nursery
- Training on seed harvesting, nursery techniques, and seed physiology

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

CNSF: PARTNER OF MSBP IN BURKINA

- **Some achievements**

- Average 6 tones of seeds of 100 species are yearly collected and 4 tones are distributed mainly in Burkina ;
- So far more than 100 tones of seeds have been collected and distributed mainly in Burkina Faso
- 500 000 seedlings are produced yearly in the CNSF experimental nursery to support reforestation operations for specific needs
- Conservation of genetic resources: 500 seed stands selected throughout the country and managed with the participation of the local communities
- Seed bank with a regional vocation for commercial seed and also for long term conservation purpose

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

Grafted karité (vegetative propagation)

Arabic gum (*A. senegal*)

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

- The MSBP IN BURKINA FASO

Officially started at CNSF in 2000, with the signature of the Access and Benefit Sharing Agreement between CNSF and Royal Botanic Gardens of Kew (RBG).

The specific aim of the project at CNSF is to safeguard as much as possible plant genetic resources from arid and semi-arid areas of West Africa particularly Burkina Faso and Mali, by 2010.

Likewise in many other African countries, the main threats to Burkina Faso's biodiversity are overexploitation of plant resources or setting of new farms on one hand and habitats destruction and reduction due to harsh climatic conditions on other hand.

Forest resources, especially medicinal and utilitarian species, are subject to non-sustainable harvesting and collection, over-grazing and browsing.

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

- The MSBP IN BURKINA FASO

The MSBP in Burkina Faso is contributing directly to the conservation of local flora, through the following activities:

- Expedition for collecting of rare and endemic species and utilitarian species which may be threatened by non-sustainable exploitation. The seeds and their genes are put into secure long-term storage in gene bank at CNSF as well as at the project main seed bank in the UK.
- Valorization of MSBP's collections and living collections cultivation in Burkina Faso. Through the project, is also being built up living collections of some utilitarian species both in collaboration with farmers in rural areas as well as at CNSF in Ouagadougou. This increases the number of useful wild species that have been domesticated and used in planting programs in Burkina.
- Research on seed physiology

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

THE MSBP IN BURKINA FASO

- **Expedition statistics :**

- Species collected:

109 botanical families of 435 genus and 813 native species have been collected to date by CNSF. This is considered to represent about 80% of the Burkina flora.

- **Herbarium management at CNSF**

- Since 2007, the MSB project has begun to capitalize on information about CNSF herbarium specimens collected in a database with the dual aim of safeguarding and facilitating access to such information. The herbarium specimens collecting sheets are registered in a BRAHMS database (Botanical Research And Herbarium Management System).
- The CNSF's herbarium has been registered in the Index Herbariorum in 2008 for its international standard and the number of specimens. This makes up to three the list of herbaria internationally recognized in Burkina Faso; (i) the National Herbarium (HNBF – 6500 specimens) at the CNRST, (ii) the University of Ouagadougou Herbarium (OUA – 2500 specimens) and (iii) the CNSF Herbarium (CNSF – 7000 specimens) at CNSF.

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

THE MSBP IN BURKINA FASO

- **Valorization of collections and living collections cultivation**

- With the aim to facilitate an increase the use of local species, living collections, mainly seedlings, are produced from the seeds of some rare, threatened, endemic and/or important species.
- A total of about 500 living collections of 22 rare and vulnerable species have been produced. The species produced include *Mimusops kummel, Pavetta crassipes, Uvaria chamae, Strophanthus hispidus, Spondiathus preussii var. glaber, Kigelia africana and Celtis integrifolia, Pentadesma butyracea, Gardenia nitida, Garcinia livingstonei, Calamus deerratus, Sterculia tragacanta, Psychotria psychotrioides, Antiaris africana, Aeffagle paniculata et Pterocarpus santalinoides.*
- In accord with the managers of the « Parc Bangré Weogo » of Ouagadougou, a conservatory plantation has been established in the park during the season 2008-2009.

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

THE MSBP IN BURKINA FASO

- **Valorization of collections and living collections cultivation**

- As part of the celebration of the International Biodiversity year, about 300 young plants of 20 local species from the whole living collections stock were planted in August 2010.

This plantation is considered as the starting point of the establishment of a new conservatory and botanical garden in Ouagadougou.

- Herbaceous species (*Andropogon ascinodis, Andropogon gayanus, Andropogon pseudapiecus, Cymbopogon giganteus, Cymbopogon schoenanthus, Pennisetum pedicellatum, Vetiveria nigritana,*) have also been tested in the field with farmers participation in order to restore degraded zones and also to produce biomasse to meet the populations needs.

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

THE MSBP IN BURKINA FASO

- **Research activities :**

- Germination and moisture content tests are systematically conducted on all new seed accessions. These tests are performed before and after drying the seed lots in an incubator (15°C, 15% RH).
- After drying, the equilibrium relative humidity (RH) of every seed lot is checked using a Rotronic apparatus. Small sized seeds are cleaned with Zig-Zag machine prior to any test.

This process of drying and initial testing are completed before the storage of the different seed accessions in CNSF genebank.

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

THE MSBP IN BURKINA FASO

- **Research activities :**

- Species tested: *Anonna senegalensis Spondias mombin, Raphia sudanica, Cola cordifolia, Parinari curatellifolia, Pterocarpus lucens, Sclerocarya birrea, , Cochlospermum planchonii, Opilia celtidifolia,* Pentadesma butyracea, *Sarcocephallus latifolius, Sterculia setigera, Strychnos innocua, Trichilia emetic, Parinari curatellifolia, Vitex doniana, Vitex chrysocarpa, Ximenia Americana and Zanthoxylum zanthoxyloides.*

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

THE MSBP IN BURKINA FASO

- **Capacity building**

The numbers of people trained through the MSBP includes formal and informal training at the MSB, in-country courses and technical support.

- 3 PhD performed: one fully and 2 partly supported by the MSBP
- 6 months training in seed physiology in Kew for one researcher
- Technical support from a Kew teamg on herbarium techniques in Burkina for the seed collection team

- **Equipment**

- canson paper for mounting the herbarium specimens
- Laboratory equipment: Rotronic Palm Ziz-Zag machine, germination boxes,
- laptops and computers, Video projector, Digital camera
- Books in seeds science for the library.
- Field expedition materiel : GPS Garmin

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

CONCLUSION

- **Benefits**

- Promotion and valorisation of local species in the reforestation program. 20% of new species (native) collected
- Special promotion of herbaceous species: increasing interest for these species in plantation. So far the MSBP has benefited the local communities through the plantation of herbaceous species to meet their every day needs and to restore some degraded areas.
- Collection and storage of rare, endangered and neglected species
- Better knowledge of a number of species: germination and conservation characteristics
- MSBP is having a positive impact on the behaviour of people, regarding plant conservation. Authorities, civil society and local communities are becoming more and more aware of that question.

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

CONCLUSION

- **Benefits**

- 10 scientific and technical publications and information products, linked to MSBP funding on seed physiology, herbarium management, conservation of forest genetic resources of native species

- **Future**

- CNSF is planning to establish an *ex situ* conservation plantation with important, rare and endangered species
- Through MSBP, CNSF is organising a seed bank with required conditions for long term conservation purpose. This seed bank will be used both at national and regional level for reforestation programs
- In order to get a better idea of the impact of these activities, it is important to gather information on the extent to which partners who have received MSBP training pass on the acquired knowledge and skills to others
- Strengthen relationship between Department of Forestry and CNSF to help guide the choice of species for reforestation

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

Plantation in the park « Bangr-weogo » in Ouagadougou

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

Preparation of herbarium specimen

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

Collection of *Digitaria barbinodis* near Boromo/BF

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

Collection of *Panicum repens* in the region of Douenza/Mali

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

- *Pentadesma butyracea* seeds *Vitex doniana* fruits

La graine pour l'arbre, l'arbre pour la vie!

Centre National de Semences Forestières

THANK YOU FOR YOU ATTENTION

La graine pour l'arbre, l'arbre pour la vie!

AFFORESTATION AND FORESTRY TECHNOLOGY IN ETHIOPIA: POLICY, STRATEGY AND STATUS

Dr. Abayneh Derero
Ethiopian Institute of Agricultural Research (EIAR)
Forestry Research Centre (FRC)
Addis Ababa, Ethiopia

Background

Ethiopia is located in the north-eastern part of Africa, popularly known as the Horn, between $3^0$24'-$14^0$53' N, and $32^0$42'-48º12'E, and covers a total area of 1.13 million Km^2 (CSA, 2011). There physiographic feature of Ethiopia consists of two highland plateaus, which are referred to as the northwestern and the southeastern highlands, which are dissected by the Great Rift Valley and escarpments. The altitude ranges from 120 m below sea level at the afar depression to 4370 m on Tulu Demtu in the SE and 4620 m on Mount Ras-Dashen in the NW (Friis *et al*., 2001).

The climate of Ethiopia is tropical monsoon with wide topographic-induced variations. There are three broad climatic zones of the country depending on the altitude. The *Kolla* or hot lowlands below 1600-1900 m, with both tropical and arid coditions, and with mean temperatures between 20 and 29 ^{0}C; the *Weyna Dega* or temperate highlands between 1600-1900 to 2400-2600 m, with mean temperatures between 16 to 20 ^{0}C and the *Dega* or cold mountains above 2400-2600 m, with average temperature between 10 and 16 ^{0}C (Von Breitenbach, 1963). The mean annual rainfall varies from 1400-2200 in the SW to 100 to 300 mm in the SE lowlands and Afar.

Ethiopia is the 2nd populous country in Africa with estimated population of over 82 million (CSA, 2011). Ethiopian economy largely depends on agriculture with employment rate of 80% of the population, 45% of the GDP, and accounts for about 83.1% of the exports. The forest cover of Ethiopia stands at 11% (FAO, 2010), and the contribution of the forestry sector to the GDP is estimated at 5.2% (FAO, 2011).

Afforestation/reforestation and tree planting in Ethiopia is carried out in many ways and for various purposes, which include establishment of woodlots, and homestead and boundary plantings, on plantings soil conservation structures, degraded area rehabilitation, peri urban

fuelwood plantations, buffer zone and timer plantations in state forests, enrichment plantings in degraded natural stands, seed stands, church compounds and in urban areas. The reforestation activity also includes excluding degraded areas from interferences for ensuring natural regeneration. Hence, the drivers for afforestation/reforestation are the need for fuelwood and wood, timber and non timber products, for generation of income, environmental protection, watershed management and harnessing other ecological services and benefits.

Planted forests in Ethiopia are estimated to cover around 230,000 ha, excluding small scale tree plantations by local people. These plantations are mainly composed of *Eucalyptus* species (59.3% of industrially planted area) and *Cupressus lusitanica* (20.6%), followed by the indigenous *Juniperus procera* (5.7%) (Lemenih and Bongers, 2011).

Forest related proclamations and policies

The proclamation on forest development and utilization (Proclamation No. 542/2007) recognizes two types of forest ownership; namely, private and public. Hence, it gives attention mainly to promotion and utilization of private forest, and conservation, development and administration of state forests. The proclamation further includes provisions on prevention of forest fire, movement of forest products, powers and duties of the ministry (i.e. Ministry of Agriculture), powers and duties of regional states as well as penalty and speedy trial (FDRE, 2007).

Following the proclamation, the Ministry of Agriculture has formulated policy and strategy on fostering private forest development and conservation, expansion of forest development technology, expanding market development for forests, administration and management of state forests, protecting forest resources from threats and establishing modern information systems on forest development, conservation and utilization (MoARD, 2007).

Another proclamation issued on access to genetic resources and community knowledge, and community rights (Proclamation No. 482 /2006) has set the legal framework for protection of community rights, condition of access, follow-up and compliance measure, exploration of genetic resources and administration of access (FDRE, 2006). The Institute of Biodiversity Conservation (IBC) is responsible for the enforcement of the Proclamation, which includes accessing genetic resources and collection of genetic resources and community knowledge.

Status of forest development activities

The bulk of forestry development activities are being underway in various regional states under the Bureau of Agriculture, for which mostly two experts for forestry at zonal and Woreda levels are engaged as well as massive trainings offered to several thousands of farmers and experts at various levels to improve quality of forest development activities. Some of the stakeholders in forestry development activities in the regional states include local and international NGOs. The

NGOs sometimes provide material support to tree nursery activities, provide fruit trees and run various rehabilitation projects. However, the impact of the ongoing forest development activities in the forest cover is not precisely known due to lack of periodic inventory though some area have become greener through area closure, soil and water conservation and tree planting activities (Derero *et al*., 2011a).

Forestry and Wildlife Enterprises/Agencies are responsible for managing state forests and parks in some of the regional states. Quite a number of the forests have been practicing various versions of participatory forest management (PFM), and reports indicate that over a million ha of forest are being managed under PFM.

Currently, Eucalypt and *Grevillea robusta* are the major plantation species in Ethiopia. Other tree species being planted include *Acacia abyssinica, A. mearansii (decurrens), A. saligna*, *Azadirachta indica, Calliandra calothyrsus*, *Cordia africana, Faidherbia albida*, *Hagenia abyssinica, Jatropha curcas, Juniperus procera*, *Leucaena leucocephala*, *Melia azadrach, Millettia feruginea*, *Moringa stenopetala, Olea africana, Pinus patula*, *Podocarpus falcatus, Sesbania sesban*, *Yushania alpina* and various fruit trees (avocado, mango, apple) (Derero *et al*., 2011a). However, in regional states like Afar, the main task of the sector is to find permanent solution to the invasive species: *Prosopis juliflora*.

Private nurseries are becoming livelihood support means in some rural areas and cities for the youth and others. The Ministry prepares packages: agroforestry package, *Faidherbia albida* package and watershed guidelines and supports and guides regional afforestation activities.

Constraints in forest development and proposed strategic actions

The constraints in forest development in Ethiopia include: lack of appropriate institutional arrangements, low profile due to under valuation of the contribution of forestry to the GDP, low budget, forestry skill gaps, absence of clear strategy coupled with poor implementation, lack of proper land use planning and administration, continued deforestation, lack of accurate and sufficient information, low level of technical support, inadequate and poor quality seed supply, poor seedling quality and inappropriate silviculture, forestry being long term investment, poor research extension linkage and poor coordination among actors in the sector (Derero *et al*., 2011a).

Several strategic actions are suggested and responsible institutions are enlisted to meet the following strategic objectives:

1. Minimizing deforestation and forest degradation
2. Strengthening integrated watershed management for rehabilitation of degraded lands and protection of major dams
3. Enhancing the role of agroforestry in food security, livelihood improvement and environmental resilience
4. Promoting energy forests and ensuring sustainable biofuel development
5. Developing industrial plantations for domestic consumption and export promotion

6. Ensuring proper land use planning and its implementation for forestry development
7. Enhancing the national tree seed supply
8. Building capacity of institutions involved in forest development and management
9. Developing forestry information data base and monitoring and evaluation system
10. Strengthening linkages in forestry research and development

Tree seed system

The Forestry Research Center has been supplying 7,278 kg of pure seeds, which could give around 600 million seedlings, annually in the period from 2007-2010 satisfying 78 % of the request. However, reports indicate the annual planting of over 3 billion seedlings nationaly in 2009 and 2010. This implies that the contribution of FRC is only about 20 % of seedlings planted, and the rest 80% comes from local collections and some other sources. Otherwise, it is highly probable that the reports on tree planting were highly exaggerated (Derero, 2011).

The actors (potential) in seed collection, distribution, test and storage in Ethiopia include the Ethiopian Institute of Agricultural Research/Forestry Research Center, Institute of Biodiversity, forest enterprises, associations established with participatory forest management, private seed suppliers, farmers, individual seed collectors, as well as religious, academic and military institutions (Derero et al., 2011b).

Tree seed system can be functional in either centralized or decentralized fashion. The use of a combination of central and decentralized strategies happens to be a sound strategy. However, there is also a need for developing seed certification system and the Forestry research Center should capacitate and work together with seed suppliers and regional forest enterprises (Derero et al., 2011b).

Forestry Research and Technology Generation

Forestry research is organized in both federal and regional states level under agricultural research institutes. Some higher learning institutes are also engaged in forestry research. At the federal level, forestry research has four research case teams, which are Plantation and Agroforestry Research Case Team, Natural Forests Research Case Team, Non-Timber Forest Products Research Case Team and Forest Products Utilization Research Case Team.

The research foci of Plantation and Agroforestry Research Case Team are rehabilitation of degraded lands, plantation of high value industrial timber species, agroforestry and tree seed and tree improvement whereas the research foci of Natural Forest Research Case Team are rehabilitation of degraded natural forests, population dynamics, resource base status, species composition, increment and population structure, forest cover, climate change and tree growth modeling and forest protection (fire, pests and disease). On the other hand the research foci Non-Timber Forest Products Research Case Team include characterization and value addition on natural gum and resin, high land and low land bamboo management and utilization,

bioenergy and other non timber forest products (medicinal, edible, etc. plants and products), whereas that of the research foci of Forest Products Utilization Research Case Team are wood anatomy and basic properties of timber products, preservation of wood, and wood panel and fiber products.

Of the above four research case teams, Plantation and Agroforestry Research Case Team is undertaking research projects, which include:

- Rehabilitation and restoration of degraded lands in various agroecologies
- Agroforestry technologies for rural livelihood improvement and natural resource management in different agroecologies
- Selection of provenances and enhancement of industrial tree plantations
- Domestication of high priority indigenous woody plant species in selected pastoral and agropastoral areas
- Conservation agriculture with trees for improved livelihoods and climate change mitigation in drylands

REDD, REDD+ and CDM related forestry activities

Ethiopia has recently produced Climate Resilient Green Economy (CRGE) document, which among others enlists plans for protected area management, stoves (off-grid solar, fuel efficient, LPG, biogass and electric), afforestation/reforestation, forest management, agricultural intensification and irrigation.

In addition, a forest carbon partnership facility (FCPF): Readiness preparation proposal (R-PP) has also been prepared and submitted to the World Bank in March 2011. It is expected that several institutions will be involved in execution of REDD and REDD+ projects, however, the DNA for REDD in Ethiopia is Environmental Protection Authority of Ethiopia.

National experience with REDD related carbon finance goes to the REDD project in the Bale Mountains in the south-eastern highlands of Ethiopia. The project aims at promoting carbon benefits from participatory forest management (PFM). It was confirmed that, around 500,000 ha area of the Bale Forest is suitable for REDD.

The national experience with the other carbon financing means, CDM, is related with Humbo Assisted Natural Regeneration (A/R) project, whose overall goal is sequestration of carbon in diverse native forest and contribute to alleviation of poverty through sale of CER, forest & non forest benefits.

Recently, a new project titled "establishment of rural development model applying clean development mechanism in Ethiopia" has been started in Tigray Region.

Conclusion

Implementation of policies and strategies need concerted efforts by all bodies. Deforestation must be avoided, and increasing forest cover would require land allocation for planted forests. It seems that exotic tree species would continue to dominate the afforestation activities in Ethiopia, and hence much effort should be put to hit the balance, and as diversification of tree plantings through the use of promising indigenous tree species is possible. Access to genetic resources should be based on trust and mutual benefit. Carbon money may help avoid deforestation and rehabilitate degraded areas.

References

CSA (2011) Statistical Abstracts. Central Statistical Agency, Addis Ababa.

Derero A (2011) Toward a tree seed system that guarantees quality and satisfies demand in Ethiopia. In: Trends in Tree Seed Systems in Ethiopia (eds Derero A, Fantu W and Eshetu, Z), pp43-56. Ethiopian Institute of Agricultural Research, Addis Ababa.

Derero A, Fantu W and Eshetu, Z (2011 b) Trends in Tree Seed Systems in Ethiopia. Ethiopian Institute of Agricultural Research, Addis Ababa.

Derero A, Mamo N and Kelemu, K (2011a) Strategic actions for integrated forest development in Ethiopia. Ethiopian Institute of Agricultural Research, Addis Ababa.

FAO (2010) Global forest resource assessment. Food and Agriculture Organization of the United Nations, Rome.

FAO (2011) State of the world's forests. Food and Agriculture Organization of the United Nations, Rome.

FDRE (2006) Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia (FDRE), Proclamation No. 482 /2006, Access to Genetic Resources and Community Knowledge, and Community Rights Proclamation, Addis Ababa.

FDRE (2007) Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia (FDRE), Proclamation No. 542/2007, Forest Development, Conservation and Utilization Proclamation, Addis Ababa.

Friis I, Edwards S, Kelbessa E and Demissew S (2001) Diversity and endemism in the flora of Ethiopia-what do the published Flora volumes tell us? In: Biodiversity Research in the Horn of Africa Region (eds. Friis, I and Ryding O), pp 173-193. Proceedings of the Third International Symposium on the Flora of Ethiopia and Eritrea at the Carlsberg Academy, Copenhagen, August 25-27, 1999.

Lemenih M and Bongers F (2011) Dry forests of Ethiopia and their silviculture. In: Silviculture in the Tropics (eds Günter S, Weber M, Stimm B and Mosandi R), pp 261-272. Springer Verlag Berlin Haidelberg, pp 261-272.

MoARD (2007) Forest Development, Conservation and Utilization Policy and Strategy, Federal Democratic Republic of Ethiopia, Ministry of Agriculture and Rural Development (MoADR), Addis Ababa.

Von Breitenbach F. (1963) The indigenous trees of Ethiopia. Ethiopian Forestry Association, Addis Ababa.

MSB-FORIG (FORIG AND AFFORESTATION IN GHANA)

Dr. Joseph M. Asomaning
Forestry Research Institute Ghana (FORIG)
National Tree Seed Centre
Kumasi, Ghana

Abstract

The Seed Section of the Forestry Research Institute of Ghana was transformed into the National Tree Seed Centre(NTSC) in 2003 under the Community Forestry Management Project executed by the Ministry of Land and Forestry (MoLF) with funds from the African Development Fund and the Government of Ghana.The objective of the project was to rehabilitate degraded forest reserves while increasing production of agricultural, wood and non-wood forestry products and strengthening the capacity of relevant institutions. Project support for the NTSC was aimed at building her capacity to collect, process, store and distribute high quality seed and planting material of exotic and indigenous tree species for forest plantation programmes. This was to be achieved through implementation of seed source surveys, tree seed orchard inventory and establishment of seed orchards. The NTSC is also involved in Seed Research, Training and Information dissemination, Technical Collaboration Provenance trials of tree species and Conservation of Plant Genetic Resources. The NTSC was one of the Institutes in Africa which carried out the Darwin Initiative Research Exercise on Community Tree Seeds (DIRECTS) from 2003 to 2006, a project spearhead by the MSB whose purpose was to enhance the role and capacity of institutes in the conservation and sustainable use of native tree seeds of community value in Africa. The NTSC in 2010 and 2011 undertook the MSB-FORIG project which had the objective of collecting and domesticating some socio-economic wild species of Ghana. Future programmes of the NTSC include phenological studies of selected indigenous species, development and management of seed sources as well as germination and storage studies of indigenous species to enhance our capacity to supply quality seeds for plantation development in the country.

Introduction

Ghana's forest resources play a significant role in the livelihood strategies of the rural poor. The forests are important sources of fuel wood, poles, timber, hunting grounds, and numerous non-timber forest products (NTFPs). The most important NTFPs include wrapping leaves, chew sticks, medicinal plants, honey and game meat. Forest also provide many environmental benefits such as , protection of water catchments, soil stabilization and erosion control (Brown and Lugo 1994), restoration of soil fertility, improvement of the micro-climate (Sedjo 1983) and protection of a wide variety of fauna, as well as the contribution of forests to carbon storage (Winjum and Schroeder,1997).

The potential for the forest resources of Ghana to contribute significantly to the socio-economic development of the country is however, constrained by the dwindling resource base Ghana lost about one third of her forest within 17 years from 1955 to 1972. Since 1977, the country's virgin forests have been reduced from 7.44 million hectares to 1.84 million hectares through illegal and unconventional means (WRM, 2002). A study, described by its authors as the most comprehensive analysis of tropical forests, has disclosed that Ghana has the highest rate of deforestation, out of 65 nations, apart from Togo and Nigeria (Ghanaian Chronicle, 2011). Ghana's deforestation rate is estimated to be approximately 65,000 ha per year (Marfo, 2010**).**

According to FAO (2001), lots of factors affect forest resource change and dynamics in Ghana.

These factors include: excessive logging, unsustainable agricultural practices, bush burning, mining and quarrying, and settlement and related infrastructure construction. However, increases in population growth coupled with migration, especially in the forest areas, also account for a high rate of deforestation (FAO, 2000).

Ghana comprises two broad ecological zones: the high forest and the savannah. The high forest zone covers roughly one third of the country and supports two thirds of the population. Most of the economic activities in the country (cocoa, oil palm, rubber, timber and mining) are concentrated in this zone. At the turn of the century, the area of high forest was 8.2 million ha, but this has been reduced to about 1.7 million ha today, of which 1.64 million ha is within the 216 forest reserves gazetted in the 1930s (Msuya *et al*. 2001).

The savannah zone covers the drier northern two thirds of the country, where the main economic activities are the production of annual crops (cereals, root crops and cotton) and livestock. Woodlands cover about 9.4 million ha of the savannah zone, producing mainly wood fuel and a small amount of building poles for local use. An estimated 70 percent of Ghana's primary energy requirements come from fuel wood, and this comprises about 10.0 million m3 of firewood and an additional 4.0 million m3 converted into charcoal for use in

urban areas (Msuya *et al*. 2001).

The increasing demand for wood resources in the country has made it imperative that efforts are made towards the expansion of the timber resource base. For example, the estimated wood requirement of the timber industry is approximately 4.0 x 10^6 m^3 yr^{-1}; far in excess of the annual allowable cut (AAC) of 1.0 x 10^6 m^3 yr^{-1} from the natural forest estate (Agyeman, 2005). It has been reiterated at many fora (e.g.Tuffour 1996, Agyemang 2005) that the time has come to take positive steps to ensure that such a demand can be met on a more sustainable basis from sources other than natural forest obviously, the only tangible option is by establishing plantation to make expected future demands, planting at a rate of 10,000 to 20,000 hectares annually in degraded forest reserves and community lands.

Current status of forest plantations in Ghana

Forest plantation culture is not new in Ghana. Since the 1950s, several efforts have been made to establish plantations in the country, mainly for productive (timber), wood lots (fuel wood and poles) and protective (improvement of environmental quality and wildlife habitats) functions. According to Winjum and Schroeder (1997), FAO records indicates that there were about 53,000 hectares of existing plantations in Ghana during the 1980 to 1990, representing about 11 percent of the total area of plantations in West Africa. Records from the Forest Services Division indicate that by 1996 there were only about 15,000 hectares of productive plantations in forest reserves (Aninakwa 1996).

Recently, the enthusiasm in plantation development in Ghana has increased significantly, with both private and public sectors playing a major role in plantation programmes throughout the forest zone. This renewed interest has resulted from several plantation development strategies put in place by Government (Agyeman 2005, Foli 2007).

The National Forest Plantation Development Programme (NFPDP) was launched by the Government of Ghana in September 2001 at Ayigbe in the Wenchi District of the Brong-Ahafo Region. The Plantations Department (PD) of the Forest Services Division (FSD) of the Forestry Commission (FC) is responsible for the implementation, coordination and management of the NFPDP. The programme is currently being implemented under three main strategies and five components (NFPDP, 2008)

The first strategy, the Modified Taungya System (MTS) involves the establishment of plantations by the FSD in partnership with farmers. The FSD provides technical direction, surveys and demarcates degraded forest reserve lands and supplies pegs and seedlings while the farm-ers provide all the labour inputs in the form of site clearing, pegging, planting, maintenance and fire protection. The farmers are permitted to cultivate their food crops which are inter-planted with the tree crops on the same piece of land. The farmers, in addition to the food crops they harvest, have a 40% share in the returns from the investment. The Government also has a 40% share while the landowner and community will have a 15% and 5% share respectively. This strategy is employed by the African Development Bank (AfDB) funded Community Forest Management Project (CFMP) and the government funded Modified Taungya Component (NFPDP, 2008)

The second strategy utilizes hired labour and contract supervisors to establish industrial plantations. Plantation workers are hired and paid a monthly allowance to establish and maintain plantations while plantation supervisors are given one year renewable contract employment to supervise and offer technical direction. The PD exercises general oversight and monitors field activities to ensure compliance with quality standards for plantation establishment. This strategy is employed by the Government Plantation Development Programme (GPDP) which is funded through the Highly Indebted Poor Countries (HIPC) benefits. Under this scheme the plantations developed are owned by government and the respective landowners who are entitled to royalty payments (NFPDP, 2008)

The third strategy involves the release of degraded forest reserve lands by the FC to private entities after vetting and endorsing their reforestation and business plans. The operations of these private developers are then monitored through periodic field visits by the PD to ensure compliance with the approved reforestation plans. The private investor earns 90% of the total proceeds from the plantation while the FC, Landowner and community earn 2%, 6% and 2% respectively (NFPDP, 2008). This is an improvement over the traditional taungya which started operating in the country in the 1930s where Ghanaian farmers had no rights to benefits accruing from the planted trees (Milton, 1994) and no decision-making role in any aspect of forest management (Birikorang, 2001). As a result, farmers tended to neglect the tree crops and to abuse the system. For example, farmers

- deliberately killed planted seedlings to extend their tenure over portions of land, since a successful plantation meant the discontinuation of cultivation on allocated plots;
- cleared more land for plantation development than needed for the available seedlings;
- failed to weed around tree seedlings, thereby retarding their growth so as to extend land-use rights beyond three years;
- illegally farmed other areas in forest reserves, degraded or not, which were not allocated for taungya;
- planted food crops that were not compatible with the tree crops, leading to reduced tree growth.

Comparison of benefit sharing frameworks under the old taungya system and modified taungya system (percentage share of benefits) (Agyeman *et al*. 2003)

Stakeholder	Old taungya system	Modified taungya system
Public agencies		
Forestry Commission	60	40
District Assembly	20	0
Administrator of tribal lands	4	0

Subtotal	84	40
Local community groups		
Tribal landowners	9	8
Traditional authority	7	7
Forest-adjacent community	0	5
Farmers	0	40
Subtotal	16	60
Total	**100**	**100**

Main threat to native species

In Ghana, only plantations of exotic trees species have succeeded despite efforts committed toward the establishment of indigenous species plantations (Foli *et al.,* 2009; Agyeman, 2004).

The main threats to local species are destruction by pests, diseases and fire. Some indigenous species that have serious pest problems are *Milicia excelsa* and *Milicia regia* Mahogany (*Khaya* and *Entandrophragma spp*) and *Pericopsis elata*. Commercial scale planting of these species high value species has been abandoned (Bosu and Apetorgbor 2009). In Ghana fire has been shown to be the single most important agent responsible for reducing productivity and depleting the genetic diversity of forests (Hawthorne, 1994). The increase in forest fires during the past two decades seriously threatens the survival of some of the nation's premium timber species notably, *Pericopsis elata* (Afrormosia), *Milicia* spp. (Iroko) and *Entandrophragma* and *Khaya* spp. (African Mahogany) among others (Agyeman et al. 2003)

The criteria used to prioritise /select tree species for reforestation:

The most important criteria used in selecting species for plantation development is the growth rate. i.e. the estimated time of passage (years) required for the species to grow to 60 cm dbh. Other factors are ease of establishment and regeneration of the species and resistance to pests and diseases, ecological characteristics of species matching local conditions.

The criteria used to prioritise species for conservation:

The most important criteria used are the conservation status and uses of the species. The MSB-FORIG project which had the objective of collecting and domesticating some socio-economic wild species of Ghana took into consideration these two factors in selecting species like *Garcinia kola* and *G. afzelii.* Other projects on Ethnobotany of Some Selected Medicinal Plants (2009-2010), Conservation and utilization of medicinal plants in Ghanaian Forest Fringe Communities(on –going) were based on the conservation status and uses of the species.

The criteria used to prioritise species for research:

Here the most important criteria used is when the species is being threatened by pest or diseases. Work has been done by FORIG on species such as *Milicia excelsa*, *Mahogany*, *Ceiba pentandra as* a result of pest/disease problems and on *Triplochiton scleroxylon* due to irregular fruiting period.

The Context

Drivers for Reforestation effort-

The main drivers of afforestaion and reforestation programmes in Ghana are:

- The Forestry Commission (FC) of the Ministry of Lands and Forestry and Mines: The Forestry Commission of Ghana regulates forest and wildlife resources, oversees the conservation and management of those resources and coordinates policies related to them.

- The Plantation Department of the Forestry Services Division which is division under the FC is very much involved in afforestation activities. This year (2011), the FC, the Forest Industry and the Forestry Research Institute of Ghana has established 500 ha of plantation made up of mostly *Cedrela odorata*, *Ceiba pentandra* and *Terminalia superba*, at Mankran in the Transitional Zone of the country.

- Private Companies: **FORM GHANA**- reforesting parts of the highly degraded Asubima Forest Reserve at Akomadan in the Ashanti Region; **Miro Forestry Company** with over 5,000 hectares of land started planting in 2010 mainly with Teak; **DuPaul Wood Treatment Ltd**- has 3 forest plantation projects of approximately 6000 ha mainly planted with teak.

- Samartex Timber and Plywood Company Ltd-

- **Global Green Limited-** 150 out of 500 ha developed; **Dormaa Forestry Limited-** 200 out of 2000 ha developed at Dormaa Ahenkro in the Brong Ahafo Region; **BonsuVonberg Farms-** 350 out of 700 ha developed at Somanya in the Eastern Region

- Timber firms: There are several 100s timber companies in Ghana. Companies that win bid to harvest timber from forest reserves and plantations are mandated by the Forestry Commission to replant the areas with tree seedlings.

- Traditional areas: Some Ghanaian Chiefs/Stools have in their custody large tract of degraded land and therefore some of them are now engaged in reforestation e.g. The Boumfoum Forestry plantation is located in the Ashanti Region of Ghana which covers an area of over 500,000 hectares that is managed by the stools of Agogo and Kumawu. These traditional Chiefs are working with some foreign investments to plant Teak and Spanish Cedar and Cedrela.

- Non Governmental Organizations (NGO's): Several NGO's eg. ADRA, World Vision International, Ricerca é Cooperazione etc. are working with many communities throughout the country to reforest degraded forest vegetations with species which can be used for fuel.

- Individual private farmers: Many farmers who own land are seriously planting species such as teak, cedrela and local species such as *Terminalia superba, T. ivorensis, Ceiba pentandra, Khaya sp., Mansonia altissima* etc.

- Metropolitan/Municipal/District Assembles: Some of the 230 Metropolitan/Municipal/ District Assembles are also engaged in reforestation programmes as a way of creating employment and restoring the degraded forests

- The Forestry Research Institute of Ghana (FORIG)/The National Tree Seed Centre (NTSC): The objectives of FORIG include developing technologies for sustainable management of the natural forest and biodiversity conservation and developing technologies fundamental to the success of plantation forestry. The NTSC is managed by FORIG and is expected to achieve the following specific objectives: - Tree Seed Collection, testing and distribution; provision of high quality tree seedlings, Seed Research, Training and Information, Technical collaboration and Conservation of Genetic Resource. FORIG has over the years established plantations and this activity has been stepped up in the last 2-3 years at Asempaneye and Mankran in the Transitional of the country.

Scale and range of reforestation activities in Ghana-

The National Forest Plantation Development Programme launched in 2001 by the then President John Agyekum Kuffour aimed at planting 20,000 hectares of exotic and indigenous species every year throughout the country. By the end of 2007 about 121,127 hectares of plantation had been established (FC 2007). The programme was relunched in 2010 by President John Evan Atta Mills and it is expected that 30,000 hectares of forest will be planted yearly in 100 districts across the country with both indigenous and exotic species in the next few years. This is expected to create over 51,000 jobs for the youth in the next five years as well as to develop a sustainable forest resource base to satisfy the future demand for industrial timber and enhance environmental quality.

Indigenous versus exotic species: proportions and reasons for choice

Well over 70% of the 121,127 hectares of plantation that had been established by 2007 under the Forest Plantation Development Programme launched in 2001 comprised of *Tectona grandis* (exotic). The remainder comprised of *Gmelina arborea, Cedrela odorata, Eucalyptus* species (all exotic) and *Terminalia superba, T. ivorensis, Triplochiton sclereoxylon* (Foli *et al*. 2009).

The private companies such as FORM GHANA, Miro, DuPaul, Global Green, Boumfoum Forestry Plantation plant more hectares of Teak as against indigenous species. In effect, the focus of plantation establishment has largely been exotic species. According to Foli *et al* (2009) exotic species have been preferred mainly because :

- They are faster growing than the indigenous species and therefore have shorter rotations, making it economically worthwhile for investment
- There is information on their growth requirements
- They have fewer management problems than the indigenous species

Britwum (1973) had earlier observed that very little information was available on the handling, dormancy breaking methods, and optimum conditions and temperatures for seed biology , phenology and seed storage behaviour of most indigenous species in Ghana and this is an impediment to seed collection and handling thereby limiting their use in planting (Personal Observation)

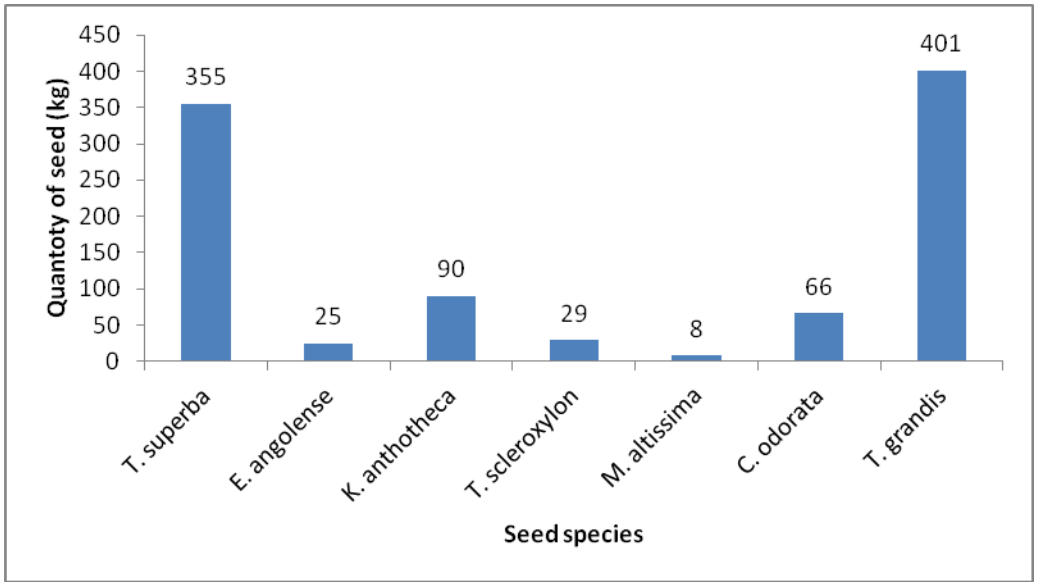


Fig 1: Seed collection by the NTSC in 2008

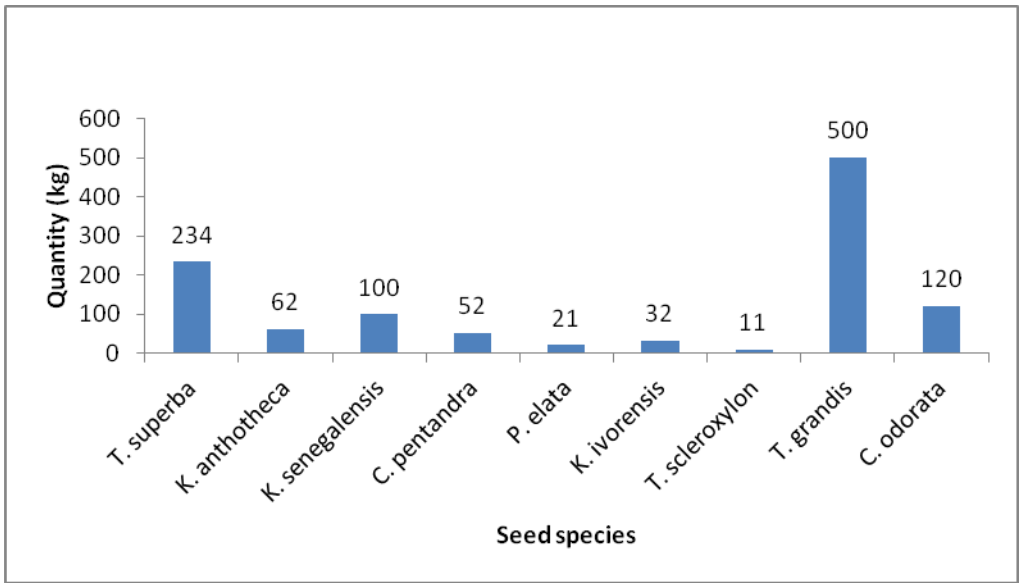


Fig 2: Seed collection by the NTSC in 2010

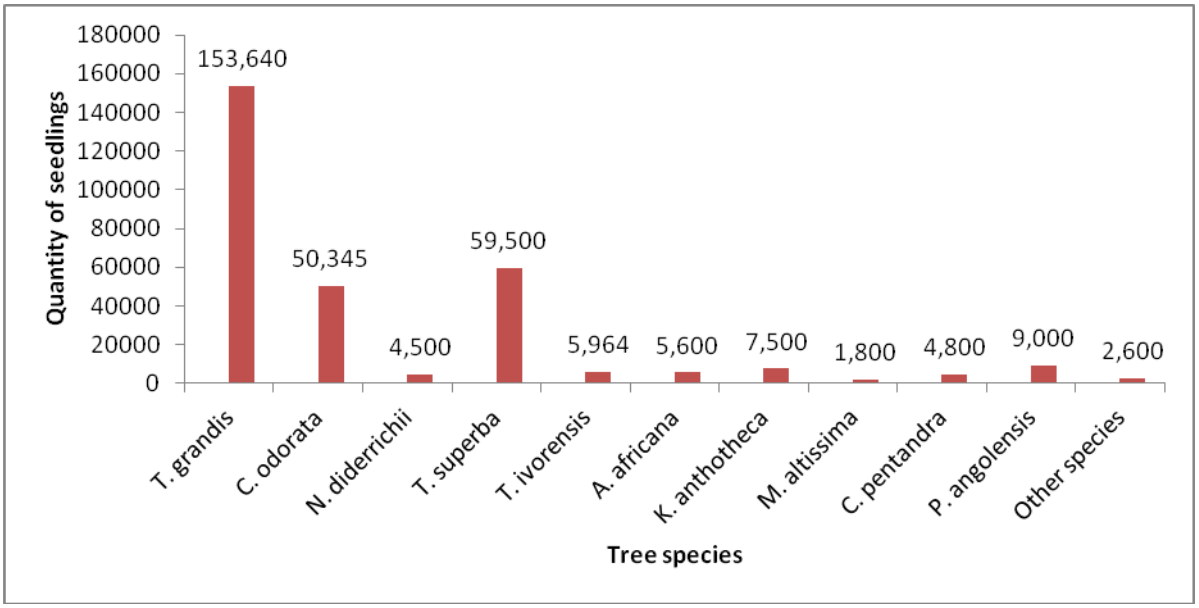


Fig 3: Seedling production at the NTSC in 2010

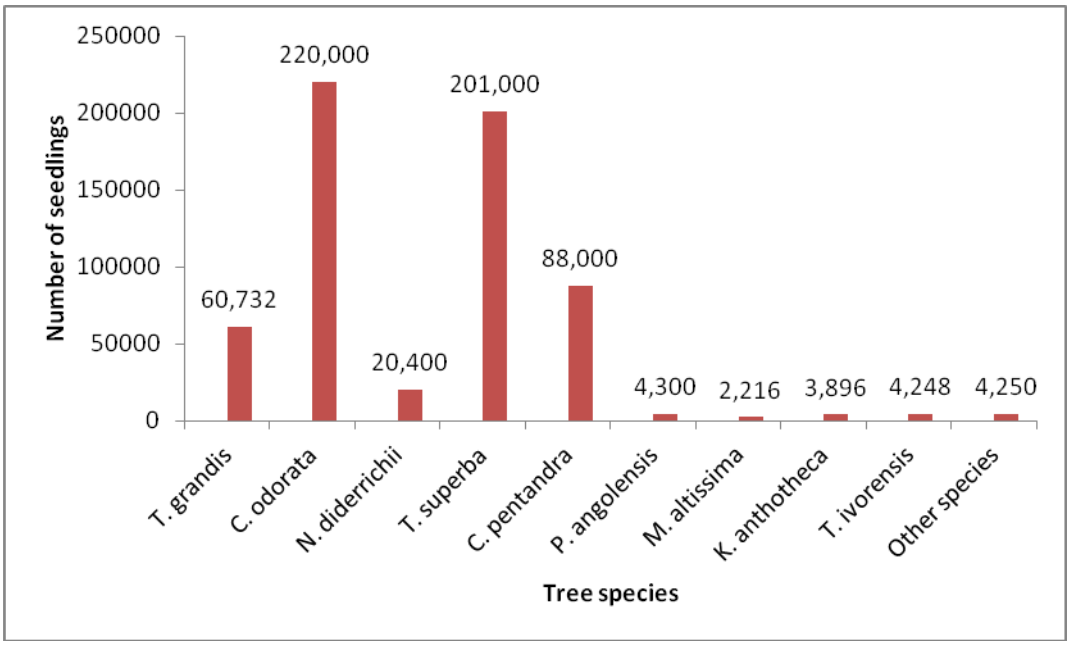


Fig 4: Seedling production at the NTSC in 2011

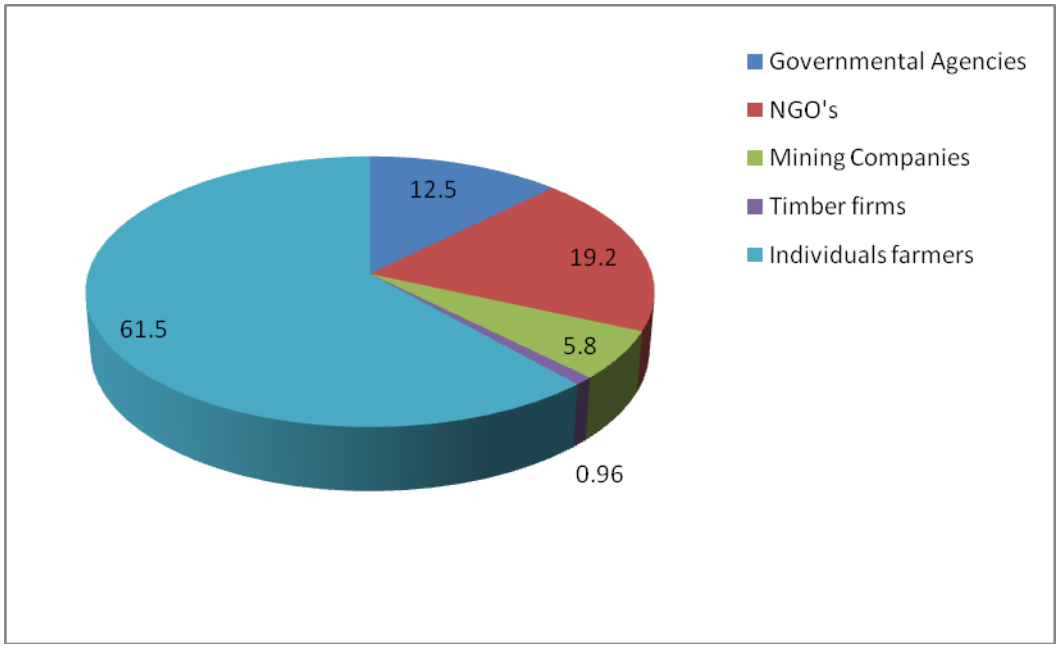


Fig 5: Clients who bought seeds from the NTSC in 2010

Table 1: Comparison of growth rates of some indigenous species grown under poorly managed plantation conditions with trees in natural forest. Figures in brackets indicate the estimate times of passage (yrs) required for the species to grow to 60 cm dbh. Growth rates of species in natural forest are based on projections from GHAFOSIM (Alder.1990). Table from Foli *et al*. 2009

Species	Site	Mean dbh (cm)	Age of crop (yr)	Diameter growth (cm yr^{-1})	
				Plantation	Natural forest
Triplochiton scleroxylon	Mpraeso	37.03	23	1.61(37)	0.68 (88)
	Benso	32.48	29	1.12 (54)	
	Amantia	54.94	35	1.57 (38)	
Terminalia ivorensis	Amantia	50.17	29	1.73 (34)	0.77 (78)
Khaya ivorensis	Benso	37.80	36	1.05(57)	0.48 (125)
	Amantia	46.16	33	1.39 (43)	
Terminalia superba	Amantia	40.00	30	1.33	-
Heritiera utilis	Mpraeso	-	-	2.56	-
	Benso	37.99	29	1.31	
	Amantia	34.00	28	1.24	
Strombosia glaucescens	Benso	13.98	310	0.69	-
Nauclea diderrichii	Benso	30.01	26	1.15 (52)	0.67 (89)
	Amantia	24.44	26	0.94 (64)	

Constraints in the afforestation sector in Ghana

The main constraints to plantation formation in Ghana can be summarized as follows:

- Limited experience with successful commercial forest plantations formation.
- No information on available land and site typing even though there is no shortage of gross area;
- Lack of adequate and genetically improved planting material;
- Security of land and tree tenure;
- Fire in the Transition Zone;
- Illegal timber markets and the sale of plantation timber below the market price by the Forestry Department, and
- Timber industry not adapted to small diameter milling.
- Absence of an adequate policy framework for benefit sharing in plantation development.
- Inadequate forest extension service
- Lack of capital
- Activities of Cattle Herdsmen are hindering plantation development in some parts of the Ashanti, Eastern and Brong Ahafo Regions of the country

Potentials in the afforestation sector in Ghana

- Favourable conditions for tree growth and quality wood development;
- Climate
- Topography, and Soils
- Political stability;
- Reasonable local infrastructure and access to ports;
- Strong domestic markets for wood products and good access to major ECOWAS and European markets;
- Favourable labour market in terms of skills, price and availability;
- Existing processing capacity; and
- Extensive areas of degraded forests within forest reserves suitable for tree planting, and by statute dedicated to permanent forest status.

Drivers for current and future policy for afforestation programmes

Currently**,** the Government's natural resource policy is embodied in the Forestry and Wildlife Policy and the Forest Development Master Plan (1996-2000). This policy aims to: (i) ensure a sustained and adequate supply of forest and woodland products; (ii) prevent further environmental degradation due to forest depletion and inappropriate farming practices; and (iii) stimulate community involvement in the management of the resources and enhance the economic well-being of rural communities. The main drivers of current and future policy for afforestation programmes in the country are the Government, International organizations (The

donor community), Non-Governmental Organisations (NGOs), Stakeholders in the timber industry and Local forest communities.

Successes and Shortcomings in the reforestation programmes in Ghana

Successes	**Shortcoming/problems**	**Strategies used to overcome problems**
1. The establishment of a Forestry Plantation Development Fund (FPDF) in the year 2000 to provide financial support towards meeting the costs of plantation.	1. Inadequate funds for massive plantation establishment	1. Government increasing the Forestry Plantation Development Fund, using portion of HIPC proceeds and general improvements in financing arrangements to encourage public and private sector participation in plantation culture
2. The lunching of the Forest Plantation Deveplopment Programme (2001) and (2010) which has ensured the planting of 10,000-20,000 hectares annually.	2. Bush fires cause enormous destruction to several hectares of plantation yearly.	2. Creation of fire belts around plantations, the Forest Services Division has acquired firefighting equipment. Most District Assembles have fire fighting squad, radio education on prevention of forest fire
3. The formation of tree grower and tree farmers associations such as The National Union of Tree Growers (NUTREEGA) involved in managing commercial seedling nurseries and mobilization of their membership to establish more woodlots and forest plantations.	3. Pests are major causes of plantation failure in Ghana	3. The Forestry Research Institute of Ghana is carrying out several studies on the possibility of using mixed plantations and genetic resistance to overcome/reduce pest incidences in native species.
*4. The establishment of the National Tree Seed Centre to provide high quality tree seed and seedlings for plantation development.	4. Dwindling seed sources due to illegal felling of trees even in seed sources leading to inadequate high quality seed and vegetative planting material;	4.FORIG has established/establishing clonal seed orchards/progeny trial fields of indigenous species e.g. *N. diderrichii, T, superba, K. anthotheca*
5. Rural Communities involvement in the management of the country's forest resources under the Forest Development Master Plan (1996-2000)	5. Inadequate forest extension workers	5. The College of Renewable Natural Resources (CRNR) at Sunyani which trains forestry extension workers is being equipped to train more students in community plantation development programmes.
6. The increase in private plantation forestry by Ghanaians as well as foreigners	6. Initial absence of an adequate policy framework for benefit sharing in plantation development.	6. Equitable benefit-sharing framework proposed: farmers and the FC should each receive 40% of benefits accruing based on their inputs, while landowners should receive 15% (i.e. traditional authorities 7 % and tribal landowners 8 %) and forest-adjacent communities should receive 5 %
7. Interventions of Major Donors such as the World Bank, Global Environmental Facility, DFID, EU, Royal Netherlands Government, The German Gov't. etc. in the forestry Sub-sector		
8. Ghana has been developing a National Forest Certification programme/standard since 1997 to ensure a responsible and good forest management (WG 2007)		

Constraints to users need in terms of seeds and seedlings supply by the NTSC/FORIG

Constraints to user needs and options to respond to these needs are summarized in Table 3. The constraints are mainly biological, technical and financial.

Constraints to and options to respond to users' needs and Government request for Seeds and Seedlings by the NTSC/FORIG.

Constraints to users' needs	Options to respond to users' needs and Government request
I. Scanty information on the flowering and fruiting phenology/seed biology of most of the indigenous species. 2. Lack of reliable seed sources for the indigenous species partly due to illegal felling 3. Technologies for collection, extraction of seed, handling and storage of some species not properly known 4. Seed Zoning System lacking 5.. Irregular fruiting pattern of some important plantation species e.g. *Triplochiton scleroxylon* and *Tarrietia utilis* 6. A large proportion of tree species produce recalcitrant seeds making their handling difficult 7. Currently the NTSC is still using an old small laboratory due to problems in completing the new premises hence seed testing and packaging and storage work are severely hampered. 8. Inadequate equipment for seed collection and processing makes these activities very slow leading to loss of seeds on the field and reduced seed quality after processing. 9. Inadequate trained staff t o handle seed collection, processing and testing of seeds; most especially tree climbers. 10. Inadequate funds for seed collection programmes	1. The need to study the flowering and fruiting phenology/ seed biology of the plantation species to ensure proper management of seed sources and the timely collection of seeds. 2. The urgent need to establish more seed sources and protect as well as properly managing the existing ones. 3. The need to carry out research on appropriate seed collection methods, seed extraction, handling and storage for the indigenous species 4. There is the urgent need to put in place seed zoning system to serve as a broad guideline for transferring seeds for national plantation programmes.. 5. To look at the possibility of employing vegetative propagation techniques that have been developed for the species to overcome difficulties of seed supply 6. Seed desiccation trials being conducted to establish species with recalcitrant storage behavior. Such species are quickly dispatched to our clients immediately after collection to be raised into seedlings. 7. To seek funds for the completion of the structures meant for the NTSC in oder to enhance seed collection, processing and testing activities. 8. The need to for the NTSC to invest in modern seed collection and processing equipment to speed up these activities in order to deliver good quality seeds to users in time. 9. The need to train more staff in the area of tree climbing, seed collection and processing . 10. A percentage of the Forestry Plantation Development Fund (FPDF) be set aside for seed procurement to support reforestation programmes.

Limits to the activities of the NTCS

1**.** Timing of seed collection: A key factor in planning is to time seed collecting to coincide with peak maturation of abundant fruit crops. Accordingly, the flowering and fruit pattern for the target species must be established. Since this has not been done for most of the indigenous species it is difficult to do collection at the most appropriate time.

2. Decreasing seed sources for seed collection: Indiscriminate tree felling over the years has led to the disappearance of most of the plus trees in our seed sources in the natural stands. In several situations this has resulted in our inability to sample the minimum number of trees required to be sampled per provenance

3. Poor and irregular flowering and fruiting of some important plantation species: Two important species i.e. *Triplochiton scleroxylon* and *Tarrietia utilis* are not being planted on a large scale because of the difficulty in obtaining seed due to poor and irregular seeding. For

example the last time *T. scleroxylon* produced seeds in appreciable quantities and quality in Ghana was in 2006.

4. Germination problems: Most of the indigenous plantation species loose viability quickly when stored under ambient temperature and relative humidity conditions. It has therefore been difficult to build up enough stocks for the needs of poor seed years as cold storage facilities are at the moment not available.

5. Inadequate staff: Inadequate trained staff to handle seed collection, processing and testing of seeds; most especially tree climbers.

6. Lack of adequate equipment for the collection, processing, testing and storage of seeds.

7. Field vehicles: There is only one vehicle for seed monitoring and collection activities. As such much of the seeds are lost since several of the species to be collected mature around the same period. Seed collection activities are therefore restricted to one or two out of the six ecological zones of the country.

8. Financial difficulties: The activities of the NTSC are limited by inadequate and late release of funds for seed collection leading to loss of seeds on the field. Routine seed testing after collection at the laboratory is also affected due to the absence of seed testing materials.

Opportunities created by the Millennium Seed Bank (MSB)

The MSB has since the year 2003 created good opportunities for the NTSC through training, technical advice, project proposal writing and project execution. Scientists from the NTSC have had the chance to attend several programmes organized by the MSB. These include Seed Conservation Training Workshop in 2003(Burkina Faso), training in Seed Research in 2005-2006 (United Kingdom), Seed Conservation Techniques Training Course 2010(Tanzania), MSB International Forestry Workshop in 2011(Kenya). The NTSC took part in the Darwin Initiative Research Exercise on Community Tree Seeds project executed in 2003-2005. The MSB and the NTSC are carrying out a project titled 'Collecting and Domesticating Socio-Economic Wild Species of Ghana' funded by VODAPHONE.

Dr. Moctar Sacande successfully co-supervised the PhD programme in Seed Science and Technology of Dr. Joseph Mireku Asomaning from 2006-2010 at the Millenniem Seed Bank in the UK, and at the Kwame Nkrumah University of Science and Technology, Kumasi in Ghana.

The trainings received from the MSB have expanded our knowledge on very important topics in Seed Conservation including:

- Assessing a potential seed collection
- Seed collection techniques
- Post-harvest handling of seed collections

- Seed moisture and principles of seed drying
- Identifying desiccation-sensitive seeds
- Selecting containers for long-term seed storage
- Equilibrating seed to specific moisture levels
- Construction of moisture sorption isotherms for seeds

Other opportunities created by the MSB are the exposure of personnel of the NTSC to the use of important seed research equipment such as the Thermogradient plate, the 100 Cell Conductivity meter, the Rotronic hygrometer workstation and various seed cleaning equipment. Scientists of the NTSC have also had the chance to meet Scientists from Tree Seed Centers/Genebanks of other African countries to share ideas on common issues relating to our profession. The NTSC has recently had the opportunity to donate some important indigenous species to the curator of the RBG Kew Millennium Seed Bank for long term seed storage in support of conservation and research purposes and we intend to send more species towards this purpose in the coming years.

Extra activities in the country programmes:

The NTSC provides other services aside our main functions. Some of these extra activities include admitting students from Government and private universities as well as the polytechnics up to 3 months to do practical/industrial attachment. Final year students from these institutions also frequently use our plant house, tree seed nursery and the seed laboratory to conduct practical work towards the preparation of their thesis under the supervision of the staff of the NTSC. Practical courses in Tree seed nursery management are from time to time organized for the nursery staff of the Forestry Commission, Non Governmental Organisations, Mining Companies and private nursery owners. In the year 2004, Scientists of the NTSC, were engaged by an Italian NGO called Ricerca é Cooperazione to train a number of tree seed collectors to deliver quality seeds for reforestation programmes under the Forest Resources Recreation Project at Sefwi Wiawso in the Western Region of Ghana. Then in the year 2005, the NTSC was contacted by another NGO called the Ghana Association for the Conservation of Nature (GACON) working together with the Wildfire Management Project(WFMP) of the Forestry Commission to train farmers in about 15 Forest Districts across three Regions of the country namely the Ashanti, Brong Ahafo and Eastern Region in Seed identification, collection and processing for the establishment of green fire belts to protect several forest plantations in the country from forest fires. Scientists of the NTSC are also very active on Radio programmes in and around the Kumasi Metropolis in educating farmers on tree seed handling and on management of tree seedling nurseries. Leaflets on germination procedures of some indigenous species have been prepared by the NTSC to help farmers who intend to use these species.

Discussions

Forest provide tangible benefits such as timber for construction, wood for fuel, Non timber forest products such as game, medicinal plants and intangible benefits such as conservation of sensitive forest ecosystems: protection of water catchments, soil stabilization and erosion control, restoration of soil fertility, improvement of micro-climate and protection of a wide variety of fauna which depend on the forest environment for survival. The valuable contribution of planted forests to carbon storage cannot be overstated.

Ghana stands to lose all the above benefits the forest provides if the present startling deforestation rate is not curtailed. There is the urgent need to embark on massive reforestation programmes as has been started under the National Forest Plantation Development Programme. The establishment of large scale plantations requires continuous and adequate supply of good quality seeds and seedlings of indigenous origin. This is where the importance of well a resourced and a well managed Tree Seed Centre comes into the picture.

The NTSC has contributed very much to the afforestation and reforestation programmes in Ghana over the years by being the first point of call when it comes to the supply of quality seeds and seedlings of both indigenous and exotic species. The importance of the activities of the NTSC has even become well-known since the beginning of the National Forestry Plantation Development Programme in 2001. The demand for seeds and seedlings for planting throughout the country keeps on increasing from year to year. Seed and seedling request have mostly come from the Central Government, the Metropolitan/Municipal/District Assemblies, Mining Companies, Ghana Cocoa Board, Cocoa Research Institute, the Forestry Services Division, Religious Organizations, NGO's, Timber Firms and Individuals plantation developers. Over the past three years, demand for seeds especially, *Khaya ivorensis, Khaya anthotheca and Khaya senegalensis* has come from South America (Brazil and Paraguay), Australia and Togo. We have not been able to fully meet the demand of our clients due to some Biological, Technical and Financial problems stated in Table 3 above.

The activities of the NTCS has also contributed to the conservation and management of the country's forest genetic resources in particular and plant genetic resources in general. This has been achieved through the establishment of clona seed orchards of exotic species like *Tectona grandis, Cedrela odorata* and native species like *Nauclea diderrichii*, *Terminalia superba*, *Khaya anthotheca, K. ivorensis and Triplochiton scleroxylon* in various locations of the country. There are also progeny trials in various locations of species such as *Nauclea diderrichii*, *Terminalia superba, Ceiba pentandra* collected from several provenances. The Centre's community work in the Eastern and Ashanti Regions of the country in Collecting and Domesticating Socio-Economic Wild Species of the county has been very successful. Mention should also be made of the importance and the successes of the practical courses in Tree seed nursery management courses organized for the nursery staff of the Forestry Commission, Non Governmental Organizations, Mining Companies and private nursery owners.

The provision of good quality seed and seedlings by the NTSC over the years has made tremendous impact on the reforestation and afforestation drive of the country evident by the planting at a rate of 10,000 to 20,000 hectares annually in degraded forest reserves and

community lands. This has helped to create several 1000s of employment for the youth of the country as well as improving food security (through the Modified Taungya System) thus ` enhancing the livelihood of the people. The establishment of seed orchards and progeny trials of various species being conducted at various locations in the country, the project of collection and domestication of socio-economic wild species in some communities in the Ashanti and Eastern Regions of Ghana are contributing immensely to the conservation and management of the forest genetic resources (FGR) of the country. The socio-economic wild plants the NTSC is domesticating with communities include medicinal species such as *Khaya senegalensis*, *Pycnanthus angolensis* and *Irvingia gabonensis* which will play vital roles in the healthcare delivery of the inhabitants. Furthermore, important species like *Entandrophragma utile* and *Nauclea diderrichii* are considered as threatened and their inclusion in the list will help to conserve them. The NTSC has contributed to the increased production levels of Cocoa in Ghana because the seeds and seedlings of *Terminalia superba* and *T. ivorensis* we supply to the Ghana Cocoa Board and the Cocoa Research Institute of Ghana are planted on Cocoa plantations and Seed farms providing a congenial growing conditions for the country's number one foreign exchange earner. Mining companies throughout the country use our seeds and seedlings in rehabilitating degraded mine sites thereby restoring the land for agricultural use.

How the National afforestation programme can be improved:

- The Government must realize the importance of community and public involvement in the management of forests and promote it by adopting new laws and policies to support this. Increased community involvement in forest management, ecotourism, advocacy, public education, and forestation and reforestation. Government must also recognize the value local users bring to resource management as their primary custodians
- Human resources development, particularly in terms of professional training, must be taken serious to meet the needs associated with sustainable management of the forest and also enhance development opportunities.
- Annual National Tree Planting Campaigns be step up to create environmental awareness and promote forest husbandry.
- Tenure/ownership rights to land and trees must be streamlined.
- Major challenges militating against sustainable management of forest resources in the country such as lack of political commitment and poor funding of the forestry sub-sector must be addressed.
- Research to develop technologies fundamental to the success of plantation forestry especially with indigenous species must be encouraged
- Bush fires are threat to forests and woodlands in Ghana; they cause enormous destruction to both flora and fauna. A forest fire prevention and awareness programme be initiated and sustained within forest communities
- Government must support the completion of the National Tree Seed Centre to e supply good quality seeds for planting development.
- Government must continue to create a congenial atmosphere for the development of private forest plantations in the country.

- Promoting conservation of forests through sustainable harvesting of products and reforestation.

Improvement in the national afforestation programme will surely lead to an increase in demand of quality seed and seedlings for planting. This will call for increase in the capacity of the NTSC to deliver these planting materials as detailed in Table 3 titiled **" Options to respond to users' needs and Government request"** above.

Future Activities

The steps that are required for enhancing and delivering effective reforestation programmes in Ghana are:

- Enhancing sustainable management and utilization of non-timber forest products (NTFPs) for the benefit of forest fringe communities in order to reduce their over dependence on timber to their livelihood.
- Developing technologies through research of the steps involved in establishing mixed-species plantation using mainly native species since apart from providing timber, mixed indigenous species plantations can as well provide a multitude of intermediate non-timber forest products for communities while at the same time ensuring the integrity of the environment, including the preservation of biodiversity.
- Problems of pest and diseases that plague plantations particularly indigenous species must be found.
- Identifying tree species that grow well in the savanna and developing techniques for their cultivation to halt the desertification of the savanna eco-zone of the country.
- Studying the phenology and seed storage requirements of the indigenous tree species to enhance their utilization in plantation development.
- Training of more forestry extension officers in community forest management.
- Greater involvement of communities in the management of forests
- De-politicization of the National Forest Plantation Development Programme (NFPDP)
- Effective supervision and monitoring of plantations to ensure proper their maintenance.
- Timely release of funds for plantation development.
- Proper training and resourcing of forest guards to patrol forests efficiently to discourage illegal use of forests.

Steps that are required to ensure sustainable use of native tree species

- Finding solutions to problems of pest and diseases that plague plantations of indigenous species.
- Eliminating the incidences of forest fires
- Providing proper management/cultural practices to indigenous plantation
- Finding solution to the problem of slow growth rate of most natives species which makes the economics of growing such long-term timber species unfavorable
- Conducting research to have in-depth knowledge of the growth requirements of indigenous plantation species

- Planting the right species at the right site (Species-site-matching)
- Studying the phenology of the indigenous tree species to enhance their timely collection and utilization in plantation development
- Conducting studies on the appropriate methods of seed collection, processing and storage behavior and germination requirements of the indigenous tree species to enhance their utilization in plantation development
- Establishment of clonal seed orchards of the important native species for seed collection for towards plantation development.
- Training of more tree climbers to enhance seed collection from plus trees in natural stands and plantations.

How can NTSCs play significant role in afforestation programmes in Africa?

Given the facts that:

- Tree planting activities has increased in many parts of Africa and that
- Conservation of the genetic resources of trees has emerged as a political priority along with the increased pressure on forest resources taking place in the continent,

One would expect NTSC's in Africa to be of high priority to governments, however, many NTSCs are at present facing serious financial problems. In some cases NTSCs are considered an economic burden rather than an asset in the development of tree planting programs (Graudal and Kjaer, 2000). Changing objectives towards increased self financing (by NTSCs) has made it unrealistic to sustain the long-term activities of primary national interest (Msanga, 2000). The assumption that trade in tree seed constitute a viable commercial option in the medium term may be wrong (Graudal and Kjaer, 2000)

In Ghana, the NTSC has actually been tasked to make profit and our success has over the years been measured by how much profit we generate.

Many elements of a national tree seed programme (such as the extension of knowledge on good practise to the users; research and development in seed collection-storage-use, genetic improvement of seed sources, and conservation of genetic resources) are of national importance. The overall national economic and environmental interest in a national tree seed centre lies in its contribution to improved production and environmental rehabilitation (Graudal and Kjaer, 2000).

The performances of Tree Seed Centres should be judged by how much they contribute to afforestation/reforestation programmes, protection and conservation of genetic resources rather than the revenue they generate.

African Governments must therefore commit themselves to financing the activities of NTSCs if they want to have successful afforestation/reforestation programmes. As much as possible NTSCs must be spurred the burden of profit making as this turn to divert them from their core mandate.

Governments must levy mining, oil and timbers firms whose activities lead to lose of vegetation and environmental quality to support Tree Seed Centres

Financial support from foreign donors should be seen as top ups.

NTSCs must be made to concentrate on their core mandate such as:

- genetic improvement of seed sources and establish improved seed sources
- conservation of genetic resources
- research into the seed biology and storage behavior of the indigenous species to enhance long term seed banking programs rather than being directed towards economic sustainability.

Collaboration amongst Trees Seed Centres in Africa

Tree Seed Centres, Plant Genebanks and Biodiversity Institutes in Africa have common problems which can be described as biological, technical and financial. These problems will be less difficult to overcome if organizations across Africa do a lot of collaborations

as was highlighted during the 4th Workshop for African Tree Centres and Biodiversity Centres in Burkina Faso in 2001. The workshop called for the need to strengthen the limited expertise and experience in seed conservation techniques in institutes across Africa. Research, capacity building and networking on seed provision, storage and use will contribute to this urgent need. The DIRECTS' project which had the objective to enhance the capacity of Scientists from sub-Saharan African tree seed and biodiversity institutes to conserve and sustainably manage native species of local importance through research on tree seed biology, training and information was a classical example of collaboration. The problem of poor and irregular fruiting of *T. scleroxylon* will require the cooperation of Scientists from Ghana, Cote d'Ivoire, Nigeria, Togo, Cameroon, Sierra Leone, Liberia and Guinea among other countries where the species occurs.

References

Agyeman,V.K. 2005. Plantation Development in Ghana. Paper presented at the Tropenbos International-Ghana Workshop on 'Restoration and Sustainable Management of Forests in Ghana'. Elmina, Ghana, 5-7 July 2005.

Agyeman, V.K. (2004). Plantation Development in Ghana: policy, silviculture,institutional arrangement and funding mechanism *in* Cobbinah, J.R, Ofori, D.A and Bosu, P.P. (eds.). *Pest Management in Tropical Plantations*. International Workshop Proceedings, 21-23 July, 2004, pp. 17-31

Agyeman, V.K., Marfo, K.A., Kasanga, K.R., Danso, E., Asare, A.B., Yeboah, O.M. and Agyeman, F. (2003). Revising the taungya plantation system: new revenue-sharing proposals from Ghana. Unasylva No 212 Vol. 54 2003/1. FAO.

Alder, D. (1990). GHAFOSIM: A Projection System for Natural Forest Growth and Yield in Ghana. Final Report. July 1990. MLNR/ODA Consultancy Report. 114p.

Aninakwa, B. 1996. Present Status of the Forest Resource Base. Paper presented at the Workshop on Forest Plantation Development in Ghana. WITC. . 27-29 Feb. 1996.

Birikorang, G. 2001. Wood industry and log export ban study. Consultancy report for the Ministry of Lands and Forestry

Boso, P. P., Apetorgbor, M. M. 2009. Rising Pest Problems in Forest Plantations In Ghana. Technical Note No. 20. Forestry Research Institute of Ghana. 9pp.

Brookman-Amissah, J. 1973. Seed problems as they affect forestry practice in Ghana. Vol II No. 6. International Union of Forest Research Organizations. International Symposium on SEED PROCESSING, BURGEN, Norway, 1973, 1-9pp.

Brown, S., Lugo, A. 1994. Rehabilitation of Tropical Lands : A Key to Sustaining Development. Restoration Ecology 2 (2): 97-111.

FAO, 2006. *Global Forest Resources Assessment 2005. Progress Towards Sustainable Forest Management.* FAO Forestry Paper 147(2006). 320pp.

FC., 2007. Ghana Forestry Commission, Annual Report, 2007, Accra.

Foli, E.G. 2007. 100 Years of Forestry in Ghana. Ensuring Sustainable Timber Production through Plantation Development. Invited paper presented at the 12th Ghana International Furniture and Industry Exhibition (GIFEX 2008), at the International Trade Fair Site, La, Accra. 21-24 October, 2008.

Foli, E.G., Agyeman, V.K., Pentsil, M. 2009. Ensuring Sustainable Timber Supply in Ghana: A Case For Plantations Of Indigenous Timber Species. Forestry Research Institute of Ghana. Technical Note No. 1.

Forestry Research Institute of Ghana (FORIG 2003). Final Technical Report: Forest Fire Management in Ghana. December 2003.

Ghanaian Chronicle, 2011. Ghana has the highest rate of deforestation (http://ghanaian-chronicle.com/?p=28196).

Graudal, L., Kjaer, E.D. 2000. Can National Tree Seed Programmes generate economic, social and/or environmental benefits that cover their costs? Considerations on economics, sustainability and challenges ahead for tree seed centres in tropical countries. Presentation given at the SAFORGEN Regional Training Workshop on the Conservation

and Sustainable Use of Forest Genetic Resources in Eastern and Southern Africa, Nairobi, Kenya, 6-11 December, 1999

Hawthorne, W.D. 1994. Fire Damage and Forest Regeneration in Ghana, ODA Forest Series No. 4, Natural Resources Institute, Chatham, 1994.

Irvine, F.R. 1961. Woody Plants of Ghana. Oxford University Press, Amen House, London.

Marfo, E. 2010. Chainsaw Milling in Ghana: Context, drivers, and impacts. Tropenbos International, Wageningen, the Netherlands. 64pp.

Milton, R. 1994. Some issues and observations arising from District taungya studies … for use in discussion for development of FP4 – Forest Reserve Rehabilitation. Forestry Commission memo.

Msanga 2000. National Tree Seed Programme (NTSC): A brief Introduction

Msuya, M.M., Helsen, J., Khumbanyiwa, A.G., Basalirwa, M. 2001. Appraisal Report: Community Forestry Management Project. Republic of Ghana. 58pp.

NFPDP., 2008. The National Forest Plantation Development Programme. ANNUAL REPORT 2008. Forestry Commission.

Sedjo, R.A. 1983. The Comparative Economics of Plantation: A Global Assessment. Resources for the Future. Washington, DC.

Tuffour, K. 1996. Restoration of Degraded Forest Land. Invited paper. Workshop on Plantation Development in Ghana. WITC, Kumasi. 27-29 Feb. 1996.

Winjum, J.K., Schroeder, P.E. 1997. Forest Plantations of the World. Their Extent, Ecological Attributes and Carbon Storage. Agriculture and Forest Meteorology **84**: 153-167.

Working Group (WG, 2007). Working Group on Forest Certification, Ghana. Ghana Forest Management Certification Standard, Version 5 (www. workinggroup.org).

World Rainforest Movement (WRM) 2002. Africa Forest Under threat 232pp.

KENYA FORESTRY RESEARCH INSTITUTE AND AFFORESTATION IN KENYA

Mr. William Omondi
Tree seed programme
Kenya Forestry Research institute (KEFRI)
Nairobi, Kenya

Introduction

Forests and Forestry in Kenya

The total area under woodland in Kenya is estimated at 48.6 million hectares. Of these, 1.3 million are under natural forests, 0.17 million are forest plantations, 9.5 million are farmlands and settlements and 37.6 million are woodlands, bushlands and wooded grasslands. Between 2000 and 2005, Kenya lost an average of 12,000 hectares of forest per year according to the Food and Agriculture Organization of the United Nations (FAO). However this situation has improved since the government banned logging in government forest from 1999. Kenya's forests are under pressure from competing user-groups. In some cases, extreme poverty forces forest adjacent communities to open up forested areas for subsistence agriculture. Planned deforestation for development needs forms a major part of forest loss. Incidentally this activity has not kept tandem with the reforestation rate thus resulting into large parts of planting backlogs: Transmigration programme of communities and settlement due to increasing population has contributed to substantial loss of forest cover in the last decade. Unsustainable forest practices, illegal logging and forest fires have similarly played significant roles if forest loss.

In Kenya, an increasing proportion of tree cover is owned and managed by local communities. Recent studies by Kenya Forestry Research scientists (2007) indicate that eucalyptus trees in western Kenya region are expected to increase from 14.5 billion to 31.6 billion by 2020 as more farmers venture into farm forestry. This shows that trees are increasingly becoming an essential part of diversified farm production, providing both subsistence products and incomes while contributing to soil and water conservation, and soil fertility. Indeed the general thinking in the country is that the future of trees is on farms as more and more people take up tree planting as an enterprise. Many efforts for implementing tree planting programmes have been made and ambitious targets set, along with a reorientation towards the use of indigenous tree species. However, propagation of some of the seeds still hamper they use.

Intervention – tree planting

Kenyan farmers have appreciated the value of trees through sale of products to supplement their income. In addition, the government, in its Session Paper No.9 (2005) on Forest Policy,

has developed enabling guidelines for intensified tree planting inside and outside gazetted forests. The policy paper further emphasizes the need for availability of planting material to support the afforestation and reforestation programme in a bid to increase the country's forest cover. To this end, the Kenya Forest Service has set a national planting programme of 80 million seedlings annually. In addition to this involvement of other organizations and investors could put this figure to 100m seedlings. Seeds are critical to production of seedlings, and the success of government policies on afforestation thus depends heavily on the supply of sufficient quality seed of the species in demand by farmers and others stakeholders. The status of demand for tree seed in the country is increasing at the rate of 20% annually and is expected to reach 25,000 kg by 2010.

In areas where extensive deforestation have given way to expansion of agricultural opportunities, the Government has a instituted a deliberate policy for enhancing food security, by promoting tree planting along farm boundaries and rehabilitating adjoining lands have been undertaken. Indigenous trees and shrubs would be the best candidates for such initiatives. With the advent of social and farm forestry, tree planting in newly settlements and farms have had significant contribution to increase in total tree cover and provision of tree based products and services while at the same time increasing opportunities for forestry related enterprises. KEFRI, through its Seed Programme have therefore positioned itself to addressing germplasm needs for these impending tree planting programmes.

The role of KEFRI in national seed production and supply

Background and status

Kenya Forestry Seed Centre was established in 1985 with support from German Agency for Technical Cooperation (GTZ). Prior to this, the silvicultural department of the Kenya Agricultural Research Institute that had a broader mandate including forestry issues handled seed production activities. The department however concentrated mainly on seeds of exotic industrial plantation species, such as cypress, pines and eucalypts. The Seed Center, which has since been upgraded into a Programme within KEFRI is mandated to provide certified, site appropriate, high quality tree seeds in sufficient quantities to meet the national demand and to undertake research and policy formulation to guide tree seed production and use. KEFRI emphasizes on best practices throughout its seed production chain to ensure provision of high quality seeds to its clients. This involves adherence to the principles of source-identified and quality declared in accordance with OECD scheme. Seed sources must therefore be identified or if necessary established in all different ecozones. A seed zoning system, based on the similarity of ecological conditions, has been developed as a suitable expedient for a preliminary provenance differentiation (Albrecht and Braun 1993). Tests for both physiological (germination) and physical (purity) quality are mandatory and are done in accordance with the International Seed Testing Association (ISTA) rules.

KEFRI is registered as a Tree Seed merchant with the Kenya Plant Health Inspectorate Service (KEPHIS) and therefore carries its operations within the legal frameworks. The Institute is also a member of the Seed Trade Association of Kenya (STAK); a body that provides a forum for interaction and information exchange among its members hence

contributing in the promotion and development of the national seed industry. In addition, the Institute offers technical advice in the establishment of seed sources; a pre-requisite in the promotion of advancement in the use of high quality tree seed.

Seed production and distribution

Seeds are critical to production of seedlings, and the success of government policies on afforestation depends heavily on the supply of sufficient quantity and quality seed of the species in demand for planting programmes. Over a period of 10 years, the Institute has increased its production capacity from 2 tonnes in 2000 to 5.6tonnes in 2005 and 8.8 tonnes in 2010. Most of the seeds are collected from selected, established and marked sources located in protected areas, trust lands and private land. During the last 20 years, the Institute established 14.6 ha of seed stands and 33.1 ha of seed orchards. It is from these sources that the Institute collects improved seeds of high genetic quality as compared to those from natural forests. Improvement activities are a continuous process and work on more indigenous species is in progress.

The Institute has responded to the increased National demand of seeds and seedlings by decentralizing distribution to its regional centers, agents, and stockists). This exercise also involves packaging seeds in various quantities to meet the demand of different clientele. In order to improve its seeds production capacity, the Institute has embraced the informal seed sector in the production and distribution of seeds. The registration of private seed sources and training their owners in basic seed handling are undertaken to ensure their formal recognition as source of seeds. The Institute will thus focus its resources on production of seeds from superior sources i.e. orchards and established stands and also capitalize on those species which it has a technological advantage in terms of handling.

There has been a steady increase in seed production form 1.9tonnes in 1995 to 9.7 tonnes in 2010 as indicated in Figure 1. This increased in production have been accompanied by a steady rise in distribution form 1.1 tonnes to 6.8 tonnes over the same period. Analysis of amount of seeds of 35 priority species produced and distributed during a 5-year period (2006 to 2010) in relation to size of land planted using the seedlings raised, was about 1.0m Ha. Table 1. This area translates to 2.6% of Kenyan land cover. This signifies the increased recognition of the Institute as a source of high quality seeds.

The overall impact of these is the promotion of tree planting hence contributing to the achievement of vision 2030 that requires the state to achieve 4% forest coverage by 2012 and also in line with the constitution, article 69 Cap (1b) that requires the state to work towards achieving and maintaining a tree cover of at least 10% of the Kenyan land area. These achievements clearly indicate the positive role the Institute have and continue to play in afforestation and reforestation programmes and generally enhancing the availability and use of tree products and services in Kenya.

Table 1. Amount of seeds (35 species) distributed and area (Ha) planted between 2006 -2010

	Species	Seed weight (kg)	Approximate seedlings	Area planted (ha)
1	*Eucalyptus grandis*	2,877.8	28,778,000	287,780
2	*Cuppresus lustanica*	1,858.04	185,804,000	185,804
3	*Pinus patula*	1,216.7	121,670,000	121,670
4	*Eucalyptus camaldulensis*	1,103.9	110,390,000	110,390
5	*Eucalyptus saligna*	1,090.8	109,080,000	109,080
6	*Podocarpus falcatus*	1,055.7	633,420	633.42
7	*Leuceana leucocephala*	784.98	7,849,800	7,849.8
8	*Azadirachta indica*	736.8	1,473,600	1,473.6
9	*Senna siamea*	723.55	14,471,000	14,471
10	*Acacia polyacantha*	684	4,788,000	4,788
11	*Acacia zanthopholea*	546	3,822,000	3,822
12	*Juniperus procera*	472.3	4,723,000	4,723
13	*Dovyalis coffra*	462.5	4,625,000	4,625
14	*Cordia abissinica*	440.9	440,900	440.9
15	*Croton megalocarpus*	427.8	342,240	342.24
16	*Bischofia javonica*	424.9	1,274,700	1,274.7
17	*Acacia melifera*	341.9	2,393,300	2,393.3
18	*Makhamia lutea*	332.4	9,972,000	9,972
19	*Acacia garrardii*	323.8	2,266,600	2,266.6
20	*Casuarina equisitofolia*	300.8	90,240,000	90,240
21	*Acacia senagal*	292.1	2,044,700	2,044.7
22	*Acacia seyal*	280.3	1,962,100	1,962.1
23	*Acacia tortilis*	257.3	1,801,100	1,801.1
24	*Vitex keniensis*	2000	2,000,000	2,000
25	*Terminalia mentalis*	193.15	1,158,900	1,158.9
26	*Gravilla robusta*	155.8	4,674,000	4,674
27	*Acacia melanoxylon*	149.9	1,049,300	1,049.3
28	*Ecalyptus maculata*	120.4	12,040,000	12,040
29	*Olea europea*	91.5	549,000	549
30	*Calliandra calophyrsus*	91.3	730,400	730.4
31	*Ecalyptus europhyla*	89.8	8,980,000	8,980
32	*Acacia melanoxylon*	149.9	1,049,300	1,049.3
33	*Ecalyptus maculata*	120.4	12,040,000	12,040
34	*Jacaranda mimosifolia*	71.1	2,844,000	2,844
35	*Acacia mearnsii*	62.3	436,100	436.1
36	*Ecalyptus paniculata*	18.3	1,830,000	1,830
	TOTAL	**20,776.92**	**1,007,139,160**	**1,007,139**

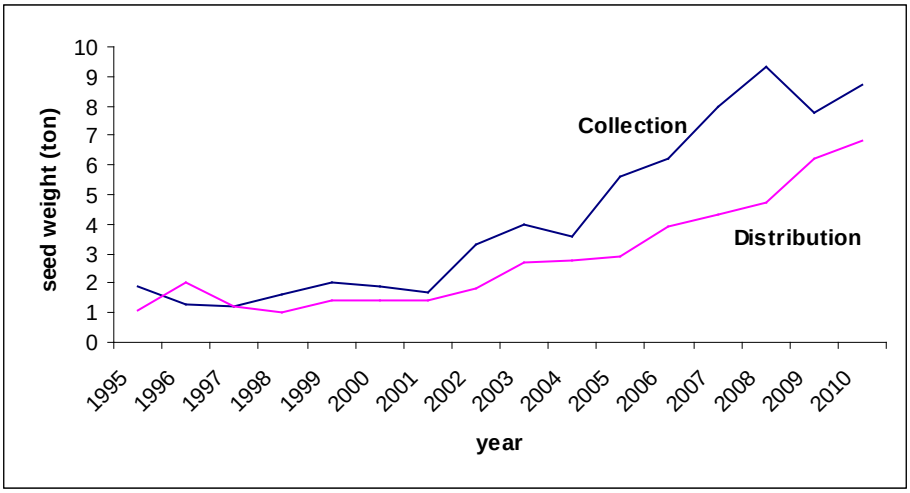


Figure1. Seed collection and distribution from 1995 to 2010

Development of Seed policy and regulations

The Institute is registered as a seed merchant and is in the process of developing seed regulations to streamline its operations to be in line with both the Forestry Act (2005) and Seeds and Plant Varieties Acts (2001). The Institute has established a Seed Advisory Committee, which will formulate best policies and practices with respect to seed production and use in Kenya; to review emerging issues on production and related issues and to make appropriate recommendations. These policy frameworks have enhanced and promoted the production and use of high quality seeds by streamlining operations in the tree seed industry.

Advancement of ex-situ conservation through seed storage

The prevailing rate of environmental degradation, does not guarantee the continued survival of some plants and habitats, making it necessary to resort to *ex-situ* conservation measures. In domesticating some of the national obligations to the CBD and to mitigate the loss of plant diversity, seed banking is one of the most efficient and inexpensive ways of ensuring that seeds of many wild plant species are maintained alive for hundreds of years. Stored seed offers a source of planting material whenever required. The process of seed banking entails collecting representative seed samples from a species population, followed by cleaning and drying the seeds to low water content normally *c.* 5%, before hermetically packaging and storing at sub-zero temperatures. The seeds are stored at the National Genebank of Kenya. Since 2000, the Programme in collaboration with its partners in the Seeds for Life project collected, documented, and stored seeds of 600 plant species representing 120 families, 359 genera and 554 species indigenous to various regions of Kenya. These collections form part of Kenya's heritage of plant genetic resources that are available for use in research, re-introduction for multiplication and specialized use.

Development and application of seed handling protocols

Basic research to backstop production and handling is pre-requisite to ensure continuous provision of appropriate technologies and protocols. The focus of seed research is on

storage and dormancy release. For example not all seeds will germinate when sown even with appropriate conditions. In nature seed remains dormant until the conditions are favorable this is adaptation strategy that ensures species survival. Treating (germination pre-treatment) the seed before sowing eliminate this “resting period.” The findings from these studies have narrowed the knowledge gap, while enhancing the important role of germplasm use and conservation. Further, the results from the studies have enhanced our understanding of storage and germination behavior of the challenging indigenous species namely, *Melia volkensii, Polyscias fulva, Moringa stenopetala, Zanthoxylum gilletii, Terminalia brownii* and *Osyris lanceolata among other.s* Anothetr area where reseach progrees have been made is the determination of seed desiccation tolerance which aims to assess seed storage potential at low temperature and moisture content both of which are pre-requisites for long-term seed storage. It is evident that it is not possible to determine seed storage potential based on either fruit or seed morphological characteristics. Through these studies, we have been able to identify plant bearing species whose seeds, which are non-storable under conventional cold stores. The results of these studies have been compiled and published in the Tree Seed Handbook of Kenya and tree seed information leaflets.

Mitigation and adaptation measures to address impacts of climate change

Evidence of climate change in Kenya is unmistakable. Temperatures have risen throughout the country. Rainfalls have become irregular and unpredictable, and when it rains, downpour is more intense. The purpose of mitigation measures on climate change address indicators and the various evidences of climate change. These include among others forest reafforestation and afforestation, development demonstration of technologies for biomass multiplication in order to enhance carbon stock and seed production and production to meet seedling production targets. Adaptation measures focuses on measurements and assessment of options such as: Selection and breeding to produce superior fast-maturing, drought tolerant and pest and disease tolerant trees and establishing seed sources of the same. This will ran parallel to identification of species for diversification for different end uses in adaptation to climate change across agro-ecological zones.

Publication to support seed policy, production and use

Information generated from the seed handling research and experiences have been packaged into several publications as listed below. About 4,000 copies of the Tree Seed Handbook in particular have been distributed widely to both local and international libraries, NGO's and to several academic institutions. The publications are listed below :

1. National Seed Policy 2010 – Ministry of Agriculture
2. The State of Plant Genetic Resources for Food and Agriculture in Kenya – FAO Report, 2009
3. Seed Production and Research Strategy – 2011; KEFRI
4. Seed collection and handling; a Reference Manual – KEFRI 2011
5. Tree Seed Source Re-classification Manual: 2009, ICRAF /KEFRI
6. Tree Seed Quality Guide 2009, ICRAF/KEFRI
7. Promoting tree planting through provision of high quality seeds: Information leaflet; KEFRI 2011
8. Seed Catalogue; KEFRI 2010
9. Evolution of provision of Tree Seed in extension programmes. RELMA Technical note; 1994
10. Tree Seed Hand Book of Kenya 2nd Edition 2007
11. Tree Seed Information Leaflets
12. Forest Seed Zones of Kenya

Training and skills development

Training in tree seed collection and handling has become a major task of KEFRI'S Seed Programme in recent years since seed collection activities are carried out by an increasing number of national and local groups, projects and organizations. The Institute also made a remarkable the regions seed-training programme. For instance, between 1992 and 1996 the programme undertook training for about 100 technical staff from about 12 countries in East and Southern Africa. In addition, the Programme has over the years offered short-term training to about 300 participants drawn from specialized communities and Institutions in Kenya. The skills acquired by the recipient of the trainings have enhanced their seed production capacity and thus promoted tree-planting activities through the provision of high quality seeds. Key scientists have been involved in curriculum development in seed science and technology for Londiani forestry college and Maseno University. In addition, we have spearheaded the development of a training manual for community groups and extension staff. Most of the programme technical staff have aquired specialized skills through in-house training, technical attachments in partner laboratories in Wakehurst Place; RBG Kew, Australia Tree Seed Centre (ATSC), Malaysia Forestry Reasech Institute (FRIM), Danida Forestry Seed Centre (DFSC) and several forestry institutions in Germany and South Africa. Key technical staff have also undertaken study tours and academic training in seeds science, collection and handling techniques at different local and International Institutions.

Table 3. Some challenges facing the provision of high quality seeds to planting programmes in Kenya

Challenges	Strategy
1. Slow rate of tree improvement hinders the development of seed sources of high genetic quality	Allocate more resources in seed source development.
2. Low funding level of research limits capacity to develop more technologies to address problems associated with seed production and use.	Enhance National and International Networking and partnerships in research through joint proposals and training programmes
3. High cost of procurement and maintenance of seed production and testing equipment.	Test and validate best practices that use localized equipments conditions.
4. Large number of species (mostly indigenous) whose propagation methods are yet unknown and some which are to be optimized.	Seek collaborative research activities and exchange of test samples to establish common protocols
5. Regulating the use of seeds of low quality produced and distributed through the informal sector (vendors)	Training and registering all informal seed producers /vendors and promoting formations of their Associations
6. Estimating seed demand – amounts and specie	Compile an inventory of informal seed vendors and nurseries and analyze the volumes of seeds and seedlings produced through theses channels
7. High cost of seed production	Liberalize seed production by involving the informal sector through training programmes and registration of seed supplier

Table 4. Indigenous species and their associated handling problems

Species	Challenges
Aningeria adolfi-friedericii	Extraction methods Pretreatment, drying method,
Antiaris toxicaria	Extraction methods
Boscia coriaria	Drying
Brachylaena huillensis	Processing and germination
Combretum schumannii	Germination
Terminalia spinosa	Germination
Croton macrostachys	Processing
Ocotea usambaransis	Poor pollination
Fagara macrophylla	Oily and hard seed coat - germination
Podocarpus graciolor	Pre-treatment; hard seed-coat (endocarp)
Dovyalis caffra	Storage
Dobera glabra	Storage
Juniperus procera	Pollination and hard seed coat
Maesopsis eminii	Extraction
Melia spp.	Seed extraction and germination
Olea spp.	Processing and germination
Prunus africana	Timing maturity period and storage
Salvadora persica	Storage
Vitex keniensis	Extraction
Warburgia ugandensis	Extraction and storage

Albrecht and Braun 1993

REFORESTATION PROGRAMMES IN KENYA

Mr. James Mwang'ombe Mwamodenyi
Biodiversity Managment
Kenya Forest Service (KFS)
Nairobi, Kenya

KENYA
Forest Service

REFORESTATION PROGRAMMES IN KENYA

JAMES MWANG'OMBE MWAMODENYI
Head Biodiversity Management
Kenya Forest Service

INTRODUCTION

- forests cover approx 2.8% of Kenya's total land area.
- dominated by closed canopy indigenous forests (about 1.24m ha) and forest plantations (about 0.165m ha).

Fig 1. Gazetted forests in Kenya.

Introduction..

- Kenya's forests are classified into 4 basic categories which are based on regional climatic conditions;
  - coastal forests (82,500 ha of natural forests and another 3,200 ha of plantations),
  - montane rain forests (consisting of about 748,500 ha of natural forests and 102,800 ha of plantations),
  - western rain forests (mainly located within the western region of the country and they cover 49,000 ha of natural forests and 18,600 ha of plantations) and,
  - dry zone forests (about 211,000 ha and 8,200 ha of natural forests and plantations respectively) (Mogaka *et al*, 2001).

Contribution to national economy and local livelihoods.

- As well as providing environmental security and ecological stability, the forest estates provide the local communities with energy sources, construction materials, foods, medicinal plants and socio-cultural satisfaction.
- Estimated that about 3 million forest adjacent dwellers directly depend on forest resources to meet their basic household requirements.
- At the national level, it contributes about 1% and 13% to the monetary and non-monetary economies, respectively. However, this is grossly under-estimated given that the contribution of the sector to local economies is not accurately reflected.

FOREST COVER LOSS & DEGRADATION

- Agricultural land expansion.
- Illegal land excision
- Overgrazing
- Wildlife damage – especially elephants
- Charcoal trade.
- Political/election aftermath.

FOREST MANAGEMENT and INSTITUTIONAL SET UP

- Forest Department initially managed the forest estate but there were serious problems and limitations (Cap 385).
- Some forest areas have dual gazettement e.g. Mt. Kenya, Kakamega forest, Shimba hills, Mt. Elgon (challenges)
- Forest Act 2005
  - KFS set up as a semi-autonomous body.
  - Conservation Fund.
  - Expanded categories of forest gazettement.
  - Introduced community participation in forest management.
  - Entrenched biodiversity conservation.

FOREST MANAGEMENT and INSTITUTIONAL SET UP

- Management plans – Strategic plans, PFM plans, Enterprise development plans,
- Reduced political pressure and influence from other government arms.
- Enabled recovery of illegally excised forest land e.g. Mau forest >60,000ha recovered so far.
- Opportunity to raise/mobilise resources – retention of revenues, private sector, engage community, venture into enterprise (eco-tourism). Attracting development supports – projects e.g. NRM (WB), GZDP (AfDB), MMMB (Finland) etc.
- Paramilitary training of forest professionals and rangers and arming increasing protection.

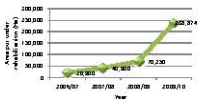
Reforestation Efforts - Natural forest management and conservation

- main objective of managing natural forests is to ensure sustainable supply of various environmental goods and services.
- Restoration of degraded forest areas through enrichment planting and protection for natural regeneration, both national and county council forests.

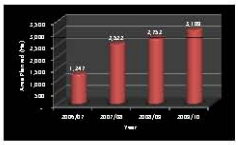
Fig 2. Totally deforested hill in Rachuonyo.

Reforestation Efforts.

Rehabilitation of natural forests.



Rehabilitation through enrichment planting.



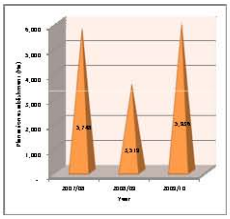
Reforestation Efforts.

Fig 3. Tree nursery supported by GZDP.

Fig 4. Tree planting in Toropket Forest Along the River bank.

Reforestation Efforts – Plantation development and management.

Fig 5. Plantation establishment trends.



Establishment of Industrial Plantations

- A total of 14.9 million seedlings were produced and used to establish 5,936 ha of new industrial forest plantations in 2009/10.
- achieved through the use of PELIS where over 4,000 ha were established using this method.
- Other partners i.e. COMPLY and Timsales participated in plantation establishment and maintenance.

Reforestation Efforts – Plantation development and management.

Fig 6. Plantation tree nursery in Nandi South forest zone.

Fig 7. Young cypress plantation in Mt. Elgon.

Reforestation Efforts – Farm and dryland forestry.

- The Constitution of Kenya 2010, Vision 2030 and Farm forestry rules 2009 all require 10% forest cover.
- Any forest cover expansion only possible on private land and the drylands.
- Tree seedlings production.
  - One of the cardinal duties of the KFS extension arm is to promote tree seedlings production for on-farm tree planting.
  - In 2009/10 financial year over 99 million exotic and indigenous tree seedlings were raised by both KFS and private nurseries (Fig 13).
  - Of this 80% was from private nurseries (thus raising the issue/concern on quality of germplasm used) while the balance was produced by KFS.
- Establishment of commercial woodlots .
  - 5,053 ha of woodlots were established with high potential areas realizing 4,378 ha while 675 ha were established in the ASALs.

Reforestation Efforts – Farm and dryland forestry.

- In the high and medium potential areas, *Eucalyptus grandis and E. saligna*, Grevillea and Casuarina were the most common species while in the drylands *Melia volkensii, E. camandulensis, Azadirachta indica* and Acacia species were the most preferred species.
- Increased community awareness on the economic potential of forestry as well as good weather conditions contributed to the fair achievements.
- **Farm Forestry Field Schools.**
  - /10, 62 schools involving about 1,200 farmers were established. Among these 28 were in the high potential areas while 34 were established in the ASALs.
- **Tree planting in schools and urban areas**
  - KFS is promoting the *'adopt-a-tree'* approach to tree planting in schools.
  - Stimulus Programme (ESP) boosted the schools' efforts.
  - 1,631 schools participated in the programme

Other Reforestation efforts

- The military - Department of Defence,
- Civil Society - NGOs and CBOs/FBOs.
- Government parastatals/institutions - Kenya Power Company, Kenya Power Generating Company, Geothermal Power Company among others.
- Private companies such as Kenya Breweries Ltd, Kenya Commercial Bank, Safaricom Foundation.
- Educational institutions – local and foreign universities such as Yokohama University of Japan that is testing a methodology of habitat restoration in Mau.
- CDTF-CEF has played a major role in supporting forest rehabilitation. Through projects implemented by CBOs all over the country, almost every project supported has a component of tree planting as a requirement particularly targeting catchment and biodiversity-sensitive areas.
- *Kazi kwa Vijana* programme (an economic stimulus programme of the government) has contributed a lot to afforestation in the country.
- Carbon-offset projects – CAAC/KFS MoU. Allows the community members to plant trees in degraded forest areas and earn carbon credits while KFS benefits through rehabilitation of such areas.

Other Efforts…

- Heightened awareness and sensitization activities such as;
  - Beauty pageants,
  - Awareness creation caravans,
  - Cross-country marathons.
- Registration of private tree nurseries.

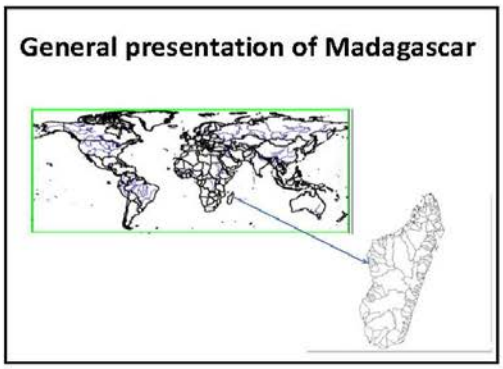
Fig 8. Miss Forest Beauty pageantry.

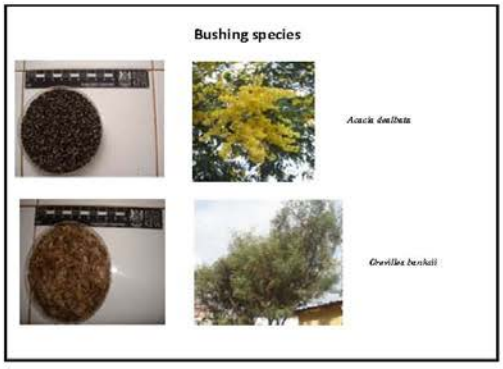
CONSTRAINTS

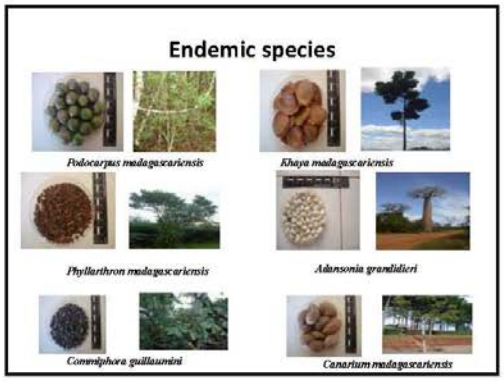
- Lack of political goodwill – until very recently, forest conservation did not attract much political goodwill. (Wildebeest migration of the Serengeti/Maasai Mara).
- Low government allocation to the sector. Hopefully this will be overcome by the setting up of a conservation fund (as per Forest Act 2005) and the provision for KFS to retain and plough back its revenues/income.
- Enactment and enforcement of legislation.
- Seed supply. Indigenous tree seeds are not readily available and some farmers have complained of obtaining supplies that failed to germinate.
- Indigenous tree species not preferred due to their slow growth and the quest for quick returns.
- Political/election upheavals.
- Insecurity/community hostility e.g. Mt. Elgon, Indigenous-peoples' problems etc.
- Transitional phase – from a FD to a Parastatal – and – from District/centralized governance system to County/decentralized system.
- Partial ban on harvesting resulted in inadequate supply of forest products especially timber shifting the demand to on-farm and illegal cutting in the forests.
- Conflicting legislation and institutional mandates (KFS, KWS, NEMA).
- *Implementation of the Constitution and decentralisation will affect current set up.*

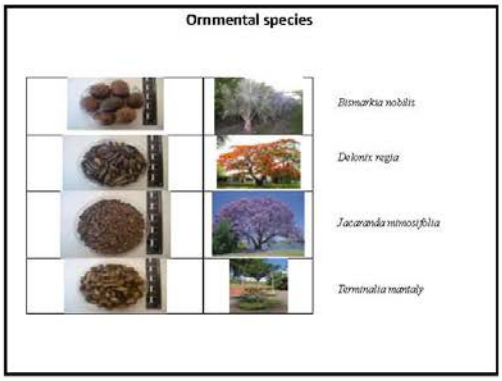
AFFORESTATION IN MADAGASCAR

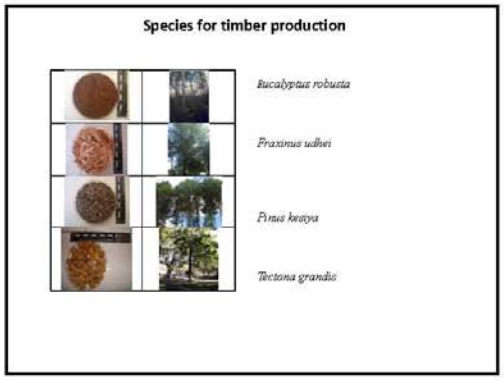
Mr Mamy Andriamahay
Silo National des Graines Forestieres (SNGF)
Antananarivo, Madagascar



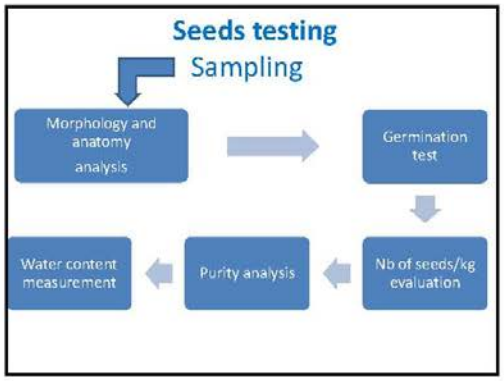



Endemic species
Podocarpus madagascariensis
Khaya madagascariensis
Phyllarthron madagascariensis
Adansonia grandidieri
Commiphora guillaumini
Canarium madagascariensis


Ornmental species
Bismarkia nobilis
Delonix regia
Jacaranda mimosifolia
Terminalia mantaly


Species for timber production
Eucalyptus robusta
Fraxinus udhei
Pinus kesiya
Tectona grandis

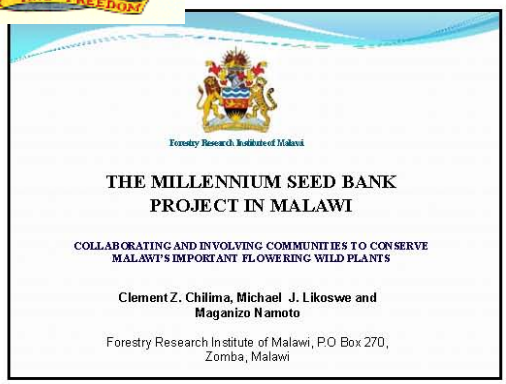

Seeds processing: extraction, cleaning and drying

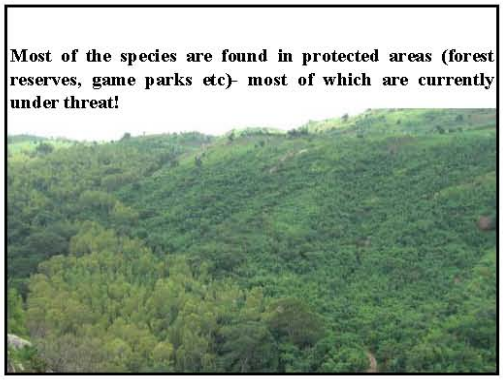

Seeds testing
Sampling
Morphology and anatomy analysis
Germination test
Nb of seeds/kg evaluation
Purity analysis
Water content measurement

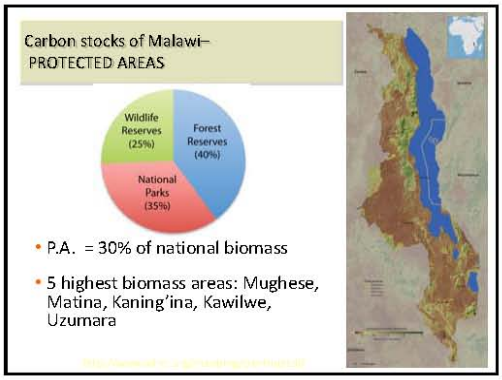

Seeds storage

THE MILLENNIUM SEED BANK PROJECT IN MALAWI:
COLLABORATING AND INVOLVING COMMUNITIES TO CONSERVE MALAWI'S IMPORTANT FLOWERING WILD PLANTS

Clement Z. Chilima, Michael J. Likoswe and Maganizo Namoto
Forestry Research Institute of Malawi







The MSB Project began in Malawi in May 2003.

Partnerships and Collaboration: The activities of the project were carried out by three local partner institutions; the Forestry Research Institute of Malawi (FRIM), the National Herbarium and Botanic Gardens of Malawi (NHBG), the National Plant Genetic Resources (NPGRC) and the National Research Council of Malawi (now within the National Commission for Science and Technology (NSCT).

Closely collaborated with the University of Malawi, Mzuzu University, Mulanje Mountain Conservation Trust, Kew Gardens.

Threats to Plant Conservation in Malawi

Frequent uncontrolled Wild Fires

Habitat loss due to cultivation into Forest Reserves and infrastructure development, urbanisation, and human settlements

Over-exploitation (medicinal plants, charcoal, fire, curios, construction timber etc)

Climate change (frequent droughts and floods)

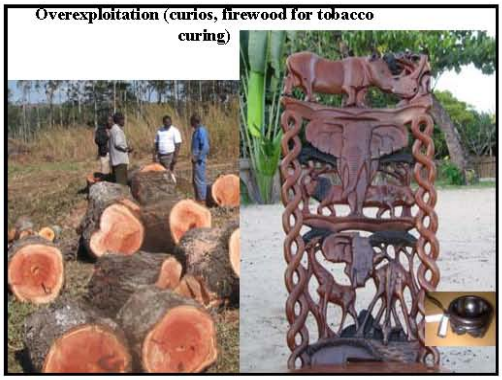
Infrastructure development (eg road construction, buildings)

Mining

Alien invasive species

Utilisation and Threats to Conservation of Wild Plant Species in Malawi

Overexploitation (curios, firewood for tobacco curing)



Over-utilisation -Firewood

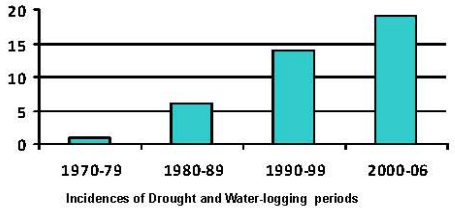
Forest Seeds Harvested to Produce Curios and Jewellery

charcoal

Forests Cleared for Settlements and Agriculture

Mining and Other Industrial developments

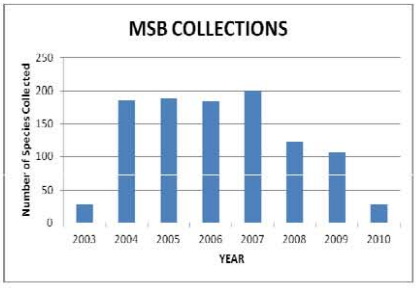
Climate Change



Incidences of Drought and Water-logging periods

Major Milestones and Achievements of the MSB in Malawi

1) Identification, Collection, Cataloguing and Long Term Storage: More than 1,000 rare, endemic and endangered wild plant species have been identified, catalogued and their seeds collected and stored at National Plant Genetic Resource Centre and duplicated at Kew Gardens.



More than 1,000 species collected from the wild and preserved (2003 to date)

MSBP teams collecting seeds in various sites in Malawi. The teams copprised members from various partner institutions.

ii) **Training and Research:** Graduate and postgraduate training supported- 1xPhD, 1xMasters and 2 x Batchelor of Science Degrees.

Short term trainings supported in plant conservation assessments and seed conservation techniques

Improved taxonomic expertise imparted through attachments to special expeditions arranged through Kew Gardens and short term training

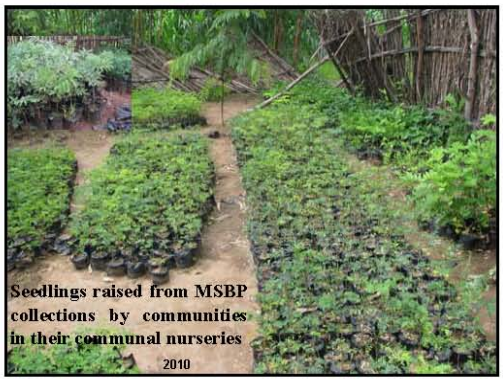
Research- seed germination, Ecology of Mulanje cedar, etc

v) **Equipment and Facilities:** Seed collection, processing and storage facilities provided to the partner institutions for seed collection, moisture content determination and seed storage

v) Supporting Tree Planting Activities (Latest Developments **in Zomba**)

Seedlings have been raised and distributed to individuals, schools and other members of communities, to plant in degraded sites, as ornamentals etc

(3200 tree seedlings of rare and economically important species have been raised in 2011. including; *Widdringtonia whytei, Ralvofia caffra, Buttdavya nyasica, Khaya anthotheca, Brideria micrantha, Parkia filicodia, Garcinia huillensis, Newtonia buchananii and Trichilia emetica, Albizia adianthifolia, Adansonia digitata)*



Seedlings raised from MSBP collections by communities in their communal nurseries

2010

Seedlings from the MSBP collections are distributed to primary schools, City assembly, faith groups, village natural resource committees (VNRMCs) and other members of the communities for planting in degraded sites, ornamentals etc

A memorial tree provided by the MSBP being planted at an international School.

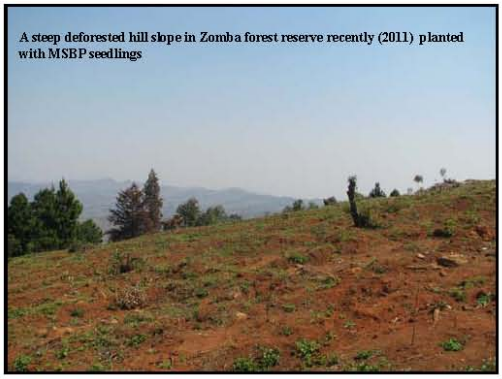
A young seedling planted from MSBP collections near FRIM offices (2010)

Tree seedlings provided by the MSBP being planted in the City of Zomba by members of the Lions Club International.

Reclaiming an Encroached Forest Land Using MSB seedlings

Tree seedlings provided by the MSBP being planted on a Fragile Site in Zomba Mountain Forest Reserve by the Faith community and Members of Parliament

A steep deforested hill slope in Zomba forest reserve recently (2011) planted with MSBP seedlings



Contribution to the State of the Forest Genetic Resources Report

- **List of FGR**
- **In-situ and ex-situ conservation**

Looking Forward

Continue collection and preservation of target species- targeting species and ecosystems that were left out in previous collections and Nyika plateau and Mulanje massif where there is increasing loss from fires and invasive species

Improve local seed storage facilities at FRIM and NPGRC- Considering the current challenges faced by some national institutions in Malawi, it is critical to have at least two functional seed storage facilities within the country.

Enhance involvement of communities in rehabilitating degraded sites and establishing plant conservation areas using MSBP collections **(including riverine areas, catchment areas and hill slopes).**

eg Rehabilitation of a cement mining site in Zomba (La Farge)

In-situ and ex-situ conservation of selected conservation tree species (eg replanting in Mulanje in other suitable sites in Malawi) and indigenous bamboo species (which are currently dying in large numbers)

Regeneration of important medicinal plants, indigenous fruits species, fuelwood species eg botanic/medicinal plant gardens with involvement of communities (targeting women, traditional healer grooups etc)

Link tree planting and conservation to REDD and other related initiatives

Challenges

Seed availability and supply (increasing demand for "new spp"
Finances (insecure)
Awareness- Access/Benefit for communities
Staff retention

AFFORESTATION IN AFRICA: CONSTRAINTS AND OPPORTUNITIES

REPORT OF MALI

Mr Sidi Sanogo
Institut d'Economie Rurale
Centre Regional de Sikasso, Unite Semences Forestieres
Sikasso, Mali

Abstract

Following the partnership Millennium Seed Bank Project, Kew and the Institut d'Economie Rurale du Mali, an unit of seeds and herbarium has been put in place at the Centre Régional de Recherche Agronomique de Sikasso. This unit is unique in the country, leads the studies and experimentations on the techniques of harvest, germination and conservation of seeds. Activities of afforestation and reintroduction of useful plant species are undertaken in the village area with the communities (therapists, nurserymen, planters, forest products operators, transforming of the fruits, agricultural producers, etc.). Seeds of more than 800 species of plants are collected and are kept. More of 8000 specimens of herbaria collected to Mali and Burkina Faso are prepared and are classified. For afforestation activities, 15 ha are planted (arboretums of useful plants and wild species fruit parcels) have been achieved at farmers associations and 2 sacred forests are under restoration by enrichment plantation with communities. Ethnobotany surveys permitted to list the main species why are frequently exploited by the users. The nurserymen and planters are trained and follow-up on the seedlings production. In collaboration with the department of research on the traditional

medicine, some analyses phytochimiques has been achieved from organs of 10 medicinal species for determined their chemical groups. The herbarium was registered on the Herbariorum Index. In the future, unit of seeds and herbarium will play the functions of production and propagation of the forest species seeds and support advice on the preservation of biodiversity.

Résumé

Suite au partenariat Millennium Seed Bank Project de Kew et l'IER du Mali, une Unité de Semences Forestières et Herbier a été mise en place et équipée au niveau du Centre Régional de la Recherche Agronomique de Sikasso. Cette unité, unique au Mali, mène des études et expérimentations sur les techniques de récolte, de germination et de conservation des semences. Des activités de reforestation et de réintroduction d'espèces végétales utiles sont entreprises dans les terroirs villageois avec les communautés (thérapeutes, pépiniéristes, planteurs, exploitants produits forestiers, transformatrices des fruits, producteurs agricoles, etc.). Les semences de plus de 800 espèces de plantes sont collectées et conservées. Plus de 8000 spécimens d'herbiers collectés au Mali et au Burkina Faso sont préparés et classés. En matière d'afforestation, 15 ha de plantations (arboretums et parcelles fruitières) ont été réalisés chez des associations paysannes et 2 forêts sacrées sont en cours de restauration par plantation d'enrichissement avec des communautés villageoises. Une enquête ethnobotanique a permis de lister les espèces de plantes fréquemment exploitées par les utilisateurs. Des pépiniéristes et planteurs sont formés et suivi sur les techniques de production de plants. En collaboration avec le département de recherche sur la médicine traditionnelle, des analyses phytochimiques ont été réalisées à partir d'organes prélevés sur 10 espèces de plantes médicinales afin de mettre en évidence leurs groupes chimiques. L'Herbier a été inscrit sur l'Index Herbariorum. Avec son développement, l'Unité de Semences Forestières et Herbier jouera pleinement les fonctions de production et de propagation des semences forestières, de formation et d'appui conseil sur la conservation de la biodiversité végétale.

Introduction

Le Mali est un vaste pays sahélien, enclavé au centre de l'Afrique de l'Ouest. Il couvre une superficie de 1.241.238 km². Le pays recèle d'écosystèmes terrestres et d'habitats naturels particuliers. On distingue plusieurs grands groupes, répartis sur les différentes zones agro-écologiques et régions naturelles. Le climat du Mali est de type soudano-sahélien avec 4 grandes zones agro-climatiques qui se succèdent du Sud au Nord par :

- la zone soudano-guinéenne,
- la zone soudanienne,
- la zone sahélienne, et
- la zone saharienne.

En plus de ces 4 zones agro-climatiques, il y a le Delta Intérieur du fleuve Niger (site RAMSAR) qui présente une écologie particulière.

Au cours des trois dernières décennies, l'aridité climatique s'est accrue et les isohyètes se sont déplacés d'environ de 200 km en allant du Nord vers le Sud (Dolo, 1996). Dès lors, à l'instar des autres pays du sahel, les ressources végétales du Mali sont soumises à de fortes pressions d'ordre climatique (irrégularité des pluies, érosion, etc.) et anthropique (coupe de bois, feux de brousse, surpâturage, prélèvement d'organes de plantes, etc.). Ces diverses pressions constituent de véritables menaces pour la préservation de la diversité des espèces végétales. Une étude menée dans la partie Sud du Mali a révélé que plusieurs espèces de plantes (alimentaires, médicinales, artisanales, fourragères) préférées des populations deviennent de plus en plus rares dans les terroirs villageois (GRASE, 1999).

La flore du Mali présente une grande variété d'espèces. Elle a été étudiée et décrite par plus de 100 collecteurs. Dans le Catalogue des Plantes Vasculaires du Mali (Boudet et Lebrun, 1986), 1.739 espèces spontanées ont été répertoriées. Ces espèces appartiennent à 687 genres qui se regroupent dans 155 familles. Les familles les plus importantes numériquement sont par ordre, les Poaceae, les Fabaceae et les Cyperaceae. Dans le catalogue, les espèces suivantes sont considérées endémiques : *Maerua de waillyi, Elatine fauquei, Pteleopsis habeensis, Hibiscus pseudohirtus, Acridocarpus monodii, Gilletiodendron glandulosum, Brachystelma medusanthemum, Pandanus raynalii.* En outre, sur la liste rouge de l'IUCN, une espèce est classée comme menacée *: Dalbergia melanoxylon ;* quatre sont classées comme vulnérables *: Afzelia africana, Khaya senegalensis, Pavetta lasioclada, Gilletiodendron glandulosum ;* et deux sont classées comme étant en danger : *Vepris heterophylla* et *Pteleopsis habeensis* (MEA/DNEF, 2009).

Les plantes contribuent à la satisfaction des besoins énergétiques de plus de 95 % de la population malienne. Pour la satisfaction des besoins en bois d'énergie et bois de service, beaucoup de plantations industrielles et de plantations villageoises à base d'espèces exotiques (*Eucalyptus camaldulensis, Gmelina arborea, Azadirachta indica, Tectona grandis*, *Anacardium occidentale*) ont été installées dans les forêts classées et dans les terroirs villageois. La plantation d'espèces alimentaires, médicinales et fourragères qui subviennent aux besoins quotidiens des populations est toujours restée timide. Les principales raisons étaient entre autres, l'absence de matériel végétal performant (semences et plants) et la méconnaissance des techniques sylvicoles.

Pour préserver les formations forestières naturelles, l'Etat malien a mis progressivement en place un réseau de forêts classées et des réserves de faune constituant ainsi des moyens efficaces de conservation *in situ* des ressources biologiques. En matière de protection

d'espèces végétales, 11 plantes ligneuses sont intégralement protégées par le code forestier du Mali (ME/DNCN, 1999). Il s'agit de : *Elaeis guineensis (*Palmier à huile), *Borassus aethiopum (*Rônier), *Pterocarpus erinaceus (*Vène), *Afzelia Africana (*Doussier d'Afrique), *Acacia Senegal (*Gommier blanc), *Parkia biglobosa (*Néré), *Butyrospermum paradoxum (*Karité), *Bombax costatum (*Kapokier rouge), *Khaya senegalensis (*Caïlcédrat), *Acacia albida, Anogeissus leiocarpa (*Bouleau d'Afrique). En examinant cette liste, il ressort qu'aucune graminée rare, endémique et/ou plantes rampantes ne sont officiellement protégées par ce code. Par ailleurs, en plus des mesures institutionnelles et techniques instaurées par l'Etat, il existe habituellement dans les villages des conventions locales et/ou ancestrales en matière de gestion des ressources végétales.

Pour contribuer à une meilleure connaissance de ce matériel végétal, le Programme Ressources Forestières mène depuis les années 1990, des études et expérimentations sur la biologie et la sylviculture des espèces locales, l'agroforesterie, l'aménagement et la restauration des formations forestières. Des technologies ont été mises au point sur les techniques de production de plants à la pépinière, les techniques de plantation, la régénération naturelle assistée, l'enrichissement des forêts et l'amélioration des jachères. A partir de la collaboration avec MSBP de Kew, une unité de semences et un herbier ont été installés au Centre Régional de Recherche Agronomique (CRRA) de Sikasso. Les semences de beaucoup d'espèces spontanées du Mali sont collectées et conservées. En vue de conserver et de gérer de façon durable ces plantes, des actions portant sur la réintroduction, la multiplication et le développement de stratégies d'utilisations efficientes des produits de ces plantes sont en cours d'exécution avec les communautés et les services d'encadrement et de vulgarisation. Les plantations réalisées sont de types communautaires ou individuels. Toutefois, il ressort toujours que dans la mise en œuvre de leurs activités de reboisement, les communautés sont confrontées à l'acquisition de matériel végétal (plants, graines) de bonne qualité, à la non maitrise des techniques de production des plants et de plantation. Aussi, le manque d'encadrement et d'appuis financiers pour l'entretien et la protection entrainent l'échec des plantations installées dans les terroirs villageois.

Activités et résultats obtenus

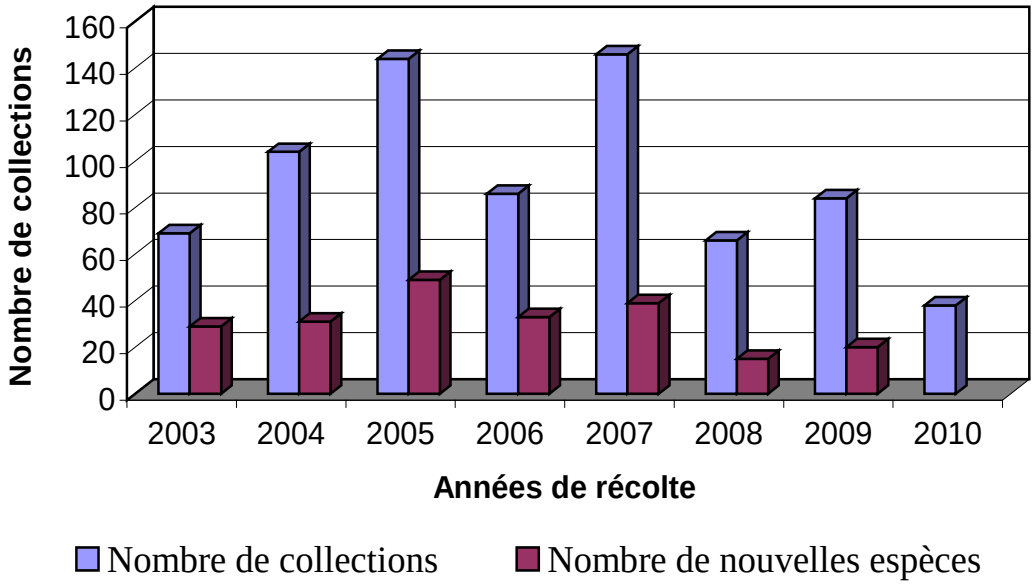
Les principales activités misent en œuvre au Mali dans le cadre du programme MSB, se résument en ces différents points :

- Récolte des semences et d'herbiers, identification des plantes
- Etude des caractéristiques de germination et de conservation des graines
- Plantation et restauration d'habitats naturels avec les communautés
- Inventaire et identification des plantes utiles aux communautés
- Production et propagation de matériel végétal performant chez les communautés
- Etude et détermination des groupes chimiques de plantes médicinales
- Organisation et renforcement des capacités des communautés

Collection des semences et d'herbiers, reconnaissance des plantes

Des expéditions de récolte de graines, d'herbiers et des prospections botaniques sont conduites à travers les provinces et zones agro écologiques du pays. Au Mali, plusieurs expéditions de récolte sont conjointement conduites avec une équipe du CNSF (Burkina Faso). Des missions d'appui de Kew ont participé aussi aux collections.

Les récoltes sont planifiées à l'aide des guides de collection et/ou de façon opportuniste dans certaines localités du pays non encore explorées par l'équipe de récolte. Durant la première phase du MSBP, les semences de plus de 800 espèces ont été récoltées. Les spécimens d'herbiers de plus de 1000 espèces du Mali et du Burkina Faso ont été prélevés. La figure 1, illustre l'évolution des collections de semences et d'herbiers envoyées à Kew.



Beaucoup d'efforts ont été fournis pour le montage et l'arrangement des herbiers. Présentement, l'Herbier du CRRA de Sikasso comptabilise plus de 8000 spécimens montés et classés. Les photos de différents stades phénologiques des espèces récoltées sont disponibles et sont en cours d'introduction dans la base de données BRAHMS. Sur les 8 espèces endémiques répertoriées dans le catalogue des plantes vasculaires du Mali, les semences de 4 sont récoltées et conservées, les peuplements d'une sont localisés et suivis pour l'obtention des semences. Toutefois, les 3 autres espèces ne sont pas encore retrouvées sur le terrain. En août 2010, l'Herbier a été inscrit sur l'**Index Herbariorum**.

Etude des caractéristiques de germination et de conservation des graines

Au niveau de l'USFH, les semences récoltées sont conservées dans des congélateurs dont les températures varient de – 10 à – 6 °C (saison froide à saison chaude).

Après préparation, on procède à un premier séchage des semences à l'ombre. Le séchage à l'ombre est suivi par un séchage à froid dans un incubateur (T à 15 °C, HR entre 15 et 20 %) durant 3 semaines. Avant le séchage des semences à l'incubateur, des tests de germination sont effectués afin de déterminer le taux de viabilité initiale des graines. Pour les tests de germination, le sable fin de fleuve, le papier filtre et agar sont les substrats de culture utilisés à USFH. Avant l'empaquetage et la mise à la conservation dans les congélateurs, on procède encore à une évaluation de la viabilité des semences. Les semences conservées sont évaluées tous les 5 ans.

En plus des tests de germination des collections MSBP, des études sont menées sur le développement des fruits et les caractéristiques de germination des semences des certaines espèces socio-économiquement importantes. Les principales espèces étudiées au laboratoire, à la pépinière et chez des pépiniéristes villageois sont : *Parinari curatellifolia,*

Terminalia albida, Pterocarpus lucens, Anogeissus leiocarpa, Isoberlinia doka, Carapa procera, Crossopteryx febrifuga, Zanthoxylum zanthoxyloides, Mitragyna inermis, Securidaca longepedunculata, Lophira lanceola, Daniellia oliveri, Spondias mombin et Ximenia americana. Les difficultés liées à la production des plants de ces espèces sont la mauvaise germination et la faible croissance des plants.

Plantation et restauration d'habitats naturels avec les communautés

Les plantations sont réalisées dans des exploitations communautaires ou individuelles mais au profit de toute l'organisation paysanne partenaire. De 2008 à 2011, les plantations réalisées et les forêts restaurées se résument comme suit :

- 7 arboretums (Zégoua, Kouguè, Ifola, Yanfolila, Tori, Sanzana, Kolokani) de 11 ha de superficie, au profit de 7 communautés (thérapeutes, planteurs, pépiniéristes, exploitants de bois, producteurs bio, herboristes)
- 3 plantations fruitières (Katélé, Bla, Ifola femmes) de 4 ha au profit de 3 associations (2 associations de pépiniéristes, 1 association des transformatrices de fruits)
- 2 forêts sacrées (Zégoua, Founa) sont en restauration avec 2 communautés villageoises.

En plus de ces associations partenaires, les plants ont été fournis à des ONG, Bureaux d'études, écoles et des individus. La liste des espèces, leurs caractéristiques et leurs utilisations est donnée en annexe.

Inventaire et identification des plantes utiles aux communautés

Une liste d'espèces prioritaires utiles aux communautés a été établie à partir d'une enquête ethnobotanique. Différents groupes socioprofessionnels et organisations faîtières ont été interviewés à l'aide de guide d'entretien et de parcours de transects écologiques dans le terroir pour collecter les plantes. Les données de ces enquêtes ont été complétées avec une revue bibliographique d'inventaires forestiers et des études de la médicine traditionnelle. Au total, 323 espèces ont été répertoriées comme plantes utiles exploitées par les groupes socioprofessionnels. Sur les 323 espèces répertoriées, 98 % sont des plantes médicinales et alimentaires, seulement 2 % sont des plantes fourragères. Les organes de plantes exploités pour la production de médicaments sont les feuilles, les racines, les écorces et les épiphytes. Pour l'alimentation, on récolte les feuilles, les fruits, les fleurs, les tubercules et souvent la sève. Les artisans exploitent les branches, les feuilles, les racines, la gomme et utilisent souvent les fruits et graines de certaines espèces.

Production et propagation de matériel végétal performant

Dans le cadre de la valorisation des collections, des semences sont préparées et des plants sont produits à la pépinière. Des demandes sont adressées aux partenaires qui expriment leurs besoins au début du démarrage des travaux de la pépinière. Durant ces 2 dernières années, la production annuelle en plants a été estimée à 50.000 pour une cinquantaine d'espèces. Sur l'ensemble des espèces produites, 80 % sont autochtones et 20 % exotiques. En 2010, 23 kg de semences ont été données à des pépiniéristes villageois.

En matière de propagation des fruitiers, l'accent est mis sur l'utilisation des plants greffés de *Ziziphus mauritiana* améliorés, Tamarinier sucré, *Cola nitida* greffé sur *Cola cordifolia*, *Vitellaria paradoxa, Adansonia digitata, Lannea microcarpa* greffés avec des spécimens aux fruits sucrés.

Suivi de la production des plants dans la pépinière du PRF à Sikasso

Les espèces les plus demandées sont : *Khaya senegalensis, Eucalyptus camaldulensis, Parkia biglobosa, Tamarindus indica, Ziziphus mauritiana, Afzelia africana, Jatropha curcas, Adansonia digitata, Gmelina arborea, Pterocarpus erinaceus, Carapa procera, Cassia siamea et les semences d'Andropogon gayanus et de Cymbopogon giganteus*,
Certaines espèces posent des difficultés au moment de la livraison à cause de leur petite taille. Sur la base de la production de 2010, la figure 2 illustre les critères de choix des espèces au moment de la commande. Les espèces ornementales ont été demandées par les écoles et les particuliers pour les plantations d'ombrage et d'alignement.

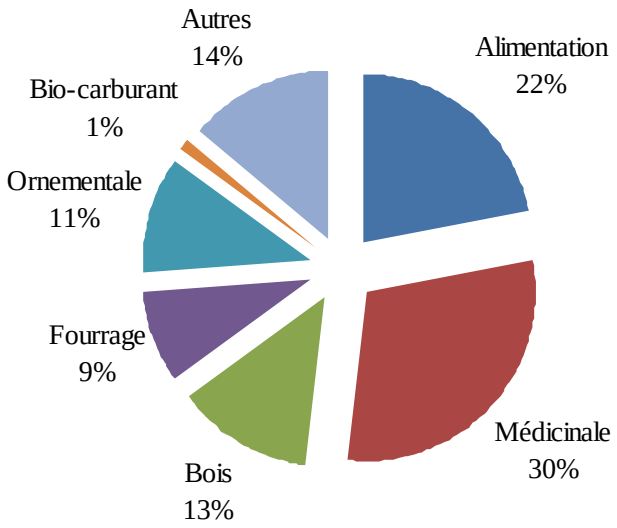


Figure 2 : Principaux critères motivants le choix des espèces par les utilisateurs

Etude et détermination des groupes biochimiques de plantes médicinales

Sur demande d'associations de thérapeutes, une liste d'espèces médicinales a été soumise au département de la médicine Traditionnelle de l'INRSP de Bamako pour identifier les groupes chimiques qui se trouvent dans leurs organes exploités (feuilles, écorces, racines). Les espèces étudiées sont : *Alchornea cordifolia, Evolvulus alsinoides, Maytenus senegalensis, Moghania faginea, Stylosanthes erecta, Strychnos spinosa, Swartzia*

madagascariensis, Erythrina senegalensis, Vitex simplicifolia, Anthocleista djalonensis. Les groupes chimiques de ces plantes ont été déterminés et des tests sont en cours au laboratoire afin d'évaluer leurs efficacités en fonction des indications traditionnelles dans le traitement des maladies énumérées par les thérapeutes.

Organisation et renforcement des capacités des communautés

Les organisations paysannes sont formées en techniques de production des plants, en techniques de greffage des fruitiers locaux et aux techniques de plantation. Une organisation de femmes a été formée sur les techniques de compostage afin de produire de la fumure organique pour leur plantation de néré (*Parkia biglobosa*).

Discussion

Durant la première phase du MSBP, de efforts ont été déployés pour la récolte de semences et d'herbiers au Mali, mais beaucoup de zones restent inexplorées. Après examen des collections envoyées à Kew, il est ressorti que seulement, les semences d'un tiers de la flore répertoriée du Mali ont été collectées. En effet, compte tenu de la similarité de la flore de certains pays partenaires du MSBP, il n'était pas opportun de revenir sur la récolte de certaines espèces collectées dans d'autres pays. Toutefois, il a été reconnu que cette situation pénaliserait nos banques de semences qui viennent juste d'être installées. Sur l'ensemble des collections déjà réalisées au Mali, 341 genres appartenant à 91 familles botaniques ont été répertoriés. En matière d'identification, les espèces de 30 collections n'ont pas encore été déterminées. A l'analyse des données de récolte, 19 % des collections sont des Leguminosae, 13 % sont des Poaceae, 11 % des Cyperaceae et 8 % des Compositae. Ces 4 familles sont numériquement les plus importantes et regroupent plus de 50 % des espèces de la flore malienne. Excepté le cas des Leguminosae, ces statistiques ont une tendance identique à celles du Catalogue des Plantes Vasculaires du Mali de Boudet et Lebrun (1986).

En matière de production de plants, de très faibles taux de germination ont été enregistrés avec les graines de certaines espèces. Ces espèces qui constituent un challenge pour les recherches au laboratoire et à la pépinière sont : *Crossopteryx febrifuga, Pteleopsis suberosa, Mitragyna inermis, Lophira lanceolata, Zanthoxylum zantoxyloides, Cussonia arborea*. Comme on peut le remarquer, ces espèces sont majoritairement des plantes médicinales fréquemment exploitées par les thérapeutes. Compte tenu du faible taux de croissance des plants de certaines espèces, nous recommandons un long séjour à la pépinière (par exemple 18 mois) afin d'obtenir des plants plus vigoureux.

L'enquête ethnobotanique a permis d'identifier une large gamme de plantes utiles aux communautés qui font l'objet d'exploitation intensive dans les terroirs. Parmi les plantes médicinales répertoriées, il a été démontré que l'organe exploité est choisi en fonction de la maladie et des connaissances pratiques du thérapeute. L'enquête a révélé qu'une même plante intervient dans le traitement de plusieurs maladies. La liste des espèces répertoriées montre que la proportion des plantes médicinales est plus élevée que celles des autres utilisations. En effet, les guérisseurs traditionnels disent que toute plante de la nature soigne une maladie.

Pour l'ensemble des arboretums installés et des bois sacrés enrichis, le taux de survie moyen des plants est supérieur ou égal à 70 % à l'âge de 2 ans. On peut attribuer ce bon résultat à l'arrosage des plants pendant la saison sèche, à la protection des parcelles par la

clôture en grillage et le traitement phytosanitaire des plants contre les attaques de termites. Les résultats obtenus indiquent que certaines espèces en occurrence, *Adansonia digitata, Nauclea latifolia, Anogeissus leiocarpus, Khaya senegalensis, Ceïba pentandra, Erythrina senegalensis* et *Acacia senegal* ont une bonne croissance avec plus de 1 m de hauteur moyenne par an. Par contre, *Stereospermum kunthianum, Daniellia oliveri, Ximenia americana* et *Securidaca longepedunculata* ont une faible croissance en hauteur et résistent moins d'où, des taux de survie de moins de 20 % pour ces espèces malgré l'arrosage en saison sèche.

Activités futures

La première phase du MSBP a permis de mettre en place l'Unité de Semences et d'Herbiers qui constitue un acquis majeur en matière de sauvegarde et de préservation de la biodiversité dans notre pays. Alors, les acquis de la première phase seront consolidés et les récoltes de semences et d'herbiers se poursuivront dans les autres localités non explorées du pays.

Les recherches sur les techniques de germination et de conservation des semences seront poursuivies au laboratoire et à la pépinière.

Plus d'efforts seront déployés dans la valorisation des collections de semences stockées pour la régénération. Les plantations d'espèces utiles et la restauration des forêts seront poursuivies avec les communautés.

Des émissions d'informations et de sensibilisation seront réalisées au niveau des radios de proximité sur les rôles et intérêts des banques de semences et d'Herbiers dans la préservation de la biodiversité.

Références

Boudet G. et Lebrun J. P., 1986. Catalogue des plantes vasculaires du Mali. IEMVT, Etudes et Synthèses de l'IEMVT, n0 16, Paris, 480 p.

Dolo, P., 1996. L'état des ressources phytogénétiques pour l'alimentation et l'agriculture dans le monde. Rapport du Mali, 39p.

GRASE, 1999 : Rapport d'enquête sur les espèces forestières en voie de disparition et identification des peuplements de *Raphia sudanica, Elaeis guineensis* et *Anthocleista kerstingii* dans les cercles de Sikasso, Kadiolo, Koutiala et Yorosso. ONG GRASE, Etude commanditée et financée par l'Appui à la Recherche Forestière Participative de Sikasso, 30 p. + annexes.

ME/DNCN, 1999. Politique forestière du Mali

MEA/DNEF, 2009. Quatrième Rapport du Mali sur la mise en œuvre de la Convention sur la Diversité Biologique. Rapport, Bamako (Mali), 103p.

AFFORESTATION IN MOZAMBIQUE

Mrs. Camila De Sousa
Mozambique National Institute of Agrarian Research (IIAM)
Maputo, Mozambique

AFFORESTATION MOZAMBIQUE

HISTORY

1. Tree planting dated back from years 1920 with the purpose of:

- draining waterlogged areas to reduce the incidence of malaria
- programme to afforestate 3,200 ha in the Libombos mountains (Namaacha) to supply the urban needs of timber wood
  - *Eucalyptus*, *Pinus*, *Araucharia*, *Cedrela*, and some indigenous species

HISTORY

- Stabilize sand dunes
  - *Casuarina equisetifolia*
- In the same period small plantations established to supply timber, poles and fuelwood (Matola, Marracuene, and the Tea Companies in Zambézia) and along the main railroads
  - mainly *Eucalyptus, Pinus*

HISTORY

2. Commercial plantations started in the 1950-60s. About 20,000 ha were established for timber, electricity poles, and a reserve for pulp wood.
   - *Pinus* (68%), *Eucalyptus* (30%) and the remaining with *Casuarina* and other species in Manica, Salamanga, Lichinga and Limpopo Valley
   - Establishement of trials with indigenous species

HISTORY

3. From 1977, three plantation projects were launched to supply fuelwood and charcoal for the main cities of Maputo, Beira and Nampula.
   - Commercial plantations in Manica were expanded to supply timber for a sawmill and a particleboard established in 1981 (IFLOMA),
   - mainly *Pinus* and *Eucalyptus* species and *Casuarina*

History

- 1990 - Phasing out of commercial plantations projects with NORDIC Funds.
- All these totalizing aprox. 40,000 ha
- 1993 - concentration in harvesting operations of the country's natural forests
- Community Based Resource projects

The new environment for a forest development in Mozambique (2005)

To solve unemployment and improve the standard of living of the rural population the Government launched from 2005 a new program for the establishment of forest plantations mainly for

1. **fast growing, commercial forest plantations**
2. **Multipurpose community plantations**
3. **Environmental protection plantations**

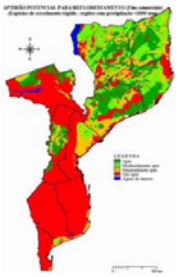
Several Key stakeholders identified :

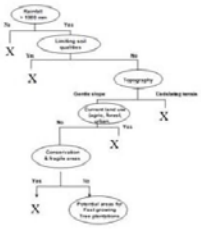
- Individuals with small nurseries and Entrepreneurs with tree seedling production
- Local communities organized in Families, Associations or NGOs

Key stakeholders

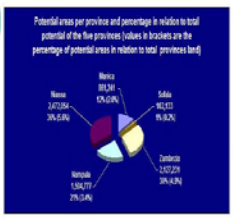
- Government (e.g. dunes, rehabilitation of degraded areas)
- Industry
- Educational and research institutions

Potencial areas for commercial plantations





Potential versus available



- 7 milions ha of **suitable** land for large scale industrial plantations : Sofala, Manica, Zambézia, Nampula e Niassa
- **Available land for afforestation 3 milions ha**
- 5 enterprises and 15000ha planted

Community initiatives/demand driven

- Technical support
- Financial resources
- Development of Agroforestry schemes
- Research (species selection & seeds, practical manuals)

Community initiatives/demand driven




- Windbreak & shade
- Handy craft & Bamboo
- MPTs
- Charcoal and poles
- Non-wood products
- Fodder

Conservation


- Rehabilitation of degraded areas
- Dune stabilization
- Native species enrichment
- Aforestation of mangroves
- Carbon

Challenges

- Available financial incentives
- Land
- Communities willing to plant indigenous trees
- Application of legislation
- ABS
- Funds

AFFORESTATION IN NIGERIA

Dr. Sola Ajayi
Department of Crop Production & Protection
Faculty of Agriculture
Obafemi Awolowo University
Ile-Ife, Nigeria

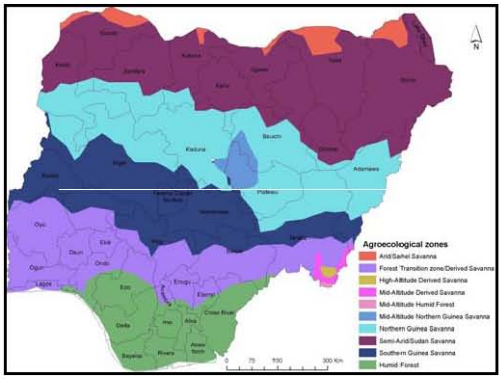
AFFORESTATION IN NIGERIA

Sola Ajayi
Department of Crop Production & Protection
Faculty of Agriculture
Obafemi Awolowo University
Ile-Ife

sajayi@oauife.edu.ng

INTRODUCTION

- Nigeria covers an area of 923,768 square km with >140 million inhabitants
- There are nine distinct ecological zones
- There are 7,895 plant species from 338 families and 2,215 genera that have been identified in Nigeria
- About 0.4 and 8.5% of the plant species are considered threatened and endangered, respectively.
- Of the IUCN list of threatened species, 146 are found in Nigeria, 18 under the 'endangered' and 15 under the 'critically endangered' categories
- About 79 million hectares are agricultural land, while 11% are under forest and 43% are woodland. Only 46% of the agricultural lands are under cultivation



INTRODUCTION cont'd

- Forestry Department established in 1889
- Evolution of forest resources management was in three phases
  - **The reservation phase: 1899-1930**
    (25% of land area set aside as forest reservation area, demarcation and establishment of tracts of forestlands)
  - **The exploitation phase: 1930-1960**
    (commercial exploitation of Nigerian timber species, concessions to timber companies, mainly expatriates)
  - **The development phase: 1960-date**
    (large-scale artificial regeneration, establishment of large plantations of fast growing exotic tree species)

INTRODUCTION cont'd

- Since the colonial forest management plans expired in the 1960s, there has been no new significant forest management plan
- Political formations/administrative units have affected forestry activities negatively because of lack of coordination and synergy
- Current status of forest resources
  - 1,160 constituted forest reserves, 10% of total land mass
  - 20 game reserves
  - 8 National parks (2,403, 140 ha)
  - 6 Strict Nature Reserve
  - 269,000 ha plantation comprising 109,377 of *Gmelina arborea* and 159,623 others

PROBLEMS OF FOREST MANAGEMENT IN NIGERIA

- Over-exploitation of forest resources, rate of deforestation is 3.5%% p.a. (350,000-400,000 ha p.a.)
- Lack of growth and yield data for estimation of annual allowable cut
- Lack of political will to invest in forest resources renewal
- Insufficient institutional security to attract private investors
- Incessant encroachment into forest reserves and illegal logging
- No mapping data on various forest reserves
- Inadequate community participation in formulation and implementation of forestry programmes

DRIVERS OF DEFORESTATION IN NIGERIA

Land degradation attributable to

- deforestation
- Increasing agricultural intensity
- Livestock overgrazing
- increasing demands for fuel wood (3.5% deforestation)

Indigenous, endangered tree species experiencing deforestation

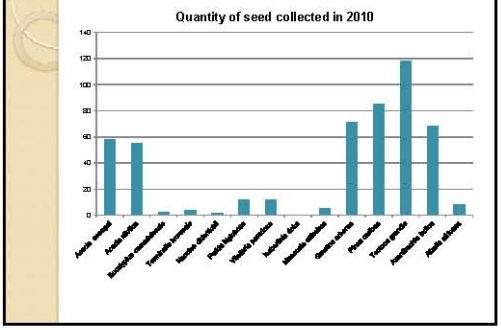
Milica species
Triplochyton sckroxy
Khaya species
Chodea milini
Afzelia species
Sterculia species
Lophira alata
Erythrophileum species
Danicella species
Pterocarpus sp
Pycanthus species
Alstonia boonei
Ricinodendrum species
Terminalia species
Mausonia species
Nacichlea diderechi
Ceiba pentadra
Uacappa species
Mytrgyna stipulosa
Albizia species
Entandno pharagma species
Diospyros species
Lovoa species
Celtis species
Acacia cumusos
Annogeisus leocanpus

DRIVERS FOR AFFORESTATION IN NIGERIA

- Ecological problems- Desert encroachment, gully erosion
- Environmentalists' climate change awareness campaigns
- Ecological fund (5% Federation Account) disbursement
  - 60%- Drought and Desertification control
  - 25%- Soil Erosion, Flood/Gully control
  - 5%- Pollution control
  - 10%- Administration of Ecological Fund Office/National Committee on Ecological Problems and other emergencies

SELECTED TREE SPECIES USED IN AFFORESTATION IN NIGERIA

S/No	Species	Conservation Status	Seeds Collected	Seedlings produced	Proportion of Seedlings Planted
1	*Acacia senegal*	Threatened	58 kg	10, 850	4, 500
2	*Acacia nilotica*	Threatened	55 kg	29, 800	15, 750
3	*Eucalyptus camaldulensis*	Threatened	2 kg	12, 830	4, 000
4	*Terminalia ivorensis*	Endangered	3.5 kg	14, 000	7, 500
5	*Nauclea diderrichii*	Abundant	1.5 kg	20, 000	12, 800
6	*Parkia biglobosa*	Threatened	12 kg	15, 000	8, 600
7	*Vitellaria paradoxa*	Threatened	11.8 kg	12, 250	10, 200
8	*Isoberlinia doka*	Abundant	-	-	-
9	*Mansonia altissima*	Endangered	5 kg	7, 500	4, 500
10	*Gmelina arborea*	Abundant	71 kg	900, 580	550, 000
11	*Pinus caribea*	Threatened	85 kg	92, 300	12, 300
12	*Tectona grandis*	Abundant	118 kg	1, 896, 500	1, 500, 000
13	*Azardirachta indica*	Abundant	68 kg	28, 250	21, 850
14	*Afzelia africana*	Endangered	8 kg	8, 100	6, 200



SELECTED TREE SPECIES USED IN AFFORESTATION IN NIGERIA

- Other species used in the northern parts largely because of economic reasons (food/fruits, medicines, fuel wood and shade production) include
  - *Parkia biglobosa*
  - *Acacia albida*
  - *Acacia nilotica*
  - *Tamarindus indica*
  - *Mangifera indica*
  - *Anacardium occidentale*
  - *Adansonia digitata*
  - *Azadirachta indica*
  - *Tenninalia catapa*
  - *Zizyphus spinachristii*
  - *Psidium guajava*
  - *Moringa oleifera*
  - *Anona muricata*

CONTRIBUTIONS

- Optimization of germination and development of protocols for seed germination of difficult seeds of afforestation species
- Establishment of a nursery to supply improved seedlings of afforestation species
- Establishment of conservation gardens on the University campus
- One Training program on tree seed handling conducted

Spondias mombin

OPPORTUNITIES

- Awareness is at all time high
- Growing Political 'talk' about environmental challenges and the need to address them
- Youth involvement
- Newly launched National Afforestation Program (*as part of the Federal Government's efforts at combating Climate Change impacts and creating wealth for Nigerians)*
  - ₦5 billion ($33 million) earmarked for the program in which every State of the federation, including the Federal Capital Territory, was required to plant one million tree seedlings.

CONSTRAINTS

- There is no national tree seed system
- Insufficient Technical capacity
- Nursery capacity is minimal, less than 25% of national requirement
- Afforestation is largely targeted at addressing ecological problems- erosion, desertification with no attention to conservation issues.
- Lack of coordination and channeling of available funds to political routes and therefore not accessible to non-political actors

*("States send their requests for intervention to the Ecological Fund office but when such requests are granted and approved, they divert the funds into other uses that are not even relevant to the socio-economic development of their states. They collect money to solve ecological problems in their states but end up using the money to purchase fleet of cars and indulge in other frivolities" **The Vanguard, 13 September 2010**)*

ON-GOING ACTIVITIES

- Building partnership with the Forestry Research Institute of Nigeria (FRIN) and the National Centre for Genetic Resources and Biotechnology (NACGRAB), both in Ibadan
- Proposed the inclusion of tree seeds in the mandate of the National Agricultural Seeds Council (NASC)
- Policy guidelines for Linkage of tree planting with REDD planned for January

FUTURE OUTLOOK

- Partnership for technical capacity enhancement for tree seed collection and banking support.

NATIONAL AFFORESTATION PROGRAMMES AND POLLICY WITH RESPECT TO SEED SUPPLY

Dr. Heriel P. Msanga
Tanzania Tree Seed Agency (TTSA)
Morogoro, Tanzania

Abstract

The Government Forest Policy emphases on incorporation of the management plans of production natural forests and plantations with biodiversity conservation. According to the Policy the replacement of natural forests by exotic plantations will be minimized and plantations of indigenous tree species will be promoted. During the period 2006- 2011 Tanzania Tree Seed Agency (TTSA) supplied within the country 90.8 tons of tree seeds. The seeds comprises of 200 tree species of which 60% are indigenous to Tanzania. There is also unrecorded quantity of tree seeds used for afforestation in the country which is procured locally by private investors and communities. These seeds were used to raise about 705.4 million seedling which were planted in Tanzania during the past five years (2006-2010). There are 90,000 Ha of Government industrial plantations distributed in 12 Forest Plantation Projects which are located within Forest Reserves. Outside Forest Reserves there are about 150,000 Ha of industrial plantations owned by private companies. There are also 120,000 Ha of small-scale woodlots established by local communities.

The major exotic tree species in the plantations include: Pinus patula, Pinus carribaea, Tectona grandis, Eucalyptus spp. Cedrella odorata, Acacia mearnsii and Grevillea robusta. Indigenous tree species which have been planted in small-scale include: Khaya anthotheca, Juiperous procera, Milicia exelsa, Maesposis eminii, Acacia polyacantha Dalbergia melanoxylon, Acacia nilotica, Afzelia quqnzensis etc. The Government promotes planting of the indigenous tree species by making sure that their seeds are available when needed.

Introduction

It is estimated that in 2010, Tanzania Mainland had 33.4 million hectares (ha) of forests and woodlands representing 38% of total land area out of which 16 million ha are comprised of reserved forests; 2 million hectares are forests in national parks; and the rest, 16 million ha (47.9 per cent of all forestland) are unprotected forests in general land. A total of 4.2 million ha are of forests in the general land under Participatory Forest Management 2.4 million ha are under Community Based Forest Management (CBFM) and 1.9 million ha are under Joint Forest Management (JFM). There are 600 National forest reserves and 200 local Authority forest reserves covering about 13% of the total land area. The reserved area also includes 1.6 million ha that are managed as water catchment forests and 90,000 ha of government plantations. In addition, outside Forest Reserve there are about 150,000 ha owned by major private industrial plantations and estimated 120,000 ha of small-scale woodlots. Major tree species used for afforestation purposes include *Pinus patula*, *Pinus carribaea*, *Tectona grandis*, *Eucalyptus* spp., *Cedrela odorata*, *Acacia mearnsii* and *Grevillea robusta*.

Indigienous trees in Tanzania were once abundant in their natural habitats (Mnzava, 1980). Forest clearing for agriculture, and illegal feeling inside forest reserves and else where, have caused such over exploitation that tree populations have been reduced to the extent that they can no longer recover through natural regeneration. This is a serious situation, and some endemic and rare tree species are now threatened with extinction. Examples of threatened tree species of economic importance are: *Allanblackia stuhlmanii, Beilschmiedia kweo, Bussea massaiensis, Cephalasphaera usambarensis, Cordyla densiflora, Entandrophragma excelsum* and *Podocarpus usambarensis*.

The government of Tanzania recognizes the seriousness of this situation, and there are plans to reforest exploited areas with the original species. One of the examples is in Kazimzumbwi Forest Reserve near Dar es Salaam. The importance of planting indigenous trees cannot be over-emphasized. As tropical hardwoods become more and more scarce globally, prices will rise. It is hoped that eventually higher prices may compensate for the slow growth of these species, so that management becomes profitable (Msanga, 1998).

Before the 1960s, the Tanzanian government's plan had been to reforest exploited areas by planting fast-growing exotic trees to meet timber requirements. Reforestation with indigenous trees was given a low priority. As a result, little or no effort was directed to research on indigenous trees (Shehaghilo, 1982). Thus studies for seeds of local trees did not receive serious attention. Now, with the change of attitude to indigenous trees, there is a need for much better understanding of how seeds of these trees can be collected, stored and germinated, it is clear that scientific efforts should be focused on these aspects. Otherwise, reforestation programmes and projects based on indigenous trees will be hampered.

Implementation of National Forest Policy to address Afforestation Programmes

The Government Policy statement on production natural forests and plantations states: "Biodiversity conservation will be incorporated in the management plans of production natural forests and plantations". The replacement of natural forests by exotic plantations will be minimised. Plantations of indigenous tree species will be promoted. Principles of multiple-use forest assessment and monitoring will be emphasised in the management of production natural forests and exotic and indigenous species plantations. Research on mixed species plantations will be intensified. Biodiversity management and monitoring will be incorporated in all management regimes (MNRT, 2009).

In the implementation of the Forest Policy there are several challenges and strengths:

- It is proposed that the Ministry of Natural Resources and Tourism should involve districts and villages to participate in forest management as stipulated in the forest policy.
- On matters related to inadequate measures to improve patrols in forest due to lack of forest guards, managers and limited budget the Government has transformed the Forest Department into an Executive Agency known as "Tanzania Forest Service - TFS". This is a semi autonomous body within the ambit of the Ministry of Natural Resources and Tourism. The main objective is to maximize efficiency and effectiveness of the service delivered. This Agency was formed through Government Notice No. 269 of July 2010 in according to the Executive Agencies Act No 30 of 1997 and its amendment of 2009.
- With regards to the challenge of illegal transport of forest products the Ministry of Natural Resources and Tourism has entered into an agreement with the Police Defense Forces to strengthen the patrol and inspection.
- On revenue sharing an arrangement will be made between Central Government and Local Government Authorities to suit both parties.
- To reduce the rate of deforestation, which is 92,000 ha per year, the Ministry of Natural Resources and Tourism and the Ministry of Energy and Minerals has developed a strategy for alternative energy sources which includes the use of biomass fuel, the Local Produced Gas for cooking, reduction of some taxes, etc.
- On the issue of lack of database, the Ministry of Natural Resources and Tourism has established National Forestry and Beekeeping Data (NAFOBEDA) base to improve the collection and management of data from the forest resources.

Achievements on afforestation programmes

The government has established 90,000 ha of forest plantations in 12 Forest Plantation Projects. Private investors own about 150,000 ha of forest plantations outside forest reserve areas. There are also about 120,000 ha of small – scale wood lots and medium – sized plantations owned by small – holders communities, districts, tea/tobacco companies, religious organizations and schools. The detailed main tree species used for afforestation programmes in Tanzania are shown in Table 1.

Tabele: 1 Detailed main tree species used for afforestation programmes in Tanzania

S/N*	Family	Genus	Species	Common names	Distribution/Abundance	Uses
1	Pinaceae	*Pinus*	*patula*	Mexican weeping pine	Highland areas	Timber
2	Pinaceae	*Pinus*	*carribaea*	Carribean pine	Lake zone	Timber
3	Verbenaceae	*Tectona*	*grandis*	Teak	Lowland areas	Timber
4	Myrtaceae	*Eucalyptus*	*saligna*	Sydney blue gum	High land area	Poles
5	Myrtaceae	*Eucalyptus*	*tereticornis*	Forest river gum	Low rainfall areas	Poles
6	Myrtaceae	*Eucalyptus*	*maidenii*	Maidens gum	Highland areas	Poles
7	Myrtaceae	*Eucalyptus*	*grandis*	Rose gum	Highland areas	Poles
8	Myrtaceae	*Eucalyptus*	*camaldulensis*	Red river gum	Low rainfall	Poles
9	Myrtaceae	*Eucalyptus*	*robusta*	Swamp mahogany	Swamp areas	Poles
10	Myrtaceae	*Eucalyptus (Corymbia)*	*citriodora*	Lemon gum	Highland area	Poles
11	Meliacae	*Cedrela*	*odorata*	Mexican boxwood	Low land areas	Timber
12	Meliacae	*Khaya*	*anthotheca***	African mahogany	Low land area	Timber
13	Mimosoideae	*Acacia*	*meansii*	Black wattle	Highland areas	Timber
14	Mimosoideae	*Acacia*	*mangium*	Mangium	Coastal area	Tannin
15	Mimosoideae	*Acacia*	*auriculiformis*	Ear pod wattle	Coastal area	Fire wood
16	Mimosoideae	*Acacia*	*nilotica***	Scented pod acacia	Dry land	Fire wood
17	Mimosoideae	*Acacia*	*Polyacantha**	Falcon's claw acacia	Fertile area	Fire wood
18	Mimosoideae	*Acacia*	*tortilis***	Umbrella thorn	Dry land	Fire wood
19	Proteaceae	*Grevillea*	*robusta*	Silky oak	Highland areas	Timber
20	Caesalpinioideae	*Senna*	*siamea*	Iron wood	Dry land areas	Fire wood
21	Casuarinaceae	*Casuarina*	*equisetifolia*	Whistling pine	Coastal area	Timber
22	Combretaceae	*Terminalia*	*superba*	Terminalia	Low land area	Timber
23	Combretaceae	*Terminalia*	*ivorensis*	Terminalia	Low land area	Timber
24	Cupressaceae	*Juniperus*	*procera***	East African Juniper	High land areas	Timber
25	Meliaceae	*Azadirachta*	*indica*	Neem	Low land area	Fire wood
26	Moraceae	*Milicia*	*excelsa***	African Teak	Low land area	Timber
27	Rhamnaceae	*Maesopsis*	*eminii***	maesopsis	Lake zone	Timber
28	Verbenaceae	*Gmelina*	*arborea*	White teak	Low land area	Timber
29	mimosoideae	*Albizia*	*lebbeck*	Woman's tongue	Low land area	Timber
30	Caesalpinioideae	*Afzelia*	*quanzensis***	Pod mahogany	Miombo Eco Zone	Timber
31	Papilionoideae	*Dalbergia*	*melanoxylon** *	African Black Wood	Miombo Eco Zone, Coastal area	Timber

* The tree species are not arranged in order of priority or any format

**Indigenous trees to Tanzania

Supply of seeds of indigenous trees in tropical Africa

Indigenous trees are favoured over the introduced trees by local communities for planting in agroforestry systems, which is based on several factors. These include familiarity, the fact that they are generally better adapted to their environment than are exotics (species moved by humans to areas outside of their native ranges), and the multipurpose role that they play in: providing human food (FAO, 1983; Msanga, 1998; Katende *et al.,* 1999; Laverdièr, 2001; Ruffo *et al.*, 2002), wood for various end uses (Bryce, 2003; Chidumayo, 1987; Akinnifesi, 2001; UNEP, 2001), fodder and shelter for livestock and game (Mnzava, 1980; Pérez *et al.,* 1997; Kaoneka, 1999), human and veterinary medicines (FAO, 1986; Kokwaro, 1993; Crouch *et al*, 2002), preserving water catchments and controlling soil erosion (Brundtland, 1987; Barrow *et al.*, 2002).

Growing public awareness of the diverse values of indigenous trees has increased the scale of their planting. Since most of these trees are propagated from seeds, there has been a greater emphasis on rapid expansion of seed production. This has created new opportunities and problems in seed handling. During the period of nine years (2003 – 2011) Tanzania Tree Seed Agency (TTSA) had supplied within the country 90,827 kg of tree seeds and 596,934 tree seedlings. The seeds originated from 200 tree species of which 60% are indigenous to Tanzania (Table 2).

All seedlings used to establish government plantations during the period 2003 – 2011 were raised from seeds supplies by TTSA. During the period 1989 – 2002 the seeds were being supplied by National Tree Seed Programme and before that period it was the Silvicultural Research Station. Private companies and communities are not obliged to buy tree seeds from TTSA. Private companies buy tree seeds from TTSA but also import from abroad after obtaining permit from the government. Local communities may either buy seeds from TTSA or collect on their own. Therefore, the quantity of tree seeds reported here does not reflect all what is planted in the country. The total number of trees planted in Tanzania during the period of five years (2006 – 2010) is shown in Table 3.

It is with this recognition of tree seed demand that the Government of Tanzania established TTSA. The objective is "To enhance sustainable supply of forest products and environmental conservation by producing and marketing high quality tree seed and other propagating materials.

In this endeavour the MSB trained six TTSA staff on short courses herbarium techniques, on seed collection, processing and testing. One staff was trained on seed conservation at MSc level. These courses have added knowledge and experience in handling seeds, particularly of the indigenous trees. The MSB also provided facilities like seed drier which facilitates

seed processing. All these have positive impact on seed availability for afforestation programmes.

Table 2 Quantity of seeds and number of seedlings distributed by TTSA during the period of nine years (2006 – 2011).

Year	Quantity of seed (kg)	Number of seedlings
2003	7,250	9,750
2004	8,300	10,150
2005	11,252	12,852
2006	9,587	32,215
2007	10,165	41,698
2008	9,637	179,670
2009	10,136	194,619
2010	12,300	61,780
2011	12,200	54,200
Total	**90,827**	**596,934**

The quantity of tree seeds distributed to customer make a significant contribution towards rehabilitation of degraded environment and conservation of genetic resources of the species concerned.

Table 3. Total number of trees planted during the period of five years (2006 – 2010).

Year	2006	2007	2008	2009	2010	Total
Number of trees planted	14,170,552	138,297,619	136,076,881	203,818,084	213,012,800	705,375,936

Discussion

There is an indication that the current and foreseeable demands for these species are high. For example records from TTSA show that the quantity of seeds of indigenous tree species which was distributed in 2003 was 500 kg and increased almost four times after nine years to 2,100 kg in 2011. The total quantity of seeds of indigenous tree species which was distributed in past nine years (2003–2011) was 36.4 tons, which is 40% of the total (91 tons) of seeds distributed for tree planting activities over that period. Out of this, recalcitrant[1]/intermediate seeds comprised 13.7 tons (15%), and orthodox[2] seeds 77.3 tons (85%) of the total quantity handled during that period. However, the effort to reach the set goals is hampered by the recalcitrant nature of the seeds of some of the species. One of the challenges is that recalcitrant seeds pose a serious storage problem. The seeds lose viability within a short period, in terms of weeks or months depending on species. Such seeds can not be kept in stores for a useful period and consequently cannot be available to seed users (customers) when they are demanded. A customer has, therefore, to be advised to wait

[1] Seeds that are shed wet and cannot be dried or stored for prolonged periods.

[2] Seeds that are shed dry and can be dried down to a low water content (around 5%) and successfully stored at low or sub-freezing temperatures for long periods.

until the following fruiting season. Furthermore, these seeds often lose viability during the period of transportation from the Seed Centre to the customer, a problem which is magnified by weak infrastructure in many countries in tropical Africa (Msanga, 1998). In many cases, countries have been obliged to rely on exotic tree species, resulting in the neglect of management, and conservation of their own, well-adapted natural resources (Ouédraogo *et al*., 1998).

References

Akinnifesi, F.K. (2001). Domestication – Tapping the unexploited wealth of indigenous fruit trees in Malawi. *Horticulture* 3: 9-24.

Barrow, E., Timer, D., White, S. and Maginnis, S. (2002). *Forest landscape restoration: Building assets for people and nature. Experience from East Africa.* IUCN, Nairobi. 30 pp.

Brundtland, G. H. (1987). *Our common future: World Commission on Environment and Development,* Oxford University Press. London, 383 pp.

Bryce, J. M. (2003). *The commercial timbers of Tanzania.* Government Printer, Dar es Salaam, 315 pp.

Chidumayo, E.N. (1987). A survey of world stocks for charcoal production in the miombo woodlands of Zambia. *Forest Ecology and Management* 20: 105–115.

Chidumayo, E.N. (1988). Early post felling response of Marquesia woodland to burning in Zambia Copperbelt. *Journal of Tropical Ecology* 4: 361-372.

Crouch, N., von Ahlefeldt, D. and Nichols, G. (2002). *Medicinal plants traded on South Africa's Eastern Sea Board.* University of Natal, Durban, 13 pp.

FAO (1983). Food and fruit-bearing forest species. 1. Examples from Eastern Africa. FAO Forestry paper No. 44/1. FAO. Rome, 172 pp.

FAO (1986). *Some medicinal forest plants of Africa and Latin America.* FAO Forestry paper. No. 67. FAO. Rome, 252 pp.

Kaoneka, A.R.S. (1999). African forests, societies and environments. In: M. Palo and J. Uusivuori (Editors). *World forests, societies and environment.* Kluwer Academic Publishers. Amsterdam. pp. 139-145.

Katende, A. B., Ssegawa, P., Birnie, A., Holding, C. and Tengnäs, B. (1999). *Edible wild plants of Uganda.* Technical Handbook No.19. SIDA's Regional Soil Conservation Unit. Nairobi, 500 pp.

Laverdièr, M. (2001). *The propagation and dissemination of indigenous fruit trees in East and Southern Africa.* Proceedings of the regional training seminar, FAO, Harare, 30 pp.

Kokwaro, J.O. (1993). *Medicinal Plants of East Africa.* Kenya Literature Bureau, Nairobi, 401 pp.

MNRT, (2009). National Forest Policy. (Draft).

Mnzava E.N. (1980). *Village afforestation: lessons and experience in Tanzania.* FAO, Rome, 61 pp.

Msanga, H.P. (1998). *Seed germination of indigenous trees in Tanzania: Including notes on seed processing, storage and plant uses.* Natural Resources Canada, University of British Columbia Press, Vancouver, 292 pp.

Ouédraogo, A.B., Thomsen, K. Engels, J.M.M, and Engelmann, F. (1998). Challenges and opportunities for enhanced use of recalcitrant and intermediate tropical forest tree seeds through improved handling and storage In: M. Marzalina, K.C. Khoo, N. Jayanti, F.Y. Tsan, B. Krishnapillay (Editors). *Recalcitrant Seeds.* Proceedings of IUFRO Symposium. Kuala Lumpur, pp. 14-24.

Shehaghilo, I.M. (1982). An out-look of seed storability problems of some useful indigenous trees in Tanzania. Pages 13 – 16 in B.S.P. Wamg and J.A. Pitel, eds. Proc. International symposium on forest tree seed storage, 23 – 27 Sept. 1980. Chalk River, Ont.

UNEP (2001). *An assessment of the status of the world's remaining closed forests.* UNEP, Nairobi, 49 pp.

Appendix

DEFINITIONS ACCORDING TO NATIONAL FOREST POLYCY OF SOME TERMS USED IN THIS REPORT

Agroforestry: growing trees (woody perennials), crops and/or animals in interacting combinations.

Biodiversity means all species of native organisms, plant and animal, vertebrate and invertebrate, macro and micro as well as the genetic and morphological variation within the populations of each of those species.

Catchment forest reserve is a forest area for water catchments controlled under the Forest Act and declared by the Minister.

Community Based Forest Management is a forest management approach where communities own and manage forest resources.

Deforestation is the conversion of forested areas to non-forested land, for uses such as shifting agriculture, pasture, logging and human settlements.

Executive agency is a semi-autonomous body owned by the government and created for the specific purpose e.g. of managing a forest reserve or an industrial plantation or seed supply. The staff are government employees but with specific terms and conditions defined for employment by the agency. (as defined in Executive Agency Act No 30 of 1997.

Forest means all land bearing a vegetative association dominated by trees of any size, exploitable or not, and capable of producing wood or other products of exerting influence on the climate or water regime or providing shelter to livestock and wildlife.

Forest degradation refers to a quality decrease in forest condition, this being related to one or a number of different forest ecosystem components (vegetation layer, fauna, soil, ...), to the interactions between these components, and more generally to its functioning.

Forest product includes all wood and non-wood forest products.

Forest reserve is a forest area, either for production of timber and other forest produce or protective for the protection of forests, water cat chments and biodiversity, controlled under the Forest Act and declared by the Minister.

Forest resources include all wood and non-wood-based resources in the forests.

Industrial plantation means an area of land planted with trees for industrial use.

Joint forest management means involvement of local communities or non-governmental organisations in the management and conservation of government owned forests and forest land with appropriate user rights as incentives.

Local authority includes a district council, city council, municipal council, town council, local council and village council.

Local authority forest reserve is a forest area administered and managed by the local authority.

National forest reserve is a forest area administered and managed by the central government.

National park is an area representing outstanding natural, archaeological or cultural resources of Tanzania's heritage and/or critical water and/or soil resources necessary to maintain ecological integrity. National Parks are created and controlled through National Park Ordinance and declared by an act of Parliament.

Participatory Forest Management is a strategy which allows stakeholders to participate in forest management through community based forest management or joint forest management.

Production forest reserve is a forest managed for of timber and other forest products.

Tree includes palms, bamboos, canes, shrubs, bushes, plants, poles, climbers, seedlings, saplings, and the re-growth thereof, all ages and all kinds and any part.

Woodland is land covered with woods or trees; it means a forest.

THE UGANDA NATIONAL TREE SEED CENTRE

Mr. David Mununuzi
National Tree Seed Centre, National Forestry Authority
Kampala, Uganda

ABSTRACT

There is no doubt that the population of Uganda has started embracing tree planting seriously. This is evidenced by the hundreds of new roadside tree nurseries that have sprung up in most parts of the country and are all doing good business. Even at National Tree Seed Centers, the demand is outstripping the ability of the current spaces and expansions are proposed. The current national demand for plant material is estimated at 25 million plants.

The planting is being done by individuals or companies with their own resources or with subsidies from support organizations like European Union (EU) funded Saw Log Production Grant Scheme (SPGS), the World Bank/Norwegian Development Assistance (NORAD) funded Farm Income Enhancement and Forestry Conservation Project (FIEFOC), Government of Uganda (GOU) Community Tree Planting Project (CTPP), World Vision, Swedish funded Vi Agroforestry, World Food Programme (WFP) and a host of other Non Governmental Organizations and funding agencies. The drive to plant is not about combating climate change; it is about making money from the trees but at the end both objectives are made. The people have realized that trees are one of the securest medium to long term investments and with the highest return on investment for any known crop. While large lumber companies are establishing their own plantations, most of their wood resource will continue to come from out growers as the available mature stock with the National Forestry Authority (NFA) will run out in the next 3 years. For many planters in the country, the dilemma has been obtaining quality seedlings. Many farmers buy seedlings from the nearest nursery irrespective of the source of the seed because they are cheap. Unfortunately for the farmers, the effect of quality is not seed until after 5 years in the field when the plants start branching heavily, can't grow straight, can't give good fruits in case of fruit trees or simply get stunted. Even when they grow, they do not attain the required height and breadth to give the poles or timber worth the farmer's investment. The farmer will have lost permanently and may never invest in tree planting. This report examines the opportunities, constraints and challenges to afforestation in Uganda and steps taken by the Uganda National Tree Seed Center (NTSC) with a view of increasing the quantity of quality planting materials available for tree planting programmes.

Background to the Uganda National Forestry Authority

The Government of Uganda, in 1988 adopted a policy to restructure many government departments including the Forestry Department. It recognized an urgent need for a change in systems and institutions controlling forestry in the country. There was a sense of crisis about the state of the country's forests and a particular outcry at the state of the forest reserves in the hands of the Forestry Department- which was clearly no longer appropriate for the task of managing them.

The restructuring report proposed the dissolution of the Forestry Department and the establishment of a National Forestry Authority (NFA) to manage gazzetted Central Forest Reserves (CFR's) and a District Forest Service (DFS) to mange forest resources outside CFR's.

The Government of Uganda worked with DFID, Norway, GTZ and the EU towards this institutional change since 1999, which change was actualized by an act of parliament, the National Forestry and Tree Planting Act of 2003, section 52. The NFA was launched in April of the following year, 2004. The establishment of NFA was preceded by the development of the new Forest Policy and the National Forestry Plan. These were to provide for a framework of shifting roles and responsibilities for the whole sector, not just Forestry Department

Mandate of National Forestry Authority

The mandate of NFA is to manage the Central Forest Reserves in Uganda on a sustainable basis and to supply high quality forestry related products and services to Government, local communities and the private sector

Objectives of NFA

a. Improve the management of the Central Forest Reserves through agreed forestry management plans, new investment initiatives and professional forestry management.
b. Expand partnership arrangements for management of the Reserves with local Governments, communities and private investors.
c. Supply high quality forestry products and services including seed, seedlings, technical advise, ecotourism, GIS and mapping.
d. Attain financial sustainability through own resource mobilization and investment.

Uganda's Central forest Reserves

Uganda has a total area of 236,040 km2 of which 15% are water bodies. The country has 3,627,000 ha of Forest cover of which 1,882,000 ha is gazzetted. The gazzetted Forest is referred to as the permanent Forest.

Estate and represents 9% of the total land area in Uganda. The rest of the Forest cover (1,745,000 ha) is forest on privately owned land

Of the 1,882,000 ha, 1,151,000 is Forest Reserve land and 731,000 ha is National Parks and Wild life Reserves. The land is held in trust by the Government for the people of Uganda. The number of CFR's is 506 spread in the different (9) agro ecological zones of the country.

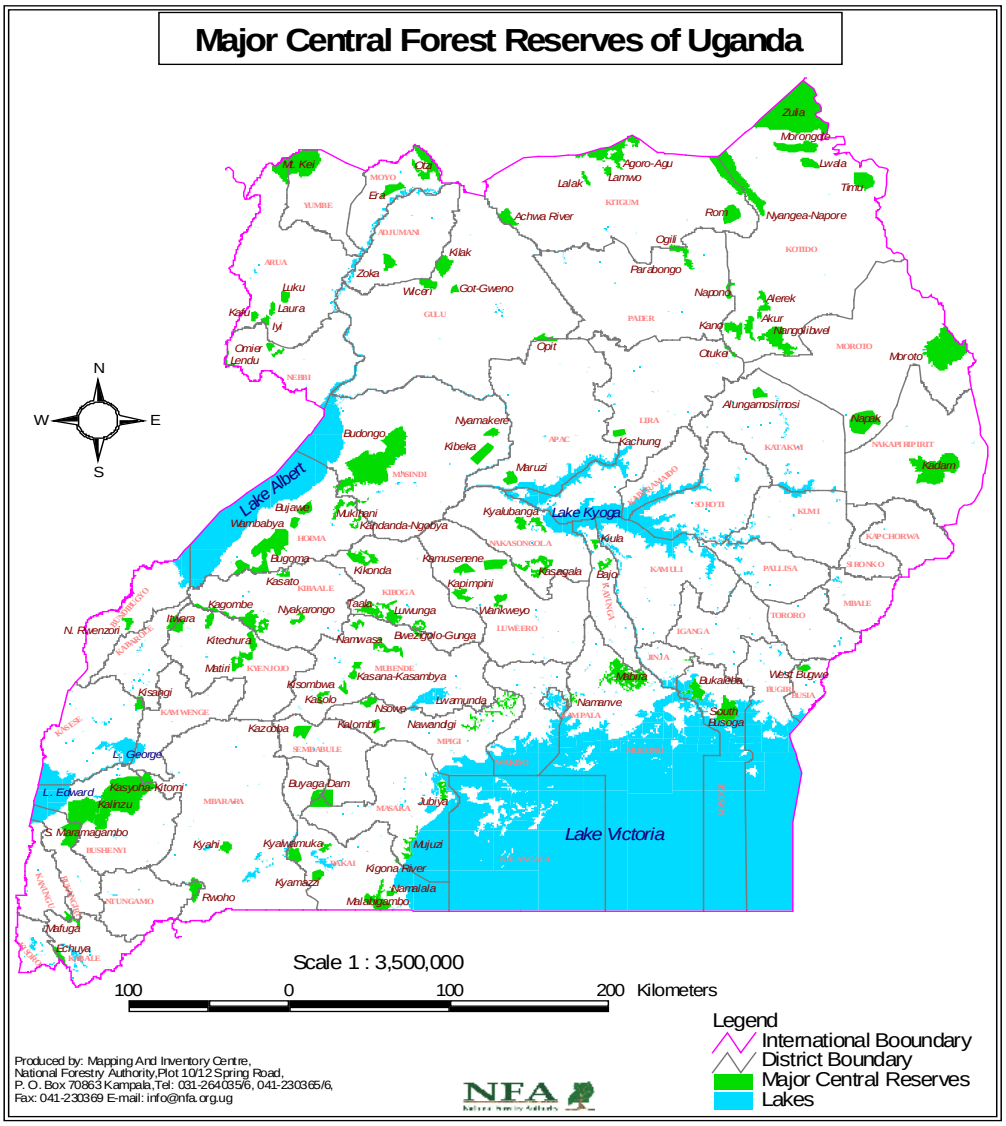
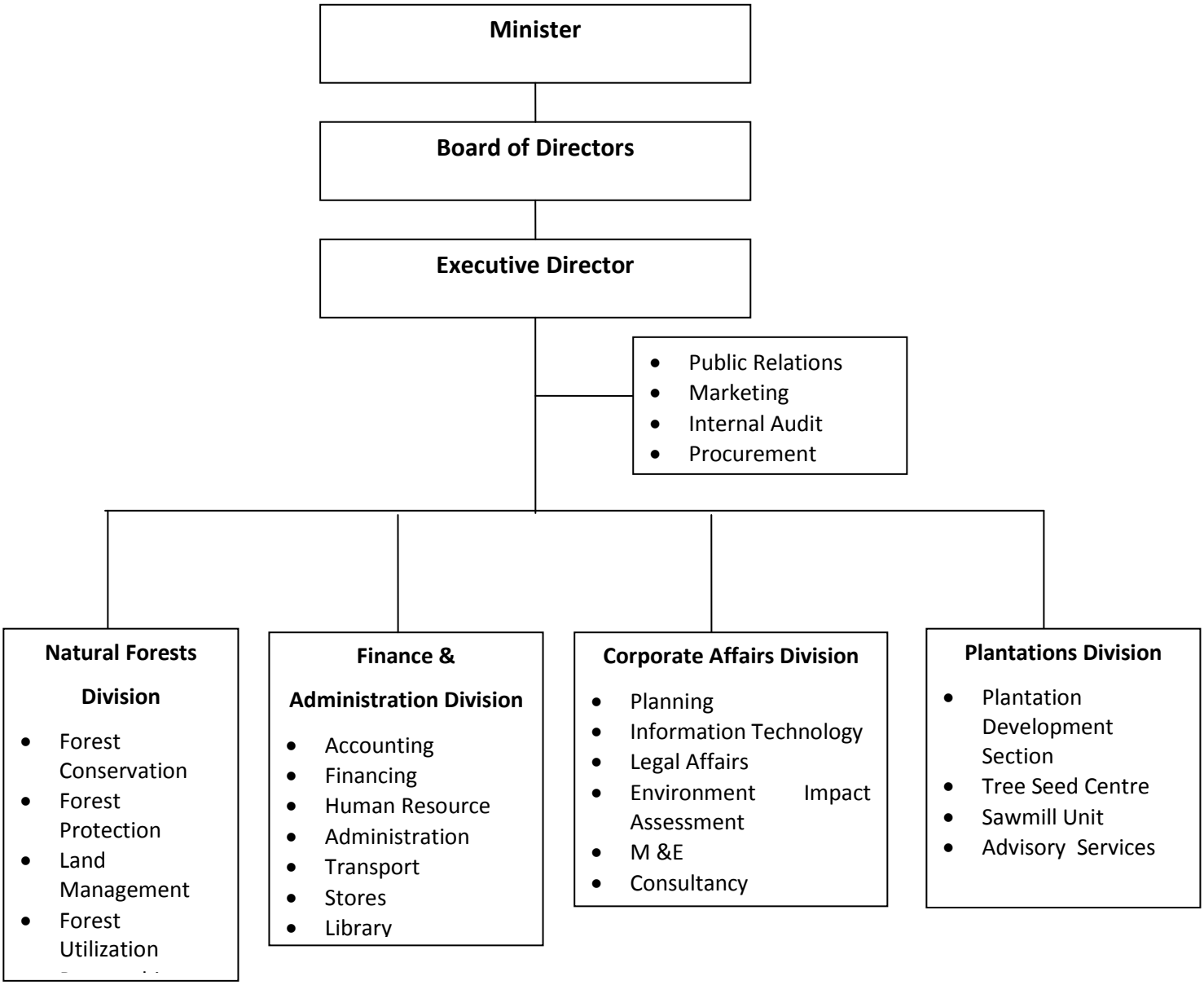


Fig.1 MAP OF UGANDA SHOWING FORESTRY RESERVES MANAGED BY THE NFA

In order to be able fulfill it mandate, NFA has 3 technical and 1 support Directorate namely:

- Natural Forests
- Plantations
- Corporate Affairs
- Finance and Administration

Figure 2:Organizational structure NFA



The Uganda National Tree Seed Centre (NTSC)

The NTSC has its genesis in 1992 as the Uganda Tree Seed Project under the Forestry Department of the then Ministry of Environment Protection.

The project which started with UNDP support through its UN Sudan Sahelian Organization UNSO was meant to address the problem of insufficient seed supplies, of desired species, in required quantities and of satisfactory quality.

Uganda had just come out of 20 years of economic and environmental decline during which management of the Forestry Sector had virtually ground to a halt.

The World Bank, EEC, DANIDA, UNDP, USAID and NORAD together with the Government of Uganda through its Ministry of Environmental Protection had developed a Forestry Rehabilitation Project FRP, aimed at securing and restoring the degraded forests under an improved management. This was to be achieved through enrichment planting, encroachment planting, boundary planting and establishment of demonstration industrial plantations. There was also the peri-urban plantations project supported by NORAD and the Farm Forestry Project managed by CARE International with USAID funding. For theses to be successfully implemented there was need for plant material of the desired species with good genetic and physiological quality. It was immediately realized that the country lacked both quality seed sources and a National seed bank for tree seed. All attempts at planting relied on seed collected haphazardly and the quality of plants coming up was visibly poor At the time, organized supply of seed was virtually non existent and there was no provision for cleaning and testing the seed before it was used. The FRP had allocated very limited resources to seed supply, collection and distribution, but also lacked 2 vital components namely: tree improvement and genetic conservation of valuable seed sources. The Tree Seed Project was formed to bridge the existing gap.

At its inception, the Tree Seed Project was mostly focusing on internal seed supply to the Forest Department, CARE and the few tree planting projects. The volume of seed and variety of species were limited to soft woods, a few hard woods and fodder species. In 1993, the Project formally opened its doors to other Government departments, private organizations and the general public. The project which later evolved into the National Tree Seed Center NTSC, changed management from Forestry Department to NFA in April 2004 following the gazzettement of the National Forestry and Tree Planting Act 2003 that vested management of CFR's and all activities there in under NFA. NTSC is administered under the Plantations Directorate of NFA.

Mandate of NTSC

NTSC is mandated to provide adequate quantities of seed and plant material with desired genetic and physiological qualities to meet the demand for tree planting activities in the country. The activities of NTSC include the following:

- Seed source identification and development
- Seed source establishment
- Seed source register update and management
- Crop assessment
- Seed collection
- Seed processing
- Seed testing
- Seed packaging and storage
- Seed sales/distribution
- Seed imports/exports
- Propagation and distribution/sale of plant materials
- Training and Advisory services

Drivers for reforestation in Uganda

The major causes of deforestation in Uganda include the following:

- Agricultural expansion due to Uganda's rising population (3% per annum) with an estimated 30 million people. Yield per unit area is low because fertilizer use is less than 10% among the farmers and rudimentary tools are still used.
- Charcoal production for the growing urban population. Less than 5% of Uganda's population uses electricity for cooking (500,000 tones per annum)
- Fuel wood for industrial use (tea, tobacco, textiles, bricks, tiles) and for domestic use
- Commercial agricultural plantations (palm and sugarcane) BIDCO cleared 6,000 ha of Natural Forest on Buggala island on Lake Victoria for palm growing and are seeking more land. Part of Mabira Forest has been earmarked for growing of sugarcane by Mehta group.
- Demand for timber for the local as well as Regional market (especially Southern Sudan) This is estimated at over 500,000m3 per annum
- Over grazing coupled with seasonal bush burning in the cattle corridor stretching from Central to Western Uganda. This has the effect of preventing regeneration
- The 2003 National Biomass study report puts the total annual biomass loss for Uganda at 26 million tons

Reforestation activities

The major actors in reforestation in Uganda include the following:

- National Forestry Authority (NFA)
- Saw log Production Grant Scheme (SPGS)
- Private timber companies
- Farm Income Enhancement and Forestry Conservation Project (FIEFOC)
- Multilateral Agencies (WFP, UNHCR)
- Non Governmental Organizations (World Vision, Via-Agro forestry, Mercy Corps, Tree Talk)
- Schools
- Community Based Organizations

- Private tree planters

All of these put together plant an estimated 13,000 ha of trees per annum, an area below the National target of 20,000 ha per year.

Major species

While Multilateral agencies, NGO's and communities have emphasized planting of indigenous species in their reforestation programmes, NFA, SPGS, FIEFOC, private timber companies and private tree planters who comprise the bulk of the planting have concentrated on introduced species with mainly Pines and Eucalypts. 90% of all the planting done since 2004 is from these 2 families. The main reasons for this lie in the following factors:

- The main driver for tree growing in the country is the lucrative timber market. The rotation period for indigenous timber species is 30 to 50 years while that for introduced species is 10 to 25 years. The preference for introduced species is therefore economic.
- Many of the indigenous species, especially the Mahoganies perform poorly in plantation form unlike when there in the natural forest. This has discouraged tree farmers from raising them as plantations.
- Collection areas for indigenous seed are natural forests and the seed supply is not regular, yet some of the species have recalcitrant seed that cannot store for many years. This makes planning for commercial growing difficult resulting in farmers opting for the pines and Eucalypts.
- Nearly all the trial plots of indigenous species established in the 1960's that would be a demonstration to prospective farmers were cut down. Would be farmers have nothing to encourage them take on such species.
- SPGS and FIEFOC that give grants to private tree farmers have pegged their money on introduced species. This leaves the farmers with no choice.
- The National Forestry Resources Research Institute naFORRI that is mandate to identify, try out and promote different indigenous species for different agro ecological zones is understaffed, under funded and not linked to forestry extension at the Districts. (annex 1 shows the main species used in afforestation in Uganda)

Opportunities for afforestation in Uganda

- NFA offers permits to individuals and companies for growing of trees in Central Forest Reserves with a period of up to 50 years, and with a provision for renewal for as long as the land is kept under forest. The rate charged is only US $ 2.4 per ha per year and for only that land already planted
- FIEFOC offers free seedlings (raised with a World Bank soft loan to Government and a NORAD grant) to both subsistence, small scale and medium scale tree farmers and goes to the extent of providing transportation up to the farm for those who may be constrained. These include plantation, agro forestry, fruit and ornamental plantlets.

- SPGS provides grants on a reimbursement basis (with EU funding) to farmers that are willing to commit at least 25 ha of their land to commercial tree growing. The fund which is US$ 313 per ha is sufficient to cover the cost of establishing and maintaining 1 ha of crop for up to 2 years.
- NTSC collects up to 91 different tree species that can be used for afforestation
- NFA operates 12 tree nurseries for supply of quality seedlings
- The Government of Uganda has established a community tree planting fund through which 5,000,000 million seedlings are raised annually by NFA and given to community members free of cost
- The World Bank, through its Environmental Management Capacity Building Project is funding the Establishment of 4,000 ha of plantations for timber and charcoal production
- Uganda, through NFA signed an agreement with the World Bank Bio carbon Fund to establish 5,000 ha of plantations in exchange for carbon credits. The first credits are expected in 2013
- The private sector has taken up commercial nursery management and is producing up to 5,000,000 seedlings per annum
- NTSC offers training in tree nursery establishment and management, plantation establishment and fruit tree propagation
- SPGS produces and distributes manuals and guidelines for specie selection and plantation establishment and management
- Several wood processing 9ndustries have been established in the last 10 years with a demand for raw materials
- Tree seed and seedlings are exempt of taxes in Uganda

Constraints to afforestation in Uganda

- The majority of Ugandans have small land holdings (1-2.5 ha) with average family size of 7, on which the priority is growing of food. This makes them not eligible for SPGS.
- Government suspended the licensing of Central Forest Reserve grasslands for growing of trees because of political reasons
- Banks in Uganda do not give financing for forestry establishment because it is thought to be risky and the repayment period too long
- Most of the privately owned tree nurseries do not care about the source of their planting materials and end up providing poor quality seedlings. This has discouraged many farmers from continued planting
- Forestry Extension was mandated to the District Forestry Services which have neither funding nor manpower. The local Governments hardly provide any funding to the DFO's with many Districts having only 1 staff in the Forestry Department
- The Ministry of Agriculture is supposed to control movement of plant material into the country but this is only done at the Airport. A lot of uncertified seed come into the country by road making control of plant diseases difficult. In 2003 hundreds of Cypress plantations were lost to aphids

- Quality seed from orchards in Brazil, Australia and South Africa is very expensive and cannot be afforded by many farmers
- Heavy encroachment on Uganda's Forest Reserves which now stands at 100,000 persons occupying over 60,000 ha of land that would have been put to Forestry purposes
- Land in many parts of Uganda is communally owned and investing in tree planting would require community consensus which does not come easy

Partners implementing afforestation programmes

Uganda has about 60,000 ha of industrial plantations with 25,000 ha under NFA and 35,000 ha under the private sector

The biggest player in afforestation in Uganda was until recently, NFA whose target was to plant 10,000 ha of plantations per year. In 2007, there was a shift in policy from State planting to the private Sector with NFA providing the land and ensuring that the right species and standards are maintained.

NFA now concentrates on providing quality planting material through its 12 nurseries and seed unit under NTSC.

SPGS is so far supporting 280 farmers who have establishes 25,000 ha of plantations between 1 and 9 years old. Besides giving financial support of up to US $313 per ha planted, SPGS provides training to farmers in plantation management and gives organized community groups seedlings for establishment of woodlots

FIEFOC has over the last 4 years given over 12 million seedlings to small and medium level farmers and will continue to do this for the next 3 years.

The Government of Uganda Community Tree Planting programme raises and supplies 5 million seedlings of mostly indigenous species every year to community for planting. NGO's World Vision and Mercy Corps buy at least 2 million mostly fruit tree every year for the communities mostly in the marginal areas.

World Food Programme and UNHCR buy and supply tree and fruit seeds to communities in the former war torn area of Northern Uganda and drought prone Karamoja area. Various churches and schools have on going tree planting programmes which emphasize woodlots for fuel and fruit trees. The Tree Talk foundation has been instrumental in promoting tree planting through school children. Many individuals especially in the middle to high income brackets have taken on tree planting as a retirement investment, with each ha of 25 year old pine (600m3) fetching US$ 35,000

Policy on afforestation programmes

Management of Forestry Resources in Uganda is guided by a Forest Policy whose overall objectives are:

i. To maintain and safeguard adequate forest land so as to ensure sufficient supplies of forest products and services on a sustainable basis including maintenance of suitable conditions for agriculture, conservation and recreation.

ii. To manage the forest estate so as to optimize economic and environmental benefits through planned utilization, appropriate utilization technologies, and research aimed at increasing growth and yields.

iii. To increase awareness among the people on the importance of forests and trees for them to develop woodlots and commercial timber plantations.

The Forest Policy is operationalized by the National Forest Plan which has strategies for management of Forests in Central Forest Reserves, management of forests on private land and development of commercial forest plantations.

The strategies for Central Forest Reserves include:

- Strengthening the NFA
- Strengthening the capacity of Local Governments to manage Local Forest Reserves
- Promotion of collaborative Forest Management with local communities
- Develop commercial timber plantations in grassland and degraded Forest Reserves
- Conserve Forest biodiversity

The strategies for natural forests on private and customary land include:

- To support reforestation of environmentally sensitive watersheds
- To develop a national land use policy
- Improve advisory, training and information services for private forest owners

Strategies for development of plantation forestry include:

- To put in place economic incentives for private sector plantation establishment
- To increase establishment of new plantations by the private sector in forest reserves
- To improve management of existing government plantations
- The National Forestry and Tree Planting Act (2003) provides the legislation for operationalizing these strategies. Section 39 of the Act gives provisions for Tree Planting and Growing which include the establishment of a Tree Fund.

Achievements

Seedling production

The number of nurseries operated by NTSC has increased from 1 to 12, distributed in different parts of the country to address the increasing demand for quality seedlings and the capacity has raised from less than 100,000 seedlings in 1998 to 10 million seedlings. This represents almost 50% of the national requirements for tree planting. The species have

increased from about 6 mainly plantation species to over 50 including agro forestry, rangeland, ornamental and fruits. This can go up to 89 depending on the orders received. The graph below shows seedling production by category between 2004 and 2010.

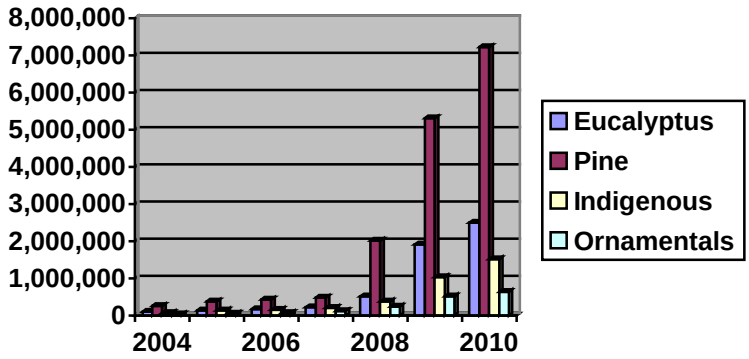


Fig 3. NFA Seedling production 2004-2010

Seed source identification

Seed source identification is used by NTSC as an interim measure to meet immediate demand for tree planting activities in the country until permanent seed orchards become available. The activities carried out include surveying/exploring suitable tree populations, selecting and marking outstanding phenotypes in natural stands and plantations and collecting seed from them. These stands are cleaned by rouging and are managed for optimum seed production. To date NTSC has 113 identified seed sources measuring 400 ha

from which 91 different species of seed are collected (see annex 2). Theses occur both in CFR's and privately owned land.

Seed source establishment

This is deliberate establishment of seed orchards for the provision of genetically and physiologically suitable seed and plant material of both indigenous and exotic woody species, capable of meeting present and future needs in Uganda. The selection of planting material is done in conjunction with National Forestry Resources Research Institute NaFoRRI.

2 types of orchards are being established by NTSC namely:

a. Vegetative Seed Orchards, raised by grafting PCH seedlings from locally collected pine with scions from mature seed bearing plus trees of the same species from a Clonal seed stand. The population of the orchard now stands at 264 trees and expansion continues.

b. Seedling seed orchards raised by planting seedlings originating from seed of selected plus trees, followed by rouging that will remove the poorer trees and leaving the best trees for seed production. NTSC has 68.4 ha of seedling seed orchards with 7 different plantation species (Pines, Eucalypts, Maesopsis, Bathedavia).

Seed source register update and management

NTSC maintains a seed source register which currently stands at 113 seed sources. The register is updated every time a new seed source is added or removed due to non productivity. The register provides information on the seed source including the following:

- Species
- Name and location of seed source
- Altitude
- Approximate seed yield per season
- Flowering period
- Fruiting period
- Seed collection period
- Seed source type
- Ownership and
- Protection status

NTSC is now in the process of picking and including GPS points of the seed sources for inclusion in the register and for production of the seed source map

Seed collection

The importance of using good quality seed cannot be over emphasized. Use of good quality seed is central to successes in all tree-planting activities all over the world. In ensuring this, NTSC employs both Centralized and Decentralized systems as strategies of procuring and or collecting seed.

Centralized Strategy

Under this strategy, the Seed Centre uses its trained high tree climbers/collectors, provides the necessary seed collection tools and equipment, under the supervision of the seed procurement staff to collect seed from selected mother trees. It is also under this Centralized strategy that NTSC imports pine seed from Brazil and Australia

Decentralized strategy

To employ this strategy, the seed centre recruited, and trained private seed suppliers (contractors), and other tree seed users to improve the quality of seed produced and delivered to the seed centre.

Depending various factors such as:- Relative size and number of dispersal units, characteristics of the fruit(size, number, position and distribution of fruits), characteristics of the tree,(shape, diameter, length of the bole, bark thickness, resistance to breakage of branches), characteristics of the stand(distribution and stocking of trees), characteristics of the site (slope, accessibility), the collection crew makes a choice of seed collecting method(s) and equipment it uses to collect fruits/seed. NTSC annual collection is up to 10 tones of seed from up to 91 species in the category of:- Agro-forestry species, indigenous hard wood / or soft wood timber species, introduced species, imported plantation species, Fruit tree species, and medicinal species.

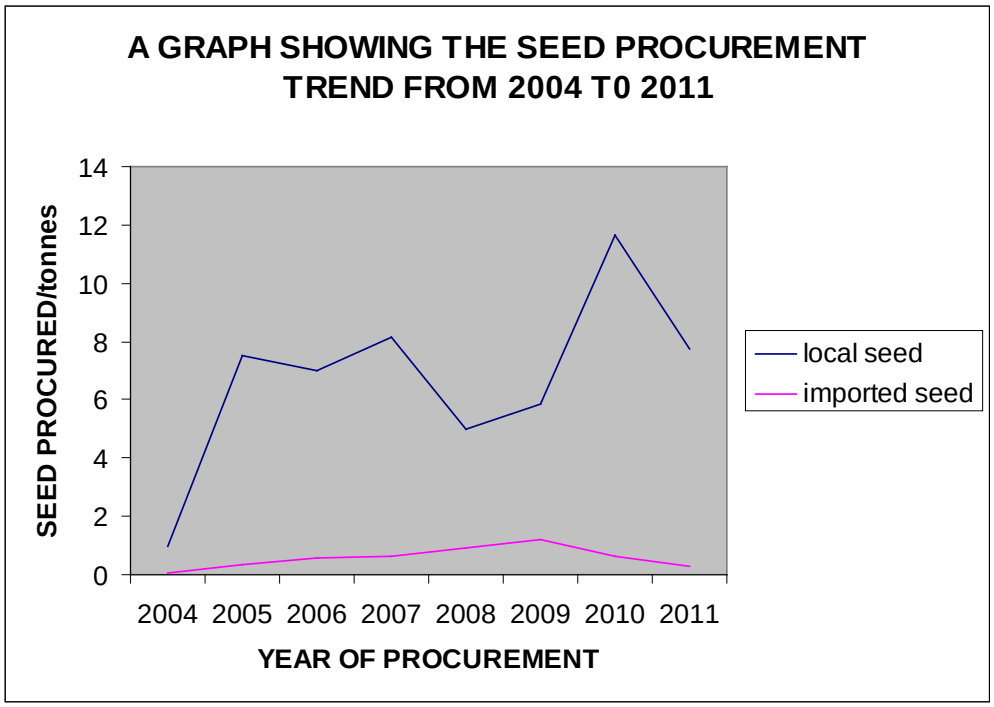


Fig 4. Seed Procurement Trend from 2004 to first half of 2011.

Seed processing

Although the term “Seed collection” is a convenient one in common use, it should be noted that almost invariably it is the “*fruits*” which are harvested from the trees. Only at later stage in some species are seeds extracted and fruits discarded.

Fruit processing there fore is one of key activities carried out by seed collection centers for a simple reason that all seed handlers know that almost all seed is collected in form of fruit then seed is later extracted. Knowledge on the method of extraction to be employed while handling a particular tree fruit species is paramount. Lack of it can lead to damage of seed during extraction hence causing decline in viability, wastage of resources (fuel) and energy spent during collection and extraction period. One should be able to determine whether to use **wet method of extraction** or **dry method.** NTS C uses both methods to ensure that fruits are subjected to an extraction method which is appropriate, and does not cause severe damage to seed. Drying of the already extracted seed is either directly under sun or first under shade then to the sun, or completely under shade depending on the species category (orthodox species, intermediate or Recalcitrant).

The seed is graded after extraction to remove the undersized, empty, and severely damaged seeds such that only intact and viable tree seed are packaged and stored for distribution.

Below in the diagram is one of the multipurpose seed extraction machine (Kim Seed machine/ Macerator) used by NTSC to process seed using both “Wet” and “Dry” methods of seed extraction/processing.

Seed collectors processing *Measopsis eminii seed,* using a Kim seed machine (Macerator) by Wet method of seed extraction.

Seed testing

Test of the quality and other characteristics of tree seed needs to be made at several stages for instance during crop assessment and evaluation stage where test is carried out on fruit development/ maturity status, to ensure that both the quantity and quality of seed justify the effort and cost of collection.

At the processing stage 2 tests, the Moisture content test and purity analysis test are carried out. The two are vital in determining the extent of dryness, or wetness of the seed, and also if its cleanness measure to the acceptable standard.

After processing, the Viability test, the weight analys/1000sw test, moisture content test again, and Germination tests are yet other essential quality test NTSC caries out on specific seed lots before they are recommended for storage under specific storage conditions / or distribution.

Some of these quality tests (viability, moisture content test, and germination tests are repeatedly carried out at intervals throughout the storage life of the seed lot.

The NTSC laboratory is fairly equipped with basic seed quality testing tools and equipment to enable us carry out these quality tests as and when it is necessary, following the ISTA rules and guidelines.

Seed distribution

NTSC distributes seed to various categories of clients including Government Institutions, schools, NGOs, commercial tree farmers, private tree nursery and outside the country to Tanzania (Green Resources) and Sudan. Distribution since 2008 was as follows: 2008/2009 (7.9tones), 2009/2010(9.3tones), 2010/2011(7.7tones) of seed, from the initial 0.2tones of seed before 2004.

The categories of seeds distributed ranges from: - Agro-forestry species, indigenous hard wood / or soft wood timber species, introduced species, imported plantation species, Fruit tree species, and medicinal species.

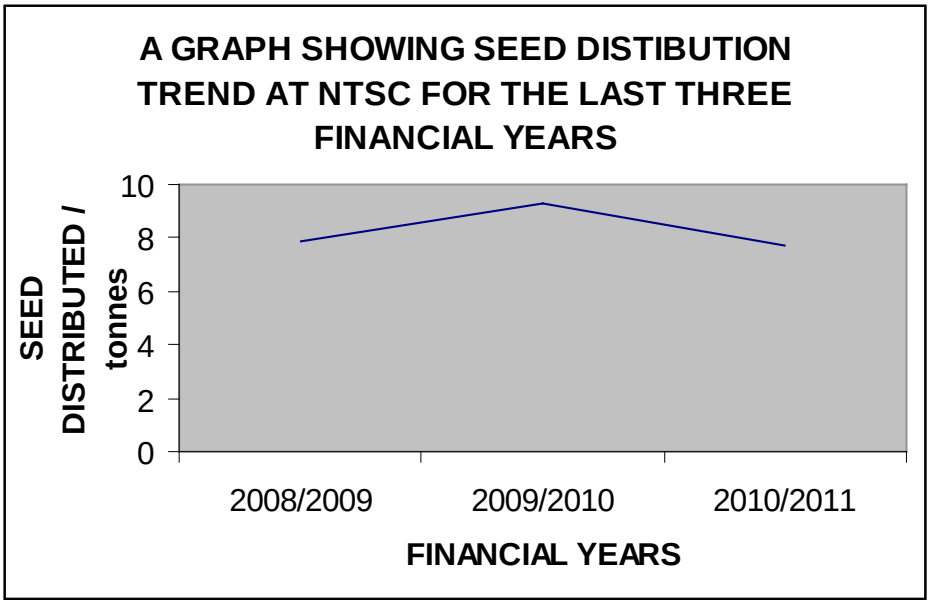


Fig. 5. Seed distribution/Sales 2008-2011

Training and advisory services

NTSC offers tailor made practical training modules in seed collection and processing, tree nursery establishment and management, plantation establishment and management and fruit tree propagation through grafting for nursery managers, private tree growers and commercial timber growing companies.

Advisory services are provided to prospective investors in nurseries and plantation forestry by NTSC and NFA extension services in general if infield.

Constraints/challenges

- There is limited storage capacity for seed and processing facilities. The same facilities that were handling 0.5 tones are now handling up to 12 tones
- Constant power outages that affect the viability of orthodox seed
- Pressure on seed sources, especially those on public land with communal access
- Unplanned orders for both seed and seedlings from especially Government agencies that are made with no notice
- High labor turn over of skilled manpower
- High cost of improved seed especially from Australia, Brazil and South Africa
- Limited number of tree breeders
- Irregular seeding pattern of indigenous species (especially mahoganies), making planning difficult.

Conclusion

For the afforestation programmes to be more successful there is need for substantial investment in the establishment of seed orchards of priority species for both indigenous and introduced. There is also need for training of staff (short courses) in tree breeding, because

this is a specialized area of forestry. The facilities for both testing and storage of seed need to be expanded and made more modern to cope with the increased demand. Mechanisms for management of seed source on private land should be explored including getting into Memoranda of understanding with the owners. Farmers should also be encouraged to grow trees with seed as a management objective. We should work towards certification of both the seed sources and the seed that comes from them to reduce on the level of circulation of substandard seed

Lists of References

Mugyenyi, O., Twesigye, B., Muhereza, E. (2005) Balancing Nature Conservation and livelihood "A legal analysis of forestry evictions by the National Forestry Authority" .ACODE Policy briefing paper No. 13.

Kaum, S. and Esegu, F. September 2000. Baseline survey, seed demand / supply for Uganda National Tree Seed Project by: EU funded Forestry Resources Management and Conservation Programmes (July 2006) Management of Uganda's Tropical Moist Forests for Timber Production.

Uganda National Biomass Study, Technical Report November 2008.

The National Forestry Plan 2002

The National Forestry and Tree Planting Act 2003

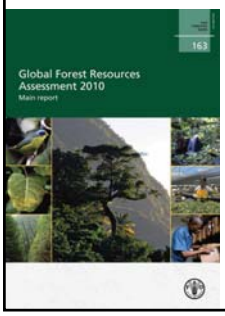
The National Forest Policy 2001.

The Uganda Forestry Nature Conservation master plan 2002.

LIST OF ACRONYMS

EU	European Union
SPGS	Saw Log Production Grant Scheme
FIEFOC	Farm Income Enhancement & Forestry Conservation Project
NORAD	Norwegian Development Assistance
GoU-CTPP	Government of Uganda Community Tree Planting Project
WFP	World Food Programme
NFA	National Forestry Authority
NTSC	National Tree Seed Centre
CFR	Central Forest Reserves
DFID	Department for International Development
GTZ	German Technical Assistance
EEC	European Economic Community
DANIDA	Danish Development Agency
USAID	United States Agency for International Development
CARE	Corporation for American Relief
UNHCR	United Nations High Commission for Refuges

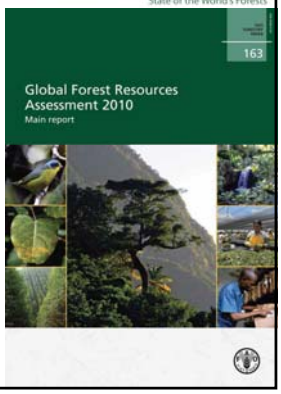
State of Africa Forests



Source of information

Based on FRA 2010 which analyzed status and trends of the world's forests resources for the period 1990-2010:

- Country reports
- Remote sensing survey
- Special studies
- External data providers



Regional distribution

North Africa
Algeria
Egypt
Libyan Arab Jamahiriya
Mauritania
Morocco
Sudan
Tunisia
Western Sahara

West Africa
Benin
Burkina Faso
Cape Verde
Côte d'Ivoire
Gambia
Ghana
Guinea
Guinea-Bissau
Liberia
Mali
Niger
Nigeria
Senegal
Sierra Leone
Togo

Central Africa
- Burundi
- Cameroon
- Central African Republic
- Chad
- Congo
- Democratic Republic of the Congo
- Equatorial Guinea
- Gabon
- Rwanda
- Saint Helena
- Sao Tome and Principe

Southern Africa
Angola
Botswana
Lesotho
Malawi
Mozambique
Namibia
South Africa
Swaziland
Zambia
Zimbabwe

East Africa
Comoros
Djibouti
Eritrea
Ethiopia
Kenya
Madagascar
Mauritius
Mayotte
Réunion
Seychelles
Somalia
Uganda
United Republic of Tanzania

Total forest area in Africa

The estimated area in forest land use in Africa in 2010 was almost **675 million hectares**, **about 23 percent of the total land area in the region a**nd accounting for **17 percent of the global forest area.**

Subregion	Area (1 000 ha)	%
Central Africa	**254 854**	**37**
East Africa	**73 197**	**11**
North Africa	**78 814**	**12**
Southern Africa	**194 320**	**29**
West Africa	**73 234**	**11**
Total Africa	**674 419**	**100**

TOP 5 countries (largest forest area)

- Democratic Republic of Congo
- Sudan
- Angola
- Zambia
- Mozambique

Totaling 55% of the forest area in the continent

Area of other wooded land in Africa

Total area of other wooded land in Africa is close to 351 million ha (31 % of the global area of other wooded land and 12% of the land area in the region)

10% is primary forests

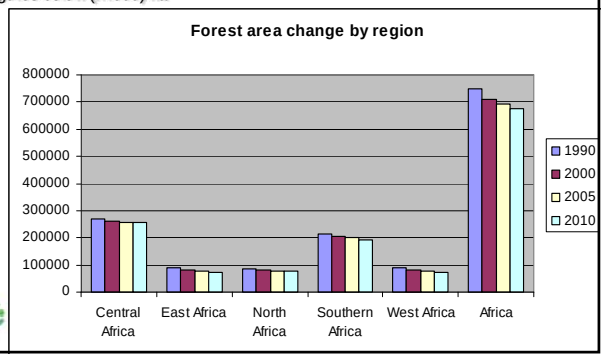
State of the World's Forests

Primary forest change rate
- 1990-2000 = - 57,000 ha/year
- 2000-2010 = - 59,000 ha/year

Deforestation rate is slowing down

State of the World's Forests

- From 4 million ha/year (1990-2000) to 3.4 million ha/ year (2000-2010)
- Figures below (x1000) ha



Planted forests in Africa

State of the World's Forests

2.3% of total forest area = 15 million hectares

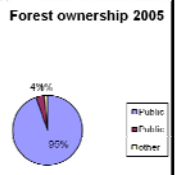
Biggest area of planted forests is in North Africa (Sudan having more than 6 million ha)

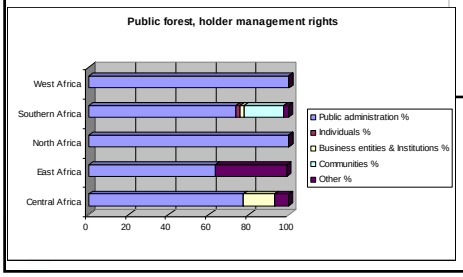
South Africa have almost 2 million ha (2/3 privately owned)

Ownership
Reporting period 1990, 2000, 2005

State of the World's Forests

- 49 countries reported for the year 2005 and 47 complete trend
  - 94.5% are public owned
  - 4% are private owned
  - 2% are other type

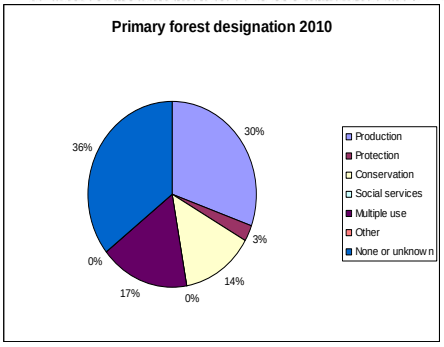




Forest primary designated function in Africa

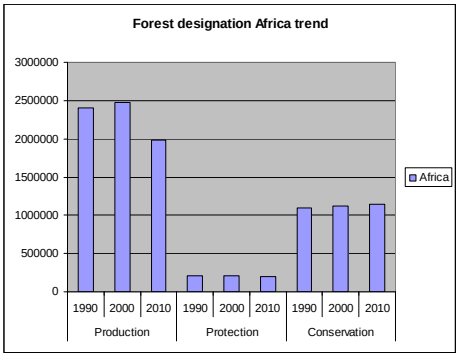
State of the World's Forests

Total forest area in Africa close to 675 million hectares

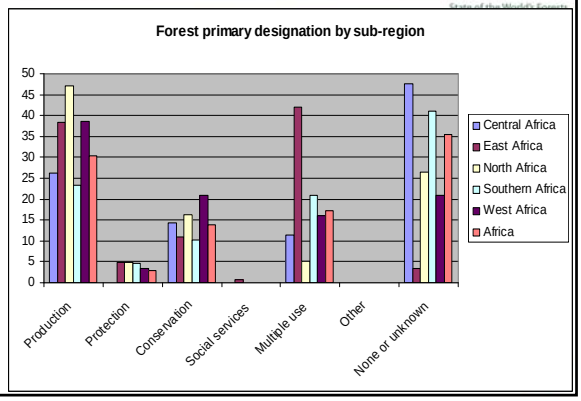


Trend on major designated functions for Africa

State of the World's Forests



Forest designation



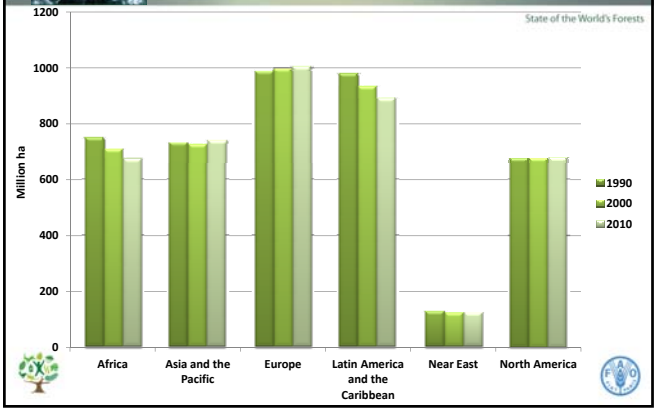
Legislation, policy and institutions

State of the World's Forests

- **40 countries have a specific policy**
- **39 countries have a NFP**
- **43 countries have a specific law**
- **Employment 44 countries informed 73,000 persons 15% women**
- **Education 40 countries reported around 4,500 with a forestry diploma less than 1% female**

Extent of Forests

State of the World's Forests



Forest loss in Africa

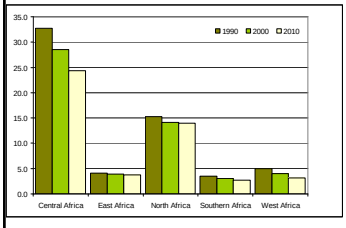
State of the World's Forests

While there are signs that the net loss of forests in Africa is decreasing (from 4.0 million hectares per year in the 1990s to 3.4 million hectares per year in the last decade), few countries have reliable data from comparable assessments over time, so the resulting trends should be treated with caution.

Sub-region	Area (1 000 ha)			Annual change (1 000 ha)	
	1990	2000	2010	1990–2000	2000–2010
Central Africa	268 214	261 455	254 854	-676	-660
East Africa	88 865	81 027	73 197	-784	-783
North Africa	85 123	79 224	78 814	-590	-41
Southern Africa	215 447	204 879	194 320	-1 057	-1 056
West Africa	91 589	81 979	73 234	-961	-875
Total Africa	**749 238**	**708 564**	**674 419**	**-4 067**	**-3 414**
World	**4 168 399**	**4 085 063**	**4 032 905**	**-8 334**	**-5 216**

Primary forest in Africa

State of the World's Forests



Area of primary forest in Africa, 1990–2010 (million ha)

About 10 percent of the total forest area in the region

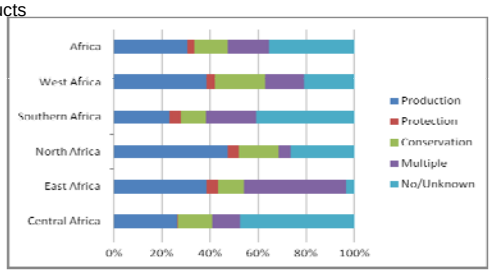
Evidence of an overall decline in primary forest area in the region, with with primary forests declining by :

- close to 700 000 ha annually between 1990 and 2000
- around 570 000 ha per year over the period 2000–2010.

Forest designation in Africa

State of the World's Forests

- Only about 3 % of the forest area was designated primarily for protection of soil and water
- 30% designated primarily for production of wood and non wood forest products



Forest designation in Africa in percentage, 2010

FAO Supported Policies and programmes on afforestation and forest restoration

Nora Berrahmouni, Walter Kollert
Oudara Souvannavong, Albert Nikiema
Forestry department, FAO, Roma

MSB-ICRAF workshop, Nairobi, 5-10 December 2011

Presentation overview

- **FAO Forestry Department Mission**
- **Highlights on FAO work relevant to Africa:**

  policy, technical assistance & capacity development

  1. Responsible management of planted forests: voluntary guidelines
  2. Forest Genetic Resources
- **New opportunities:**
  3. State of the World's Forest Genetic Resources
  4. Lessons learnt and operation guidelines for forestation and landscape restoration in Drylands

FAO Forestry Department Mission

FAO Forestry works to balance social, economic and environmental objectives so that present generations can reap the benefits of the Earth's forest resources while preserving them to meet the needs of future generations by:

- Serving as a **neutral forum for policy** dialogue;
- Acting as a reliable **source of information** on forests and trees;
- Providing **expertise and technical assistance and advice** to help countries develop and implement effective national forest programmes.

1. Policy dialogue - Voluntary guidelines for responsible management of planted forests

•Based on a participatory process for countries capacity development on sustainable management of planted forests

•A set of principles to assist in the planning, the establishment and the monitoring of sustainable management of panted forests

1. Policy dialogue - Voluntary guidelines for responsible management of planted forests

Participants to the process

- •International organizations (FAO, ITTO, CIFOR, IUCN, The World Bank)
- •Non Governmental Organizations (WWF, FPP, IIED)
- •Private sector associations (ICFPA, BRACELPA, AFPA, CEPI, IFBWW)
- •Governmental organizations from selected countries (New Zeland, South, India, China, Vietnam, Iran)
- •Universities (University of Oxford, Australian National University)
- •International consultation (FAO member countries)

1. Policy dialogue - FAO voluntary guidelines for responsible management of planted forests

The 10 principles

Principle 1. Good Governance

- Enabling legislation, policies , norms, plans and processes
- Regulations for best practices on sustainable management
- Long term land tenure arrangements
- Equal distribution of benefits among stakeholders

Principle 2. Integrated decision making and Multi-stakeholder approaches

- Understanding stakeholders' needs, priorities and responsibilities
- Promoting participation of all interested groups
- Solving conflicts

Principle 3. Effective organisational and personal capacity

- Decentralization and devolution of responsibility to local level
- Financing mechanisms
- Continuous professional education and training, extension , support services
- Strengthening National Research Capacity

Principle 4. Recognition of the value of goods and services

- Economic valuation of the value of the full range of planted forests goods and services to help justify investments
- Applying the integrated value of goods and services in the planning, management, monitoring and reports preparation
- Weighing trade-offs between return on investment and the costs and benefits to society

Principle 5. Enabling environment for investment

- Direct and indirect incentives to boost investments in planted forests
- Avoiding or removing perverse incentives having adverse impacts
- Reviewing periodically the incentives, monitor evolution of investments and management of the planted forests

Principle 6. Recognition of the Role of the market

- Transparent access to information on markets (wood and non wood forest products), enabling respond to signals
- Recognize the role of planted forests in mitigation and adaptation to climate change including in the emerging carbon trade markets
- Recognize that the market may not account for all social values

Principle 7. Recognition and maintenance of social and cultural values

- Recognizing values of local communities
- Opportunities of employment, appropriate capacity, equipment and technology
- Establishing mechanisms for conflicts solving
- Working environment and conditions – health and safety
- Protecting sites and landscapes of archeological, cultural, traditional, spritual, scientific and aestetic values
-

Principle 8. Maintenance of environmental sustainability and forest health

- Integrated Watershed Management and soil protection
- Reducing at the minimum level impacts of fires, pests, climate conditions risks
- Managing the use of herbicides, pesticides, fungicides and fertilizers in accordance with legal requirements and best-practice standards



Principle 9. Biodiversity conservation

- Avoiding conversion of natural forests or other ecosystems of high environmental value
- Controlling illegal practices (poaching, collection of protected plant species)
- Selecting native species for establishment of planted forests
- Evaluating the risk of introduced species (can become invasive)


Principle 10. Management of landscapes for social, economic and environmental benefits

- Recognising the role played by natural forests together with planted forests within the landscape/ watershed
- Educating local communities and the public in understanding better the links and interactions between the land uses
- Retaining naturally regenerating riparian reserves or buffers or their conservation importance

2. Forest Genetic Resources (FGR) in forestry programmes: Some key issues

- FGR support economic, environmental and social functions of naturally managed and planted forests
- Genetic diversity and processes: basis for evolution and adaptation to changes - Resilience
- FGR under utilised, poorly known, under threat
- Lack of knowledge and information to define and implement policies and programmes in conservation and use of FGR
- Institutional capacity of African countries on FGR management needs to be strenghthened (ex situ conservation facilities, etc)


2. Coordination and Capacity Development on FGR Assessment, Evaluation and Conservation

- **Support to international tree seed collections and exchanges:** *Eucalyptus sp, Azadirachta indica,* Autralian acacias*, Acacia senegal, Parkia biglobosa*, etc.)
- **Support to Regional and National tree seed centers in the years 1990s:** Regional Programme in the sahel, country project in Senegal
- **Support to Regional Networks on FGR (SAFORGEN) in collaboration with Bioversity International**


3. Opportunity - State of the World Forest Genetic Resources (SoW-FGR)

- **Focus on Diversity and Genetic processes**
- **First World Report on Forest Genetic Resources (by 2013)**
- **Based on National Reports and Thematic Studies**
- **Synergy with other programmes (eg FRA) and collaboration with CBD and other organizations (Bioversity International, ICRAF, and regional Networks)**
- **Serve as source of information and a basis for identifying priorities for actions at national, regional and global level**



3. Opportunity - Analysis and lessons learnt from afforestation and forest restoration programmes in drylands

Why ?

- Develop operational guidelines for afforestation and forest restoration in drylands
- Near East Forestry Commission and COFO 2010
- Develop a new generation of projects/programme
- 10-year strategic plan and framework of the UNCCD (2008-2018)
- Respond to Climate change adaptation and mitigation needs

High regional significance:

- Great Green Wall Initiative (over 20 countries)
- Silva Mediterranea: Projects on CC-SFM, Collaborative Partnership on Med Forests

Analysis and lessons learnt from afforestation and forest restoration programmes in drylands

- **Selected** field projects/ programmes (FAO and other organizations)
- Evaluate past successes and failure experiences
- Developing a monitoring tool
- In partnership with interested countries, organizations, research and technical networks

5. Analysis and lessons learnt from afforestation and forest restoration programmes in drylands

- **Nouakchott Green Belt (Mauritania)** with Walloon Region support where we used native plant species:

Acacia raddiana, A. senegal, Balanites aegyptiaca, Leptadenia pytotechnica, Panicum turgidum, Aristida pungens, Nitraria retusa, Tamarix aphylla

4. Analysis and lessons learnt from afforestation and forest restoration programmes in drylands

- **Acacia operation project: Support to food security, poverty alleviation and soil degradation control in the gums and resins producer countries**

- Funded by Italy (implemented in 2004-2010)
- Burkina Faso, Chad, Niger, Senegal, Sudan, Kenya and Network for Gum Arabic and Resins in Africa (NGARA)
- Mechanized water harvesting technology (Vallerani system)
- Total of 13,000 ha agro-sylvo-pastoral systems established in arid and semi-arid lands
- NGARA Strengthened
- Long Term Plan for NGARA member countries

4. Analysis and lessons learnt from afforestation and forest restoration programmes in drylands

Examples of species used:

- Seedlings and seeds: *Acacia senegal, A. seyal, A. nilotica, A. millifera, Bauhinia rufescens, Ziziphus mauritania, Jatropha curcas, Melia volkensii, Azadirachta indica*, Mango,
- Direct sowing of herbaceous plants: *Cassia tora, Andropogon gayanus, Cymbopogon sp.*, etc)

4. Analysis and lessons learnt from afforestation and forest restoration programmes in drylands

Analysis will focus on:

- **Site description:** climate, topography, soils, vegetation cover before, socio-economic features, drivers of forest and deforestation
- **Forest restoration/ afforestation objectives**
- **Context**: legal framework, participation, access to incentives, human capacity and human resources, cost and financing

4. Analysis and lessons learnt from afforestation and forest restoration programmes in drylands

Analysis will focus on

- **Implementation**: landscape planning, species selection, source of reproduction material, plant production in tree nurseries, field seeding and planting operations, maintenance operations, natural regeneration, efficiency of water use, techniques
- **Monitoring and evaluation**
- **Results and impact**: plantation results, environmental impact, socio-economic impact, drivers reduction/ suppression, sustainability

4. Analysis and lessons learnt from afforestation and forest restoration programmes in drylands

Process and outputs :

- Contact potential partners
- **Desk study** of selected field projects with partners (using a monitoring tool)
- **Field visits** to selected projects
- **Expert consultations** (Turkey International Workshop, Spring 2012)
- **Publication on lessons learnt** about afforestation and landscape restoration efforts in drylands (illustrated by pictures, maps, boxes and case studies)
- **Partnership platform** developed on afforestation and forest restoration in drylands - a new **joint programme designed for submission** to donors

Websites and contacts

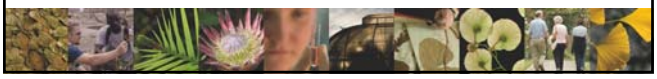
http://www.fao.org/forestry/plantedforests/en/
http://www.fao.org/forestry/aridzone/en
http://www.fao.org/forestry/fgr/en

walter.kollert@fao.org
nora.berrahmouni@fao.org
oudara.souvannavong@fao.org
albert.nikiema@fao.org
sow-fgr@fao.org

Kew's Millennium Seed Bank Partnership in Africa:

achievements and challenges in afforestation

Dr Paul Smith
Head of Kew's Millennium Seed Bank



Outline of talk

- The global context
- Why plants are important
- The Millennium Seed Bank model
- Afforestation & restoration
- Conclusions

The global context: population

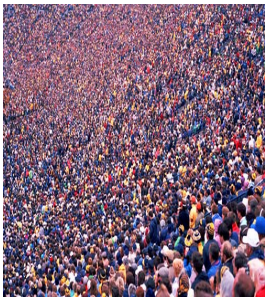
Population1960: 3 billion

Population today: 6.9 billion

Population growth rate: 1.1%

Population 2050: 7.5-10.5 billion

Source: UN



The global context: less land

In India nearly all available land is now sequestered for agriculture

100 000 hectares of agricultural land being lost per annum

Salinated land: 5.76 million hectares lost to agriculture in India.

The global context: want of water

Critically depleted aquifers and rapidly declining water tables

In the US, the high plains Ogallala Aquifer has been depleted by as much as 60% in some areas. It supplies water to 20% of US agriculture.

By 2020 world demand for water will outstrip supply (World Bank 2005)

Climate change will exacerbate the problem

The global context: climate change

Doubling of atmospheric CO_2 concentrations expected to occur in the next 100 years.

Food security is threatened by shifting growing zones, CO_2, rainfall and temperature effects.

Invasive species, pests and diseases likely to emerge

Agriculture, horticulture and forestry will be fundamentally affected, and new species and varieties will need to be utilised

The global context: loss of biodiversity

- 60,000 to 100,000 plant species are currently threatened with extinction
- The current extinction rate is 100 times the background rate.

www.millenniumassessment.org

Why plants are important

All life depends on plants

Provisioning services

Food, medicine, fuel, construction, clothing, etc.

Regulating services

Climate moderation, disease regulation, flood regulation

Cultural services

Spiritual, recreational, aesthetic, inspirational, educational

Supporting services

Soil formation, nutrient cycling, primary production.

Economic value $30-40 trillion per annum.

Why plants are important

Plant-based solutions will be required for all the major environmental challenges:

Biodiversity conservation

Food security

Water scarcity

Energy

Human health

Climate change

Why plants are important

There are ca. 60,000 trees species in the world, and we have detailed knowledge of only about 1000.

Can we continue to rely on such a tiny fraction of tree diversity for all our future needs?

The Millennium Seed Bank model

The concept of global seed banking has been proved by the Millennium Seed Bank Project, and it is based on:

Partnerships

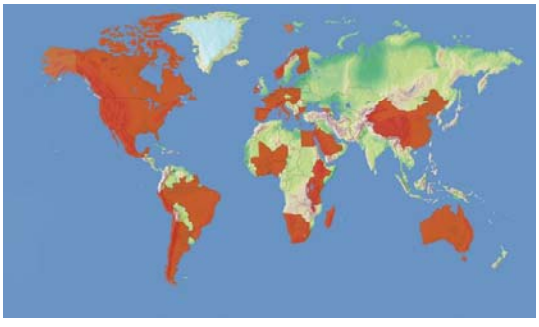
Collections

Training and technology transfer

Enabling use of plant diversity through research

Millennium Seed Bank partnerships

123 partner institutions in 54 countries.



Millennium Seed Bank partnerships

THE CONVENTION ON BIOLOGICAL DIVERSITY

- Ownership
- Consent
- Activities
- Notification of transfer
- Benefit sharing
- Non-commercialisation
- Transfer to third parties
- Duration

Training and technology transfer

Since 2001, Kew's Millennium Seed Bank Partnership has trained > 1500 agriculturalists, horticulturalists, foresters, botanists, ecologists etc. in seed conservation via in-country and UK-based training courses

Training and technology transfer

Since 2001, the Millennium Seed Bank Partnership has:

- Provided >£15 million to partner organisations to support and advance the seed conservation effort
- Provided advice on the design of seed bank facilities to 27 institutes in 19 countries

Training and technology transfer

Rotronic hygrometers delivered to 15 MSB partner countries

Millennium Seed Bank collections

The Millennium Seed Bank Partnership has the largest wild plant seed bank collection in the world – Currently 30,000 species duplicated in the MSB

ca. 8,500 African species secured in safe storage

A third of collections are of known use

Enabling use through research

Development of germination protocols are a vital and novel output of the Millennium Seed Bank

Currently >10,000 germination tests carried out each year. For most species the methods are new.

All germination protocols are available on Kew's website at http://www.kew.org./data/sid

Afforestation and restoration

Afforestation increasingly cannot be achieved with monocultures because they are vulnerable to disease, pests, extreme weather events and climate change.

More complex ecosystems need to be constructed or put back in order to ensure resilience.

Afforestation and restoration

Afforestation and restoration

Afforestation and restoration

Afforestation and restoration

The Millennium Seed Bank holds seeds from >10,000 tree/shrub species.

>1000 MSBP collections have been used in restoration and recovery programmes so far in Africa, Australia, Madagascar, the USA and the UK

The MSB has worked with partners in Botswana, Burkina Faso, Madagascar and Mali this year to plant 50,000 trees of 150 species

Afforestation and restoration

217 'difficult' species

40 fruit trees (33 native)

151 native species (vegetables, medicinal, ornamental etc.)

38% (82) of the species had handling/storage problems

52% (112) had germination problems

For 46 of the 112 species with germination problems we already have protocols that deliver >75% germinability

Afforestation and restoration

Useful Plants Project

Community-based programme

Kenya: medicinal plants in Tharaka District

Botswana: edible plants in Tsetseng

Mali: medicinal plants and natural pesticides, Yanifolila

South Africa: medicinal plants and schools in Mpumalanga

Conclusions

2010-2020

Concentrate efforts on work with communities in Africa for domestication, sustainable use and restoration of indigenous plant species.

Collect and conserve 10,000 wild species in Africa towards a global target of 45,000 species, so that 25% of the world's flora is in safe storage by 2020.

Conclusions

Conclusions

Challenges

Technical institutes are marginalised

Short term, insecure funding

Poor infrastructure, morale, staff retention etc.

Resistance to change

Competition

Vicious circle

Conclusions

Opportunities

Carbon offsets
Biodiversity offsets
Biomass renewable energy
Water catchment
BRIC demand
Partnership!

Conclusions

Outcomes

- Common approach and integrated forest seed-based solutions to afforestation, including seed systems;
- Forest seed network approach to technical input and problem solving
- Improved access to funding mechanisms related to afforestation.

MILLENNIUM SEED BANK PARTNERSHIP Kew

Conclusions

Outcomes

A prospectus detailing what an efficient, on-the-ground, technical network can deliver with well-adapted indigenous trees:

- agroforestry
- plantation forestry
- catchment restoration

Millennium Seed Bank Partnership's contribution to tree seed research in Africa

Dr Moctar Sacande
International Co-ordinator

THE MILLENNIUM SEED BANK PARTNERSHIP 2010-2020

Target 1

- Secure in safe storage 25% of the world's orthodox plant species by 2020

Target 2

- Enable the sustainable use of plants, and the repair and re-establishment of damaged vegetation, for human innovation, adaptation and resilience.

SEED BANKS: THE BASICS

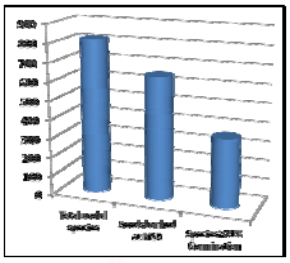
- Kew's Millennium Seed Bank, United Kingdom
- Non-crop species (>99% of plant diversity); active research methodology; seeds supplied for research and use;
- Currently 30,000 species duplicated in the MSB
- >10,000 tree/shrub species

VALUE OF MSB TO AFRICA

- Ca. 51.000 wild species in Africa
- 8.360 species securely stared at the MSB as duplicate collections from 44 countries
  - 16150 African collections
  - 8360 Species
  - 2036 Genera
  - 228 Families

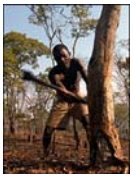
VALUE OF MSB TO AFRICA

- 813 species identified as important useful species to local communities since 2003 (DIRECTS, FAO, UPP)
- Ca. 600 species in the MSB
- >300 species germinate to >75%



MAJOR PROBLEMS

- Over-exploitation of forest resources (timber, firewood)
- Agricultural activities
- Population growth resulting in huge pressure on forested land



MAJOR PROBLEMS
OVER-EXPLOITATION

MAJOR PROBLEMS
HARVESTING

MAJOR PROBLEMS
TECHNICAL LIMITATIONS

- Very little work done and documented in agriculture/forestry departments relating to native useful species

MAJOR PROBLEMS
TECHNICAL LIMITATIONS

- Difficulties in carrying out afforestation and cultivation due to lack of know-how, very low germination of wild species
- Limits in Sharing information / knowledge transfer
- Limits in the valorization of research results

THERE ARE SOLUTIONS
SEED COLLECTING

THERE ARE SOLUTIONS
SEED CLEANING

There are solutions
Enabling use through research

- Mulanje cedar (*Widdringtonia whytei),* Malawi's National Tree and multipurpose species

- Nawonga or thankful (*Oldfieldia dactylophylla)* , medicinal plant from Malawi

There are solutions
Enabling use through research

- Mungongo seed (*Schinziophyton rautanenii, Southern Africa), used for* cooking and personal care products

- Karité seeds (*Vitellaria paradoxa*), used for food, medicine and cosmetics

There are solutions
Plant propagation

Working with local Communities

Community-based programme (>30 communities in SSA)

- Community consultations (workshops)
  - Priority lists, work-plan, management structure, delivery
- Species collecting, propagation, planting and maintenance in home gardens

UPP in Botswana, Kenya, Mali, Mexico and South Africa

USE OF MSB COLLECTIONS

Since 2010, the International Year of Biodiversity:

- >200 community tree species produced in >70,000 seedlings
- Planted with and in communities' land, farms and home gardens.
- Protected and maintained

SEEDS FOR NEEDS

- Expansion of the work with communities and increase cultivation of useful species through various partnerships in the next decade
- Communities at the centre of conservation

SEEDS FOR NEEDS

- Reduce reliance/dependence on harvesting wild native species
- Develop opportunities for communities to improve livelihoods and income through the use of cultivated species

MSB model: Seed based solutions

Challenges

- Technical institutes are marginalised
- Short term, insecure funding
- Poor infrastructure, morale, staff retention etc.
- Resistance to change
- Competition / Collaboration (NGOs)
- Vicious circle

Opportunities

- Partnership!
- International and National policies and demands (sustainability re. food, energy, health, climate)
- Offsets (CO_2, Biodiversity)
- Biomass renewable energy

There is no technological reason why any plant species should become extinct ...

Thank you!

Project MGU The Useful Plants Project

Welfare of local communities improved through the conservation and sustainable use of useful important plants

Tiziana Ulian

Seed Conservation Department
Royal Botanic Gardens, Kew
(United Kingdom)

Project MGU - The Useful Plants Project Background

- Grown from a proposal made to the Kew's Millennium Seed Bank Partnership by a philanthropist based in Spain (MGU)
- Developed and managed by Kew's Seed Conservation Department through the Millennium Seed Bank Partnership
- June 2007 – May 2011 (1st Phase)

Project MGU - The Useful Plants Project Countries involved

Botswana, Kenya, Mali, Mexico, South Africa

Project MGU - The Useful Plants Project purpose

To enhance the capacity of local communities in Latin America and Africa to conserve and use sustainably useful plants

Project MGU - The Useful Plants Project main outputs

- Targeting & prioritizing useful plant species
- Seed collection & conservation
- Plant propagation
- Support to *in situ* conservation of priority useful plants

Targeting of useful plant species Literature review

- Publications & grey literature (student thesis/ reports/ leaflets)
- Databases (e.g. SEPASAL & PROTA)
- Herbarium specimens (Kew and national herbarium)

Targeting of useful plant species
ETHNOBOTANICAL SURVEYS

1223 targeted useful species (*taxa*) compiled

Targeting of useful plant species
ETHNOBOTANICAL SURVEYS

Collection and identification of useful plants with local people

1223 targeted useful species (*taxa*) compiled

Prioritization of useful plant species
COMMUNITY WORKSHOPS

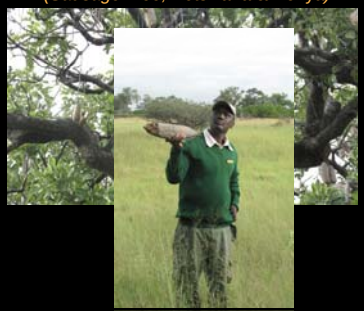
Selection of the most important species with the community for propagation

Different groups (e.g. traditional healers, cotton producers and farmers)

Prioritization of useful plant species
SOME EXAMPLES

Selection of the most important species

Kigelia Africana (*Sausage Tree*, Botswana & Kenya)



Adansonia digitata (*baobab*, Botswana, Kenya & Mali)

Prioritization of useful plant species
SOME EXAMPLES

Selection of the most important species –BOTSWANA

Hyphaene petersiana (Vegetable-ivory palm)

Citrullus lunatus (Kalahari melon)

Seed collection & conservation of useful plant species – COLLECTING & RECORDING

Seeds/fruits, herbarium specimens and information

Seeds of **784** useful sp. collected

Seed collection & conservation of useful plant species - PROCESSING

Seed/fruit cleaning

Seed/fruit drying @ 15% RH

Seeds of **784** useful sp. collected

Seed collection & conservation of useful plant species – BANKING

Seed storage in MSBP partner seed banks with duplicates in the MSB (UK) @ T= - 20 ºC

Seeds of **630** useful sp. conserved in country with duplicates stored in the Millennium Seed Bank (MSB) in the UK

Seed collection & conservation of useful plant species - TESTING

Seed viability, germination requirements, storability & longevity in the seed bank

Germination tests for **513** useful sp

Plant propagation– PROPAGATION TRIALS

Propagating plants and developing propagation protocols

Propagation protocols developed for **194** useful sp.

Plant propagation – CAPACITY BUILDING

Improving propagation facilities in local communities

9 community nurseries + 1 rural greenhouse (Mexico)

Plant propagation– CAPACITY BUILDING

Training in seed collecting and plant propagation

Workshops, training events, technical & scientific support

Support to *in situ* conservation – PLANTING

Community gardens, experimental plots & forest enrichments

19 community gardens/plots + 5 hectares of land reforested with **132** useful sp. planted

Plant propagation & support to *in situ* conservation – SCHOOL PROGRAMME

Sharing knowledge with children on uses of plants, plant conservation & cultivation

11 schools involved

Support to *in situ* conservation – APPLIED RESEARCH

Ethnobotany, plant physiology, phytochemestry, population biology/ecology, DNA profiling, *in vitro* propagation

Research in support to *in situ* conservation of **168** useful sp

Project Dissemination– PLANT USE, CONSERVATION & PROPAGATION

Achievements – Plant Conservation

- ✓ List with **1223** targeted useful species (*taxa*) compiled for each country
- ✓ Seeds of **784** useful sp. collected
- ✓ Seeds of **630** useful sp. conserved in country with duplicates stored in the Millennium Seed Bank (MSB)
- ✓ Germination/propagation of **513** useful sp. with propagation protocols for **194** useful sp.

Achievements – Livelihoods

- ✓ Capacity building in seed conservation and plant propagation in 12 local communities through training and the improvement of local facilities
- ✓ **132** useful sp. propagated in 9 nurseries and/or planted in 19 community gardens + 5 hectares of land reforested
- ✓ **12** local communities and **11** schools involved

Achievements – Applied Research

✓ Research in support to *in situ* conservation of **168** useful sp.

Project MGU - The Useful Plants Project –Next steps

Scaling Up

- 12 old communities + 16 new ones = 28 communities
- 11 old schools + 27 new schools = 38 schools

Project MGU - The Useful Plants Project –Next steps

Emphasis

- Plant conservation & propagation in/with local communities
- Education & Awareness
- Sustainable use & income generation

Sustainable use & Income generation

- Plants used sustainably and promoted
  - Plants (seeds/seedlings) or plant products identified for 83 sp.
- Project sustainability
  - Enabling users to be self-sustaining
  - Establishing strategic partnerships (e.g. forestry and food sectors, government and NGOs,)

Marama Bean (*Tylosema esculentum*)

Project MGU - The Useful Plants Project –Thank You!

Mali, June 2010: visit of KOFI A. ANNAN - United Nations

World Agroforestry Centre (ICRAF)
Global Research Project 1

Domestication, utilization and conservation of superior agroforestry germplasm

http://www.worldagroforestrycentre.org/research/grp1_agroforestry_germplasm

Presentation for MSB International Forestry Workshop
5 – 8 December 2011

Roeland KINDT
(based on a presentation of the GRP 1 team HQ and ICRAF Regions during ICRAF's Science Week, 12 – 17 September 2011)

Global exports value for some tree commodities (Edible) 2001-2008 (US$ '000)

Source: FAOSTAT, 2011

Commodity	2001	2002	2003	2004	2005	2006	2007	2008
coffee	8,661,842	8,462,349	9,769,085	11,810,867	15,637,891	18,256,575	22,061,510	26,800,406
Palm oil	4,916,280	7,479,292	9,841,363	11,842,625	11,638,148	13,962,578	21,346,063	33,016,870
Citrus	7,709,475	8,598,655	10,217,484	10,924,690	11,597,821	12,661,180	15,869,879	17,689,609
Apples	3,410,183	3,852,300	4,675,737	5,354,522	5,622,449	6,410,561	8,398,383	9,320,535
Olives	2,761,684	3,085,092	3,996,924	5,989,857	6,716,176	8,049,248	7,289,693	7,754,972
Cocoa	2,208,064	3,219,631	4,200,355	4,836,469	4,954,083	4,790,227	5,708,236	7,246,038
Almonds	917,197	1,176,724	1,461,219	1,840,873	2,650,190	2,571,436	2,637,102	2,652,035
Cashew nuts	947,931	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,025,783	2,735,722
Coconuts	[illegible]	976,193	1,210,337	1,527,598	1,876,246	1,633,117	[illegible]	2,895,301
Pears	929,469	996,744	1,166,412	1,333,622	1,546,355	1,606,612	[illegible]	2,376,579
Peaches, nectarines	944,861	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,702,527	2,112,357
Kiwi fruit	611,803	720,365	833,194	1,104,284	1,241,451	1,387,549	1,584,275	2,019,843
Pistachios	610,856	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,425,435	1,707,343
Plums & sloes	610,560	613,885	709,624	751,423	842,534	951,051	1,079,191	1,184,595
Raisins	558,066	577,380	673,286	809,938	895,637	915,796	954,722	1,285,479
Walnuts	424,313	462,340	535,894	685,925	830,099	1,010,112	1,171,124	1,270,622
Mango	428,299	401,188	578,874	585,438	646,821	778,814	918,524	1,001,681
Apricots	291,164	331,417	390,074	464,738	491,066	514,222	541,578	763,834
Papayas	124,014	130,550	161,481	201,833	185,248	182,419	186,153	188,050
Brazil nuts	51,840	57,901	70,975	109,783	163,617	129,307	154,651	159,584
Sheanuts	10,452	12,376	22,807	8,938	7,167	18,835	30,399	42,410
Gums natural	6,628	9,646	11,656	7,761	8,311	5,656	6,747	6,513
Kolanuts	6,932	1,808	1,668	5,241	477	600	1,916	1,904
Total value (US$)	**38,466,348**	**44,396,109**	**54,734,826**	**64,881,375**	**73,099,654**	**82,507,849**	**100,932,445**	**126,284,602**

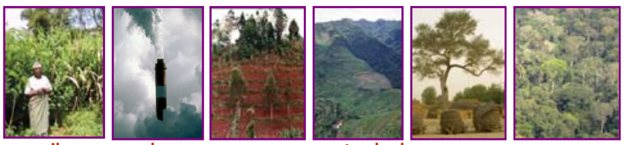
USD 126,282,549,680 industry

The Right Trees for the Right Place

A. Trees for Products

fruit | firewood | medicine | income | sawnwood | fodder

B. Trees for Services



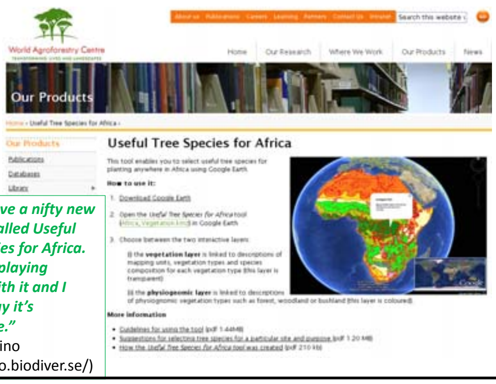
soil fertility | carbon sequestration | soil erosion | watershed protection | shade | biodiversity

GRP 1 sub projects

GRP1.1: <u>Improved tree planting material</u> produced (fruit, medicinals, fertilizer, bioenergy, timber, etc.) to contribute to mitigating global challenges of hunger, health, climate change and environmental degradation. **(CRP 6, CRP 4)**

GRP 1.2: <u>Access to quality agroforestry tree germplasm</u> for smallholder farmers through formal and informal sector supply systems and development of **associated extension information** that influences production, use and adoption. Address best **conservation** strategies for agroforestry trees.
(CRP 1 , CRP 6)

Decision-support tools for species selection



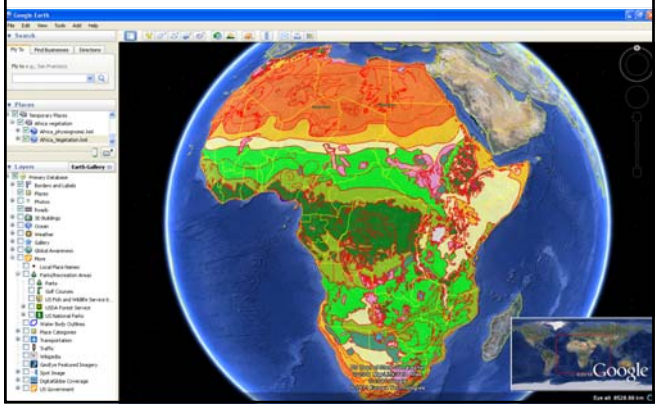
"ICRAF have a nifty new tool out called Useful Tree Species for Africa. I've been playing around with it and I have to say it's impressive."
Luigi Guarino
http://agro.biodiver.se/)

Decision-support tools for species selection

- Why did we develop these tools?
  - "the right trees for the right place"
  - Advise our clients on good candidate species for planting in a particular area
  - Point location data are not sufficient for statistical modelling for most species
- How did we develop these tools?
  - By using vegetation maps and data on their species assemblages

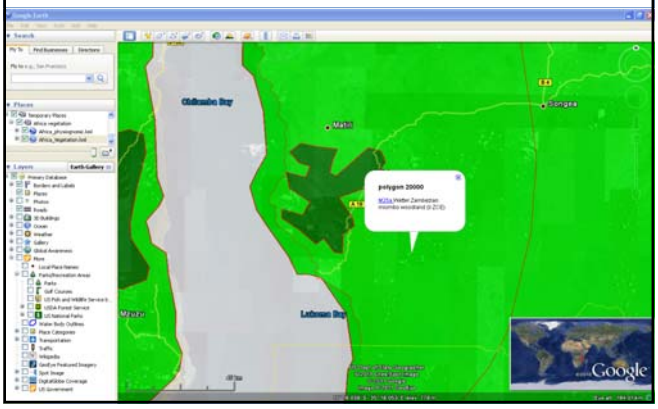
Suggested method for using the tool

... Please try it yourself



Suggested method for using the tool

1. Zoom to your area of interest



Suggested method for using the tool

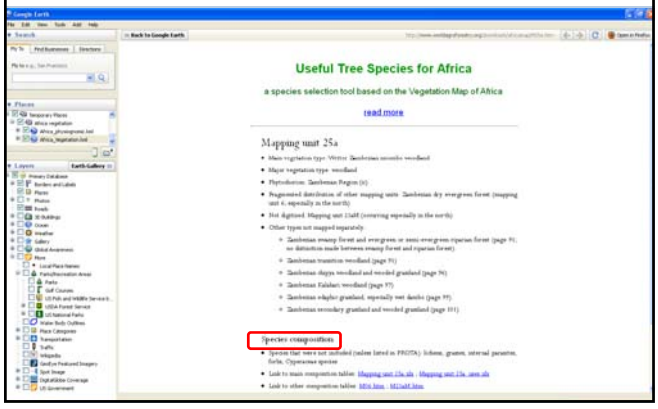
2. Identify the vegetation type

Suggested method for using the tool

2. Identify the vegetation type

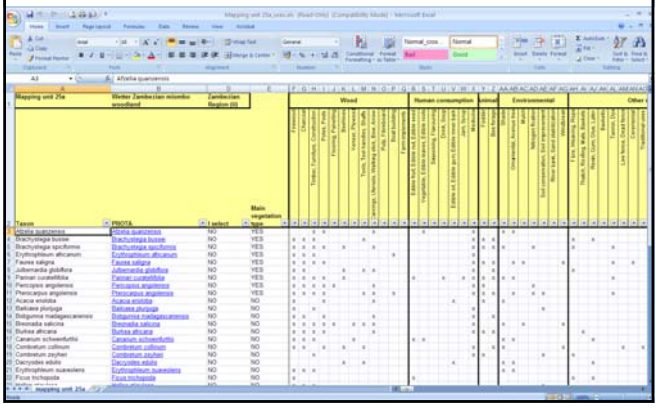
Suggested method for using the tool

3. Select species



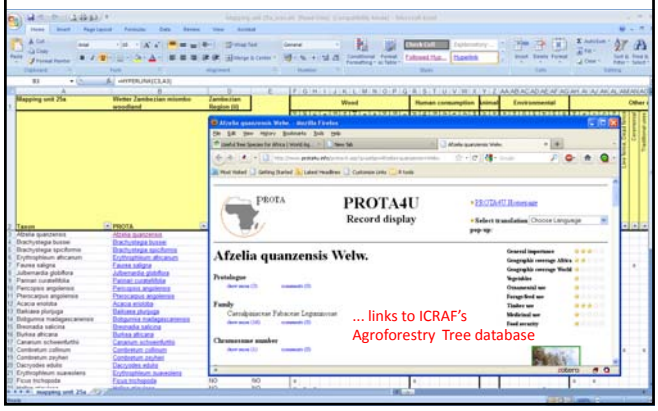
Suggested method for using the tool

3. Select species



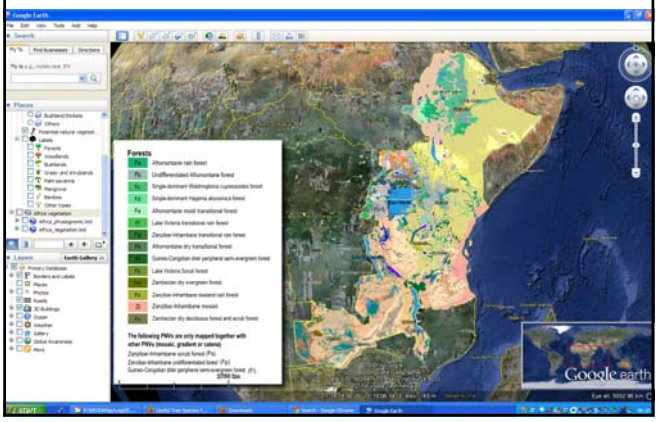
Suggested method for using the tool

3. Select species



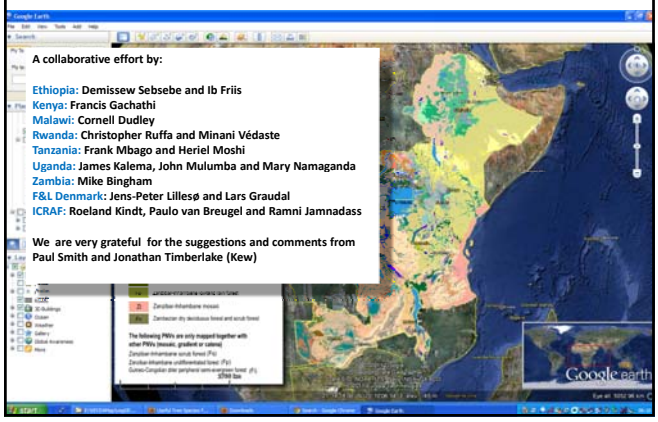
VECEA: A higher resolution map for 7 countries in eastern Africa
(Ethiopia, Kenya, Malawi, Rwanda, Uganda, Tanzania and Zambia)

http://www.sl.life.ku.dk/English/outreach_publications/computerbased_tools/vegetation_climate_change_eastern_africa.aspx



VECEA: A higher resolution map for 7 countries in eastern Africa
(Ethiopia, Kenya, Malawi, Rwanda, Uganda, Tanzania and Zambia)

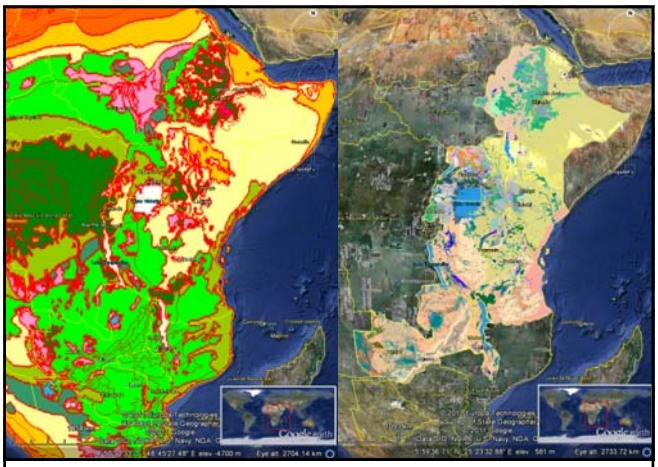
http://www.sl.life.ku.dk/English/outreach_publications/computerbased_tools/vegetation_climate_change_eastern_africa.aspx



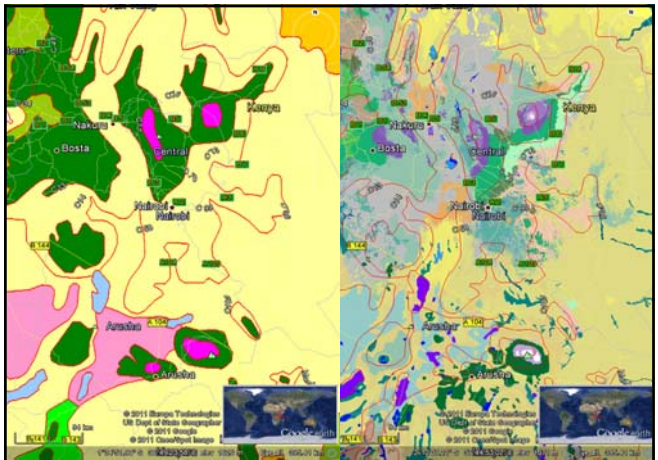
A collaborative effort by:

Ethiopia: Demissew Sebsebe and Ib Friis
Kenya: Francis Gachathi
Malawi: Cornell Dudley
Rwanda: Christopher Ruffa and Minani Védaste
Tanzania: Frank Mbago and Heriel Moshi
Uganda: James Kalema, John Mulumba and Mary Namaganda
Zambia: Mike Bingham
F&L Denmark: Jens-Peter Lillesø and Lars Graudal
ICRAF: Roeland Kindt, Paulo van Breugel and Ramni Jamnadass

We are very grateful for the suggestions and comments from Paul Smith and Jonathan Timberlake (Kew)



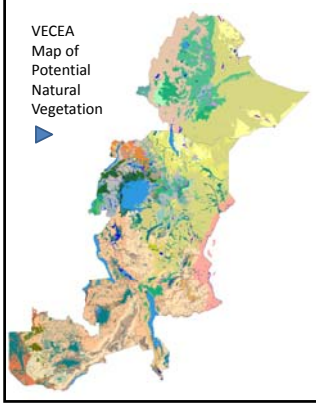
Useful Tree Species for Africa VECEA



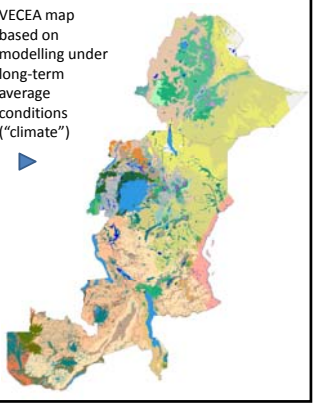
Useful Tree Species for Africa VECEA

VECEA: Climate change modelling

VECEA Map of Potential Natural Vegetation

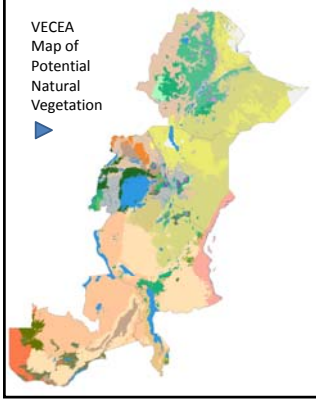


VECEA map based on modelling under long-term average conditions ("climate")

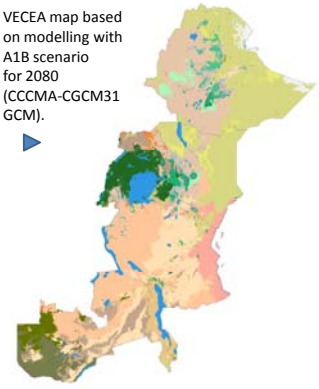


VECEA: Climate change modelling

VECEA Map of Potential Natural Vegetation

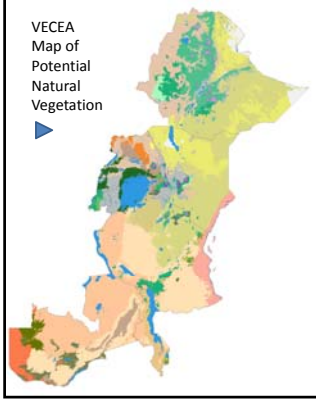


VECEA map based on modelling with A1B scenario for 2080 (CCCMA-CGCM31 GCM).



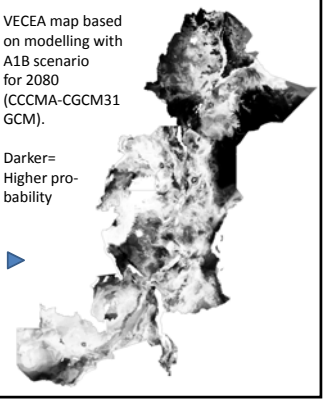
VECEA: Climate change modelling

VECEA Map of Potential Natural Vegetation



VECEA map based on modelling with A1B scenario for 2080 (CCCMA-CGCM31 GCM).

Darker= Higher probability



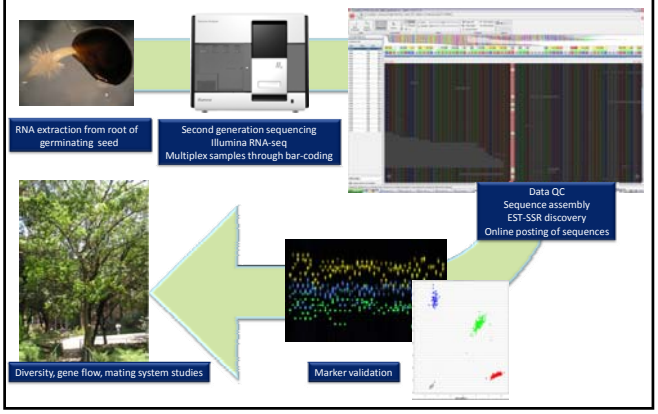
Affordable molecular markers for agroforestry trees: developing expressed sequence-tagged site simple sequence repeats for 36 species

- Molecular markers can provide useful data for field management, but 'starting from scratch' has been expensive. Can new technology reduce development costs?
- A possible approach for a magnitude of reduction in development expense is 'tagged' Illumina Solexa second generation sequencing
- Trial on 36 tree species important to smallholders, from a wid-- pool of priority species identified by ICRAF scientists
- Expressed sequence-tagged site simple sequence repeat (EST SSR) sequences will be placed online in the public domain

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

The James Hutton Institute

Affordable molecular markers for agroforestry trees: developing expressed sequence-tagged site simple sequence repeats for 36 species

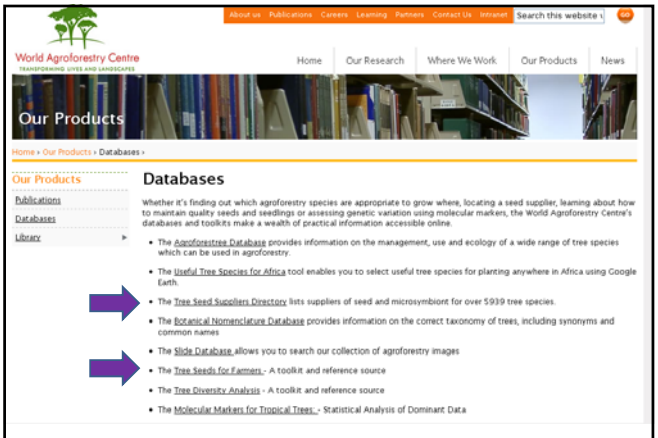


Affordable molecular markers for agroforestry trees: developing expressed sequence-tagged site simple sequence repeats for 36 species

36 species that give the best quality RNA from the following list...

Acacia angustissima	*Croton macrostachyus*	*Kigelia africana*	*Prosopis africana*
Acacia mangium	*Croton megalocarpus*	*Leucaena diversifolia*	*Prosopis juliflora*
Acacia melanoxylon	*Cupressus lusitanica*	*Leucaena esculenta*	*Prunus africana*
Acacia mellifera	*Dalbergia melanoxylon*	*Leucaena leucocephala*	*Pterocarpus erinaceous*
Acacia nilotica	*Detarium senegalense*	*Leucaena trichandra*	*Sclerocarya birrea*
Acacia senegal	*Diospyros mespiliformis*	*Macadamia tetraphylla*	*Senna spectabilis*
Acrocarpus fraxinifolius	*Dovyalis caffra*	*Maesopsis eminii*	*Sesbania macrantha*
Adansonia digitata	*Enterolobium cyclocarpum*	*Mangifera indica*	*Sesbania sesban*
Adenanthera pavonina	*Erythrina abyssinica*	*Markhamia lutea*	*Spathodea campanulata*
Afzelia quanzensis	*Eucalyptus camaldulensis*	*Melia azedarach*	*Strychnos spinosa*
Albizia lebbeck	*Eucalyptus grandis*	*Melia volkensii*	*Tamarindus indica*
Albizia saman	*Eucalyptus saligna*	*Milicia excelsa*	*Tectona grandis*
Artemisia annua	*Faidherbia albida*	*Moringa oleifera*	*Tephrosia candida*
Balanites aeagyptica	*Garcinia livingstonei*	*Moringa stenopetala*	*Tephrosia vogelii*
Bauhania purpurea	*Gliricidia sepium*	*Newtonia buchananii*	*Terminalia brownii*
Bischofia javanica	*Gmelina arborea*	*Olea capensis*	*Terminalia ivorensis*
Brachylaena huillensis	*Grevillea robusta*	*Paraserianthes falcataria*	*Tetrapleura tetraptera*
Calliandra calothyrsus	*Grewia bicolor*	*Parkia biglobosa*	*Tipuana tipu*
Cassia siamea	*Grewia tenax*	*Passiflora edulis*	*Vangueria madagascarensis*
Casuarina equisetifolia	*Guazuma crinata*	*Persea americana*	*Vangueria senegalensis*
Casuarina junghuniana	*Guiera senegalensis*	*Piliostigma reticulatum*	*Vitex doniana*
Carica papaya	*Hagenia abyssinica*	*Piliostigma thonningii*	*Vitex keniensis*
Combretum glutinosum	*Jacaranda mimosifolia*	*Pinus caribea*	*Vitex payos*
Commiphora baluensis	*Jatropha curcas*	*Pinus patula*	*Warburgia ugandensis*
Cordia africana/abyssinica	*Juniperus procera*	*Podocarpus falcatus*	*Ximenia americana*
Cordia sinensis	*Khaya senegalenis*	*Polyscias kikuyuensis*	*Ziziphus mauritiana*

Already sequenced *Ready to sequence* *Subset of remainder to add....*



URL http://www.worldagroforestrycentre.org/our_products/databases

Tree Seeds for Farmers ("the toolkit")

- Accommodates for various types of seed systems (centralised/decentralised)
- Summarises existing technical information on seed collection and handling
- Introduces methods of privatisation

- Three sessions based on these objectives:
  - Strategies (actors and roles within seed systems)
  - Technical guidelines (quality)
  - Private sector (sustainability)

- List of online resources

URL http://www.worldagroforestrycentre.org/resources/databases/tree-seeds-for-farmers

ICRAF's contribution to reforestation programmes in Africa

Dr. Daniel Ofori

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Introduction

- By 2050; food, shelter etc will be required for the sustenance of approximately 9 billion people.
- Loss of plants leads to worsening food insecurity, increasing vulnerability to disease and deteriorating social relations

Introduction

- Continued misuse of ecosystems is leading into crisis.
- It is estimated that 60,000 to 100,000 plant species, with diverse economic uses, are under threat of extinction and need to be protected.
- ICRAF uses a diversity of trees to transform lives and landscapes

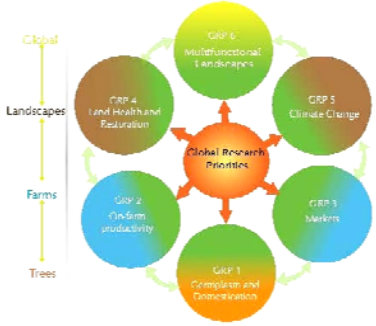
ICRAF's Vision

- Rural transformation in the developing world as small holder farmers strategically increase their use of trees in agricultural landscapes to improve their food security, nutrition, income, health, shelter, energy resources and environmental sustainability

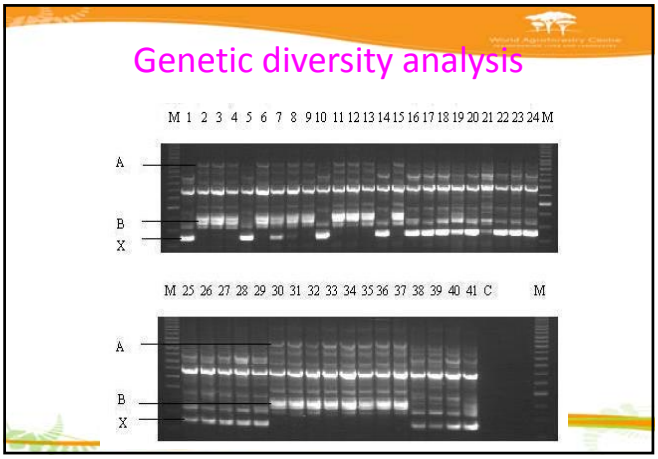
World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Where ICRAF works

How does ICRAF's contribute to afforestation




Agroforestry Products
Provide a range of benefits
Allanblackia
Fruits and nuts
Nutrition and health
Varieties of fruits
Calliandra
Livestock
Fodder
Income, livelihoods
Fertilizer
Soil health & food security
Faidherbia albida
Tectona grandis
Shade, energy
Timber, fuelwood
Medicinal, gums, etc
Combating diseases, industrial produce
Prunus africana
Assessment Workshop for a PPP Unit in Kenya, 29th-30th November 2011, at ICIPE


Genetic diversity analysis
M 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 M
A
B
X
M 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 C M
A
B
X

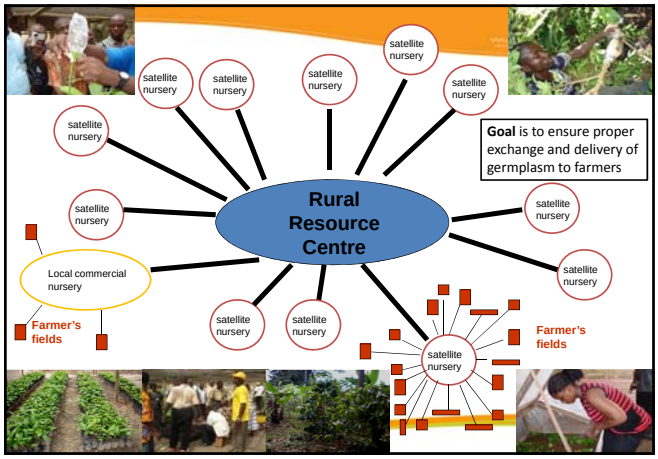

satellite nursery
Rural Resource Centre
Goal is to ensure proper exchange and delivery of germplasm to farmers
Local commercial nursery
Farmer's fields
Farmer's fields

Table I: Tree species and number of accessions stored at ICRAF *ex-situ* genebank

Accessions collected from African, Australian and South American countries

Species	Accessions	No of countries represented
Faidherbia albida	*845*	9 countries
Acacia Karroo	435	4 countries
Calliandra calothyrsus	371	9 countries
Gliricidia sepium	218	7 countries
Acacia erioloba	135	4 countries
Acacia tortilis spirocarpa	132	5countries
Leucaena salvadorensis	83	2 countries
Leucaena diversifolia	75	4 countries
Leucaena Lempirana	70	1 country
Leucaena Shannonii	69	3 countries
Other less represented species	1273	more than 10 countries
	3,705	

Seed orchard management

Field gene banks

Region name	Agro-ecological zone	No of countries represented	No of locations	No of species	Total no of accessions	No of accessions manipulated in 2010	Managed by
Latin America	Humid-Tropics	1	1	3	3,633	199	ICRAF and National partners
East Africa	Sub-montane	4	14	11	197	93	ICRAF projects, farmers and National partners
West and Central Africa	Humid-tropics and moist deciduous	8	7	31	3,274	350	ICRAF projects and national partners
South East Asia	Humid and Sub tropic highlands	3	5	70	108	58	ICRAF projects and National partners
South Asia		2	7	6	967	450	ICRAF projects and National partners
Southern Africa	Semi-arid, sub tropical highlands and sub-humid sub-tropical	4	28	18	4,363	2,450	ICRAF projects communities and government funds
	Total	**22**	**62**	**139**	**12,542**	**3600**	

Capacity building

- Training of nursery operators
- Training of students/Technicians/Scientists
- Publications

Constraints

- High cost of maintenance
- Storage of recalcitrant seeds
- Breaking of seed dormancy
- Low donor support for agroforestry tree seeds

Opportunities

- Future breeding
- Expansion of partnerships

Thanks for listening

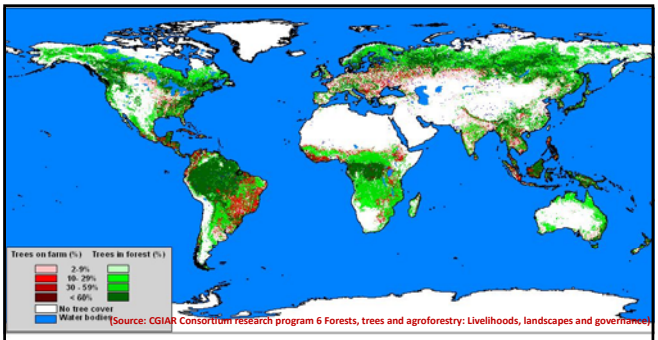
MSB Input-supply agro-forestry, plantations and restoration

Presentation based on many years of collaboration between:

- Forest and Landscape Denmark (Including Danida Forest Seed Centre),
- World Agroforestry Centre (ICRAF), and
- National Tree Seed Centres in Africa (NTSCs)

Presentation will concentrate on MSB Workshop Purpose 1:

To explore and document the technical and policy constraints related to afforestation using native species in agro-forestry, plantations and restoration



(Source: CGIAR Consortium research program 6 Forests, trees and agroforestry: Livelihoods, landscapes and governance)

The National Tropical Forestry Action Plans (NTFAPs) never materialized.

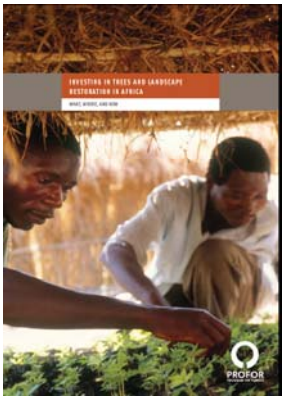
Afforestation will involve local people in ecosystem restoration and planting trees on their farmland

Distribution of seeds and seedlings will be decentralised

Investments planting material ←→ Reaping the benefits of improved material

Investing in growing plants

Contrast in approach between forestry/agroforestry and agriculture



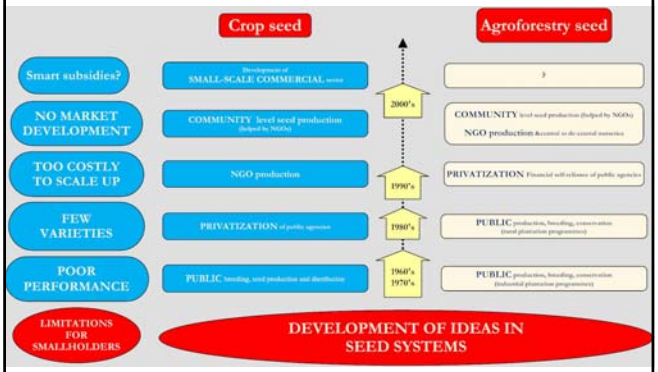

Global Forum on Agriculture
29-30 November 2010
Policies for Agricultural Development, Poverty Reduction and Food Security
OECD Headquarters, Paris

The Use of Input Subsidies in Developing Countries

Steve Wiggins, ODI,
Jonathan Brooks, OECD Secretariat,
jonathan.brooks@oecd.org

OECD

Learning from crop sed systems – defining stages in seed production



Learning from crop sed systems – defining stages in seed production

Why are crop seed systems more dynamics?

For crop seed there are relatively clear definitions of the entities and links in the breeding, production, and distribution cycle.

(i) the earliest generations of a variety are referred to as **breeding seed**,
(ii) the generations of seed used by seed producers are termed **foundation seed**; and
(iii) the seed purchased by farmers is **commercial seed**.

Consequently,

the roles of the different actors in the system can be defined clearly and interventions determined accordingly

In addition, many countries recognize categories such as 'standard seed'; 'truthfully labelled seed'; and 'quality declared seed', which does not require full formal certification (Tripp 2006)

Tree sed systems – seed production stages cannot be separated

For **tree seed** –in contrast to crop seed - there is **generally no defined point** at which public and large private institutions can breed new materials and then hand this foundation seed over to smaller enterprises for the production and distribution of commercial material.

Tree Seed Sources - **3 things in one: breeding seed, foundation seed; and commercial seed**

Public - private collaboration in tree seed systems will require some innovative thinking by NTSCs

NTSCs must be strategic to ensure wide availability of quality sources

NTSCs should have a central role in creating networks
- **networks of Quality Seed Sources and**
- **networks of small-scale nurseries**

NGOs are the dominant organisations in tree seed & seedling supply – that is a suboptimal use of resources

Tree sed systems – a useful classification

The current version of the OECD 'Forest Seed and Plant Scheme' is not a blueprint for successful afforestation programmes, it has some shortcomings:

The OECD classification may have the effect of emphasising only public production of breeding, foundation, and commercial seed for the smallholder sector.

The classification does not include an explanation of the genetic variation, and
does little to explain how the 'designated authority' can support private producers and distributors

Amore detailed classification corresponding to crop -'standard seed'; -'truthfully labelled seed' and -'quality declared seed', which does not require full formal certification may be part of a solution

A classification based on the biology and logistics of collection

Seed source types:
•Natural Forest – Farmland – Plantations - Seed Orchards
Source type:
•Vegetative propagation

Classification including biological and logistical characteristics

Table 1 Germplasm source types employed in agroforestry; four are from seed and one is from vegetative material (based on Dhakal et al. 2005)

	Brief description	Current use	Timing of seed production/further notes
Seed source type			
Natural forest	Natural vegetation, ranging from high forest to woodlands, material of local origin	Under-utilised, a reservoir of little-planted, under-researched, indigenous species	Producing now. Seed production may be limited in some forests due to limited fruit set and difficulties in collection
Farmland	Trees on farms, planted or remnants of natural vegetation, may be local or non-local (often unknown) origin	Over-utilised, a limited number of indigenous and exotic species, quality criteria not applied	Producing now. Seed yield may be a trade off with farm function, such as branch and leaf production for fodder/reducing competition with agricultural crops
Plantations	Trees planted in a plantation or woodlot, origin not always known	Very few, mainly industrial, species	Producing now. Quality depends on origin and diversity of the base population
Seed orchards	Trees planted in a plantation or woodlot specifically for seed production, offspring generally from carefully selected trees	Very limited use, for a few exotic species	Producing only after a number of years. Quality can be improved further by selective thinning, if performed carefully
Source type			
Vegetative propagation	Grafts, stem cuttings, micro-cuttings, somatic embryos or marcots, etc., propagated from selected clones or seedlings, genetic diversity often narrow, may be local or non local (potentially unknown) origin	A few exotic fruit tree selections, unfortunately also used for unselected germplasm	Vegetative multiplication protocols generally take a few years to develop and adopt

Classification that can be recognised by actors

Table 2 Characteristics of 210 germplasm sources in the Kenya case study

Type of source	Exotic species[a]	Indigenous species[a]	Total no. of species[a]	Exotic sources	Indigenous sources	On government land	On communal and private land	Total no. of sources
Farmland	15	7	22	127	9	4	132	136
Natural forest		6	6		8	8		8
Plantation	14	5	19	22	15	28	9	37
Seed orchard	3	1	4	6	1	3	4	7
Vegetative propagation	6		6	22		2	20	22
Total	26	14	40	177	33	45	165	210

[a] As several species occur in more than one type of source, numbers for individual categories are different from the overall totals

This detailed classification also provides clues as to what types of support to improving quality are needed

Seed systems – sources: Suggested outline of coordination activities for NTSCs

Natural forest	**NTSCs should coordinate collection together with several NGOs and networks of small-scale nurseries**
Farmland	**best collected and distributed by small-scale enterprises**
Plantations	**by NTSCs or private specialised small-scale collectors for distribution to networks of small-scale nurseries.**
Seed orchards	**low-input breeding initiatives supported by NTSCs**
Vegetative propagation	**Clones may be developed centrally, but multiplication should be organised at a decentralised level to save the costs of transportation and support entrepreneurial nurseries**

African indigenous species – too little is known

Definition (OECD, 2011): For a species or sub-species, the Region of Provenance is the area or group of areas subject to sufficiently uniform ecological conditions in which stands showing similar phenotypic or genetic characters are found.

Nothing is known of GxE for practically all the African useful species.

We suggest focus should be on potential GXE interactions - **seed application zones/planting zones** - different seed sources should be used at different sites (due to GXE).

Immediate term focus: Avoiding failures
Longer term: Understanding GXE for individual species

We propose that it is possible to delineate individual potential planting zone for hundreds of useful African Tree species. These planting zones can be turned into immediate recommendation for use of surces.

Delineation of provenance areas

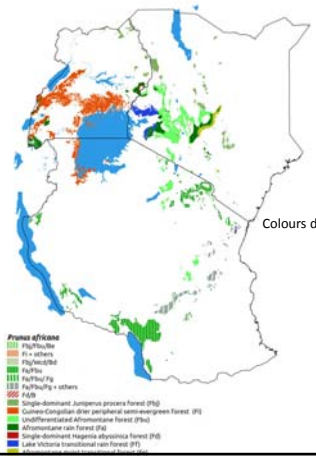
2,1 Establishing Regions of Provenance is fundamental to the implementation of the OECD Scheme. The Designated Authority will delineate Region(s) of Provenance for all species to which the Scheme applies

Delineation requires that the species are known
or at least hypotheses can be made on their variation

Example: Delineation of provenance areas in 3 countries – based on potential distribution areas

Prunus africana

(Kenya, Tanzania, Uganda)

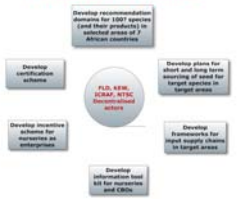


Colours denote vegetation types=different environments

Seed Systems: Sources, seeds and seedlings should be the core of any plans involving local people in tree planting

The most difficult task is not technical, but in making decision makers and our colleagues aware that new trees do not materialise out of thin air.

Develop a conducive institutional environment and support systems for market driven agroforestry input supply systems.



That means that Seed systems is the starting point for Project design

UNEP

Seeds for a GREEN economy

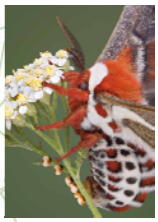
MSB International Forestry Workshop
5-10 December 2011
Niklas Hagelberg, UNEP

UNEP

Biodiversity

- Major reservoirs of terrestrial biodiversity (50-90%),
- Biodiversity underpins continuing functioning of ecosystems and the delivery of ecosystem services (CBD Technical series 43)
  - Stability and Resilience
  - Functional species





Increasing demand for resilient forests

- Increased pressures and political/economic a
  - UNFCCC
  - CBD
  - UNCCD
- Forests in a green low carbon economy
  - Low carbon services and goods (hydro, charcoal, construction material, chemicals, pharmaceuticals, food etc.)

⇒ **Opportunity** to sell services and products as part of the transformation of forest ecosystem management and utilization
  - Multiple benefits included in REDD+ decisions, EBA, CDM (UNFCCC)
  - 15% of degraded land restored (CBD/UNFCCC/UNCCD)
  - Private sector (risk management, certification, chemicals, genes)

An economic issue

- Forest industry contributed USD468 billion (1%) of global gross value added in 2006
- Trade in wildlife products est. at USD 15 billion/year
- Sales of natural origin pharmaceuticals worth USD75 billion/year

- An average annual additional investment of **US$ 40 billion** could increase reforestation and afforestation by **140 per cent** by 2050, and create 5 million new jobs relative to business as usual (BAU). Green Economy report 2011

UNEP

From theory to real life...

Loess Plateau (China)

- 10 year restoration project worth USD520million
- 2,5 million people lifted out of poverty
- Annual grain per capita increased from 365 to 591kg
- Sediment loads (Yellow River) decreased by 100 million tonnes/year

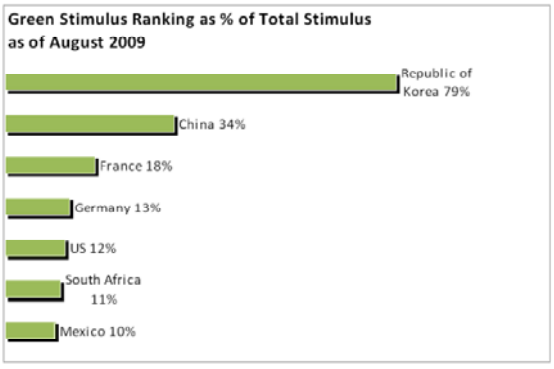
Mangrove restoration (Vietnam)

- Mangrove restoration worth USD1.1 million
- Annual savings of USD7,3 million in sea dyke maintenance

UNEP

Green Growth – Investing in the Green Economy

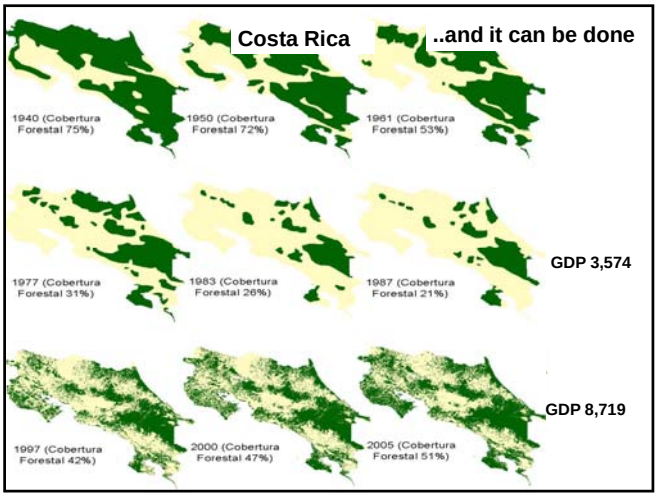
Allocation of Stimulus Packages



Source: HSBC Global Research

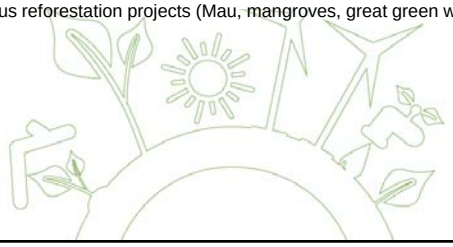
Green Growth – Investing in the Green Economy

Green New Deal, Republic of Korea	Employment	US$ billion
Expanding mass transit and railroads	138,067	7,005
Energy conservation (villages and schools)	170,702	5,841
Fuel-efficient vehicles and clean energy	14,348	1,489
Environmentally friendly living spaces	10,789	351
River restoration	199,960	10,505
Forest restoration	**133,630**	**1,754**
Water resource management (small & medium sized dam)	16,132	684
Resource recycling (including fuel from waste)	16,196	675
National green information (geographic information system infrastructure)	3,120	270
Total for the nine major projects	**702,944**	**28,573**
Total for the Green New Deal	**960,000**	**36,280**



A few related UNEP work areas

- UN-REDD Programme
- Economic valuations of forest ecosystem services
- Forest Restoration Information System (FRIS) http://quin.unep-wcmc.org/forest/restoration/fris/
- Billion Tree Campaign
- Traditional Knowledge
- Various reforestation projects (Mau, mangroves, great green wall, etc)



Forests in 2050: BAU and Green Investment Scenario (contd.)

Key Forest Sector Indicators in 2050	Business As Usual	Green Investment Scenario (G2)
Natural Forest Area (Billion ha)	**3.36**	**3.64**
Deforestation rate (ha/year)	**14.9**	**6.66**
Planted forest area (Million ha)	**347**	**850**
Total forest area (Billion ha)	**3.71**	**4.49**
Carbon storage in forests (Billion tonnes)	**431**	**502**
Gross Value Added (US$, Trillion)	**0.9**	**1.04**
Employment (Million)	**25**	**30**

DFID Department for International Development

UKaid

Reforestation Programmes in Africa

Dr Virinder Sharma,
Climate Change
Adviser, DFID Kenya

DFID Department for International Development

UKaid

Presentation focus areas:

1. Situation Analysis
2. Emerging UK govt thinking
3. International Climate Fund (ICF)
4. Lines of work under Forestry FGMCC; FLEGT; REDD+
5. Specific work in Africa
6. How we can work better together

DFID Department for International Development

UKaid

The situation analysis

- Increasing pressure on forests
- Convergence in food, fuel, fibre markets
- Progress in tackling illegal logging
- Clear & secure rights key to reducing deforestation/ degradation
- Emerging market investors increasingly shape land and resource use with opportunities for small forest enterprises

DFID Department for International Development

UKaid

UK government thinking

- Triple goals –Poverty, climate change, biodiversity
- Forest governance is a prerequisite for meeting the triple goals
- In and beyond forests
- Expand current work to other drivers: Illegal logging + other commodities
- Promoting public-private investment, green growth,
- Approaches underpinned by robust evidence; better knowledge uptake

DFID Department for International Development

UKaid

UK's International Climate Fund

- £2.9 billion ICF
- Challenge in programming and spending
- International Forestry and climate initiative: 20%
- How to reduce transaction costs
- How to get & demonstrate results fast

DFID Department for International Development

UKaid

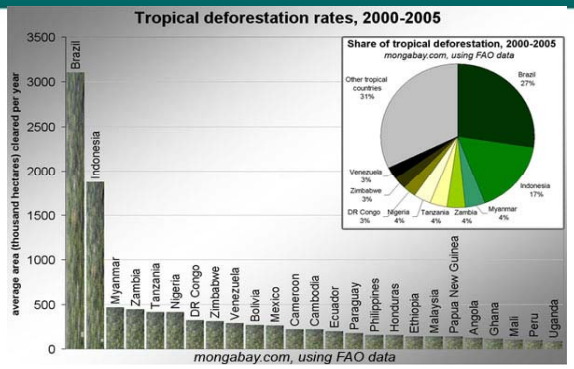
3 lines of work under ICF Forestry Pillar

1. New 10 year forest governance markets and climate programme supporting governance and market reforms that reduce the illegal use of forest resources and benefit poor people in 10 countries
2. Under design - Promotion of forestry & land use investments for REDD+
3. Uptake of knowledge and tools

DFID Department for International Development

UKaid

Tropical deforestation rates, 2000-2005



DFID Department for International Development

UKaid

Forest Governance, Markets, Climate
Not a single approach

- Where governance is weak and illegality persistent – FLEGT VPAs
- A focus on legality and law enforcement that reinforces sovereignty
- Use the power of the market to change the dynamics of the debate
- Demand and supply side measures to help markets discriminate
- Multi-stakeholder processes to tackle deep rooted governance problems; Coalitions of interest that sustain momentum

Slide 8

DFID Department for International Development

UKaid

Key elements of EU FLEGT Action Plan

- Links demand & supply
- Formal legal trade agreements
- Uses commodity markets to leverage change
- Carefully sequenced; strong local ownership
- Multi-stakeholder institutions

• Combines bilateral within a stepwise constructed EU legal framework

Briefing Note Number 01

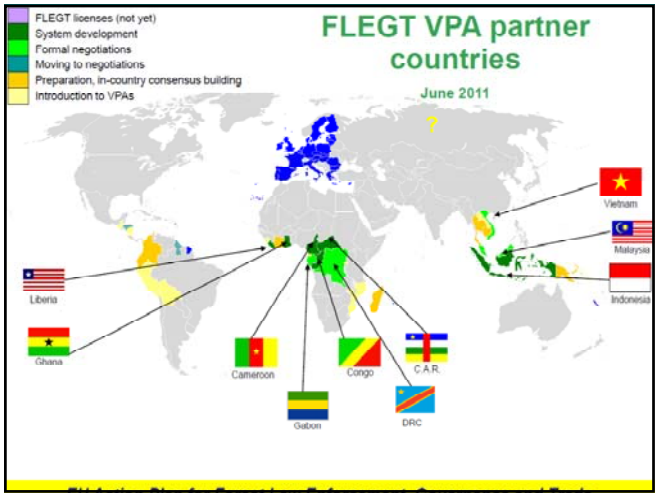
FLEGT Briefing Notes

DFID Department for International Development

UKaid

Voluntary Partnership Agreements

- **Legally binding international treaties**
  - Timber producing countries licence timber exports as being legal
  - EU only accepts licensed imports
- **Legality definition** is a key component:
  - Which laws and regulations are relevant?
  - Stakeholder consultations
    - seek consensus on rights and obligations
    - identify unclear areas of law
    - identify areas of disagreement or where laws don't support policy
    - improve transparency
    - identify indicators of compliance
- **Verifying legal compliance and tracking products**
- **Independent monitoring**
  - Improved accountability… does the system work?



Growing interest in VPA

VPA agreed. System Development	Ghana, Congo (Brazzaville), Cameroon, Central African Republic, Indonesia, Liberia
Formal negotiations	Malaysia, DRC, Gabon, Vietnam
Preparation, country consensus building	Honduras, Guyana, PNG, Madagascar, Cote d'Ivoire, Cambodia, Ecuador, Columbia, Laos, Thailand
Introduction to FLEGT and VPAs	Sierra Leone, Solomon islands, Equatorial Guinea, Nigeria, Tanzania Mozambique, Guatemala, Peru, Bolivia, Nicaragua, Suriname, Russia,

EU Action Plan for Forest Law Enforcement, Governance and Trade

DFID Department for International Development

UKaid

Investing in better forestry and land use management
UK REDD+

- PWC report
- Targeted bilateral support to complement multilateral actions
- Tapping private sector potential
- A focus on countries with potential to make progress on REDD+
- Continued support for better forest governance

Slide 13

DFID Department for International Development

UKaid

Work together: Knowledge Uptake & Gaps

- Plethora, diversity of fragmented evidence & case studies; difficult for FL P&Ps to navigate
- Lack of aggregated & comparable evidence, systematically gathered
- Flows of international forestry project finance to specific geographic footprints; dispersed smaller, shorter projects
- More limited finance to research & knowledge uptake
- Links between hard/soft measures

Slide 14

IV. GENERAL DISCUSSION

SEED AND SEEDLING SUPPLY SYSTEM

WESTERN AFRICAN GROUP

Strengths

1. This workshop is the first of its kind where TSCs and Forestry Departments sit together. It is a good initiative that should be encouraged in order to strengthen their coop and collaboration. But there is need to go further to engage and involve the customers (governments, NGOs, farmer groups and private sector).

2. A model is emerging where seed suppliers (TSC) will be talking to Forestry Dept and this is expected to facilitate the availability of good quality seeds.

3. Certification is necessary not only for international markets but also for local markets. Examples of oil palm in Nigeria and gum Arabic in Burkina. It will be a good protection that standards are established and it will eventually facilitate opening up of the market to eternal opportunities.

4. The OECD certification model should be adopted as an internal mechanism because of its advantage that it opens up the markets to others.

5. Regional networks should be encouraged across different African regions and these networks should be linked under the umbrella of MSBP for the exchange of information and materials.

6. In addition to an internal forest department monitoring of its own activities, there is also a need to set up an independent mechanism to monitor the impacts (on the community, environment, etc) as well as progress of afforestation projects.

Weaknesses

1. Forestry Seed education is very weak and rarely feature in the curriculum of post-secondary educational institutions

Opportunities

1. The FAO-Supported/African Union Programme- Great Green Wall for the Sahara and Sahel Initiative where ECOWAS member countries and ECOWAS as an organization are partners.

2. ECOWAS is also coordinating the Convergence Plan for for sustainable management and use of forest ecosystems in West Africa

3. MSB has served as a platform for bringing together the different country members of this group and the emerging regional networks.

4. FAO International Workshop with the government of Turkey in 2012 on afforestation and reforestation in dry lands is a good partnership opportunity for MSB to strengthenand bring the group together again.

5. There is also the possibility of organizing a 2nd Africa dryland week later in 2012 in East Africa.

6. Access to markets funding

Threat

1. Indigenous species are being neglected and marginalised for exotic species because of lack of interest in the indigenous species.

RECOMMENDATION

2. Seed certification programme to guarantee quality seed source should be accorded a priority.

3. Develop and support the provision of good quality seed and seedling for the for the Great Green Wall for the Sahara and Sahel Initiative covering Burkina, Faso, Niger, Nigeria, Gambia, Mali, Senegal, Mauritania, Chad, Sudan, Ethiopia, Djibouti, Algeria and Egypt.

4. Forestry Research Institutions are encouraged to undertake genetic improvement and selection of indigenous tree species in order to promote their use.

SEED AND SEEDLING SUPPLY SYSTEM

EAST AFRICAN GROUP

Strengths

1. NTSC exist (part de-centralised and semi-autonomous) and are part of the Government framework
2. Good knowledge, wide range of species/seed sources
3. Model seed supply and seed source legal register (Kenya), encouraging private seed collectors
4. Planned seedling supplier register (nurseries in Kenya)
5. International seed export/import framework
6. Model training initiatives (KFFS)
7. Non taxation of tree supplies

Weaknesses

1. There is a conflict of principle about NTSC being able to influence the private seed sector
2. Technical capacity impediment and manpower to implement the tree seed export & import regulations
3. Donor funded/NGO projects can compromise and undermine the development of seed/seedling supply enterprises
4. We know demand is greater than supply but the full picture of size of market is not well understood
5. 70% of seed distribution is not through the NTSC and is therefore “unknown” and can’t be monitored (problem with large NGO funded programmes)
6. Centralised systems cannot reach the full market
7. Poorly managed seed sources
8. Inability to protect quality seed sources

Opportunities

1. Decentralised NTSC and local enterprises can better reach the villages and the bigger market
2. Better collaboration between regional NTSC
3. Participation of private sector for seed and seedling supply
4. Income generation, improving livelihoods
5. Underutilised small scale nurseries can become a major vehicle for seedling supply
6. Use of growing understanding of environmental issues (CC) to develop the market (including woodlots = viable enterprises)
7. Developing smallholders = developing the society
8. Supporting restoration projects and international projects

Threats

1. Over-regulation (OECD!!)
2. Loss of seed sources
3. Indigenous species in agroforestry systems prone to pests and diseases
4. Low genetic quality as a demand for rapid ££
5. Unrealistic expectations of ££ return
6. Boom and bust, unpredictable markets (Moringa, Bixa, Jatropha etc.)
7. Changing climate

SEED AND SEEDLING SUPPLY SYSTEM

SOUTH AFRICAN GROUP

KNOWLEDGE AND TECHNICAL CAPACITY

Strengths

1. Plantation crops there's sufficient understanding (exotics)
2. Recognition of the environmental service functions of tree planting
3. Accumulated knowledge of active seed sources
4. e.g. ICRAF does provide wide range of information
5. We know how to create and compile knowledge

Weaknesses

1. Lack of economic analysis of performance for indigenous tree species
2. Do the existing seed sources capture the full genetic diversity --- genotype environment inter-action
3. Weak information dissemination channels and models (linked to collapse of extension services)
4. Staff retention and appropriate staffing structure
5. IK is restricted = eroded
6. Funding to FGR research is less than the same in agriculture sector

Opportunities

1. Valuable novel techniques under development e.g. VECEA
2. IK can add more value to a species etc.
3. Biotechnology offers up wider potential for difficult species and improvements etc

Threats

1. Knowledge may become irrelevant in a changing climate
2. Changing political climate (donor agendas)

ACCESS TO MARKETS

Strengths

1. The imperative for farmers to partially invest in seed/seedlings is valuable

Weaknesses

2. Current market is often driven by external (NGO's) that do not have sustainability as their interest
3. Seed ordering takes place too late - ?inability of NTSC to understand the market
4. Tree nursery operators don't have the correct business skills
5. Overdependence on what customers already know (fast growing exotics)
6. NGO's drifting between what is needed and defining the market rather than being able to stick to a constant market
7. Few quality seed sources for indigenous species
8. Lack of understanding by customer that quality seed/seed source is a better investment
9. Silvicultural expertise and experience is not well known ("indigenous trees are slow growing.....", or Mahoganies in plantations don't perform well.)

Opportunities

1. Identification of wide number of products that can drive demand for trees
2. A also value of the products can be higher for indigenous species
3. Entrepreneurial training and approach is available and ready (CITI)
4. Gov policy creates the market (2% - 10% in Kenya)
5. Learn from agricultural sector tricks to improve access to local markets (e.g vouchers)

Threats

1. Lack of guidelines about detail of planting targets (amateurism, not consulting knowledge base)
2. Free distribution by Government and NGO's distorts the market-customer relationship

V. CONCLUSIONS AND NEXT STEPS

Dr Tim Entwisle

Director of Conservation, Living Collections and Estates

Royal Botanic Gardens, Kew

As I said yesterday I'm here to learn, and learn I have

- Trees and forests are a big issue in Africa - deforestation continues (even if the rate is dropping) and forests are needed for livelihoods
- Community engagement part of all the successful projects
- Government support at highest level important, if backed up with funding and clear policy
- Partnerships (e.g. Within Africa but also with MSB and other multinational partners)
- Track record of delivery on the ground
- Challenges: funding, increasing difficulty getting seed in some areas (after low hanging fruit collected), seed supply and quality; technical support; access to markets and customers.
- Useful plants - collating existing uses and finding new ones
- Tree planting worthy but needs to be targeted and under environmentally reasoned policy.
- Need to establish and maintains standards and certification, preferably through carrot rather than stick.

Outcomes

- Consortium of technical partners that can deliver on the ground - need leadership
- Quality assurance
- Technical underpinning
- Need to, and can, scale up
- Package in way to appeal to customers and funders. *Unique Selling Points:*

- Indigenous species or at least suited to environment and sustainable ("right plant in the right place"
- Encouraging innovation and biodiversity
- High quality
- Trees and Forests are important for Africa's future but they must be the right trees and the best trees, in the right place.
- Royal Botanic Gardens Kew is here for the long haul
- As long as we are needed and invited, the Millennium Seed Bank will remain a strong partner in this emerging consortium.


5 mm

ANNEX 1: Workshop Information

MSB INTERNATIONAL FORESTRY WORKSHOP
(FOREST 2011)

AFFORESTATION IN AFRICA: CONSTRAINTS AND OPPORTUNITIES

5 – 10 DECEMBER 2011
NAIROBI, KENYA

Coordinator
Dr Moctar Sacande, MSBP, Seed Conservation Department, Royal Botanic Gardens, Kew, UK (m.sacande@kew.org)

Background

Over the past 10 years, Kew's Millennium Seed Bank has been working with African government forestry and agriculture organisations to remove technical impediments to the use of native trees with utilitarian value in afforestation activities ranging from agro-forestry through to habitat restoration. Technical constraints that have reduced the range of native species available for afforestation include lack of facilities and trained personnel, limited seed availability, poor germination and storage issues. Substantial investments in time, money and effort by the MSB and its partner institutions have resulted in many of those technical impediments being removed, although other constraints – especially resource-related impediments – remain. With increasing concern about land availability, food security, water scarcity and climate change, the case for planting and using low input, well-adapted native species has never been stronger. In the next 10 years, the Millennium Seed Bank Partnership is committed to supporting innovation and adaptation by enabling the use of semi-domesticated and underutilised species in forestry, agriculture, horticulture and habitat restoration. ICRAF- the World Agroforestry Center, is also helping and supporting the organisation of this programme. The findings at the workshop will be used to develop a strategy to guide MSBP efforts in the area of afforestation over the next decade.

Workshop purpose

1) To explore and document the technical and policy constraints related to afforestation using native species in agro-forestry, plantations and restoration; presenters will draw on case studies from both government and NGO based schemes.

2) To identify opportunities for native species reforestation in development, offsetting and through multilateral mechanisms such as REDD+; specifically, how the MSB Partnership can support more production and planting of native species.

3) To develop a Millennium Seed Bank Partnership strategy and portfolio of services and programmes relevant to policy makers and funders.

Participants (see list below)

1) Millennium Seed Bank Partnership technical institutions from 10-12 mainly African countries (i.e. Botswana, Burkina Faso, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Nigeria, Tanzania, Uganda and UK). Participants from national Forestry Departments will be invited from some of the countries to present case studies.

2) Policy makers. Participants from DFID, UNEP, FAO-Forestry, ICRAF and World Bank-GEF multilateral organisations will be invited to the workshop.

3) Representatives from donor/sponsor organisations and other partners. Other sectors (e.g. NGOs) will be invited to participate and to help us to navigate funding and collaborative opportunities.

Workshop content

(1) Participants: 20-25 managers from both National Tree Seed Centres (NTSC) + Forestry Department (FD) from 12 Sub-Saharan African countries;

(2) Case studies: Burkina Faso (CNSF + FD, as e.g. in West Africa), Madagascar (SNGF) and Tanzania (TTSA), the three well-established tree seed banks with in-country satellite stations. Case studies will be extended to Botswana (BCA/UPP + FD/MEWT, as e.g. in Southern Africa); Kenya (NTSC/KEFRI + FD, as e.g. in East Africa), Malawi (FRIM/NTSC); Mali (USF/IER); Ghana (FORIG/NTSC); Ethiopia (FRC/EIAR); Uganda (NTSC/NFA); Nigeria (TSC) and Mozambique (IIAM).

(3) Presentations: (**1**)- Day1- Tree Seed Technology: Forest species collections and their uses in forestry activities (pre-MSB vs. MSBP in Burkina, Madagascar and Tanzania), i.e. range of species worked on and relationship with FD, and perspectives (future options). The second group could present their cases as well. (**2**)- Day2- Afforestation Policy: Type of and core operations in FDs, e.g. how do they respond to various needs and requests, challenges in fulfilling users and government (missions) demands and relationship with NTSCs (see case studies from Botswana, Burkina and Kenya); and Multinationals' involvement in African forestry (DFID, UNEP, FAO, Worldbank, ICRAF, etc.). (**3**)- Day3- Network Partnership: Technicality, Policy and Funding through Regional approaches (East, West and Southern Africa).

(4) Outcomes: (a) Common approach and integrated forest seed-based solutions to biodiversity conservation and sustainable use; (b) Forest seed network approach to technical input and problem solving (c) Improved access to funding mechanisms related to afforestation.

0-Title
1-Abstract: (about 250 words)
2-Introduction: (2 pages)
3-The Context: (the presentations should include)
4-Results/Achievements (3 pages)
5-Discussion (2 pages)
6-References
7- Global APPENDIX: Table for all (tree) species mentioned in report and presentations and used in afforestation programmes in the 12 countries.

	Family	Genus	Species	Common names	Distribution / Abundance	Conservation Status	Uses	Parts Used	Source of information (on uses)	Seeds Collected	Seeds banked (with accession No)	Germination Tests carried out	Seedlings produced	Propagation protocols produced	Proportion of Seedlings Planted	Remarks
1																
2																

Annex 2: List of participants

	Name	Organisation and address	Country
1	Dr. Kebadire K. **Mogotsi**	Botswana College of Agriculture (BCA), Private Bag 0027, Gaborone,	**Botswana**
2	[Mr. Edmond B. **Moabi]** **Adjourned.**	Ministry of Environment, Wildlife and Tourism, Private Bag O199, Gaborone	**Botswana**
3	Dr. Sibidou **Sina**	Centre National de Semences Forestieres (CNSF), 01 BP 2682 Ouagadougou 01	**Burkina Faso**
4	Mr. Adama **Doulkom**	Direction des Forets (DIFOR), Ministry of Environnent, Ouaguadougou	**Burkina Faso**
5	Dr. Abayneh **Derero**	Ethiopian Institute of Agricultural Research (EIAR), Forestry Research Centre (FRC); P.O.Box 30708, Addis Ababa	**Ethiopia**
6	Dr. Joseph M. **Asomaning**	Forestry Research Institute Ghana (FORIG), National Tree Seed Centre, University Box 63, KNUST, Kumasi, Ghana	**Ghana**
7	[Dr. Lolona **Ramomonjisoa**] Mr Mamy **Andriamahay**	Silo National des Graines Forestieres (SNGF), BP 5091, 101. Antananarivo	**Madagascar**
8	Dr. Clement **Chilima**	Forestry Research Institute Malawi (FRIM), P.O. Box 270, Zomba	**Malawi**
9	[Mr. Sidi **Sanogo]** **Adjourned.**	Institut d'Economie Rurale, Centre Regional de Sikasso, Unite Semences Forestieres (USF), BP 16 Sikasso	**Mali**
10	Mrs. Camila **De Sousa**	Mozambique National Institute of Agrarian Research (IIAM), Av. das FPLM No 269, Maputo C. P. 3658	**Mozambique**
11	Dr. Sola Adesola **Ajayi**	Obafemi Awolowo University, Faculty of Agriculture, Department of Crop Production & Protection, Ile-Ife 220005	**Nigeria**
12	Dr. Heriel P. **Msanga**	Tanzania Tree Seed Agency (TTSA), PO Box 373, Dodoma Road, Morogoro	**Tanzania**
13	Mr. David **Mununuzi**	National Tree Seed Centre, National Forestry Authority, 10/20 Srpting Road, PO Box 70863, Kampala	**Uganda**
14	Dr. Paul **Smith**	Head of MSB, RBG Kew, Wakehurst Place, Ardingly, West	**UK – Kew SCD**

		Sussex, UK, RH17 6TN	
15	Dr. Moctar **Sacande**	International Co-ordinator, Royal Botanic Gardens, Kew, Millennium Seed Bank Partnership, Wakehurst Place, Ardingly, West Sussex, UK, RH17 6TN	**UK – Kew SCD**
16	Mr. Tim **Pearce**	International Co-ordinator, Royal Botanic Gardens, Kew, Millennium Seed Bank Partnership, Wakehurst Place, Ardingly, West Sussex, UK, RH17 6TN	**UK – Kew SCD**
17	Dr. Tiziana **Ulian**	UPP Co-ordinator, RBG Kew, Millennium Seed Bank Partnership, Wakehurst Place, Ardingly, West Sussex, UK, RH17 6TN	**UK – Kew SCD**
18	Mr. Richard **Hunt**	Associate Director; Corporate and Foundation Partnerships, Kew Foundation; Royal Botanic Gardens, Kew Richmond, Surrey, TW9 3AB;	**UK- Kew Foundation**
19	Dr. Virinder **Sharma**	DFID Climate Change and Environment Adviser based in the UK Embassy**,** Climate Change Adviser, DFID Kenya & Somalia, British High Commission, Upper Hill Road, Post Box 30465-00100	**UK DFID- Nairobi**
20	[Dr. Ramni **Jamnadass]** Roeland **Kindt**	ICRAF, Global Research, Tree Improvement and Sustainable Seed Seedling Systems, CGIAR Consortium, United Nations Avenue,Gigiri, PO Box 30677, Nairobi 00100	**Nairobi - ICRAF**
21	Dr. Daniel **Ofori**	ICRAF, Global Research, Tree Improvement and Sustainable Seed Seedling Systems, CGIAR Consortium, United Nations Avenue, Gigiri, PO Box 30677, Nairobi 00100	**Nairobi – ICRAF**
22	Dr. William **Omondi Oloo**	Kenya Forestry Research institute (KEFRI), Tree seed programme, P.O. BOX 20638 City Square, Nairobi, Kenya	**Nairobi**
23	[Dr Bernard **Kigomo]** Dr. Benjamin **Chikamai**	Kenya Forestry Research Institute (KEFRI), P. O. Box 20412, Nairobi	**Nairobi**
24	[Mr. Esau **Omollo]** Mr. James Mwang'ombe **MWAMADENYI**	[Deputy Director in charge of Conservation] Senior Assistant Director - Head of Biodiversity Management; Kenya Forest Service (KFS); Headquarters in Karura, Off Kiambu Road, Opposite CID headquarters; P.O. Box 00100-30513, Nairobi	**Nairobi**
26	Dr. Patrick **Muthoka**	National Museum of Kenya, East Africa Herbarium, P.O Box	**Nairobi**

	(+1 participant from NMK)	45166 – 00100, Nairobi	
28	Dr. Desterio **Nyamongo** (+1 participant from KARI)	Kenya Agricultural Research Institute, Genetic Resources Conservation, National Genebank of Kenya, P.O. Box 30148 00100, Nairobi; Tel: +254- (0)725 234249	**Nairobi**
29	Mr. Dan **Rugabira**	FAO Representative- Africa	**FAO- Forestry**
30	Ms. Nora **Berrahmouni**	Forestry Officer (Arid Zone Forestry), Forest Assessment, Management and Conservation Division, Forestry Department, FAO Rome, Viale delle Terme di Caracalla. 00153 Rome	**FAO- Forestry Rome**
31	[Mr. Simon A.P. **Rietbergen]** **Adjourned.**	Senior Forestry Specialist – Africa Region of the World Bank; AFTEN Mail Stop J6-600 The World Bank 1818 H Street NW; Washington, D.C. 20433	**World Bank – Africa**
32	Mr. Jens-Peter Barnekow **Lillesø**	Senior adviser - Forest & Landscape Denmark/Forest genetic resources Rolighedsvej 23; 1958 Frederiksberg C;	**FLD- Denmark**
33	[1. Dr Ibrahim **Thiaw;**[2. Mrs. Meryem C. **Amar]** Mr Niklas **Hagelberg**	1-UNEP Africa; 2-Information Officer, United Nations Environment Programme (UNEP) Division of Communications and Public Information UNEP;	**UNEP Nairobi**
34	[Dr Peter **Minang]** **Adjourned.**	REED++ (Head of ASB-)	
35	[Mrs. Mmasera **Manthe-Tsuaneng]** **Adjourned.**	Director, Department of Forestry and Range Resources, Private Bag BO 199, Gaborone, Botswana;	**Botswana**
37	Ms. Rose **Makena**	Marketing Manager, Tree Biotechnology Programme Trust	**Nairobi**
38	Ms MaryAnne **Mwaura**	Public Affairs Officer- East Africa; Citibank N.A.; Citi Bank House; 2nd Floor, Upper Hill Road, Nairobi, Kenya;	**Nairobi**
39	Dr Tim **Entwisle**	Director, Conservation and Living Collections - Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB	**UK – Kew Directorate**
40	Dr Mark **Nicholson**	Director, Brackenhurst, Plants for Life, PO Box 617, Limuru, Kenya	**Nairobi**

Taxa	Family	Country
Anacardium occidentale	Anacardiaceae	Mali, Nigeria, Burkina
Lannea microcarpa	Anacardiaceae	Mali, Burkina
Mangifera indica	Anacardiaceae	Burkina, Nigeria
Ozoroa insignis	Anacardiaceae	Burkina
Rhus tenuinervis	Anacardiaceae	Botswana
Sclerocarrya birrea	Anacardiaceae	Botswana, Burkina, Mali
Spondias mombin	Anacardiaceae	Burkina, Nigeria, Mali, Ghana
Annona muricata	Annonaceae	Nigeria
Annona senegalensis	Annonaceae	Burkina, Malawi
Uvaria chamae	Annonaceae	Burkina
Adenium obesum	Apocynaceae	Burkina
Alstonia boonei	Apocynaceae	Nigeria
Raulvofia caffra	Apocynaceae	Malawi
Saba comorensis	Apocynaceae	Burkina
Saba senegalensis	Apocynaceae	Burkina
Strophantus hispidus	Apocynaceae	Burkina
Cussonia arborea	Araliaceae	Mali
Cussonia djalonensis	Araliaceae	Mali
Polyscias fulva	Araliaceae	Kenya
Araucaria spp.	Araucariaceae	Mozambique
Bismarckia nobilis	Arecaceae	Madagascar
Borassus aethiopum	Arecaceae	Burkina
Calamus deerratus	Arecaceae	Burkina
Cocos nucifera	Arecaceae	Burkina
Elaeis guineensis	Arecaceae	Mali, Burkina
Hyphaene thebaica	Arecaceae	Burkina
Phoenix dactilifera	Arecaceae	Burkina
Phoenix reclinata	Arecaceae	Botswana
Raphia sudanica	Arecaceae	Burkina, Mali
Stomatostemma monteiroae	Apocynaceae	Botswana
Balanites aegyptiaca	Balanitaceae	Mali, Burkina
Jacaranda mimosifolia	Bignoniaceae	Madagascar
Kigelia africana	Bignoniaceae	Burkina, Mali
Markhamia lutea	Bignoniaceae	Uganda
Phyllarthron madagascariensis	Bignoniaceae	Madagascar
Stereospermum euphoroides	Bignoniaceae	Madagascar
Stereospermum kunthianum	Bignoniaceae	Mali, Burkina
Cochlospermum planchonii	Bixaceae	Burkina, Mali
Adansonia digitata	Bombacaceae	Malawi, Botswana, Mali, Nigeria, Burkina, Madagascar
Adansonia grandidieri	Bombacaceae	Madagascar
Adansonia madagascariensis	Bombacaceae	Madagascar
Adansonia za	Bombacaceae	Madagascar
Bombax costatum	Bombacaceae	Mali, Burkina
Ceiba pentandra	Bombacaceae	Ghana, Mali, Nigeria, Burkina
Cordia millenii	Boraginaceae	Nigeria
Cordia abysinica	Boraginaceae	Malawi
Cordia africana	Boraginaceae	Ethiopia, Uganda
Cordia alliodora	Boraginaceae	Ethiopia
Cordia myxa	Boraginaceae	Mali
Cordia sinensis	Boraginaceae	Ethiopia
Canarium	Burseraceae	Madagascar

madagascariensis		
Canarium schweinfurthii	Burseraceae	Mali
Commiphora guillaumini	Burseraceae	Madagascar
Bauhinia petersiana	Leguminosae	Botswana
Bauhinia rufescens	Leguminosae	Mali
Cassia abbreviate	Leguminosae	Botswana
Cassia siamea	Leguminosae	Mali
Cassia sieberiana	Leguminosae	Mali
Senna alata	Leguminosae	Mali
Senna sieberiana	Leguminosae	Burkina
Tamarindus indica	Leguminosae	Ethiopia, Mali, Burkina, Nigeria
Crateva adansonii	Capparaceae	Burkina
Casuarina 3 spp.	Casuarinaceae	Ethiopia
Casuarina equisetifolia	Casuarinaceae	Ethiopia, Mozambique, Mali
Casuarina spp.	Casuarinaceae	Kenya
Elaeodendron transvaalense	Celastraceae	Botswana
Maytenus senegalensis	Celastraceae	Mali
Neocarya macrophylla	Chrysobalanaceae	Mali
Parinari curatellifolia	Chrysobalanaceae	Burkina, Mali, Malawi
Allanblackia parviflora	Clusiaceae	Ghana
Allanblackia spp.	Clusiaceae	Tanzania
Garcinia huillensis	Clusiaceae	Malawi
Garcinia huillensis	Clusiaceae	Malawi
Garcinia kingaensis	Clusiaceae	Malawi
Pentadesma butyracea	Clusiaceae	Burkina, Mali
Garcinia afzelii	Clusiaceae (Guttiferrae)	Ghana
Garcinia kola	Clusiaceae (Guttiferrae)	Ghana
Garcinia livingstonei	Clusiaceae (Guttiferrae)	Burkina
Anogeissus leocanpus	Combretaceae	Nigeria, Mali, Burkina
Combretum fragrans	Combretaceae	Mali
Combretum imberbe	Combretaceae	Malawi
Combretum micranthum	Combretaceae	Mali, Burkina
Combretum molle	Combretaceae	Uganda
Pteleopsis suberosa	Combretaceae	Mali
Terminalia albida	Combretaceae	Mali
Terminalia brownii	Combretaceae	Uganda, Kenya
Terminalia catapa	Combretaceae	Mali
Terminalia catappa	Combretaceae	Nigeria
Terminalia ivorensis	Combretaceae	Ghana, Ethiopia, Uganda, Nigeria
Terminalia mantaly	Combretaceae	Madagascar, Ethiopia, Botswana, Mali, Burkina
Terminalia spp.	Combretaceae	Nigeria
Terminalia superba	Combretaceae	Ghana, Uganda
Vernonia kawoziensis	Compositae	Malawi
Vernonia kayuniana	Compositae	Malawi
Evolvulus alsinoides	Convolvulaceae	Mali
Citrullus lunatus	Cucurbitaceae	Botswana
Cucumis africanus	Cucurbitaceae	Botswana
Widdringtonia whytei	Cupressaceae	Malawi
Cupressus 3 spp.	Cupressaceae	Ethiopia
Cupressus lusitanica	Cupressaceae	Kenya, Uganda
Cupressus torulosa	Cupressaceae	Ethiopia
Juniperus procera	Cupressaceae	Tanzania, Ethiopia

Diospyros mespiliformis	Ebenaceae	Burkina, Mali
Diospyros spp.	Ebenaceae	Nigeria
Jatropha curcas	Euphorbiaceae	Ethiopia, Botswana, Mali, Burkina
Oldfiedia dactyllophylla	Euphorbiaceae	Malawi
Ricinodendrum spp.	Euphorbiaceae	Nigeria
Schinziophyton rautenanii	Euphorbiaceae	Botswana, Malawi
Alchornea cordifolia	Euphorbiaceae	Mali
Bridellia mollis	Euphorbiaceae	Botswana
Tetrapleura tetraptera	Leguminosae	Ghana
Flacourtia indica	Flacourtiaceae	Botswana
Hypoxis spp.	Hypoxidaceae	Malawi
Irvingia gabonensis	Irvingiaceae	Ghana
Tectona grandis	Lamiaceae	Ghana, Mada, Uganda, Mali, Tanz, Nigeria
Vitex chrysocarpa	Lamiaceae	Burkina
Vitex doniana	Lamiaceae	Burkina, Malawi, Mali
Vitex mossambiscens	Lamiaceae	Malawi
Vitex payos	Lamiaceae	Malawi
Vitex simplicifolia	Lamiaceae	Mali
Bauhinia thonningii	Leguminosae	Malawi
Brachystegia speciformis	Leguminosae	Malawi
Abrus precatorius	Leguminosae	Botswana
Afzelia africana	Leguminosae	Mali, Nigeria, Burkina
Afzelia quanzensis	Leguminosae	Tanzania
Afzelia spp.	Leguminosae	Nigeria
Albizia adianthifolia	Leguminosae	Malawi
Albizia chinensis	Leguminosae	Uganda
Albizia lebbeck	Leguminosae	Mali, Burkina
Albizia spp.	Leguminosae	Nigeria, Mali
Albizia versicolor	Leguminosae	Malawi
Albizia visicolor	Leguminosae	Malawi
Albizzia coriaria	Leguminosae	Uganda
Andira inermis	Leguminosae	Mali
Calliandra calothyrsus	Leguminosae	Ethiopia
Calliandra spp.	Leguminosae	Africa
Colophospemum mopane	Leguminosae	Botswana, Malawi
Colvillea racemosa	Leguminosae	Madagascar
Cordyla madagascariensis	Leguminosae	Madagascar
Cordyla pinnata	Leguminosae	Mali
Dalbergia louveli	Leguminosae	Madagascar
Dalbergia melanoxylon	Leguminosae	Tanzania
Daniellia oliveri	Leguminosae	Burkina, Mali
Daniellia spp.	Leguminosae	Nigeria
Delonix regia	Leguminosae	Madagascar, Burkina, Mali
Detarium microcarpum	Leguminosae	Burkina, Mali
Detarium senegalensis	Leguminosae	Burkina
Faidherbia albida	leguminosae	Burkina, Mali, Nigeria
Gliricidia sepium	Leguminosae	Mali
Guibourtia copallifera	Leguminosae	Burkina
Isoberlinia doka	Leguminosae	Mali, Nigeria
Jubernadia globiflora	Leguminosae	Malawi
Lanchocarpus capassa	Leguminosae	Malawi
Millettia feruginea	Leguminosae	Ethiopia
Moghania faginea	Leguminosae	Mali
Peltophorum ferruginum	Leguminosae	Burkina
Pericorpsis angolensis	Leguminosae	Malawi
Lonchocarpus philenoptera	Leguminosae	Botswana

Philenoptera violacea	Leguminosae	Botswana
Piliostigma reticulatum	Leguminosae	Mali
Sesbania sesban	Leguminosae	Ethiopia
Stylosanthes erecta	Leguminosae	Mali
Swartzia madagascariensis	Leguminosae	Mali
Tephrosia vogelii	Leguminosae	Madagascar
Triplochiton sclereoxylon	Leguminosae	Ghana, Nigeria
Tylosema esculentum	Leguminosae	Botswana
Vigna subterranea	Leguminosae	Botswana
Erythrina abysinica	leguminoseae	Malawi
Erythrina senegalensis	leguminoseae	Mali
Anthocleista kerstingii	Loganiaceae	Mali
Strychnos spinosa	Loganiaceae	Botswana, Malawi, Mali
Strychnos coculeoides	Loganiaceae	Botswana
Strychnos innocua	Loganiaceae	Burkina, Mali
Strychnos madagascariensis	Loganiaceae	Botswana
Lawsonia inermis	Lythraceae	Mali
Azanza garkeana	Malvaceae	Botswana
Mansonia altissima	Malvaceae	Ghana, Nigeria
Sterculia spp.	Malvaceae	Nigeria
Sterculia tragacanta	Malvaceae	Burkina
Khaya anthotheca	Meliacea	Ghana, Tanzania, Malawi
Khaya ivorensis	Meliacea	Ghana
Khaya madagascariensis	Meliacea	Madagascar
Khaya senegalensis	Meliacea	Burkina, Mali, Uganda
Khaya spp.	Meliacea	Nigeria
Azadirachta indica	Meliaceae	Ethiopia, Kenya, Uganda, Burkina, Nigeria
Carapa procera	Meliaceae	Mali
Cedrela odorata	Meliaceae	Ghana
Cedrela spp.	Meliaceae	Mozambique
Entandrophragma spp.	Meliaceae	Nigeria, Ghana
Guarea cedreta	Meliaceae	Ghana
Lovoa spp.	Meliaceae	Nigeria
Melia azedarach	Meliaceae	Ethiopia
Melia volkensii	Meliaceae	Kenya, Uganda
Pseudocedrela kotschyi	Meliaceae	Mali
Trichilia emetica	Meliaceae	Burkina, Malawi, Mali
Acacia senegal	Mimosaceae	Nigeria, Burkina
Acacia 2 spp.	Mimosaceae	Ethiopia
Acacia abyssinica	Mimosaceae	Ethiopia
Acacia cumusos	Mimosaceae	Nigeria
Acacia dealbata	Mimosaceae	Madagascar
Acacia laeta	Mimosaceae	Burkina
Acacia macrostachya	Mimosaceae	Burkina
Acacia mangium	Mimosaceae	Madagascar
Acacia meansii	Mimosaceae	Uganda, Ethiopia, Tanzania
Acacia mellifera	Mimosaceae	Botswana
Acacia nilotica	Mimosaceae	Botswana, Ethiopia, Mali, Burkina, Nigeria
Acacia pennata	Mimosaceae	Burkina
Acacia polyacantha	Mimosaceae	Tanzania
Acacia raddiana	Mimosaceae	Burkina
Acacia saligna	Mimosaceae	Ethiopia
Acacia senegal	Mimosaceae	Burkina, Ethiopia, Mali
Acacia sieberiana	Mimosaceae	Mali
Acacia spp.	Mimosaceae	Kenya

Acacia tortilis	Mimosaceae	Ethiopia
Entada africana	Mimosaceae	Mali
Leucaena leucocephala	Mimosaceae	Madagascar, Ethiopia, Botswana, Mali, Burkina
Parkia biglobosa	Mimosaceae	Mali, Burkina, Nigeria
Parkia filicodia	Mimosaceae	Malawi
Prosopis africana	Mimosaceae	Mali
Antiaris toxicaria (syn. *africana*)	Moraceae	Uganda, Burkina
Ficus capensis	Moraceae	Malawi
Ficus ingens	Moraceae	Malawi
Ficus platyphylla	Moraceae	Burkina
Ficus spp.	Moraceae	Malawi
Ficus spp.	Moraceae	Malawi
Ficus sur	Moraceae	Burkina
Ficus sycomorus	Moraceae	Malawi
Milicia excelsa	Moraceae	Tanzania, Uganda
Milicia spp.	Moraceae	Nigeria
Morus mesozygia	Moraceae	Botswana
Moringa oleifera	Moringaceae	Burkina, Madagascar, Nigeria, Mali, Botswana
Moringa stenopetala	Moringaceae	Ethiopia, Kenya
Pycnanthus angolensis	Myristicaceae	Ghana
Pycnanthus spp.	Myristicaceae	Nigeria
Myrothamnus flabellifolius	Myrothamnaceae	Botswana
Eucalyptus 70 spp.	Myrtaceae	Ethiopia
Eucalyptus camaldulensis	Myrtaceae	Nigeria, Mali, Burkina, Kenya, Uganda, Ethiopia
Eucalyptus cladocalyx	Myrtaceae	Ethiopia
Eucalyptus deglupta	Myrtaceae	Ethiopia
Eucalyptus globulus	Myrtaceae	Ethiopia
Eucalyptus grandis	Myrtaceae	Kenya, Uganda, Ethiopia, Tanzania
Eucalyptus robusta	Myrtaceae	Madagascar
Eucalyptus saligna	Myrtaceae	Ethiopia, Kenya, Tanzania
Eucalyptus spp.	Myrtaceae	Ghana, Mozambique
Eucalyptus viminalis	Myrtaceae	Ethiopia
Psidium guajava	Myrtaceae	Nigeria
Syzgium cordatum	Myrtaceae	Malawi
Syzgium guinensis	Myrtaceae	Malawi
Fruit trees	N/A	Ethiopia
Some indigenous species	N/A	Mozambique
Lophira alata	Ochnaceae	Nigeria
Lophira lanceolata	Ochnaceae	Mali
Ximenia americana	Olacaceae	Burkina, Mali, Botswana
Ximenia caffra	Olacaceae	Botswana
Fraxinus udhei	Oleaceae	Madagascar
Olea africana	Oleaceae	Ethiopia
Olea europaea	Oleaceae	Botswana
Opilia celtidifolia	Opiliaceae	Burkina
Orchids spp.	Orchidaceae	Malawi
Ostryoderris chevalieri	Papilionaceae	Mali
Pterocarpus erinaceus	Papilionaceae	Mali, Burkina
Pterocarpus lucens	Papilionaceae	Burkina, Mali
Pterocarpus santalinoides	Papilionaceae	Burkina, Mali
Pterocarpus spp.	Papilionaceae	Nigeria
Xeroderris stuhlmannii	Papilionaceae	Burkina
Brideria micrantha	Phyllanthaceae	Malawi
Hymenocardia acida	Phyllanthaceae	Mali

Spondiathus preussii var. Glaber	Phyllanthaceae	Burkina
Uapaca spp.	Phyllanthaceae	Nigeria
Pinus 6 spp.	Pinaceae	Ethiopia
Pinus carbaea	Pinaceae	Tanzania, Uganda
Pinus caribaea	Pinaceae	Nigeria, Uganda
Pinus kesiya	Pinaceae	Madagascar
Pinus patula	Pinaceae	Ethiopia, Tanzania, Kenya, Uganda
Pinus radiata	Pinaceae	Ethiopia
Pinus spp.	Pinaceae	Mozambique, Ghana
Andropogon ascinodis	Poaceae	Burkina
Andropogon gayanus	Poaceae	Burkina, Mali
Andropogon pseudapiecus	Poaceae	Burkina
Coix lacryma-jobi	Poaceae	Mali
Cymbopogon giganteus	Poaceae	Burkina, Mali
Cymbopogon schoenanthus	Poaceae	Burkina
Digitaria barbinodis	Poaceae	Burkina
Panicum repens	Poaceae	Burkina, Mali
Pennisetum pedicellatum	Poaceae	Burkina
Vetiveria nigritana	Poaceae	Burkina
Podocarpus falcatus	Podocarpaceae	Ethiopia
Podocarpus madagascariensis	Podocarpaceae	Madagascar
Podocarpus usambarensis	Podocarpaceae	Uganda
Securidaca longepedunculata	Polygalaceae	Mali, Burkina
Erythrophyllum spp.	Pottiaceae	Nigeria
Grevillea banksii	Proteaceae	Madagascar
Grevillea robusta	Proteaceae	Ethiopia, Uganda, Tanzania
Grevillea spp.	Proteaceae	Kenya
Berchemia discolor	Rhamnaceae	Ethiopia
Colubrina decipiens	Rhamnaceae	Madagascar
Maesopsis eminii	Rhamnaceae	Tanzania, Uganda
Ziziphus mauritania	Rhamnaceae	Ethiopia, Mali, Burkina
Ziziphus mucronata	Rhamnaceae	Botswana, Mali, Burkina
Zizyphus spina-christii	Rhamnaceae	Nigeria
Hagenia abyssinica	Rosaceae	Ethiopia
Prunus africana	Rosaceae	Uganda, Africa
Adina microcephala	Rubiaceae	Malawi
Burttdavya nyasica	Rubiaceae	Malawi
Crossopteryx febrifuga	Rubiaceae	Mali
Gardenia nitida	Rubiaceae	Burkina
Gardenia sokotensis	Rubiaceae	Mali
Mitragyna inermis	Rubiaceae	Mali
Mitragyna stipulosa	Rubiaceae	Nigeria
Nauclea diderrichii	Rubiaceae	Ghana, Nigeria
Nauclea latifolia	Rubiaceae	Mali, Burkina
Pavetta crassipes	Rubiaceae	Burkina
Psychotria psychotrioides	Rubiaceae	Burkina
Sarcocephallus latifolius	Rubiaceae	Burkina
Vangueria infausta	Rubiaceae	Botswana
Aefragle paniculata	Rutaceae	Burkina
Cedrelopsis grevei	Rutaceae	Madagascar
Citrus spp.	Rutaceae	Burkina
Fagara zanthoxyloides	Rutaceae	Mali
Zanthoxylum gilletii	Rutaceae	Kenya
Zanthoxylum zanthoxyloïdes	Rutaceae	Burkina

Dobera glabra	Salvadoraceae	Ethiopia
Osyris lanceolata	Santalaceae	Kenya
Blighia sapida	Sapindaceae	Mali, Burkina
Manilkara multinervis	Sapotaceae	Burkina
Mimusops kummel	Sapotaceae	Burkina
Mimusops zeyheri	Sapotaceae	Botswana
Vitellaria paradoxa	Sapotaceae	Burkina, Mali, Nigeria
Hannoa undulata	Simaroubaceae	Burkina
Rhopalocarpus lucidus	Sphaerosepalaceae	Madagascar
Cola cordifolia	Sterculiaceae	Mali, Burkina
Cola grandifolia	Sterculiaceae	Mali
Cola laurifolia	Sterculiaceae	Burkina
Cola nitida	Sterculiaceae	Mali
Sterculia setigera	Sterculiaceae	Burkina, Mali
Gnidia chapmanii	Thymelaeaceae	Malawi
Grewia bicolour	Tiliaceae	Botswana
Grewia flava	Tiliaceae	Botswana
Grewia flavascence	Tiliaceae	Botswana
Grewia villosa	Tiliaceae	Botswana
Celtis integrifolia	Ulmaceae	Mali, Burkina
Celtis spp.	Ulmaceae	Nigeria
Gmelina arborea	Verbenaceae	Ethiopia, Ghana, Uganda, Mali, Nigeria, Burkina
Lippia javanica	Verbenaceae	Botswana