

LAND USE, LAND-USE CHANGE AND AGROFORESTRY SECTOR

9 Improved Tropical Hardwood & Pine Caribe Species Nurseries and Reforestation (Mountain Pine Ridge & Chiquibul Forest Reserves)

Sector: Land use, Land-use Change and Agroforestry	
Sub-Sector/Technology Option: Agroforestry	
Technology: <i>Improved Tropical Hardwood & Pine Caribe Species Nurseries and Reforestation (MPR & Chiquibul Forest Reserves)</i>	
Introduction	<i>Brief introduction to the technology</i> Agricultural lands and degraded forests are believed to be a major potential sink and could absorb large quantities of Carbon if trees are reintroduced to these systems and judiciously managed (Albretch and Kandji, 2003). Carbon sequestration potential of tropical agroforestry systems produce a median sequestration value of 95 metric tonnes/ha/yr (Albrecht & Kandji, 2003). Considering variables of location, soil type, rainfall and species it can be as high as 228 metric tons per hectare. Assuming a median of 95,000 kg divided by 1,250 trees per hectare one would get 76 kg (167 lbs) per tree. In a managed plantation trees are culled back to about 600 trees per hectare, which would result in 158 kg (348 lbs) per tree per year (Albrecht & Kanji, 2003). Managed plantation generally produce 20 to 30 times more wood than do natural forests, resulting in higher sequestration rates per hectare (Dombro, 2015). The Mountain Pine Ridge Forest Reserve (MPRFR) Visitor Master Plan (De Vires, 2004) calls for a Nursery and Agroforestry Park to educate visitors about tropical agroforestry techniques, reforestation of degraded areas of the Mountain Pine Ridge and the Chiquibul National Park, and the growing and harvesting of live plants for activities to be carried out through the Visitor Use Master Plan, including construction material and food. The climate change mitigation technology, namely: “Improved tropical hardwood and Pine species nurseries and reforestation for the Mountain Pine Ridge and Chiquibul National Park”, is a response to the MPRFR Master Plan, as well as a means of generating badly needed income for the sustainability of the Douglas D’Silva Forest Station (DDFS) Eco-Tourism, Research and Education Facility. Visitors, students and the public at large will be invited to participate by planting their own tropical tree in Belize in pre-selected areas of degraded forest for a minimal fee, thus enhancing the carbon sink in this region of the country, and contributing to the goal of a carbon neutral tourist destination in Belize.

Technology characteristics	The Forest Department of Belize identifies over 10,000 acres (4046.9 ha) of degraded forests in the greater Mountain Pine Ridge Forest Reserve (MPRFR) and the Chiquibul National Park, resulting from the persistent, devastating effects of the Southern Bark Beetle infestation of 2000-2004, inadequate fire management, uncontrolled wildfires, and illegal logging (personal comm. Officials of the Forest Dep., 2016). The key assumption in an earlier reforestation project for the MPFR through the Clean Development Mechanism (CDM) was that in the absence of a CDM financing (Carbon Credits), there would be no need to protect the area from wildfires, and consequently the ecosystem would transition to grassland (Silviculture Belize Ltd, 2004). The proposed reforestation technology transfer under the TNA initiative will target about 5,000 acres (2023.6 ha) for rehabilitation over a project time horizon of 5-years, during which the Forest Department and other stakeholders such as the DDFS Eco-Tourism, Research and Education Facility authorities, will be institutionally and technically strengthened to sustain and manage the reforestation program as a vital part of their enterprise. Reforestation of degraded tropical forest begins at the nurseries where indigenous, tolerant and suitable seeds are harvested from healthy trees in their natural environment in Belize. In the case of <i>Pinus caribaea</i> var. <i>Hondurensis</i> and <i>Pinus Ocarpa(patula)</i> of the original MPRFR provenance; seeds can be imported from tropical tree seeds centres, such as the Pine Seed Bank of the Queensland Forestry Research Institute, Department of Primary Industries, Government of Queensland, where the Belize <i>Pinus Caribaea</i> var <i>Hondurensis</i> provenance has been preserved as a source of seed for the Queensland forest industry (Global Forest Nursery Development Inc., 2002). Pine seeds of this variety and others can also be collected locally from small, robust stands in the MPRFR. Forest technicians will supervise the collection of tropical timber species such as Mahogany, Cedar, Santa Maria, Ramon (indigenous edible fruit timber species), Nargusta, and Granadia. Seed harvesting can be done twice per year, i.e., April - June and September – November. Sowing in seed beds can be carried out in July – August and October – January, after seeds have been carefully selected. Planting will be staggered so there will always be seedling/trees for the field planting programme. Nurseries will be constructed with local material, with a netting-roof and open-side design. Other nursery material such as the drip irrigation/fertigation systems, and agro chemicals such as lanate and other mild pesticides will be procured as needed. Four nurseries will be established: two for the broad leaf timber species, and two for pine varieties. Water for the drip irrigation will be abstracted from a small reservoir in a nearby stream. The technology transfer will incorporate the following:
-----------------------------------	--

	1) Seed collection and procurement in country or abroad, and technology transfer (know how) in advanced reforestation nursery installation and operations. (<i>Duploys Botanical Garden as potential source, Bullridge Limited</i>). 2) Silviculture training for forest officers and 10 labourers to be conducted at the onset of the programme, and repeated on a yearly basis for new recruits during project cycle. 3) Forest management work plan and activities will be prepared and executed to care for the reforested zones. 4) Management and Planning strategy will be implemented for forest officers and some Eco-tourism Centre staff who will deal with the tourists and visitors, and supervise replanting programme. 5) Public awareness/education programmes on climate change and mitigation technologies for carbon sink and emission reduction (e.g. reforestation/afforestation) will be conducted for visitors, tourists, students and others. Equipped Welcome Lecture Centre for visitors/training.
Costs, including cost to implement mitigation options	Capital cost for the Reforestation Technology programme for the MPRFR and Chiquibul National Park is of the order of US \$36,000 per year for the first three years and US \$24,000.00 per year for the last two. Capital cost: US \$156,000.00
Operational Costs	1) Forest management work plan and activities will be prepared and executed to care for the reforested zones. (CSFI & Ya'axche) 2) Spares and equipment 3) Public Awareness and education programme. US \$20,800.00 per year or US \$104,000.00 for five years
Cost of not modifying the project	The no action alternative (doing nothing, accepting the status quo) is further transformation of degraded forest to savannah, weak forest management, increased impacts of climate change (threatened watershed, droughts and uncontrolled bushfires).
Potential development impacts, benefits	Potential development impacts will be the gradual establishment of the Douglas D'Silva Forest Station Eco-Tourism, Research and Education Facility in the MPRFR, income generation for private sector partners/tour guide companies and the GOB (Forest Department) operating at the Eco-Tourism Facility and nature attractions in the area, employment for people in the buffer communities, improved forest management and reforestation in the MPRFR and the Chiquibul National Park.
Economic	<i>Costs, employment, investment, others...</i> Increase employment for villagers in buffer communities, stimulation of local economy in the tourism trade, encouraging participations of locals in the food, beverage and fruit sales, etc.

Social	<i>Income, education, health, other</i> Increased job opportunities for men and women in buffer communities, improved livelihood security (food, education, health, recreation, self-employment for tourist industry, etc.)
Environmental	<i>Local pollution, GHG emissions, other</i> Visitors and tourist-oriented reforestation and education programme will be managed in an eco-friendly and best-practice standard that will have the least impacts on the environment. GHG emissions will be kept at a minimum in daily operations of the facility. Carbon sequestration benefits from one hectare of actively growing <i>Pinus caribaea</i> var. <i>Hondurensis</i> is: 42 - 69 metric tons per ha per year (Duca de Lima, et al. 2016). Meanwhile the Carbon sequestration potential from one hectare of well-managed <i>broad leave tropical species</i> such as mahogany or Cedar is about: 95 metric tons/ha/year (Albrecht & Kandji, 2003). Transplanting of timber seedlings is estimated to commence before the end of the first year of operation, generating revenues to offset operational cost. The GOB will be contributing in-kind to this climate change mitigation technology initiative through the provision of office and land resources, some heavy equipment, and technical personnel from the Forest and Agriculture Department, and the University of Belize School of Agriculture.
Status	A successful reforestation pilot project was carried out in the mid 80s- to the mid 90s in the Programme for Belize Forest Reserve in the Orange Walk District through GEF funding (Nature conservancy, 2010). The pilot project is projected to sequester and avoid emission of millions of tons of carbon dioxide through two primary approaches: i) Prevention of deforestation; ii) Sustainable forest management and regeneration. The Conservancy points out that the project is a model project demonstrating how saving forests is part of the solution to climate change. Reforestation initiatives in Belize are also being conducted mainly by private landowners on small plots of less than 100 ha. In 2002, an ambitious, reforestation project was started in the Mountain Pine Ridge Forest Reserve by Global Forest Nursery Development Inc. — Silviculture Belize Ltd., the Mountain Pine Ridge Forestry Company Ltd., and the Government of Belize, targeting initially some 4047 ha, and later an additional 24,282 ha (or 70, 000 acres total in 4-year period), and funded partially through private sector investments (62 %) and the Clean Development Mechanism (CDM) LULUCF facility (38 %). Unfortunately, this promising initiative faltered before the middle of the second year, as funding from stakeholders did not come through. Thereafter, all operations ceased and the project closed down.

Barriers	– includes <i>barriers</i> to implementation and issues such as the need to adjust other policies to accommodate the mitigation option. - Policy/Legal Framework: Lack of Coordination among agency. Project will address. - Outdate Forest legislation, does not have any provision to stimulate or encourage reforestation. Does not consider Climate Change. - There is a draft Forest Policy that considers both reforestation and climate change. Measure - get Cabinet to adopt the Strategy - <i>Finance</i>: High capital cost. Tourism market downturn - <i>Security</i>: Key to maintain security of the area. Now it is only for Caracol, need to be expanded to MPR and the Chiquibul National Park - <i>Institutional and Technical Capacity</i>: Weak institutional capacity among some stakeholder agencies - <i>Extreme weather events and bushfires</i>: Hurricane impacts and extreme drought resulting in uncontrolled bushfires in Mountain Pine Ridge Forest Reserve - Lack of comprehensive management plan for MPRFR
Acceptability to local stakeholders	<i>Not all mitigation technologies will be equally attractive to all stakeholders for political, economic, social, or, a cultural reason.</i> The proposed TNA project mitigation technology intervention, “<i>Improved Tropical Hardwood & Pine Caribe Species Nurseries and Reforestation (MPR & Chiquibul Forest Reserves)</i>” is highly favoured by local stakeholders including the Forest Department that is directly responsible for the management of the Mountain Pine Ridge Forest Reserve and the Chiquibul National Park.
Endorsement by experts	– <i>in some countries decision-makers will partly base their selection on consistency of proposed adaptation options with international best practices</i> Experts in the Forestry Sector (both public and private), policymakers and NGOs endorse this initiative as another step forward to rehabilitate the tropical forests in the MPR and Chiquibul.
Timeframe	<i>Specify timeframe for implementing the technology</i> The time horizon for the Nursery and reforestation of a portion of the degraded forest in the MPR and Chiquibul is for 5-years.
Institutional capacity	<i>How much additional capacity building and knowledge transfer is required for the mitigation option to be implemented</i> For a viable and sustainable nursery and reforestation programme, and marketing of the concept, “<i>plant your tree in Belize and halt global warming</i>”, will require additional capacity and knowledge

	transfer for Forest Department and Tourism personnel, field workers and others. This can be in the form of workshop training and field demonstration. Experts in Silviculture Systems and Agro-Forestry and marketing will be invited or procured to facilitate training as needed.
Adequacy for current climate	– <i>are there negative consequences of the mitigation option in the current climate? Some mitigation may be targeted at the future climate but may have costs and consequences under the current climate</i> Very adequate after the failure of the Global Forest Nursery Development Inc. to complete its reforestation objectives and target back in 2002-2004. Also, the forest management of the area has much to be desired mainly because of the lack of public funds to carry out the work.
Size of beneficiaries group	– <i>adaptation technologies which provide small benefits to large numbers of people will often be favoured over those that provide larger benefits, but to fewer people</i> The size of the beneficiary group will include forest field workers and technicians, tour operators, traders in local tourism industry, and families in the buffer communities. For the country at large, it will enhance increase visitors to the area and provide much need foreign exchange into the national economy.
References: Albrecht, A, and S.T. Kanji, 2003: Carbon Sequestration in Agroforest Systems. Agriculture, Ecosystems and Environment. <i>Elsevier</i>, Vol. 99, Issue 1 – 3, 15 – 27 p. De Veries, G. 2004. Mountain Pine Ridge Forest Reserve Visitor Use Master Plan. Forest Department, Ministry of Natural Resources, the Environment, and Industry. Belmopan, Belize. Dombro, D. B. 2015: How much carbon does a tropical tree sequester? In partnership with the United Nations Environment Programme. Plant for the planet. Billion tree campaigns. Retrieved from http://www.tree-nation.com/public/documens Duca de Lima, M.C. et al., 2016: Biomass and carbon stock from <i>Pinus caribaea</i> var. <i>hondurensis</i> under homogenous stands in southwest Bahia, Brazil. <i>Ciencia Rural</i>. Brazil. IPCC, 2007: Climate Change 2007. Mitigation of Climate Change. Summary for Policymakers and Technical Summary. WG III, IPCC FAR. UNEP/WMO. Global Forest Nursery Development Inc, 2002: Mountain Pine Ridge Reforestation Project. Silviculture Belize Ltd, <i>Putting Back the Forest</i> Final Version. Belmopan, Belize. www.info@globalforestnursery.com. Nature Conservancy, 2010: The Rio Bravo Carbon Sequestration Pilot Project. Belize. www.nature.org/ourinitiatives/centralamerica/belize/placesweprotect/rio-bravo-conservation-area.xml	