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Potential for Biochar in Stann Creek and Toledo Districts of Belize

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Introduction

The design of an effective biochar system for a given location is dependent on many environmental and economic factors; from a biochar engineering perspective, the goals of the potential biochar users are critical to determining what kind of biochar system should be implemented.

The Stann Creek and Toledo districts in the south of Belize consist of large protected land areas, commercial farms for citrus, banana and shrimp exports, native communities practicing traditional milpa (slash and burn) agriculture, coastal areas and cayes (islands) frequented by tourists, Mayan archeological sites, and tropical rainforest. Climate and soil quality vary significantly across the region though many areas have very weathered soils prone to low fertility, inconsistent rainfall, and erosion. As a soil amendment and as an energy production platform, biochar has the potential to address some of these issues.

Three scenarios are considered for potential biochar implementation: a nearly self-contained ecosystem on a small caye, a relatively large commercial farm growing citrus for export and a milpa-style farm primarily used for sustenance.

Among the factors for consideration were soil and environment information available from previous land surveys, goals of the national governing bodies such as the Ministry of Agriculture and Fisheries, the Department of Forestry, and the Protected Areas Conservation Trust (PACT), cultural and policy emphases on diversity and sustainable eco-tourism, and local development goals regarding import/export balance, affordable energy, education and capacity building, environmental conservation and sustainable revenue sources.

Results and Discussions

The first scenario considered Small Mulligan Caye, also known as Frigate Caye or Big Bird Caye, just 45 minutes by boat off the coast of Placencia town. The very small island has a dock and two small buildings, a manager's shack and a gazebo bar, and is used for camping and as a staging area for line fishing and diving trips. Waste management and energy are two of the main challenges for the island. Typically, food/compostable waste is tossed into the sea to feed the fish, and paper products such as toilet paper and food packaging are burned, but most garbage has to be transported back to the mainland. Energy comes from a solar/battery system, a propane stove, a charcoal grill, and if necessary, a diesel generator. A small biochar cook stove (i.e. low temperature gasifier) could be used here to replace the propane that must be shipped in for cooking with heat provided by the pyrolysis of paper products, garden wastes, and driftwood. The biochars produced could then be added to the garden soils, which were brought in one bucket at a time from the mainland to grow vegetables, fruit trees, palms, and sugarcane on top of the infertile sand.

The second scenario considered a large (~100 ha) citrus farm in the Stann Creek district used to grow juicing oranges and grapefruits for one of the Citrus Products of Belize Limited (CPBL) processing plants that makes juice concentrate for export to the U.S. and other countries. While the soils in this region are well-drained and are good for supporting tree root growth, the low pH (4-5) and high demand for fertilizers are constant challenges [1]. A relatively high ash biochar applied to the built-up area around the base of the trees would provide some of the necessary liming capacity to raise the pH, some phosphorus and potassium, as well develop nutrient holding capacity over time such that less fertilizer would be needed. Biochars could be produced at the juice processing plants utilizing the fruit rinds, seeds, tree cuttings, etc. The energy co-product could be used within the plant and to dry the biomass prior to pyrolysis. Previous research has shown that citrus byproducts can be used as feeds for ruminants [2], as well as feasible feedstocks for producing chars [3].

The final scenario considered a small (5-10 ha) family/community farm practicing milpa agriculture for home consumption. The farm is situated on the side of a hill and produces maize, beans, squashes, tomatoes, peppers and other vegetables, trees such as palm, almond, mango and papaya, annatto (used as a food coloring and flavoring) and other spices, and a couple cacao trees. The low soil fertility of the region requires that fields must be cleared and burned every year during the dry season, then allowed to lie fallow after harvest for 7-10 years before they can be used again [4]. Such land-clearing is very time consuming, requires a large amount of land per capita, emits a lot of air pollution, and increases the risks of soil erosion. Production and application of biochar during the clearing process in mobile, efficient pyrolyzers could mitigate several of these challenges, most importantly by helping to build up and maintain soil fertility such that fields could be used for more than one growing season and less land would need to be put into production. The need for less land would be especially important in regions immediately adjacent to protected lands, where illegal use of the forests for timber, fuel and crop land remain a serious concern [5]. As with the first scenario, a small biochar-producing high-efficiency cook stove could also lower the demand for expensive propane.

Conclusions

Three scenarios were used to demonstrate the potential for biochar implementation in the Stann Creek and Toledo districts of Belize on small and large scales. The needs in these scenarios for waste management, renewable energy and soil fertility improvements, combined with strong cultural emphasis and government policies focused on ecological sustainability, make Belize an especially promising location to develop biochar research programs.

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