

## 10 Integrated Landscape Forest Management: A Management Alternative in the Vaca Forest Reserve

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| <b>Sector:</b> Land use, Land use Change and Agroforestry                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Sub-Sector/Technology Option:</b> Agroforestry                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Technology:</b> <i>Integrated Landscape Forest Management: A Management Alternative in the Vaca Forest Reserve</i> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Introduction</b>                                                                                                   | <p>Sequestering atmospheric carbon (C) and storing it in the terrestrial biosphere is one of the options, which has been proposed to compensate greenhouse gas (GHG) emissions. Agricultural lands and degraded forests are believed to be a major potential sink and could absorb large quantities of C if trees are reintroduced to these systems and judiciously managed together with crops and/or animals (Albretch and Kandji, 2003). Thus, the importance of agroforestry as a land-use system is receiving wider recognition not only in terms of agricultural sustainability but also in issues related to climate change.</p> <p>Carbon sequestration potential of tropical agroforestry systems produce a median sequestration value of 95 metric tonnes/ha/yr. (Albrecht &amp; Serigne, 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 &amp; Kandji, 2003). Managed plantation generally produces 20 to 30 times more wood than do natural forests, resulting in higher sequestration rates per hectare (Dombro, 2015).</p> <p>Soil Carbon sequestration is another realistic benefit in many agroforestry systems. The potential of agroforestry for CO<sub>2</sub> mitigation is well recognised. However, some shortcomings that need to be considered include the uncertainties related to future shifts in global climate, land-use and land cover, the poor performance of trees and crops on substandard soils and dry environments, pests and diseases such as nematodes.</p> <p>In the area of Silvicultural Systems, Dombro (2013) cited studies in Science Daily indicating that natural African tropical forests absorb about 600 kg (1,323 lbs) of carbon per hectare per year. If one takes 600 kg by 25 times more wood per hectare in a plantation setting, you get 15,000 kg (33,000 lbs) per hectare per year divided by 600 plantation trees per hectare, which results in 25 kg (55 lbs) of carbon sequestered per tree per year. One of the topical species recognized as an efficient nitrogen fixing tree (NFT) is <i>Acacia mangium</i> (Dombro, 2013). A Springer publication cited by Dombro (2013) showed that NFT's sequester more carbon in the soil than do other</p> |

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|  | <p>types of tropical trees.</p> <p>Another study from the Netherlands (Samalca, <i>et al.</i> 2007 in Dombro, 2013) confirms and shows that 50% plus of a tropical tree's woody biomass is carbon. That means that fast-growing tropical trees like those planted by the NGOs CO2 Tropical Trees and Amazonia Reforestation, which reach maturity in just 10 years' time, are excellent carbon storage vessels.</p> <p>The proposed Agroforestry technology transfer under the TNA project, namely: <i>Integrated Landscape Forest Management: A Management Alternative in the Vaca Forest Reserve</i>, is targeting a group of 20 farmers operating in the de-reserved zone of the Vaca Forest Reserve (VFR) in the Cayo District of Belize. The agriculture frontier in the buffer zone of the Vaca Forest reserve has been putting stress on the Reserve in the form of logging, farming, cattle ranching, exploitation of non-timber forest products, wildlife poaching and looting (FCD, 2010). Additionally, widespread illegal logging, deforestation, and looting by illegals in the border region of the Reserve continue to exacerbate the degradation. The Defence Force of Belize and the FCD forest rangers operating in the Chiquibul National Park to the south are spread thin to contain the problem.</p> <p>According to a legal review of the Belize Forest Act (FCD, 2010), the Act does not make provision of the co-management of forest reserves. Thus, the Forest Department does not have the lawful authority to enter into co-management agreements with NGOs (e.g. FCD) or communities. However, it calls for buffer community indolent/cooperation to ensure that there is proper use and management of the reserve.</p> <p><b>Definitions:</b></p> <p><i>Deforestation:</i> A reduction of the capacity of a forest to provide goods and services (Expert meeting, FAO, 2002).</p> <p><i>Afforestation:</i> is the establishment of a forest or stand of trees in an area where there was no previous tree cover. <i>Reforestation:</i> is the reestablishment of forest cover, either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting) (Ford-Robertson, 1971).</p>  |
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|                                   | <p>Think of the rain forest canopy as a place that is busy absorbing carbon 365 days a year. Compare that with boreal trees that are only on the job 3 months of the year, and on average only sequester 1 kg or 2.2 lbs. of carbon per year. (Source: Albrecht &amp; Kandji, 2003)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Technology characteristics</b> | <p>The proposed agroforestry technology endorsed by FCD and the Forest Department for the stewardship of the Vaca Forest Reserve by farmers operating in the area, is the re-introduction of the Forest Landscape Management approach as an alternative and innovative means of management and conservation of the reserve.</p> <p>The target group will be 20 farmers from three buffer communities and the coordinating agencies will comprise of the Friends for Conservation and Development and the Forest Department. Other public and private stakeholders will be invited to activate a Vaca Forest Reserve Working Group. The time horizon for the project is five (5) years.</p> <p>The general objective is to reduce emissions arising from land use and land-use change through a community forestry program incorporating sustainable livelihood strategies and diversifying local economic opportunities.</p> <p>Four main components are:</p> <ol style="list-style-type: none"> <li>1) Activate the Landscape Management Strategy for the VFR. Special attention will be given to already impacted areas of the reserve by farmers. The Strategy recommends a set of mitigation, restoration and production activities at the farm and landscape level, that can benefit farmers, and help maintain the natural environment and restore degraded areas</li> <li>2) Establish two reforestation nurseries for native and fast-growing timber species, and develop and implement a comprehensive reforestation programme and silviculture system. Technical expertise will be required to assist farmers.</li> <li>3) Promote Integrated Farming Systems. This will be in line with the sound recommendations of the Technical Assessment Report of the Maya Mountain Massif that calls for the promotion of sustainable income generating activities such as apiculture, cacao and <i>xate</i> production among others. Activate the FCD Agro-ecology Practical Guide.</li> <li>4) Develop a five-year Agro-business and Marketing plan with the participation of farmers and business stakeholders in the communities. Farmers will be encourage to implement the business marketing products.</li> <li>5) Employment: 2 technical staff; 4 extension service staff. Total 6 personnel.</li> </ol> |
| <b>Costs, including</b>           | <p>Travel and logistics, programmes, nurseries and small demonstration</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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|                                                | activities (soil management, drip irrigation and fertigation, seed collection and harvesting, etc.).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Cost to implement mitigation options           | Capital cost: <b>US \$40,000 per year. Total US \$200,000 for the five-year project cycle.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Cost of not modifying the project              | The no action alternative (doing nothing; accepting the status quo) is further degradation/loss of biodiversity of the Vaca Forest Reserve, weak or insignificant forest management, increased impacts of climate change (threatened watershed, droughts and uncontrolled bushfires).<br><br>Operational Cost: <b>US 15,000.00 per year. Total US \$ 75,000.00</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Potential development impacts, benefits</b> | Development impacts is the increase stress and wanton exploitation of the Reserve. Benefits if interventions in the proposed TNA technology transfer will ameliorate the pressure on the Reserve and increased livelihood of famers from the buffer communities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Economic                                       | <i>Costs, employment, investment, other</i><br><br>Stimulate the local economy in the buffer communities and uplift the livelihoods of famers and their families                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Social                                         | <i>Income, education, health, other</i><br><br>Improved self-employment for farmers, more income, increase livelihood security and improved water quality for downstream communities. Preservation of this patrimony for all Belizeans.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Environmental                                  | <i>Local pollution, GHG emissions, other</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Status</b>                                  | <i>Status of technology in the country</i><br><br>The Central American Commission for Environment and Development (CCAD) Regional Environmental Plan 2010-2014, called for actions in the promotion of greenhouse gas emissions (GGE) reduction and taking advantage of opportunities in the carbon market. During the period of the Plan and to date, not much has been done in GGE reductions through carbon sequestration in Belize, and little if any, in ceasing opportunities in the carbon market, for one reason or the other. Some recent activities in reforestation are:<br><br>A successful reforestation project was carried out in the mid 80s- and early 90s in the Programme for Belize Forest Reserve in the Orange Walk District through GEF funding (PFB, 2010).<br><br>In 2002, an ambitious, reforestation project was started in the Mountain Pine Ridge Forest Reserve by Silviculture Belize Ltd - Global Forest Nursery Incorporated, the Mountain Pine Ridge Forestry Company Ltd. and the Government of Belize, targeting initially some 4047 ha and an additional 24,282 ha (or 70,000 acres in total in a 4-year period), funded partially through private sector (62 %) and the facility of the Clean Development Mechanism (CDM) LULUCF (38 %). Unfortunately, this promising initiative faltered by the middle of the second year, as funding/cooperation from private/public stakeholders did not come through as planned. |

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|                                            | <p>Thereafter all operations ceased and the project closed down.</p> <p>Reforestation initiatives have been conducted mainly by private landowners on small plots of less than 100 hectares.</p> <p>In August 2010, through the leadership of Friends for Conservation (FCD) and with a small grant from the GEF-SGP (Belize) and the Tropical Agricultural Research and Training Centre (CATIE), ten farmers operating in the buffer zone of the Vaca Forest Reserve were organized, trained and provided with small grants to promote Landscape Management in the Vaca Forest Reserve through Community Development and Support.</p> <p>Farmers were trained and equipped with tools to reduce land degradation through Beekeeping, demonstration projects using sustainable land management approach such as agro-ecological methods, reforestation, farming plans and soil management. This initiative started off very well, but soon came to an end as the funds dried up by late 2012. FCD lost contact with farmers and farmers got disinterested and returned to their customary, unsustainable practices, and putting more pressures on the Vaca Reserve.</p>                                                                |
| <b>Barriers</b>                            | <p>– includes <i>barriers</i> to implementation and issues such as the need to adjust other policies to accommodate the adaptation option</p> <ol style="list-style-type: none"> <li>1) Policy: Weak state and stakeholder ties with respect to the management of the VFR</li> <li>2) Institutional: Lack of institutional capacity of leading NGOs to facilitate most of the proposed programs</li> <li>3) Technical: Weak technical capacity of leading NGO. Some farmers have very limited education. Poor Climate Change knowledge, attitude and perception (KAP) among most farmers</li> <li>4) Financial: Limited or no co-financing among main stakeholders. Capital cost may be too high. Difficulty with marketing of farm products. Sustainability of the Agro Forestry and Silviculture programmes after project phase out.</li> <li>5) Social and cultural: Lack of interest among some farmers to participate. Cultural clash with some farmers with respect to forest and biodiversity conservation, and climate change mitigation measures.</li> <li>6) Physical and Environmental: Inaccessibility to vehicular transport during rainy season. Seasonal bush fires. Impacts of hurricanes and flash floods.</li> </ol> |
| <b>Acceptability to local stakeholders</b> | <p><i>Not all mitigation technologies will be equally attractive to all stakeholders for political, economic, social, or, a cultural reason</i></p> <p>The local stakeholders are buffer communities farmers and their families. Some of these farmers were participants in an earlier Agro Forestry initiative coordinated by FCD and the Forest Department in</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2011-2013. Farmers in the area have expressed a keen interest to participate in the proposed Agroforestry technology interventions to sequester carbon and improve their livelihood options through improved forest management.                                                                                                                                                                                                                                               |
| <b>Endorsement by experts</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>– <i>in some countries decision-makers will partly base their selection on consistency of proposed mitigation options with international best practices</i></p> <p>Experts in the Forest and Lands Department, NGOs and private sector like the Belize Electric Company who operate the nearby Hydro Electric facility in the upper Macal River all endorse the Integrated Landscape Forest Management of the Vaca Forest Reserve.</p>                                     |
| <b>Timeframe</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p><i>Specify timeframe for implementing the technology</i></p> <p>The time horizon for the Agro Forestry and Integrated Forest Management of the VFR is projected for five (5) years.</p>                                                                                                                                                                                                                                                                                    |
| <b>Institutional capacity</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <p><i>How much additional capacity building and knowledge transfer is required for the mitigation option to be implemented</i></p> <p>Technical capacity in Silviculture and Agro-Forestry, and Marketing techniques will be required for new personnel from FCD and the Forest Department working in the Vaca Forest Reserve. This can be done at the start of the programme and repeated on a timely basis as new experts are invited to participate in the activities.</p> |
| <b>Adequacy for current climate</b>                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>– <i>are there negative consequences of the adaptation option in the current climate? Some adaptations may be targeted at the future climate but may have costs and consequences under the current climate.</i></p> <p>This proposed intervention under the TNA project initiative is highly need and timely.</p>                                                                                                                                                          |
| <b>Size of beneficiaries group</b>                                                                                                                                                                                                                                                                                                                                                                                                                       | <p>– <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></p> <p>The beneficiary group(s) will be the participating farmers, FCD/Forest Department and buffer communities of the Vaca Forest Reserve.</p>                                                                                                                                               |
| <p><b>References:</b></p> <p>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.</p> <p>FCD, 2013: Baseline Survey Report. Friends of the Vaca Forest Reserve. GIZ/Selva Maya. San Jose Succotz Village, Cayo District, Belize</p> <p>FCD, 2011: A Practical Guide on Agro-Ecological Methods. Friends for Conservation/Forest</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

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