USDA Forest Service Mission to the Republic of Congo and the Democratic Republic of Congo

In Support for the Development of Community Fire Management and Restoration in the Congo Basin

FINAL REPORT

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1.0 EXECUTIVE SUMMARY

The USDA Forest Service (USFS), through the Office of International Programs, is an implementing partner in the US Agency for International Development's (USAID) Central African Regional Program for the Environment (CARPE), providing targeted technical and capacity building assistance aimed at improving forest management in the Congo Basin.

In November, 2009 the U.S. Forest Service (USFS) sent a technical assistance team to areas of the Leconi-Bateke-Lefini Landscape in the Republic of Congo and the Lac Tele – Lac Tumba Landscape in the Democratic Republic of Congo. The purpose of the visit was to provide technical assistance to Congo Basin Forest Partnership (CBFP)/CARPE landscape partners in assessing natural and human-induced fire impacts, behavior, and risk as well as developing strategies for community based fire management and degraded land restoration in the Leconi-Bateke-Lefini and Lac Tele - Lac Tumba Landscapes.

The tasks of the USFS team included:

Democratic Republic of Congo:

1. Determine the need for technical expertise and provide templates of guides for implementing for reforestation of the Emphytheose of Nioki - The Governments of the DRC and Belgium signed an agreement to create a re-plantation zone covering 1,289 km^2. The objectives of this project are threefold: i) reproduce forest cover that will increase carbon sequestration in the region, ii) help raise awareness and capacity of local communities in the development of the REDD mechanisms, and iii) help local communities to produce fuel wood for consumption and market.
2. Assist in development of a fire management system and training program for the Nkala-Nko area and in mechanisms for bonobo habitat restoration through natural and artificial reforestation as part of an African Development Bank reforestation project proposed for this area.
3. Propose methods for improving wildlife habitat and fire management that would be compatible with the livestock operations of the SEBO grazing concession.
4. Develop fire research tools (including data collection protocols and instruments) and training of the Congolese team that will continue with the work in southern Lac Tumba and other regions of the country as necessary. This will assist in zoning agricultural zones, sensitive areas and will build into a fire management scheme that takes into account different needs (agricultural, conservational and cultural). This was considered as part of an overall strategic look at fire management over both landscapes.

Republic of Congo:

5. Examine the feasibility of a demonstration project for sustainable and efficient cooking fuel production and develop specific recommendations on how CBFP/CARPE landscape partners could contribute to related activities.
6. Examine the feasibility of accelerated natural forest regeneration through the control of burning by local communities in the Bateke Plateaux region. Such a feasibility study would provide the basis for carbon-based revenue-generation for local communities that would not otherwise be able to participate in REDD-type schemes.

7. Evaluate the overarching strategy on fire management and develop specific recommendations on how CBFP/CARPE landscape partners could contribute to assisted regeneration activities that support carbon sequestration in the Republic of Congo Segment of the Bateke Plateaux. As in task 4 above, this was considered as part of an overall strategic look at fire management over both landscapes.

To address these tasks the USFS team visited with NGOs, communities, local authorities, and other stakeholders to gain an understanding of local conditions in the region in order to develop realistic recommendations that would support the engagement of these partners in meeting CBFP/CARPE landscape goals.

Overall, the team found:

1. Fire management needs to be improved to reduce degradation of wildlife habitat, maintain or improve site productivity and biodiversity, improve livestock grazing, and protect both natural and artificial reforestation sites.
2. Natural regeneration, mainly from excluding fire from regeneration sites, is needed to increase the size and diversity of gallery forests and to increase the woody component of some areas of the savannah. This would have the benefit of improving wildlife habitat, providing increased sources of wood and non-timber products for local villages, and improving carbon sequestration and possible participation in REDD-associated programs.
3. Artificial regeneration is needed to establish fuel and timber supplies for local villages, to supply charcoal for urban areas such as Kinshasa and Brazzaville, reduce harvesting pressure on remaining natural forests, or to improve the potential for participation in carbon sequestration payment programs.

Possible priority next steps for USFS engagement on community fire management and restoration:

1. USDA-FS personnel can be used to provide technical advice on reforestation project feasibility or guiding implementation at a later stage. These projects include multiple goals of reforestation, providing wildlife habitat, providing resources for local villagers, and carbon sequestration. The teams should be composed of individuals that can address the various socio-economic, ecological, and global aspects of the program.
2. Individual assistance from USDA Forest Service personnel may also be helpful to train people in assessment protocols that can be used by local groups to determine priority areas for reforestation.
3. Provide technical assistance with nursery management to enhance the establishment and operations of nurseries to raise tree seedlings for planting (See pages 11, 13, 15, 17, 19).
4. Provide training in planting/tending tree plantations and protecting the plantations from fires (See pages 12, 13, 15, 17, 19).
5. Train a cadre of SEBO managers and villagers in the implementation of fuel breaks and prescribed burning. This cadre should be committed to sharing their training and experience with other groups in the area (See page 19).

6. Provide technical assistance to help assess the fire patterns and fire regime in the landscape and develop regional and site specific fire effects monitoring protocols (See pages 5, 13, 18, 19).
7. USDA-FS personnel could also advise USAID or other donors on materials and equipment (e.g. mowers, fire equipment, personal protective equipment, and training materials) that could be provided to local villages or organizations to enhance their ability to more effectively manage fire (See pages 13 and 19).
8. Assist with the development of volume (and carbon sequestration) yield tables for selected species that represent a group of species (see page 27).

2.0 INTRODUCTION

The USDA Forest Service (USFS), through the Office of International Programs, is an implementing partner in the US Agency for International Development's (USAID) Central African Regional Program for the Environment (CARPE), providing targeted technical and capacity building assistance aimed at improving forest management in the Congo Basin. In an effort to focus this assistance in a manner which capitalizes on the relative strengths of the agency, the USFS is concentrating their efforts towards the land management planning processes of the CARPE landscapes. These landscapes were chosen for their biodiversity and conservation importance and established as foundations of regional conservation and sustainable natural resource use. These areas contain a mix of national parks and other protected areas, current or future timber and mining concessions, villages and settlements, and the neighboring areas on which communities depend for their day-to-day resources.

Natural and human induced fire has an important impact on the maintenance and provision of ecosystem services in the Congo Basin. Forest degradation and deforestation occur in the gallery forests and the forest-savannah mosaic, where the forest is exploited for the production of charcoal serving the population centers. Slash and burn agriculture and bush fires across the savannahs also contribute to deforestation and degradation and to the emissions of CO_2 in the Congo Basin. As a major contributor of greenhouse gas emissions in the Congo Basin, large grass fires annually burn across the savannah landscape as a result of hunting practices, often destroying young colonizing trees and preventing the natural spread of forest cover.

Toward this end, the USFS engaged a technical assistance team to work in collaboration with several Congo Basin Forest Partnership (CBFP)/CARPE landscape partners to assess natural and human-induced fire patterns and fire regime as part of the on-going ecological and socio-economic studies critical to land use planning. The team visited areas of the Leconi-Bateke-Lefini Landscape in the Republic of Congo and the Lac Tele – Lac Tumba Landscape in the Democratic Republic of Congo (See Appendix B for Mission Itinerary). The team worked with partners to identify strategic approaches to mitigate human-caused fire impacts on wildlife, biodiversity, biomass/carbon release, etc. This included meeting with local NGOs, communities, and local authorities to better understand the challenges and opportunities and develop recommendations to support the partner's engagement on these issues.

Detailed discussions of the observations and recommendations of the team, as well as overall strategic consideration for fire management, reforestation and tree nursery management, and charcoal supply and demand, are found in the body of the text.

3.0 OBSERVATIONS

3.1 General

The landscapes visited by the team in both the ROC and DRC were savannah-gallery forest mosaics that were mostly part of the Bateke Plateau landform. In both areas, uncontrolled wild fire is a major factor leading to ecosystem degradation. This is exacerbated by increasing human population pressure caused by immigration and internal growth. Increased population has resulted in increasing land clearing for agriculture in both forest and savannah areas; increasing timber harvesting for fuel wood and charcoal, especially along Congo, Kwa, and Fimi Rivers and along road systems; and increasing hunting and fishing pressure. Low income levels in the region force people to rely on gathering plants and animals, probably at an unsustainable level. As a result, any efforts to restore or maintain ecosystems in these areas will have to take into account the way natural resources are currently used for subsistence or livelihood by the local population.

Land use planning efforts are underway in both landscapes to determine how to address both ecosystem restoration and sustainable natural resource use. The organizations leading these efforts where the team visited – the Wildlife Conservation Society (WCS) in the Leconi-Bateke-Lefini Landscape and the World Wildlife Fund for Nature (WWF) in the Lac Tele-Lac Tumba Landscape – are doing an excellent job of developing partnerships and organizing villages, local government officials, and local NGOs. Implementation of activities identified in these plans is just beginning, and the scope of work outlined for the team (see Appendix A) mainly involved issues dealing with implementing fire management and reforestation activities.

Research (Vincens et al. 2001) indicates that the Bateke Plateau experienced a period of aridity during the late Holocene (*ca*. 3000 years BP) where woodlands were replaced by open formations rich in grasses (i.e. savanna). Within the last millennium, increasing moisture conditions have promoted the advance of forested areas into the savannas across much of Central and West Africa (ibid); however in recent decades, anthropogenic influences (e.g. fire, land clearing) have again reduced the forest area in some locations. Initial results from MODIS and Landsat data (Hansen et al. 2008) indicate that the Congo River Basin is an ecosystem absent of the large-scale clearing found in other humid tropical forest zones, such as the Lower Amazon Basin and Insular Southeast Asia. However, the forest clearing that is occurring is spatially pervasive and fragmented, with significant implications for sustaining the region's biodiversity. Frontier forests absent of human impact are not widespread in the Congo Basin, unlike some remaining forest tracts in the interior of the Amazon or New Guinea highlands. Given this fact, identifying and addressing incursions into remaining intact forests is important for CARPE project partners.

Deforestation on a regional scale can affect weather and moisture conditions. Climate has a strong impact on fire frequency and intensity, which in turn have strong impacts on vegetation dynamics. Consequently, fire is likely to play an important role in vegetation-climate feedbacks (Hoffman et al. 2003). Primary tropical forest typically requires prolonged drought to become flammable, so in most years relatively little undisturbed forest burns. However, due to vegetation-climate feedbacks, these conditions will likely be met more frequently in the remaining forest patches. Therefore, addressing deforestation and fire management in the Congo Basin, while the problems are still limited (albeit pervasive) is critical to the success of the program.

Increases in fire frequency and loss of forest over the landscape is probably reducing overall ecosystem productivity through the reduction of soil organic matter content, which subsequently reduces soil fertility and soil water holding capacity. This loss of soil productivity in turn reduces crop yields, biodiversity, carbon sequestration, and wildlife carrying capacity in the region.

However, it is important to realize that some frequency of fire is essential to maintain the forest-savannah mosaic that supports the diversity of habitats and wildlife in these areas. A description of the fire regime in the Bateke Plateau landscape, including the function of fire in the ecosystem and the past and current practices being used in the region are presented in Walters (2007). Although there is a need to reduce fire frequency and improve controlled burning techniques, a monitoring system to obtain information on the effects of changes in fire management could be developed as part any fire management program. The monitoring system should include a large scale spatial component (e.g. UMD FIRMS project) to show changes in forest cover, as well as more site specific monitoring to track changes in species composition and other ecological components.

In the Lac Tele – Lac Tumba landscape and especially in the nearby environs closer to Brazzaville and Kinshasa, there has been a decline in forest cover (deforestation) and quality of the forests (degradation) over the past few decades. This decline is caused by increases in slash and burn agriculture, increased frequency of uncontrolled wild fire in the savannah and gallery forest mosaic, and harvesting of trees for fire wood and charcoal production. These activities, along with harvesting of bush meat reduce the biological diversity and carbon sequestering capabilities in this area.

3.2 Republic of Congo

3.2.1 Causes and impacts of repeated high frequency uncontrolled wild fires

USFS team discussions with villagers and the WCS personnel in the Leconi-Bateke-Lefini Landscape found the same causes for burning as those observed by Walters (2007) in Gabon, namely:

- Plantation (agricultural) clearing in both savannah and forest
- Ease of walking
- Visibility of hazards, prey animals, and gathered plants
- Creating grazing sites for hunted animals and domestic livestock
- Stimulating new growth of gathered plants
- Gathering of termites and other insects
- As part of the hunting process
- For security – to reduce fuel around villages and crop fields.
- For “fun” – Walters (2007) noted that the Gabonese set fires for no obvious purpose and that such fire-starting behavior was socially acceptable. The same situation exists in the ROC and the DRC.

Several times during our discussions with villagers, the point was raised that fires during the dry season can burn vast acreages, and if one village tries to keep an area unburned, a fire started somewhere else may still cause it to burn. So, what is the point of trying to stop burning? Under current practices, there is no liability for lighting a brush fire unless it burns agricultural fields.

As noted earlier, an impact of high frequency burning is reduction of site productivity. Repeated burning and removal of above-ground organic matter (and simultaneous release of atmospheric carbon) ultimately reduces soil organic matter because this material is not decomposed and deposited in the soil. The sandy soils of the Bateke plateau area do not have much nutrient holding capacity so any loss of organic matter results in a reduction of soil fertility and site potential. The open grasslands have been burned so frequently over the decades that their potential for a woody savannah condition may be permanently impaired.

Frequent fires also reduce the woody component of the savannah, and large areas of the Bateke Plateau in the ROC appear to have become pure grassland. As noted by Walters (2007) Grimm's Duiker requires a mix of grass and brush habit, and other ungulates also prefer a mix of burned and unburned areas. Increases in area and frequency of fire are likely degrading habitat and reducing the carrying capacity for a number of preferred game animals in the region.

Increased frequency of fire is reducing the size and quality of gallery forests and bosquets (small upland forests) by gradually encroaching into forests during droughts. In addition to reducing the available habitat for forest animals, this is also decreasing the area of forest available for slash and burn agriculture. Villagers prefer to establish fields in forested areas because the soils are more fertile – they indicated the darker-colored (higher organic matter content) soils in forests may remain fertile for 6 or more years, while soils in savannah areas could usually only be used for 2-3 years. Loss of forest area will therefore impact both wildlife and farmers in the long term, and increasing acreages of savannah will need to be converted to fields to compensate for the loss of more fertile forest sites.

3.2.2 Increasing demand for fuel wood:

In the rural areas, the communities' fuel source for cooking is fire wood. Charcoal is primarily used for fuel in larger urban centers (Brazzaville and Kinshasa). Local and urban population growth is increasing the demand and pressure on the forest for fuel wood. Forests in the southern area of the Leconi-Bateke-Lefini Landscape are being increasingly harvested for fuel used in Brazzaville.

Villages we visited near the gallery forests in the landscape do not appear to be concerned about firewood availability. Villages farther from gallery forest and wooded savannahs would benefit from fire wood plantations. Reducing consumption of fire wood by introducing more efficient stoves into villages would also reduce the demand for fuel.

Depending upon available transportation systems (river, roads) there may be an opportunity to establish plantations for producing charcoal. This may be more economically feasible in the areas of closer to Brazzaville, especially if more high-efficiency charcoal kilns were used in conjunction with these plantations.

3.2.3 Reducing demand for bush meat:

The villagers' protein intact is primarily provided by chickens, goats, pigs, and bush meat. Bush meat is a significant component of their diet. The gallery forest and savannah provides a variety of species for food. Villagers recognized there are different animals that use the savannahs and

gallery forest and that they hunt animals in both areas. People like the taste of bush meat. There is a large market for bush meat at Kinshasa and Brazzaville.

There is an opportunity to provide alternative food sources such as fish ponds, mass production of chicken, and domestic animals that could graze the savannah. Assistance with developing fish ponds and finding an animal that could graze the savannah was requested by many villagers visited.

3.2.4 Social welfare improvements:

There is a great need for social welfare improvements such as medical, education, and infrastructure. Many villagers questioned why the concern with frequent brush fires, hunting for bush meat, climate change, and carbon sequestering when there is a greater need for basic human needs such as jobs, medical supplies, education support, and a transportation system to allow them the opportunity to get their products to market.

There is an opportunity to connect social welfare improvements to natural resource projects.

3.3 Democratic Republic of Congo

The team gathered information during meetings in Kinshasa, at the WWF Bambou base camp in the Malebo area northeast of Bolobo, and at nearby villages. Field tours were made to assess grazing lands, bonobo habitat, agricultural fields, and forest/savanna ecosystems in the surrounding Lac Tumba landscape.

3.3.1 Current Fire Regime

Current fire management practices are reducing the productivity of livestock grazing operations and wildlife habitat in savannah areas, contributing to the reduction or degradation of forests, and will prevent both natural and artificial reforestation. Reasons for igniting fires at such a high frequency were similar to those described for the Republic of Congo (Page 6, above). Community leaders recognize the high fire frequency is having undesirable effects, but expressed frustration at the lack of ability to prevent people from igniting random fires. Some legal recourse is available; for instance, if a farmer burns his field and causes damage to a neighbor's field, he is liable to pay damages. Unfortunately, little is currently being done to manage the frequent ignitions in many areas of the landscape. A clan/chief hierarchy exists in part of the Lac Tele – Lac Tumba Landscape that would be the appropriate structure for coordinating people to suppress fires or achieve other resource conservation objectives.

It is often advantageous to first work on fire management with a group of organized people, establish a trained cadre, and build on that success by having that trained cadre share their successes and knowledge with other groups. One potential group that is interested in fire management is the grazing concession in the southern Lac Tumba landscape.

The ORGAMAN (Organisation, Participation et Management) Corporation has a subsidiary - *Société d'Elevages Bostandji* (SEBO) that manages a grazing operation in their concession in the southern Lac Tumba landscape. SEBO burns their pasture blocks at 1-2 year intervals for forage improvement. Areas are burned to reduce brush and stimulate new grass growth, which is preferred by cattle. Older grass/forbs are lower in nutrients and digestibility.

It is also recognized that a high frequency of wild fire degrades the quality of forage by eliminating some of the high nutrient herbaceous species. There are approximately 200 small

cattle owners in the southern Lac Tumba landscape whose livelihoods are at risk of continuing high fire frequency, yet they are often the ones igniting the fires.

Some SEBO managers would like to manage fire to protect the gallery forest when they burn the savanna; however, some of their fires and especially random brush fires have degraded portions of the gallery forests. WWF is also concerned about fire in gallery forests, especially bonobo habitat and would like to see proper fire management in the savanna as well. The savanna is habitat to many wildlife species including bonobos and fires ignited in the interior of the savanna push elephants to the roads and into villagers crop (manioc, banana) fields.

Protecting gallery forests would also serve to sequester carbon and there is potential for future credit selling. African Development Bank is proposing a reforestation effort for carbon credit. It is not clear if they are addressing the issue of fire management to protect the reforestation effort.

3.3.2 Biological Diversity and Bonobo

The primary threats to biodiversity in unprotected areas are bush fires, villagers crop fields (slash & burn agriculture), and bush meat consumption. The closer one gets to Kinshasa & Brazzaville, the less forest cover and wildlife are found. Human population is increasing along the river corridors so gallery forest habitat is decreasing at a high rate along the rivers.

The Lac Tumba Landscape still has a high percentage of forest and undeveloped savanna, but pressures are increasing from the rising human population. WWF is developing base level information on wildlife populations, habitat and biodiversity. They are still completing inventories, so baseline for monitoring is recent or still unknown.

WWF is monitoring bonobos, elephants (trail dung occurrence), small monkeys (DeBrazza's, red-tailed, & Wolf's), fish, and water quality. Smaller monkeys are a good indicator to forest degradation. A study in progress indicates that areas without fire have a tenfold higher density of DeBrazza's monkeys.

Three groups of bonobo in the Malebo area are habituated. WWF personnel are working on a fourth group. The purpose of the bonobo habituation is for ecotourism and research. Ecotourism can bring income to local economy so the goal is to have this managed by the local community. Habituation allows researchers to more closely observe bonobo behavior and there is a control group to allow a comparison of effects. Currently there is a 60-70% chance of seeing bonobos at 15-30 meters. One of the early observations from the research indicates that bonobos used to migrate during the dry season, but are now staying in the Malebo area.

MBOU-MON-TOUR is a village based NGO working in the area – they want to protect the gallery forest and bonobo habitat and hope to benefit from ecotourism in the future.

Slash & burn agriculture in the gallery forest has been identified as the biggest threat to bonobos. Moreover, bonobos feed on the furits/seeds from high value timber species and therefore there is a direct threat from logging operations on bonobo habitat.

The Bateke people inhabiting the Malebo area believe that bonobos are their ancestors, and therefore a traditional taboo prevents the Bateke from killing bonobo (Inogwabini 2007). Thus, local chiefs prohibit people from hunting bonobos for bush meat and thus population levels are higher in the Malebo area. Unfortunately, the closer to the Congo River, the less authority is retained by traditional chiefs. This results in less protection for the bonobos, as well as other wildlife and forest habitat.

3.3.3 Forest Cover Degradation & Deforestation

There are 38 tribes in the Lac Tumba landscape; 10 of which are in the South and 28 in the North. There are approximately 10 people/sq km in the South and 0.4 p/sq km in the North. This relatively low population density has been increasing in recent years, as have the associated demands on the ecosystem. Increased human population growth, immigration (of people along the river moving into the interior), and refugees causes: 1) increased land clearing for agriculture (corn & manioc), 2) increased charcoal production for selling to the urban markets, 3) increased need for fire wood, and 4) increased random ignition of brush fires. All this leads to forest cover degradation and deforestation.

Deforestation is rampant along the rivers, due to harvesting for both local use and shipping to urban centers (Kinshasa). Deforestation of riparian forest causes other issues such as decline of fish populations and water quality. Part of the deforestation is caused by immigrants clearing for agriculture. Not only does the increasing population create pressure on the forest - decreasing productivity is having a profound effect as well. Slash and burn agriculture leads to exhaustion of soil nutrients, which results in people immigrating inland and causing conflicts with those inhabitants presently living in the area. Even on soils that have not been depleted there are challenges faced by those engaged in subsistence agriculture due to lack of information, training, techniques, and supplies that could improve yield.

Manioc varieties currently used in much of the region are highly susceptible to disease; yields are reduced by half to two-thirds of that of more resistant varieties. This results in the need to clear two to three times as much savannah or forest to produce a crop. There are disease resistant strains of manioc, but villages have to develop an organized group to apply and qualify for inclusion in distribution programs and this has not been done in much of the region.

The populations in major cities affect the distant forest ecosystems through the demand for forest products, especially charcoal. Electrical power is so unreliable in Kinshasa that people keep supplies of charcoal available. They prefer to cook with electricity but can't because of power shortages and expense. Prices of charcoal are rising in Kinshasa, thus allowing greater profit or greater transportation costs.

There is a significant and increasing charcoal trade along the Congo River - extending twice as far up the river as Malebo. Charcoal is produced in the area and shipped out by boat on the Congo to Kinshasa & Brazzaville. There is an opportunity to reduce pressure on the gallery forests by growing plantations to produce charcoal for the cities. Well designed and placed plantations would facilitate the harvest, production of charcoal (through efficient stationary kilns) and transportation to the cities, which would be preferred over the increasingly long transport of charcoal produced from the forest ecosystems.

There is awareness of, and interest in, planting native early seral tree species as "nurse" trees to help recover the forest. These early seral native tree species are the first trees that seed in the savannahs, such as the *Uapaca guineensis,* later to be replaced by other rainforest species. The development of reforestation projects is constrained by a shortage of information on forest resources. For example, growth and yield tables for forest species. This has been identified as a concern that could limit REDD associated program success throughout the Congo Basin (Dkamela et al. 2009).

Even with recognition of the increasing rate of deforestation and a desire by many villages to retain and restore gallery forests, there is often confusion as to who has the authority and responsibility to protect and restore the natural resources in a given area. Land ownership is poorly defined and clarification of this would help villages deal with immigration, as well as help protect gallery forests from unauthorized cutting and burning. WWF presence in the Malebo area is resulting in some protection to the gallery forests nearby, through their efforts with the local communities, government agencies and international partners.

3.3.4 Access

The transportation system in the DRC is not adequately developed or maintained for efficient transport of products to market. Roads are poorly maintained in the Malebo area and become impassable during the rainy season. People used to be able to drive to Kinshasa in 6 to 8 hours. Today, it is impossible to drive to Kinshasa.

The effects of an inadequate transportation system on fire management and deforestation are both positive and negative. Without efficient access, the ability to transport forest resources (timber, bushmeat) to the major cities is limited, which keeps the rate of deforestation and degradation relatively low. Improvements to the road system would also be likely to increase the rate of immigration (and the corresponding demands on natural resources) to the interior of the country.

Conversely, under present conditions, when people send products to market, they must pay for not only the actual transportation cost, but bribes to local officials resulting in sometimes doubling the cost of getting produce to market. It was suggested that taxes and bribes can cost 50% of getting commerce to market. This results in the need to take twice as many fish, or kill twice as much game, or grow twice as many crops just to get the base level take home income. This in turn results in twice as much impact to the ecosystem.

An interesting link developed by WWF between the transportation system and natural resource protection is that many villages are willing to agree to resource protection measures in exchange for road improvement or other infrastructure development projects. Thus funding for road improvements can be contingent on the communities refraining from poaching, lighting random brush fires or reducing the extent of slash and burn agriculture on a quid pro quo basis.

In addition to the infrastructure benefits, WWF employs approximately 80 people in the landscape, including trackers, guards, camp staff, researchers, etc. WWF spends time training the local villagers they employ, so they can carry on the management themselves in the future. This approach of linking both infrastructure improvements and employment to resource conservation has garnered community support for projects much more readily and effectively than where benefits to the local communities have not been directly linked or obvious.

4.0 RECOMMENDATIONS

4.1 Republic of Congo

4.1.1 Reforestation for village firewood, charcoal production, and fruit trees.

Develop demonstration projects for sustainable and efficient cooking fuel production. These projects would be carried out in two components: i) Develop one pilot site for the production of rapid growing native seedlings to furnish village plantations; and ii) Develop two pilot sites for the planting of rapid growth local species fuel wood.

The villages west of Lefini reserve and in the southern end of the landscape have a shortage of available firewood. Demand for charcoal from Brazzaville and Kinshasa results in degradation of the woody savannah and gallery forest, especially along the Congo River.

Objective: To provide reforestation for charcoal production and local fire wood consumption.

a. Type of fire management

There is high fire frequency in the area. Fire protection (fuel breaks) to reforested areas is required to allow trees to get established. Once trees are established and tall enough, depending upon the tree species, low intensity fire could be allowed to occur.

b. Reforestation

Reforestation can occur either by natural regeneration or planting depending upon the objectives of the individual village. Villages without good access to forests would benefit from establishing plantations for firewood and timber for local use, and villages with good access to Brazzaville could establish plantations for charcoal production or fruit trees such as African plum that could provide a cash crop. Several villages indicated they would like to establish a nursery for either agroforestry or timber crops. The villages Mpoh and Okiene could probably utilize the Ministry of Agriculture nursery in Ngo, and least for initial reforestation projects.

Villages such as Impini and Kebara are more isolated and also appear to have more native forests that may supply a more sustainable supply of firewood and timber. Make sure these villages have a justifiable need for nurseries; if the need is primarily for agroforestry species, these may already be available from Ngo.

c. Incentives

Plantations need to have support from local villages to receive protection from fire. The potential sale and use of charcoal and fuelwood is a primary incentive for this project. Planting of high value commercial species along with fuelwood trees, or in separate plantations, can provide an additional economic incentive.

Planting trees in association with agriculture fields provides a crop (manioc for example) concurrently with trees for a few years until trees are large enough to start providing products and income. People will protect their crops and thereby also protect the planted trees. This would require the site be eventually abandoned from growing agriculture crops.

As with the preceding project discussions, quid pro quo opportunities could be explored to link fuel wood plantations and other resource conservation objectives with a social improvement such as school, roads, or medical improvements.

d. Next Steps

Recommendations for this project and those in the Fire Management and Reforestation and Tree Nursery Operations in the Strategic Considerations section are interrelated and summarized below.

1. Because of the lack of information on plantation performance and the lack of expertise on nursery management and plantation management, this project should start with small

outplantings and increase as experience and knowledge of plantation performance increases. Consider using the Ministry of Agriculture nursery at Ngo or to produce the seedlings for initial outplantings, and obtain assistance (and perhaps seedlings) from the Ministry *du Developpement durable de l'Economie Forestiere et de l'Environment* in establishing small (1-2 hectare) plantings. Eucalyptus or some other readily available tree species could be used for these initial plantings – the objective is to gain experience in planting and maintaining plantations.

2. The same steps should be followed as outlined on page 14-15 for the project at the Emphytheose of Nioki, including: a) determine priority locations for reforestation, b) assemble information for nursery/plantation trials on both non-native and native gallery forest species and determine which species appear to be suited for nursery production, c) provide technical assistance from a USDA-FS nursery expert to enhance the establishment and operations of nurseries to raise tree seedlings for planting, d) get a commitment from the benefitting individuals or communities to maintain and protect the reforestation areas, e) request USDA-FS assistance to provide training in planting/tending the plantations and protecting the plantations from fires, and f) employ local people for the implementation of the project. The NGO RINDRA should be able to assist in developing reforestation methods for native species. Also, the team met another NGO, *Actions pour l'Environment et la Solidaritè Internationale* (AESI) which was interested in carrying out planting projects in the Lekana District
3. In the case of villages such as Mpoh and Okiene, much of this work is already incorporated into land use plans and platforms are established to implement these projects.

4.1.2 Carbon Sequestering through Gallery Forest Reforestation

This project focuses on using either natural regeneration or planting of native species to expand selected gallery forests in the Bateke Plateau as well as restoring areas of existing gallery forest degraded by fire or slash and burn agriculture. This would increase carbon sequestration and may provide carbon credit payments to participating villages through the proposed REDD program.

Objective: Increase carbon sequestration for carbon credits by allowing expansion or restoration of selected gallery forests.

a. Type of fire management

There is a very high fire frequency in the Bateke plateau. Fire protection (fuel breaks) to reforested areas is required to allow trees to get established.

b. Reforestation

Conduct reforestation either by natural regeneration or planting of trees.

Natural reforestation for gallery forest restoration may be more desirable with planting of some high value commercial species that already occurs naturally in the gallery forest ecosystems. If the gallery forest disturbance was recent, there is probably adequate seed of native species in the soil. Protection from additional disturbance may be all that is needed.

c. Incentives

There are several potential incentives for local communities to support and become involved with this project. The first and most readily apparent incentive would be in the form of employment. Local villagers should be hired to plant the trees and provide protection until carbon credit market driven funds become available.

A second incentive is the resources that would become available for local villages. Multiple use of reforested areas is desired in case carbon market payment does not materialize so trees provide benefits to villagers. Therefore, it would be advantageous to plant some trees that provide food or materials useful for villagers.

Finally, wherever possible, a quid pro quo link should be established between fire management/reforestation to a social welfare development project such as school, road, or medical improvements. Such projects should be developed with full participation by the local communities.

d. Next Steps

The recommendations for this project are very similar to those for the SEBO/WWF Landscape Fuel Break Design Using Gallery Forest Reforestation project in the DRC.

1. Assess the fire patterns and fire regime in the landscape. MODIS remote sensing data, available through OSFAC, is readily available and can be used to assess the current fire regime. This information, when compared to ecological indicators – such as loss of woody vegetation in savannas with frequent fire or degradation of gallery forests - can be used to develop a desired fire regime for the landscape. The local climate must also be considered. Technical expertise is available within the USDA Forest Service to assist with such an assessment of the fire regime.
2. Determine priority locations for reforestation. MODIS remote sensing data can also be used as a basis for selecting gallery forest to restore or expand.
3. Where fill in planting is needed, the same procedures and assistance described in earlier projects should be used, including: a) determine priority locations for planting, b) assemble information for nursery/plantation trials on gallery forest species, c) provide technical assistance from a USDA-FS nursery expert to enhance the establishment and operations of nurseries to raise tree seedlings for planting, and d) request USDA-FS assistance to provide training in planting/tending the plantations.
4. For both planted and natural regeneration areas, fire management will be necessary. Training a cadre of Lefini Reserve, NGO, and village personnel in the implementation of fuel breaks and prescribed burning would enhance the success of the project. Fire training expertise is available within the USDA-FS.
5. USDA-FS personnel could also advise USAID or other donors on materials and equipment (e.g. mowers, fire equipment, personal protective equipment, and training materials) that could be provided to local villages or organizations to enhance their ability to more effectively manage fire.

4.2 Democratic Republic of Congo

4.2.1 Emphytheose of Nioki

Due to rainy season road conditions, the team was not able to visit this area. We are basing our recommendations on discussions with David Yanggen, Deputy Director of USAID/CARPE, and Bila-Isia Inogwabini of WWF as well as the original scope of work for this mission. The Governments of the DRC and Belgium signed an agreement to create a re-plantation zone covering 1,289 km^2. The objectives of the collaboration in this zone are threefold: i) reproduce forest cover that will increase carbon sequestration in the region, ii) help raise awareness and capacity of local communities in the development of the REDD mechanisms, and iii) help local communities to produce fuel wood for consumption and market. The Belgians are willing to provide financial assistance for a major reforestation effort in the southern part of the landscape adjacent to near the Kwa river. There have been many previous investments in the area such as improved manioc seeds increasing yields, timber logging, and rubber tree plantations established in the 1940's. The Belgians are willing to assist with gallery forest restoration that have been deforested and degraded for lumber, charcoal production, fire wood, and conversion to agriculture fields (manioc and corn).

Objective: To provide reforestation for charcoal production, local fire wood consumption, and gallery forest restoration. Gallery forest restoration could also improve fish habitat depending upon locations of restoration efforts.

a. Type of fire management

There is a high fire frequency in the area. Fire protection (fuel breaks) to reforested areas is required.

b. Reforestation

This project will allow funding for either natural regeneration or planting. Part of the area has good access to river transportation to Brazzaville and Kinshasa and so may be suitable for establishing plantations for commercial charcoal or timber; the area previously supported a sawmill. This project may require a considerable area of plantations. If so, establishing large regional nurseries may be the most efficient and economical way to produce planting stock. Natural reforestation for gallery forest restoration may be more acceptable if it is supplemented by planting high value native species that occur in the gallery forest ecosystems. Natural reforestation may occur simply by protecting an area from brush fires depending if seed still exist in the soil and nearby trees can seed in the area.

c. Incentives

Plantations need to be associated with villages to allow protection from brush fires. Locations of plantations need to be determined by villagers or they will not get protection.

Likewise, land tenure issues need to be clarified, i.e., who owns the land and who owns the timber. Limited recognition of land-tenure rights has been identified as a concern that could limit REDD associated program success throughout the Congo Basin (Dkamela et al. 2009).

Planting of high value commercial species could be an incentive providing economic income when the trees are old enough for harvesting.

The incentive to villagers for gallery forest restoration, where timber harvest is not a goal, could be REDD carbon credit payment to villagers. Direct payments to villages would address the concerns regarding inequitable revenue distribution (Dkamela et al. 2009).

A quid pro quo link between gallery forest reforestation, fuel wood plantations and other resource conservation improvements and with other benefits to villages such as road, school, or medical improvements may improve the initial acceptance and implementation of this project. WWF has already had success with this approach in the Malebo area.

d. Next Steps

1. A project of this magnitude should start small and build on its successes. To coordinate the many activities over a large area and time span, it is important to identify a project leader and/or responsible group or agency. This would be best coordinated by a local NGO, such as WWF or a community development organization, with active participation by local communities.
2. Determine priority locations for reforestation. Priority should be given to areas with strong local support and willingness to participate in the reforestation effort. Part of the determination should be the desired purpose of the reforestation (e.g. fuelwood plantation, fruit or timber production, gallery forest restoration, and/or carbon sequestration). Benefits to the local people (whether an individual or village) should be clearly identified, regarding products that can be used from the forest and/or who benefits from carbon credit payments or infrastructure improvements, if available. USAID/CARPE support could be in the form of supporting the local NGO and/or bringing in a USDA-FS team to provide technical advice on project feasibility or guiding implementation at a later stage. An FAO Community Forestry Manual (Warner, 1999) includes a method for selection of species for reforestation based the community needs which would assist in this process.
3. Assemble information for nursery/plantation trials on gallery forest species. In many cases, late seral species need to be planted beneath "nurse crops" of earlier seral species. The WWF staff at Malebo indicated that many gallery forest species regenerate under *Uappaca guinensis* along savannah edges. Jonas Eriksonn, WWF-DRC said there may be information from Belgian era plantation trials and he is willing to help locate that information. Published research should also be reviewed and local knowledge should be sought.
4. After the priority reforestation areas are selected and species selection has been made, technical assistance from a nursery expert would greatly enhance the establishment and operations of nurseries to raise tree seedlings for planting. Technical expertise on planning and operating nurseries is available within the USDA-FS.
5. After successful establishment of seedlings allows reforestation to begin, the project coordinator should get a commitment from the benefitting individuals or communities to maintain and protect the reforestation areas. Technical expertise may be needed to provide training in 1) planting and tending the plantations, and 2) protecting the plantations from fires. USDA-FS personnel could assist with both training aspects.

6. The actual planting operations would be best accomplished by local people. This would provide employment as well as gaining a sense of ownership, which may help reduce the number of random fire ignitions threatening the plantations.

4.2.2 African Development Bank Project and Bonobo Habitat Restoration at Nkala-Nko

Due to rainy season road conditions, the team was not able to visit this area. We are basing our recommendations on discussions with David Yanggen, Deputy Director of USAID/CARPE, and Bila-Isia Inogwabini of WWF. The African Development Bank (ADB) is proposing to pay for planting and maintaining trees that would ultimately be used to generate carbon credits in an anticipated carbon market. This would include paying money directly to villages through NGO's before the carbon market is established.

The ADB is proposing to plant up to 600 km^2 of savannah and/or former gallery forest. Currently, funding under this scheme is only for artificial reforestation projects, not for naturally regenerated forests, and target areas for planting are inland or upstream of major rivers. There are several issues that need to be addressed prior to implementation of this project: (1) the desire to reforest savannah areas may conflict with the SEBO grazing concession in the areas; (2) artificial regeneration may not improve habitat for bonobos or other wildlife in the village region unless species and planting designs are carefully selected; (3) there is a need to reforest degraded riparian zones along major rivers to improve fish habitat and water quality, and restore forest cover; and (4) there may not be enough suitable land available for planting in the area targeted for this project.

However, it may be possible to link this project with restoring bonobo gallery forest habitat at Nkala-Nko villages if the ABD can be persuaded to allow some of the reforestation to include natural regeneration around existing gallery forest, and if a suitable mix of native trees can be developed for planting in some of the areas.

Objectives: Establish plantations for carbon sequestering to sell carbon credits on future markets. A complementary objective would be to restore gallery forest habitat for bonobo.

a. Type of fire management

There is a high fire frequency in the area. Fire protection by fuel breaks to reforested areas is required. Such fuel breaks can be existing physical features, such as roads and rivers; or they can be constructed and maintained by clearing areas of vegetation by hand, mowers or fire. The type of fuel break should be based on the existing features of the area and the ability and willingness of the local people to practice fire management.

Also need to protect the degraded bonobo habitat area near Nkala-Nko from high intensity fire before reforestation efforts can occur. Without fire protection, each successive fire is fueled by the dead wood at the edge of the gallery forest and encroaches further in, thereby eliminating natural regeneration as well as decreasing the remaining gallery forest.

b. Reforestation

The African Development Bank needs to accept some degree of natural regeneration if one of the objectives is to restore bonobo habitat. This is far cheaper then planting trees, and

successful natural regeneration will result in greater plant diversity as well as meeting a number of other REDD reforestation objectives.

c. Incentives

There are several potential incentives for local communities to support and become involved with this project. The first and most readily apparent incentive would be in the form of employment. Local villagers should be hired to plant the trees and provide protection until carbon credit marked driven funds become available.

A second incentive is the resources that would become available for local villages. Multiple use of reforested areas is desired in case carbon market payment does not materialize so trees provide benefits to villagers. Therefore, it would be advantageous to plant trees that provide food or materials useful for villagers.

In some areas an additional incentive could be realized through new opportunities, such as ecotourism, presented by the restoration of forest ecosystems. Bonobo tourism potential may be an incentive for Nkala-Nko.

Finally, wherever possible, a quid pro quo link should be established between fire management/reforestation to a social welfare development project such as school, road, or medical improvements. Such projects should be developed with full participation by the local communities.

d. Next Steps

1. The same steps should be followed as outlined above for the project at the Emphytheose of Nioki, including: a) identify a project leader and/or responsible group or agency, b) determine priority locations for reforestation, c) assemble information for nursery/plantation trials on both non-native and native gallery forest species and determine which species appear to be suited for nursery production, d) provide technical assistance from a USDA-FS nursery expert to enhance the establishment and operations of nurseries to raise tree seedlings for planting, e) get a commitment from the benefitting individuals or communities to maintain and protect the reforestation areas, f) request the USDA-FS to provide training in planting/tending the plantations and protecting the plantations from fires, and g) employ local people for the implementation of the project.
2. Technical assistance potentials are also similar to those outlined for the project at the Emphytheose of Nioki although the higher fire frequency will increase the importance of training in fire management techniques, such as creating fuel breaks by cutting or prescribed burning.
3. An additional consideration for this project is the focus on bonobo habitat restoration. Experts at WWF are in the best position to outline the priority habitat locations. Reforestation of native species would be preferred for bonobo habitat. As discussed earlier, information needs to be assembled on the ecological requirements of native gallery forest species. Although not directly contributing to bonobos habitat, there may be situations where plantations of non-native fruit trees or timber/fuelwood species could be established in locations to serve as a buffer to protect the adjacent gallery forest from fires.

4.2.3 SEBO / WWF Landscape Fuel Break Design Using Gallery Forests Reforestation

SEBO has a concern with uncontrolled random fires because they lower pasture productivity (forage quality) and disrupt their rest-rotation grazing management system. The unwanted fires also threaten and burn SEBO's reserve areas (pastures left unburned for two years) before they are ready to burn to meet their objectives of reducing brush, enhancing forage quality and killing insects & ticks. Improperly timed and ignited brush fires also can open holes in the gallery forest allowing their cattle to enter the forest and get lost.

There is an opportunity to work with SEBO to create fuel breaks of natural vegetation strategically located to separate their pastures from savannas used by nearby villages, which will help prevent brush fires from burning in undesired areas. These fuel breaks can be natural reforestation areas or planted to a species of commercial value. The idea would involve managing the existing tracts of gallery forest as fire breaks and connecting them with strips managed to promote the growth of the native shrubs and trees, with some planting to fill in where existing vegetation is too sparse to fill in expeditiously. This idea would help SEBO manage their pastures, protect the gallery forest and native trees, and sequester carbon in the forested strips.

Objective: Protect gallery forest from uncontrolled brush fires and contain random brush fires. This is achieved by creating strategically linked corridors of dense gallery type forests that act as fire breaks linking to gallery forests or other natural fuel breaks.

a. Type of fire management

There is a high fire frequency in the area. Pastures are burned by SEBO at one year intervals, except the reserve areas are burned after two years. Fires ignited by villagers often spread into the SEBO pastures, which may result in fire intervals of less than one year. Fire protection (fuel breaks) to reforested areas is required until trees are old enough to resist if fire occurs.

b. Reforestation

Natural reforestation for gallery forest restoration may be more desirable if supplemental planting is used to increase the abundance of some high value commercial species (such as construction lumber) that already occurs naturally in the gallery forest ecosystems. Planting trees that can hasten the gallery forest recovery, such as *Uapaca*, would also be beneficial to this effort.

c. Incentives

SEBO benefits from reduced random fires burning their reserve areas.

If such a system was in place, SEBO's cost of operations would be lower because they won't need to invest time chasing uncontrolled fires that may get into their "reserve" areas.

SEBO may gain access to high value commercial species (construction lumber) if they are planted as part of the gallery forest fuel break.

d. Next Steps

Recommendations for this project and those described in the sections on Strategic Considerations - Fire Management and - Reforestation and Nursery Tree Nursery Operations are interrelated and are summarized here

1. Assess the fire patterns and fire regime in the southern Lac Tumba landscape. MODIS remote sensing data, available through OSFAC, is readily available and can be used to assess the current fire regime. This information, when compared to ecological indicators – such as loss of woody vegetation in savannas with frequent fire or degradation of gallery forests - can be used to develop a desired fire regime for the landscape. The local climate must also be considered. Technical expertise is available within the USDA Forest Service to assist with such an assessment of the fire regime.
2. Determine priority locations for reforestation. MODIS remote sensing data can also be used as a basis for determining gaps in gallery forests around SEBO pastures. Those gaps should be field verified by SEBO personnel and a determination made as to whether natural regeneration is feasible or fill in planting may be needed. Assistance from a USDA-FS ecologist may be helpful to train people in assessment protocols as well as providing recommendations for retaining corridors to allow passage of cattle and savanna associated wildlife.
3. Where fill in planting is needed, the same procedures and assistance described for the previous two projects should be used, including: a) determine priority locations for planting, b) assemble information for nursery/plantation trials on gallery forest species, c) provide technical assistance from a USDA-FS nursery expert to enhance the establishment and operations of nurseries to raise tree seedlings for planting, and d) the USDA Forest Service can provide training in planting/tending the plantations.
4. For both planted and natural regeneration areas, fire management will be necessary. Training a cadre of SEBO managers and villagers in the implementation of fuel breaks and prescribed burning would enhance the success of the project. Fire training expertise is available within the USDA-FS.
5. USDA-FS personnel could also advise USAID or other donors on materials and equipment (e.g. mowers, fire equipment, personal protective equipment, and training materials) that could be provided to local villages or organizations to enhance their ability to more effectively manage fire.

4.3 Overarching Strategic Considerations

4.3.1 Fire Management

Fire in the savannas of the Congo Basin is not a new phenomenon. Lightning strikes have always caused natural ignitions and anthropogenic ignitions have been occurring for such a long time that the ecosystems have adapted to and been shaped by the human influenced fire regime. However, in recent decades as the human population has grown and spread to previously uninhabited areas, the fire regime has been altered by more frequent burning, both spatially and temporally. In other words, people are lighting fires in areas previously only subject to natural ignitions and they are burning those areas more frequently than in the past.

Fire and vegetation affect each other in a series of positive and negative feedbacks, depending on the frequency, timing and intensity of the fires (Beckage et al. 2009). Without periodic fires, savanna ecosystems are encroached by fire sensitive trees and habitat for lions, buffalo and other open area associated species is lost. On the other hand, a fire regime that is too frequent or intense can eliminate even some of the fire resistant trees characteristic of the savanna ecosystem as well as spread into the adjacent gallery forests – reducing habitat for bonobos and a host of other species of plants and animals. The latter situation is becoming prevalent in the Lac Tumba landscape and is the most pressing need for action. However, the first situation must be kept in mind, as the focus should be on managing fire frequency and intensity, but not eliminating fire from dependent ecosystems or eliminating a tool used by local villages to meet their needs.

The first step in fire management, as expressed in Item #4 of the Scope of Work (Appendix A) is to assess the fire patterns and fire regime in the southern Lac Tumba landscape. Typically the fire regime is assessed by examining historic records of fires of both natural and anthropogenic origin. Adequate records are not available to determine a long-term historic fire regime; however MODIS remote sensing data, available through OSFAC, is readily available and can be used to assess the current fire regime. This information, when compared to ecological indicators – such as loss of woody vegetation in savannas with frequent fire or degradation of gallery forests - can be used to develop a desired fire regime for the landscape. The local climate must also be considered. Woody vegetation in areas with a mean annual precipitation less than 650 mm is limited by water availability and the fire regime has little effect on the ability of the area to become forested (Sankaran et al. 2008). Technical expertise is available within the USDA Forest Service to assist with such an assessment of the fire regime.

Once a desired fire regime has been derived, an assessment of the current situation compared to the desired will indicate the highest priority areas to address. Unfortunately, there are no simple solutions to the high frequency wild fire issue. Due to the numerous reasons for igniting fires in the landscape (described on page 4), fire management planning must be site specific and consider the socio-economic, as well as the ecological aspects of burning and/or controlling fires.

For example, reforestation projects for village fire wood plantations, charcoal production, commercial products (lumber, fruit, seeds, leaves), carbon sequestration, or gallery forest restoration requires fire protection until the trees are tall enough and bark thick enough allowing some resistance(or the canopy closure provides microclimate conditions that preclude fire). The simplest solution would be to incorporate a fuel break, either one created by labor, cutting or burning of fuels, or use of existing natural features.

It would be advisable to start small with fuel breaks protecting reforestation efforts. For example, select a one to five hectare gallery forest that was degraded by brush fire or slash and burn agriculture. Create a fuel break and let it regenerate itself naturally. If desired, plant some native species that one finds in the gallery forest. But, at the same time initiate a program to educate villagers on the benefits of reduced fire frequency. There is no need to eliminate fire. The overall goal would be to reduce the frequency and intensity of brush fires.

There needs to be an incentive for the villagers to change their burning habits. If villagers stand to gain economic or other benefits from the aforementioned reforestation projects, they are more likely to become involved in efforts to protect those areas from unwanted fires. At the very least, people would be less inclined to light fires in an area where they knew it would cause damage to resources upon which their fellow villagers are depending. Continue CBRNM (community

based natural resource management) involvement. The WCS CBRNM effort is well set up and very beneficial. The only way to reduce fire frequency is for the villagers understand benefits to their community from less frequent brush fires so they will want to change their burning practices.

Some (not all) of the benefits are:

- Less fire will allow woody savannahs to increase. In areas with a paucity of woody vegetation, this would increase wildlife habitat that is dependent upon woody savannah. A benefit would be more animals, thus increase success of hunting bush meat;
- Increased soil fertility as a result of more organic matter remaining on the site and entering the soil, leading to greater productivity and longer use of agricultural fields
- Increased carbon sequestration (woody savannah and gallery forest recovery) and economic benefits from selling of carbon credits;
- Increased local fire wood and timber availability to villages;
- Increased opportunity to make and sell charcoal;

Another potential strategy to reduce fire frequency would be to work with communities to burn parts of the landscape in an organized and controlled manner. This would require communities to divide their landscape into "blocks" to burn using natural landscape barriers such as roads, streams, crop fields, foot trails, etc. Then, develop a burning schedule of these identified blocks. The objective of this system would be to burn each parcel on a cycle consistent with the desired fire regime, which may be every 2 to 5 years, rather than the current frequency of <2year intervals. With less fire, the woody savannah has an excellent chance to recover given there is still a seed source for trees. Of course, this strategy is specifically recommended for savanna sites with a paucity of woody vegetation – such as the Bateke Plateau in the ROC. Savanna areas with abundant woody vegetation may actually become less favorable habitat for savanna associated species if fire intervals are lengthened to the point that the savanna becomes a dense brush field. Therefore, it is important to again emphasize that stakeholders identify (through Community Based Management, participatory mapping or other means) the desired conditions for the land and desired fire regime, before promoting a specific burn interval.

One must exercise caution when promoting longer burn intervals, since less frequent fires will also more fuel to build up, resulting in more intense fires when they do occur (unless the interval is lengthened to the point that the area becomes humid forest, which has site conditions not conducive to burning). Higher intensity fires could kill some of the savanna trees that the longer intervals were intended to promote, as well as allow fire to encroach into the edges of the gallery forest. Proper timing and ignition tactics can mitigate the concerns resulting from higher fuel loads.

This would require training of basic burning concepts - role of temperature, wind, humidity and fuel moisture upon burning and special ignition tactics designed to influence fire behavior in critical areas (e.g. around valuable trees or at the edges of gallery forests or a field being prepared for manioc). Such training would allow a controlled (lower intensity, slower) burn that would meet the objectives of the people igniting the fires, while keeping it within the area and desired effects.

There is currently a wide range in variation of coordination among people igniting fires, which in turn affects the style and efficiency of the potential transfer of technical fire management expertise. Some SEBO staff are already using weather information and modifying their tactics to attain desired results. They would like more training to enhance their ability to protect the gallery forests and valuable trees in the savanna when they burn for forage enhancement. Prescribed fire training would be relatively easy to impart to such an organized group and ample expertise is available within the USDA Forest Service. There is potential to develop a trained cadre that could continue the transfer of fire knowledge to other areas.

Many local villagers also coordinate their efforts when they burn an area for hunting animals, which is a start, but would require a different approach and level of training than the SEBO example above. One strategy would be to invite people from various villages to fire management workshops in which basic fire training would be followed by an organized prescribed burn, such as at a SEBO pasture. Participants could discuss the methods used and aspects that could potentially be adapted for use at the local villages. Ideally, this would be followed by assisting local villages with prescribed burns that meet their specific needs.

There will always be a need to provide fuel breaks around villages and their crop fields. One method would be fuel breaks created from controlled burning. Another opportunity could be mechanical cutting of grass such as providing tractors with mowers. The Chef de Sector Agricole de District Ngo suggested this proposal thinking it would improve visibility around the villages and provide a fuel break providing protection from brush fires. He thought this may lead to less need to light fires.

Thus, the highest potential for USFS fire management assistance appears to be in three areas:

1. Technical assistance with assessing and developing a desired fire regime.
2. Training a cadre of SEBO managers and villagers in the implementation of fuel breaks and prescribed burning.
3. Advising USAID or other donors on materials and equipment (e.g.mowers, fire equipment, personal protective equipment, and training materials) that could be provided to local villages or organizations to enhance their ability to more effectively manage fire.

4.3.2 Soil Fertility

A significant cause of reduction to soil fertility is the loss of organic matter on manioc and corn fields. If the organic matter was maintained through mulching practices, this could maintain organic matter and nutrient holding capacity of the soil. Villagers could incorporate cut grass, or agroforestry derived green manure or other forbs to their fields or use animal manure as a source of fertilizer and organic matter.

Examine the opportunity for use of other types of fertilizer to extend the use of crop fields. One reason the landscape gets burned is because of the need to clear the land (wooded savannah and gallery forest) for manioc and corn fields. If an existing field can be used longer, there would be a reduction of moving to a new field and all the preparation work it requires, including burning off the grass and woody material. This may result in fewer ignitions and fewer “escaped” burns. The feasibility of using commercial fertilizer is limited by their availability to villages (cost, transportation).

4.3.3 Reforestation and Tree Nursery Operations

Reforestation is needed to expand existing natural forests or increase the tree and shrub component of savannahs, and to reduce deforestation and degradation of existing forests by establishing plantations to supply the increasing regional demand for fuel and timber. Areas protected from burning may naturally transition to forest or more wooded savannah. This transition can occur as a result of releasing existing trees or shrubs from fire, from seeds dispersed from nearby forests or savannah trees, or from seed already present in the soil. This natural regeneration process may not occur if sites have become harsher due to depletion of soil organic matter or loss of fertility, if there is no seed source of desired trees, if there is excessive browsing by animals, or if there is competition from aggressive weeds. Where conditions are not suitable for natural regeneration, or where local interest could be increased in protecting reforestation areas by planting valuable or useful native species, artificial regeneration of native species could be used to augment natural forest establishment. Little if any planting on native species is currently being done in either the DRC or the ROC, so information must be developed on what native species are preferred for both wildlife and human use. Local villages should be involved in determining what types of native and non-native species should be selected for planting based on the social and economic requirements of these communities as well as how species will provide ecosystem services such as wildlife habitat and soil and water quality. An FAO Community Forestry Field Manual 5 (Warner, 1999) describes a method for selecting species based on community needs that would help in this process.

When the preferred species have been identified, then the ecological requirements and the propagation protocols for these species must be determined. Ecological requirements include what soil types and moisture regimes the species prefers and what light levels are needed for best establishment and growth. For example, early seral, or pioneer, species are usually adapted to grow and compete with other plants in full sunlight. Later seral species often need to be planted in under a "nurse crop" of fast growing pioneer tree species that provide shade that reduces the competition from species with higher light requirements and moderates temperature, humidity, and soil moisture.

The WWF staff at Malebo has observed that that many gallery forest species regenerate under the early seral species *Uappaca guinensis* along savannah edges, so this species may be acting as a nurse crop in this ecosystem. Nurse crops, especially nitrogen-fixing species, are also used on degraded sites to improve soil conditions for more demanding species. Ecological requirements for a species can often be deduced from its distribution and abundance across the landscape. Failure to determine these requirements can result in failure of reforestation plantings, so this step is essential in initiating an artificial regeneration program for native plants.

The team is not aware of any information currently available on nursery propagation of native trees in this region. This includes information on seed collection, processing, and germination; and growing regimes (what types of containers, growing media, nutrient requirements, rates of growth, etc) for these species. Development and refinement of propagation methods for individual species is part of any nursery operation. This requires an ongoing effort to evaluate field performance of nursery stock and adjust nursery operations to improve survival and growth of plantations.

Establishing nurseries in villages without initial propagation protocols for the species being produced is likely to lead to initial failure and discourage future efforts. For this reason,

production of native trees in village nurseries is not recommended until these protocols have been developed. Sources of expertise and assistance in developing these protocols may be available in the Republic of Congo. The Ministry of Agriculture has a nursery in Ngo that is producing fruit trees, and the *Ministere du Developpement durable de l'Economie Forestiere et de l'Environment* operates nurseries and establishes forest plantations, primarily eucalyptus, in some districts of the ROC. Either of these agencies should be able to help develop propagation methods for native tree species. In addition, RINDRA, an NGO from Madagascar, is supposed to begin working in the Bateke Plateau area of ROC early in 2010. This NGO has had success using native species for reforestation in Madagascar and would be a good source of assistance in developing propagation protocols, establishing local nurseries, and establishing plantations. More information on RINDRA is available from WCS Congo (there is currently no website for RINDRA).

Establishing plantings in non-forested areas for fuel wood, timber, and agro-forestry in would reduce the pressure for harvesting in natural forests. Either native or non-native species can be used for these types of plantings.

Both Landscapes visited by the team have a need for nurseries. Many of the villages visited in the ROC were interested in developing nurseries and planting trees for fuel, timber, or food. Unless commercial charcoal operations are developed in the area, plantings in the ROC are likely to be fairly small-scale and used to supply local village needs for wood products. In the DRC, there is a potential and possible funding, for large-scale planting in the Emphytheose of Nioki and African Development Bank Projects.

Aside from the Ministry of Agriculture nursery at Ngo, there are no nurseries, and hence no plantations, currently being operated in either Landscape. Because of the lack of experience in artificial regeneration on both Landscapes, it would be best to start with small projects to develop experience. Failures are an inevitable part of any learning process, and small failures are less discouraging, less expensive, and have smaller environmental impacts, than larger ones. For example, it may be better to begin by using only a few nurseries to supply planting stock and allow villagers to become familiar with establishing and tending small (1-2 hectare) plantations. In the ROC, reforestation stock could be produced at the existing Ministry of Agriculture nursery and Ngo, and smaller nurseries could then be established after the existing nursery staff there gained experience in producing forest species and could provide training and assistance to smaller nurseries.

Unfortunately, there appears to be little or no in-country expertise in the DRC to support nursery or reforestation projects. Hopefully, some transfer of information and assistance can take place between the agencies and organizations in the ROC and DRC that are working on these landscapes or additional sources of expertise can be located in Central Africa. The World Agroforestry Center (ICRAF) (http://www.worldagroforestry.org/af/) is a source of information and expertise on nursery management as well as possible tree species to include in agroforestry or fuel wood plantings. Other sources of expertise probably exist in the region, but the team did not have the time to look for them. In any event, the Lac Tele Lac Tumba Landscape will certainly require additional expertise to develop nursery and reforestation programs on the scale being discussed. Fortunately, the size of these projects may allow funding for full-time, experienced foresters and nursery managers.

Developing and operating nurseries, regardless of the species being grown in them, requires a commitment of time and resources. Local (individual village) nurseries could be developed to

grow small amounts of material, or larger regional nurseries can be developed to produce plant material for several villages. There are advantages and disadvantages for each type of nursery:

- Local Nurseries
  - Advantages
    - Successful local nurseries develop local interest in reforestation
    - May provide a source of revenue for local people
    - Less investment in facilities and equipment
    - Smaller water supply
    - "Cost" of labor may be reduced
  - Disadvantages
    - Lower initial expertise and so greater initial chance of failure. Early failures may discourage local groups from continuing reforestation efforts
    - Limited capacity for growing a large variety of species
    - Additional water sources will need to be developed in most of the ROC villages interested in nurseries
- Regional Nurseries
  - Advantages
    - Full-time staff can focus on developing expertise in nursery management.
    - Capacity for growing a larger variety of species
    - Economies of scale usually lower the unit cost for seedlings, although labor costs may not be considered in smaller nurseries
    - Larger facility can justify investments to improve seedling quality (fertilizer, pesticides, improved growing media and containers)
    - Can serve as a supplier of seed, cuttings, and transplants for local nurseries to grow out
  - Disadvantages
    - Cost of full-time staff
    - Total facility and operating costs are higher for a large nursery (although unit costs may be lower) than for a small nursery.
    - Need for a larger water supply
    - Added cost for distributing and caring for seedlings at field site during planting operation
    - Possibly less broad local community exposure and benefit capture

Other considerations and information on establishing and operating nurseries are contained in the nursery references in Appendix D of this report. People establishing and operating nurseries,

whatever the scale, will require both initial training and ongoing on-site assistance to produce quality planting stock.

Plantation establishment will require site preparation to remove or reduce competing vegetation prior to planting. After planting, competing vegetation and grazing will have to be controlled until the trees become tall enough overtop grass and herbaceous vegetation and grow beyond the reach of animals. This may require weeding and protection for up to 3 years, depending on the growth rate of the planted trees. In addition, plantations will need to be protected from fire.

One approach to reducing the need for site preparation and initial tending would be to plant trees in agricultural fields, especially in the Republic of Congo, where fields are established in the savanna. This allows would provide initial protection from bush fires and competing vegetation. When the trees get big enough to compete for nutrients and water, the crops can be removed and the site will become a tree plantation. If farmers do not want to grow a mixture of trees and crops for a long period, trees could be planted in fields in the last growing season the field was to be cropped and still benefit from initial weed control and fire protection.

Similarly, high-value timber trees could be planted in fields established in forest areas to provide a source of increased revenue from the area after it was abandoned for agriculture.

In both the landscapes visited by this team, the greatest potential for USFS assistance in reforestation and nursery management is:

- Technical assistance in developing propagation protocols and restoration practices for native species
- Assistance in developing a cadre of trained nursery managers and reforestation specialists for village and regional nurseries
- Advising USAID and other partners on material and equipment needed for nurseries and reforestation projects.

4.3.4 Carbon Sequestration

Reforestation of degraded and deforested areas for carbon credits is feasible. Whether by planting or natural reforestation depends upon the site, available existing seed sources, and desired species mix. It is critical to protect the reforested areas from fire, so involving local villages and identifying incentives will be integral to the success of the project.

Reduced Emissions for Deforestation and Forest Degradation (REDD) can create financial incentives to keep these forests intact. But for REDD or any related climate/forest policy to be effective, it must reflect the needs and concerns of forest-dependent communities (Dkamela et al. 2009). Support a process to allow the selling of carbon credit from existing forest cover may also be advantageous for multiple objectives. Every village has a territory it has access to for natural resources which includes wooded savanna and gallery forest. If a program was created were villages could receive money directly from their existing forest, they would have an economic incentive to protect the forest from burning. This would require mapping community territories and existing vegetation.

There is a need to know the volume of carbon sequestered for the forest cover types of the Congo Basin. To facilitate this task, develop volume (and carbon) yield tables for selected species that could possibly represent a group of species. US Forest Service personnel with experience with

growth and yield development could be used to help design basic volume and carbon yield tables.

Reforestation for carbon sequestration can utilize trees (planted or natural regeneration) that maximize carbon storage. Other tree species can be grown inter mixed that have other values for villagers such as fruit, seeds, fiber or leaves that villagers now use but are harder to obtain. This could reduce total carbon sequestered but provides other useful products helping gain support from the villagers.

4.3.5 Fire Wood and Charcoal Supply and Demand

Reducing human pressure on the forest resources must be achieved in order to sustain and restore gallery forests and wooded savannahs. The greatest use of wood from these areas is for fuel in the form of firewood or charcoal. Steps must be taken to reduce demand for these products through more efficient utilization. At the same time, steps must be taken to increase the supply of wood produced on village land or other areas by more effective agroforestry or forest management practices. Two recent studies on charcoal production in Africa (Kambewa, et al, 2007; Namaalwa, et al, 2009) have examined this problem in more detail.

Reducing Demand

Reducing demand for wood, especially fuel wood, obviously involves a combination of cultural, political, and technical issues that interact at various scales. Many of the possible solutions are outside the scope of work for this mission. For instance, charcoal is preferred for cooking in urban areas, and the current unreliability of electricity in Kinshasa and Brazzaville has increased demand, and prices, for charcoal because people are keeping a supply on hand to use during power outages. A public awareness campaign to build awareness of the ecological impact of charcoal production and promote alternative fuels may help reduce the demand for this product.

Wood used for charcoal is usually harvested at little or no cost from village or general land (or illegally from these lands and forest reserves), making it a very low cost resource for producers. This results in an artificially low cost (or high profit) for charcoal that helps sustain demand (or encourage production). Regionally, issuing and charging for licenses or permits for charcoal production or increasing the local regulation of harvesting of wood, would raise the price of this resource and encourage more efficient use.

However, a more pragmatic approach to this problem may be to reduce demand for wood used for charcoal production by increasing the efficiency of charcoal production and use. The team found several sources of information on more efficient charcoal kilns and charcoal burners. These are listed in Appendix D. Based on this information, it appears that kilns are available that use as little as half as much wood to produce a given amount of charcoal compared to current methods. Also, there are more efficient charcoal burners that would further reduce charcoal use.

At the village level, firewood is used for cooking. Improved wood stoves made from local clay are available in some parts of Africa. These stoves use about half of the fuel required by the cooking methods currently used (pots over open fires) in the villages the team visited, and they use a stovepipe to remove the smoke from the cooking area. References concerning more efficient stoves are listed in Appendix D.

The willingness of villages, NGOs and local government personnel to engage in land use planning activities, indicates there may be both the political will and the institutional structure necessary to implement some local initiatives to reduce demand, especially for firewood.

Recommendations

- Provide more efficient wood stoves and charcoal burners to reduce the use of wood and charcoal for cooking. Subsidizing the cost of improved wood stoves in villages could be part of an incentive program to leverage natural resource projects such as improved fire management or reforestation. This would seem to be the quickest, easiest, and cheapest way to reduce demand for firewood in the villages, and would have the added benefits of reducing the primary cause of respiratory problems in women and reducing the amount of time and work devoted to gathering wood.
- Seek additional expertise on improving the efficiency of charcoal production and wood fuel use – this may be available through the USFS Forest Products Laboratory (Madison, WI) but it appears it to be available through other organizations operating in Africa, Asia, and Central and South America.

Increasing Supply

Increases in the value or quantity of wood and other forest products can come from village forests through improved management of natural stands and plantation establishment.

In addition, there may be an opportunity to establish commercial charcoal production operations close to Kinshasa and Brazzaville or in areas on the CARPE/CBFP Landscapes with good enough transportation to reach these cities. Commercial operations would involve establishing short-rotation plantations to supply wood to high-efficiency charcoal kilns.

Recommendations

- Implementing land use plans should improve the regulation and management of both the forest reserves and village forests. However, the land use plans tend to put less, often times no emphasis on silvicultural recommendations for improving the productivity of forest resources. For those areas where appropriate a process needs to be developed to provide these recommendations, along with training on how to implement them.
- Determine the feasibility of establishing commercial charcoal operations using short-rotation plantations and high-efficiency kilns. The Team Leader for the US AID Office of Economic Growth and Livelihoods in Kinshasa was interested in looking at this as part of an agricultural development effort. Establishing charcoal plantations in already deforested areas close to urban centers would reduce the pressure on remaining natural forests in both Landscapes. Villages with good transportation to these areas, like Mpoh or Okiene, may also be suitable sites for commercial charcoal production.

4.3.6 Develop additional protein sources to reduce reliance on bush meat

The people of both countries have their protein diet derived primarily from chickens, goats, pigs, and bush meat with bush meat constituting a significant component of their diet. The demand for bush meat is high and increasing due to population growth. In some areas, bush meat is becoming scarce due to increasing demand pressures.

Many communities expressed interest in developing ponds for raising fish. In parts of the DRC, fish ponds existed in the past so it is not a new concept. There may also be an opportunity to scale up chicken production through large poultry farms. Ostensibly, there appears to be land north of Brazzaville available for development of poultry farms. Poultry is presently a major part of Congolese diet. Because frozen chickens are imported into the capitals, the economics are probably favorable to raise chickens locally.

Investigate the feasibility to graze the Bateke plateau west of the Congo River with domesticated animals such as cows, sheep, or other livestock. Government officials in Lekana expressed interest in finding solutions to grazing the savannah to provide a readily available protein source. Due to the sandy soils, the grass west of the Congo River has lower forage quality. During the team's travels to and from Lekana from Brazzaville, several cattle herds were observed. USAID could provide assistance to investigate means to scale up locally appropriate livestock production following best practices in range management. Due to occurrence of Tse-tse fly, breeds of cattle resistant to Tse-tse flies may be needed. Not only could the grass be utilized reducing the need to burn, but meat and dairy products could be generated. USAID could seek assistance to assess the environmental impacts of grazing before implementing such a project. Introducing large herds of non-native grazers, especially in areas where the local population has little experience with grazing management, can have unintended ecological impacts. Any such intervention should proceed cautiously and judiciously, as overgrazing could reduce habitat for the very species of wildlife this type of project is intended to protect.

APPENDIX A – SCOPE OF WORK

Draft - USFS Team Scope of Work

US Forest Service International Programs

Community Fire Management and Restoration in the Congo Basin

November 2009

1. Introduction and Background

The USDA Forest Service (USFS), through the Office of International Programs, is an implementing partner in the US Agency for International Development's (USAID) Central African Regional Program for the Environment (CARPE), providing targeted technical and capacity building assistance aimed at improving forest management in the Congo Basin. In an effort to focus this assistance in a manner which capitalizes on the relative strengths of the agency, the USFS is concentrating their efforts towards the land management planning processes of the CARPE landscapes. These landscapes were chosen for their biodiversity and conservation importance and established as foundations of regional conservation and sustainable natural resource use. These areas contain a mix of national parks and other protected areas, current or future timber and mining concessions, villages and settlements, and the neighboring areas on which communities depend for their day-to-day resources.

Natural and human induced fire has an important impact on the maintenance and provision of ecosystem services in the Congo Basin. Forest degradation and deforestation occur in the gallery forests and forest savannah mosaic, where the forest is exploited for the production of charcoal serving the population centers. Slash and burn agriculture and bush fires across the savannahs also contribute to deforestation and degradation and to the emissions of CO2 in the Congo Basin. As a major contributor of greenhouse gas emissions in the Congo Basin, large grass fires annually burn across the savannah landscape as a result of hunting practices, often destroying young colonizing trees and preventing the natural spread of forest cover.

2. Overview of USFS Support for Community Fire Management

Toward this end, the USFS will engage a technical assistance team to work in collaboration with several CBFP/CARPE landscape partners to assess natural and human-induced fire patterns and fire regime as part of the on-going ecological and socio-economic studies critical to land use planning. The team will work with partners to identify strategic approaches to mitigate human caused fire impacts on wildlife, biodiversity, biomass/carbon release, soil damage, etc. The team will meet with local NGOs, communities, and local authorities to better understand the challenges and opportunities and propose recommendations to support the partner's ultimate engagement.

Objective: provide technical assistance and training to CBFP/CARPE landscape partners to assess natural and human-induced fire impacts, behavior, and risk as well as developing strategies for community based fire management and degraded land restoration in the Leconi-Bateke-Lefini and Lac Tele - Lac Tumba Landscapes.

<u>Republic of Congo:</u>

8. Support in evaluating and developing strategies for fire management in the Congo segment of the Bateke Plateaux with fire management as a component of an assisted regeneration program to support carbon sequestration.

USFS technical assistance:

Evaluate the overarching strategy on fire management and develop specific recommendations on how CBFP/CARPE landscape partners could contribute to activities that support carbon sequestration.

9. Development of one pilot site for assisted regeneration of forest savannah mosaic habitat in the Batéké Plateaux.

USFS technical assistance:

Examine the feasibility of accelerated natural forest regeneration through the control of burning by local communities in the Bateke Plateaux region. Such a feasibility study would provide the basis for carbon-based revenue-generation for local communities that would not otherwise be able to participate in REDD-type schemes.

10. Develop a demonstration project for sustainable and efficient cooking fuel production. This project would be carried out in three components: i) Develop one pilot site for the production of rapid growing native seedlings to furnish village plantations; ii) Develop two pilot sites for the planting of rapid growth local species fuel wood; and iii) Introduction at two sites, improved charcoal ovens to more efficiently produce charcoal from wood, thus reducing emissions.

USFS technical assistance:

Examine the feasibility of a demonstration project for sustainable and efficient cooking fuel production and develop specific recommendations on how CBFP/CARPE landscape partners could contribute to related activities.

Democratic Republic of Congo:

11. Assessment of fire patterns and fire regime in the southern Lac Tumba - A thorough scientific study of the fire regime and fire patterns in the southern Lac Tumba will help guide the process of zoning agricultural zones, sensitive areas and will build into a fire management scheme that takes into account different needs (agricultural, conservational and cultural).

USFS technical assistance: development of fire research tools (including data collection protocols and instruments) and training of the Congolese team that will continue with the work in Lac Tumba and other regions of the country as necessary.

12. Technical assistance in forest regeneration in the pre-selected communal forest regeneration zone - Within the context of "REDD readiness," CBFP/CARPE landscape partners have initiated negotiations with local communities at the Nkala-Nko zone to develop mechanisms of bonobo habitat restoration through planting rapidly growing native seedlings in the zone. Success will depend on fire management of the region surrounding the targeted area.

USFS technical assistance: development of a specific fire management system (fixed calendar, zonal definitions, and consensus gathering instruments) and training program for this pilot site.

13. Technical Support to the re-plantation of the Emphytheose of Nioki - The Governments of the DRC and Belgium signed an agreement to create a re-plantation zone covering 1,289 km2. The objectives of the collaboration in this zone are threefold: i) reproduce forest cover that will increase carbon sequestration in the region, ii) help raise awareness and capacity of local communities in the development of the REDD mechanisms, and iii) help local communities to produce fuel wood for consumption and market.

USFS technical assistance: expertise in the project's design and analytical capabilities in the definition of the problems and proposed solutions. Apart from those theoretical inputs, it is also expected that USFS will contribute its expertise at the implementation process through providing templates of guides.

Location and Timing: The USFS team will work with the following CARPE partners in the following landscapes to highlight the following community fire management issues. Draft itinerary follows:

Estimated Dates	CARPE partner	Landscape	Country	Focus
11/2-4/09	Arrival and preparation for field mission			
11/5-11/09	WCS	Leconi-Bateke-Lefini	Rep of Congo	
11/12-21/09	WWF	Lac Tele – Lac Tumba	Dem. Rep of Congo	
11/22-23/09	Debrief and departure			

USFS Team Composition:

This USFS team will consist of two to three individuals with a collective set of experience in:

- technical, procedural aspects of fire management;
- analyzing and addressing fire impacts on wildlife, biodiversity, biomass/carbon release, soil damage, etc.;
- tree nursery management and reforestation;
- social and community engagement in fire management and reforestation initiatives;
- training fire management and/or nursery/reforestation techniques to diverse stakeholders and partners.

It will be important for USFS experts to understand that central African institutions have far less resources and capacity than the US Forest Service, so USFS experts must be capable of adapting USFS methodologies and processes to a different environment, one that has less structure, less bureaucracy and less oversight and resources to manage forest areas. Moreover, understanding the central African context will be paramount in successfully analyzing and suggesting appropriate mechanisms for planning.

USFS Team Tasks:

1) Implement the above USFS technical assistance components;
2) Develop a trip report on the mission (see description under 'Deliverables').

Tasks for CARPE partners:

1) Prior to the arrival of the USFS team, the CARPE partners will gather all available and relevant information on the particular macrozones to be visited, the special areas of engagement, and projects being implemented for the team to review to allow them to adequately prepare for the work to be done while in-country. As much as possible, this information should be sent to the USFS team electronically prior to their arrival. Any documents not available in an electronic format should be made available to the team upon arrival.
2) Identify points of contact for each CARPE partner who will accompany the USFS team while in country and be available for follow up on information exchanges once the team has departed.
3) Inform local stakeholders and other entities operating in the areas/zones of interest of the team's arrival and purpose of the mission, such that interactions with the USFS team will be most effective and efficient in gathering the data, needs, perspectives, etc. necessary for the mission.
4) In-country logistical support:
    a. Inform local officials of team's arrival and purpose of their engagement in region.
    b. Arrange for meetings with appropriate key officials and partners.

c. Arrange for in-country transportation and necessary lodging reservations.
d. Arrange for a translator to accompany the USFS team during the mission (TBD).

Deliverables:

1) *Trip Report*: the USFS team will produce a report detailing activities during the mission and all results and findings of the work toward the accomplishment of the objectives and tasks listed above. This report will include, but not be limited to:

a. Executive summary
b. Introduction
c. Issues, findings, & recommendations (per above technical assistance component)
d. Next steps:
    i. A prioritized list of future tasks that should be addressed in advancing the community fire management in the Congo Basin,
    ii. Possible future USFS engagement on community fire management issues
e. Appendices
    i. Scope of work
    ii. Itinerary
    iii. List of contacts made

Read ahead / background documents:

- USFS/CARPE Land use planning guides: http://carpe.umd.edu/Plone/resources/carpemgmttools
- USAID Central Africa Regional Program for the Environment - http://carpe.umd.edu/
- CARPE Information Management Tool: http://carpe-infotool.umd.edu/IMT/
- The Forests of the Congo Basin: State of the Forest 2006 (English or French)- http://carpe.umd.edu/resources/Documents/THE_FORESTS_OF_THE_CONGO_BASIN_State_of_the_Forest_2006.pdf
- The Forests of the Congo Basin: State of the Forest 2008 (French) - http://www.observatoire-comifac.net/edf2008.php
- USFS Trip Reports: http://rmportal.net/library/usda-forest-service-document-collection
- USFS Overview Activities in Congo Basin: http://www.fs.fed.us/global/globe/africa/basin.htm
- FIRMS project (Fire Information for Resource Management) http://maps.geog.umd.edu
- MODIS subset images including extracts for Leconi and Lac Tele - Lac Tumba http://maps.geog.umd.edu/firms/subsets.htm
- The Global Canopy Programme – Little REDD Book (Overview on proposals for reducing emissions from deforestation and degradation in the next UNFCCC agreement) - http://www.globalcanopy.org/themedia/file/PDFs/LRB_lowres/lrb_en.pdf
- Woods Hole Research Center policy briefs on REDD - http://www.whrc.org/pressroom/press_releases/PR-2009-8-20-Redd.htm
- WRI – REDD Briefing paper - http://pdf.wri.org/beyond_carbon_financing.pdf
- Central Africa countries submission to UNFCCC on REDD+ (see page 7) http://unfccc.int/resource/docs/2009/awglca6/eng/misc04a01.pdf

APPENDIX B – MISSION ITINERARY

Date	Activity and objective	Participants
Mo 2 Nov 2009	Maercklein and Overton arrival and hotel check in.	Jean Parfait Ampali (UICN – ROC)
Tu 3 Nov 2009	Introductory meetings and technical and logistical planning.	Marcellin Agnagna (UICN – ROC), Jean Parfait Ampali), Jim Beck, Dave Maercklein, Ron Overton (US Forest Service), US Ambassador, Paul Telfor (WCS Director) ; Director General Nzala Donatien; Ministere du Developpement durable de l'Economie Forestiere et de l'Environment (MEF)
We 4 Nov 2009	Work at WCS office conducting additional preparation to understand further the situation in the Congo Basin and complete field logistics.	Ron Overton, Dave Maercklein
Th 5 Nov 2009	Travel to Lekana (Bateke Plateau) and meeting with WCS field team at Lekana.	Mabiala Noe (Liason with Ministere du Developpement durable de l'Economie Forestiere et de l'Environment and WCS), Dave Maercklein, Ron Overton; Desire Rakotondranisa (WCS – Focal Point for ROC)
Fr 6 Nov 2009	Meeting with the field team at Lekana for USFS to present the details of the mission to the field staff; Meetings with local authorities to present the mission and its objectives.	Mabiala Noe, Dave Maercklein, Ron Overton; Desire Rakotondranisa, Jaques Gakosso (Administrateur des SAF, District du Lekana); Mbami Adzou (Chef de Brigade Eaux et Forets); Tsoumou Apollinaire (WCS-Bateke Staff); Rikouya Giglah (WCS-Bateke Staff); Bongo Domnique (Chef de Sector Agricole de Lekana); Ntiakoulou Loulfbo Thiophile (Ingenorur du Eaux et Forets; Centra National des Inventories Forestier et Louniques (CNIAF))

Sa 7 Nov 2009	Site visit to two villages near Lekana (Ontourou & Impini) to introduce mission and acquire on the ground perspective of challenges facing fire management and sustainable resource management. Ontourou sees no problems and wants no assistance. Impini wants a nursery to plant local forest species, eucalyptus, and fruit trees. Thus, need to have an area protected from fire.	Mabiala Noe, Dave Maercklein, Ron Overton; Mbami Adzou; Tsoumou Apollinaire; Rikouya Giglah; Ntsiapele Ndzali Costodes Benoit (Assistant Logistique du O.N.G., Action pour L'Environnement et La Solidarite)
Su 8 Nov 2009	Site visit to the village of Kebara to introduce mission and acquire on the ground perspective of challenges facing fire management and sustainable resource management. They agreed to have a nursery to plant fruit trees and trees to plant out in the forest and are willing to set up an area protected from fire.	Mabiala Noe, Dave Maercklein, Ron Overton; Mbami Adzou; Tsoumou Apollinaire; Rikouya Giglah; Ntsiapele Ndzali Costodes Benoit, Assistant Logistique du O.N.G., Action pour L'Environnement et La Solidarite.
Mo 9 Nov 2009	Travel to Okiene and Mpoh villages meetings with the CBOs of these two villages. These villages have their Action Plans with micro projects about tree nursery, reforestation, domestication of some forests plants, etc, the AARL association. The villages are both interested in a tree nursery, planting trees, and protection from fire at a selected area near their villages. Travel to Ngo to stay the night.	Mabiala Noe, Dave Maercklein, Ron Overton; Mbami Adzou; Tsoumou Apollinaire; Rikouya Giglah; Desire Rakotondranisa, Lefini Reserve conservateur/director and Plateform association leaders
Tu 10 Nov 2009	Visit to Ministry of Agriculture nursery – producing fruit trees in polybags for distribution to villages. Visit and meeting with Sous-Prefet of District Ngo to introduce USFS members and mission objectives. Meeting with platform members to discuss perspectives on fire management, carbon sequestration, and reforestation. Travel to Brazzaville.	Mabiala Noe, Dave Maercklein, Ron Overton; Mbami Adzou; Tsoumou Apollinaire; Rikouya Giglah; Desire Rakotondranisa, AMONA Adolphe, Chief de Brigade Eaut et Forets du District Ngo; Oyo NICAISE, farmer; Opari Albert Nuller, farmer and Vice President; NGAMBOU Appolinaire, Chief de Sector Agriculture du District Ngo; JULES MIENGUIE, farmer; NGAYOU MESMIN, farmer; NDALA ELVIS THIERRY, Village Okiene, district de Ngo, President du Groupement Okiene Production (GOP)

We 11 Nov 2009	Report writing day at WCS office in Brazzaville Posner Arrival in Kinshasa	Dave Maercklein, Ron Overton, Scott Posner.
Th 12 Nov 2009	Travel to Kinshasa and introductory and preparatory meetings. RSO briefing at US Embassy in Kinshasa, USAID, and WWF	Jean Parfait Ampali, UICN – ROC, Serge Osodu UICN - DRC, John Edle; T&E species coordinator for R1 & 3, USFS, on a 6 month detail to CARPE to do landscape planning; David Yanggen; Assistant CARPE director, USAID.Joseph Hirsch, USAID Economic Growth director; Bila Isia Inogwabini, Chef de Projet Lac Tumba, WWF-CARPE
Fr 13 Nov 2009	Report writing, preparatory work for DRC segment of Mission.	Dave Maercklein, Ron Overton, Scott Posner
Sa 4 Nov 2009	Travel from Kinshasa to Malebo. Meeting with local WWF team to provide USFS team the general context of how the concept of landscape does operate in order to see how USFS can guide WWF on more specific fire management and restoration	David Yanggen; Assistant CARPE director, USAID; Bila Isia Inogwabini, WWF staff; Dave Maercklein, Ron Overton, Scott Posner
Su 15 Nov 2009	Meeting with local Stakeholders - administrative, political, traditional authorities, NGO's, private sectors, and local villagers continued. Objective of USFS participation to provide USFS the general context of how the landscape functions and concerns to see how USFS can guide WWF on more specific fire management and restoration issues.	David Yanggen; Bila Isia Inogwabini,; Dave Maercklein, Ron Overton, Scott Posner, and local leaders
Mo 16 Nov 2009	Field visit to Isali. The objective so USFS team can have an understanding for fire use in the landscape. Also discussed with Orgaman's representatives on their fire management regime for the cattle concessions at Isali.	David Yanggen; Bila Isia Inogwabini,; Dave Maercklein, Ron Overton, Scott Posner, and WWF staff.
Tu 17 Nov 2009	Visit to a bonobo group in the gallery forest.	David Yanggen; Bila Isia Inogwabini,; Dave Maercklein, Ron Overton, Scott Posner, and WWF staff.

We 18 Nov 2009	Visit to Nko, village where WWF has started discussions about reforestation for carbon sequestering.	David Yanggen; Bila Isia Inogwabini,; Dave Maercklein, Ron Overton, Scott Posner, and WWF staff.
Th 19 Nov 2009	Visit a village where elephants have damaged some manioc and banana fields. Discussion on recommendations for mission report.	David Yanggen; Bila Isia Inogwabini,; Dave Maercklein, Ron Overton, Scott Posner, and WWF staff.
Fr 20 Nov 2009	Departure from Malebo to Kinshasa.	David Yanggen; Bila Isia Inogwabini,; Dave Maercklein, Ron Overton, Scott Posner, and WWF staff.
Sa 21 Nov 2009	Maercklein and Overton Travel back to Brazzaville. Posner Departs from Kinshasa.	Dave Maercklein, Ron Overton, Scott Posner, and WWF and WCS support staff.
Su 22 Nov 2009	Report writing and planning for next steps.	Dave Maercklein, Ron Overton
Mo 23 Nov 2009	Report writing and planning for next steps continues. Close out meetings with Paul Telfer and ROC US Ambassador. Maercklein and Overton Depart from BZV on Air France flight.	Dave Maercklein, Ron Overton

APPENDIX C - ACKNOWLEDGEMENTS

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- Paul Telfer; Directeur du Progarmme for Wildlife Conservation Society (WCS);
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APPENDIX D - REFERENCES

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Walters, G. 2007. *Fire Primer for the Batéké Plateaux, Central Africa*. Missouri Botanical Garden, USA. 42 pp. available at: http://www.ruffordsmallgrants.org/files/FirePrimerWalters.pdf

Warner, K. 1999. Selecting Species on the Basis of Community Needs. FAO Community Forestry Field Manual Nol 5. http://www.fao.org/docrep/006/v5320e/V5320E00.htm#Contents.

This manual outlines a process for selecting trees for reforestation based on local environmental, social, and ecomomic factors.

ADDITIONAL REFERENCES

Fire references

Fire Regime Assessment Tools

OSFAC - Observatoire Satellital des Forêts d'Afrique Centrale http://osfac.net/index.htm

As the Central Africa regional GOFC-GOLD (Global Observation of Forest and Land Cover Dynamics) network, OSFAC works to improve the quality and availability of satellite

observations of forest and land cover in the Congo Basin and to produce useful and timely information products for a wide variety of users. It is a legally recognized NGO in the Democratic Republic of Congo that operates with a regional mandate to promote the use of satellite data and products for the management of natural resources and sustainable development. (available in English or French).

FIRMS project (Fire Information for Resource Management) http://maps.geog.umd.edu

Delivers MODIS (Moderate Resolution Imaging Spectroradiometer) hotspot/active fire information in easy to use formats and can provide data for Lac Tumba (or indeed any of the CARPE - CBFP landscapes). MODIS does not pick up all fires, particularly if it is cloudy (you can read more on their FAQs) - so they probably miss quite a lot of fires in Congo but the two EOS satellites (Aqua and Terra) go overhead at pretty much the same time each day and there is data going back to 2001. They also have MODIS subset images http://maps.geog.umd.edu/firms/subsets.htm including extracts for Leconi and Lac Tele - Lac Tumba which will give an idea of cloud coverage. Contact

FRCC - Fire Regime Condition Class is an interagency, standardized tool for determining the degree of departure from reference condition vegetation, fuels and disturbance regimes. Assessing FRCC can help guide management objectives and set priorities for treatments. http://frames.nbii.gov/portal/server.pt?open=512&objID=309&&PageID=1397&mode=2&in_hi_userid=2&cached=true

Fire.org (http://fire.org/) posts publications and software packages concerning wildland fire planning, behavior, fuel, weather, and effects. Software such as FARSITE and FOFEM can be useful in planning a desired fire regime and FIREMON is a monitoring system, complete with data collection protocols and analysis software, that will help assess whether the fire regime is having the desired outcomes.

Basic Fire Training

Wildlandfire.com http://www.wildlandfire.com/pcprograms.htm has MS Power Point presentation materials for basic fire training.

Fireline Handbook: http://www.nwcg.gov/pms/pubs/410-1/410-1.pdf

Handbook carried by professional firefighters that primarily deals with wildland fire fighting and safety, but many of the topics are relevant to safety concerns on prescribed burns as well.

Fireline Handbook Appendix B – Fire Behavior: http://www.nwcg.gov/pms/pubs/410-2/appendixB.pdf

A very useful resource carried by most fire professionals. Provides some basic fire behavior information that will enable a person with a moderate level of fire behavior training (Introduction to Wildland Fire Behavior Calculations, S-390) to predict and calculate some basic elements of fire behavior and fire size.

Incident Response Pocket Guide: http://www.nwcg.gov/pms/pubs/nfes1077/nfes1077.pdf

Smaller than the Fireline Handbook, but still has useful safety and fire behavior information that can be more quickly accessed and used on the fireline.

Ignition Techniques

Prescribed Burning Guidelines in the Northern Great Plains
http://www.npwrc.usgs.gov/resource/habitat/burning/index.htm

These guidelines present a set of reasons, criteria, techniques, and examples of simple prescriptions which aid in the planning and execution of a safe and effective prescribed burning program. Particularly useful to people in the Congo (such as SEBO managers or other local fire users) are the links to Methods of spreading fire in grasslands, Confining Fire, and Weather Conditions.

Firing Techniques: http://www.bugwood.org/pfire/techniques.html

A good primer on firing techniques and factors associated with each technique. Includes discussion and diagrams to describe when, why and how to use various ignition tactics. This site would useful to people in the Congo with burning experience, such as SEBO managers, who would like to enhance the effectiveness of their burning in various situations.

Firing Techniques: http://www.fl-dof.com/wildfire/wf_pdfs/ibpf_ch11_techniques.pdf

Another primer on firing techniques.

Nursery references

Manual on Nursery Practices. 2003. Jamica Forestry Department:
http://www.forestry.gov.jm/PDF_files/Nursery_Manual.pdf

A good basic manual for tropical nurseries

Growing Good Tropical Trees for Planting. 1998.
http://www.fao.org/docrep/006/ad228e/AD228E00.HTM

This volume 3 of a 5 – volume series "Tropical Trees: Propagation and Planting Manuals" produced by the Commonwealth Science Council. This is a very good manual covering the basics of setting up and operating a tropical nursery. This and a companion manual "Raising Seedlings of Tropical Trees" are available on-line in the FAO Document Repository.

Raising Seedlings of Tropical Trees. 2003,
http://www.fao.org/docrep/006/AD230E/AD230E00.htm#TOC

This is volume 2 of a 5-volume series "Tropical Trees: Propagation and Planting Manuals" Produced by the Commonwealth Science Council. This manual covers the basics of seed collection, cleaning, and propogation of tropical trees from seed.

The Container Nursery Manual. http://www.rngr.net/Publications/ctnm

This is a 7-volume manual covering all aspects of container nursery production. The manual focuses on producton of temperate tree species, but it contains a wealth of technical information that also applies to tropical species

Dumroese, R. Kasten; Luna, Tara; Landis, Thomas D., editors. 2009. **Nursery manual for native plants: A guide for tribal nurseries - Volume 1: Nursery management**. Agriculture Handbook 730. Washington, D.C.: U.S. Department of Agriculture, Forest Service. 302 p. http://www.fs.fed.us/rm/pubs_other/wo_AgricHandbook730.pdf

This is a fairly technical manual on production of temperate native plants. Like the Container Nursery Manual cited above, much of the information can also be applied to tropical plants.

Charcoal and fuel wood references

Low –Cost Retort Kiln or Improved Charcoal Production System: http://www.biocoal.org/3.html

This web site is devoted to more efficient use of wood fuel. The retort kiln on this web page provides approximately twice the amount of charcoal per unit of wood. Other parts of the site describe or link to other methods and products for improving efficiency of fuel wood use.

Bioenergy Lists: Boichar (or Preta Terra); http://terrapreta.bioenergylists.org/company

This web site provides links to other websites dealing with production of charcoal, briquettes, and pyrolisis and gasification of biomass for fuel. Also lists sites dealing with the use of biochar to improve soil.

Energy: Improved Cookstoves and Charcoal Production:
http://www.villageearth.org/pages/Appropriate_Technology/ATSourcebook/Energycookstoves.php

This website provides a list of publications on improved woodstoves and charcoal production that can be purchased on-line. Putting that aside, the value of this site is the list of references itself….

Wood stoves references

Bioenergy Lists: Improved Biomass Cooking Stoves:
http://www.bioenergylists.org/stovesdoc/gal2003.htm

This site has a lot of designs for efficient coking stoves that could be evaluated for use in the DRC or ROC.

APPENDIX E – LIST OF ACRONYMS

AESI	Actions pour l'Environment et la Solidaritè Internationale
ADB	African Development Bank
CARPE	Central Africa Regional Planning Environment
CBNRM	Community Based Natural Resource Management
CBO	Community Based Organizations
CBFP	Congo Basin Forest Partnership
SEBO	DRC grazing company
IUCN	World Conservation Union
DRC	Democratic Republic of Congo
MECNT	Ministère de l'Environnement, Conservation de la Nature, et Tourisme (DRC)
MEFE	Ministère de l'économie forestière et de l'environnement (ROC)
ROC	Republic of Congo
REDD	Reduction of Emissions from Deforestation and Degradation
USAID	United States Agency for International Development
USDA – FS	United States Department of Agriculture – Forest Service
USFS	United States Forest Service (informal name for USDA-FS)
WCS	Wildlife Conservation Society
WWF	World Wildlife Fund for Nature

APPENDIX F – USFS TEAM RESUMES

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2001-present	National Reforestation, Nurseries, and Genetic Resources Team, US Forest Service

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