THE AKHA TLUD - BIOCHAR PROJECT

INTRODUCTION

The BBI, CCDB and ICCO[(1)] are pioneering the development of TLUD-Biochar technology in Bangladesh. A TLUD is a top-lit updraft gasifier. It is a clean-burning, wood cookstove that makes char as a by-product. Char is carbonized biomass which can be used as charcoal fuel, or as biochar to increase agricultural productivity. Biochar is our main interest, because it can double crop yields in our soils. The combined benefits of the TLUD and biochar can be used to drastically reduce women's exposure to smoke, increase food production, increase family income, and create new livelihoods.

Figure 1. The Akha Chula designed by Islam and Winter, 2014-2016.

The "Akha TLUD - Biochar Project" (ABP) is introducing TLUD and biochar technologies to households and farms. A natural draft TLUD (ND-TLUD) called the "Akha Chula" (Figure. 1) has been designed for Bangladesh, and the knowledge is being conveyed to rural villages through clubs called "Biochar User Groups" (BUGs). The participants are trained in the new technologies, and get an Akha installed in their homes.

In the face of an extreme challenge from climate change, the aim of the ABP is to maintain national self-sufficiency in cooking and food.

THE CLIMATE CHANGE CHALLENGE

Bangladesh is a middle-income country with a per capita gross domestic product of $1,500 US (IMF, 2107). Imported goods are very expensive for most consumers. The population is >160 million at an average density of 1,237 people per km². Sea-level rise, caused by climate change, is expected to claim one-third of the land, and salinize the soil and ground water of costal communities. Weather is already more variable with droughts becoming more common. The country is presently self-sufficient in food, but a northward migration of climate-refugees is going to put pressure on food security.

BIOCHAR

Biochar will help to maintain national self-sufficiency in food by increasing the efficient use of plant nutrients and available soil water, and by improving soil physical structure [(2)]. The soils of Bangladesh tend to be low in soil organic matter (humus), because the high temperature and humidity results in fast decomposition of plant residues. The main effect of biochar on clay soils is to increase soil porosity. On sandy soils, the main effect of biochar is to increase their capacity to hold water and nutrients. Biochar is similar to activated carbon by acting as an absorbent of plant nutrients (nitrogen, potassium, phosphorous, and micronutrient elements). When mixed with manures or composting wastes, biochar adsorbs nutrients, holding them against leaching to the subsoil, and releases them slowly for plant growth. Preliminary garden and field trials have shown a strong (up to two-fold) increase in crop yields when biochar has been used.

Biochar decomposes very slowly in soil. It becomes part of soil organic matter, and lasts for hundreds of years. Therefore, biochar can be used to sequester atmospheric carbon (CO_2) and help to combat the greenhouse effect of climate change. One gram of biochar from wood (ca. 75% C dry wt.[(2)]) is equivalent to 2.75 g CO_2 (= 0.75 x 44 / 12). However, the immediate experience of farmers is their crop yields.

TLUD Cookstoves

The biggest challenge in Bangladesh is not what to do with the biochar; it is how to make it. Most of the population (25 million homes) cooks with biomass, but forest cover is sparse (ca. 15%), so leaves and straw make up half of the fuel. As a result, the rural population is under energy-stress, and that there is no spare biomass just for making biochar. Fortunately, TLUD stoves provides a solution, because they can make char as a by-product of cooking.

TLUDs operate by patrial combustion (gasification) of woody fuel, producing wood gas (white smoke) and char. The wood gas is flammable, and it is burned at the top of the stove to produce heat for cooking. This is a more efficient than a traditional cookstove, so TLUDs use less fuel yet still produces char. About 15-20% of wood dry-matter is converted to char. Therefore, from 1 kg (dry wt.) wood, a TLUD can produce 150 g dry biochar, containing 113 g C, equivalent to 413 g CO_2.

Foreign-made TLUDs are expensive, and can have components that can't be made locally. Therefore, a culturally appropriate ND-TLUD, the Akha Chula (Figure 1.; YouTube), was designed to be affordable, and reproducible by small business. Making stoves within-country helps to maintain national self-sufficiency in cooking.

An Ecosystem Approach

By making char, TLUD stoves perform a keystone function that supports other enterprises around the homestead, farm and community. This complex relationship results in a "TLUD-biochar ecosystem" approach to technology and economic development, extension education, the use of natural resources, and impact assessment. (www)

Biochar User Groups

TLUD-biochar ecosystems are introduced via Biochar User Groups: small clubs of husbands and wives who attend workshops and conduct trials. The participants are selected for their enthusiasm, and perform two important functions: (1) they are co-developers by providing important suggestions, and (2) they create neighborhood interest in TLUD-biochar through their social networks. Local businesses will be trained to make Akhas to meet the demand. (www)

The Next Challenge

The next challenge is to develop compressed biomass fuels made from low density, plant residues. This could relieve energy poverty in the countryside, and double the production of biochar and soil organic matter. If biomass pellets can be made, TLUDs could be used in cities. However, there is a need for research and development.

Figure 2. A Biochar Users Group learn to use the Akha by performing a Controlled Cooking Test comparison with a traditional cookstove.

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Notes

1. BBI — Bangladesh Biochar Initiative (www.biochar-bangladesh.org); CCDB — Christian Commission for Development in Bangladesh (estb. Dhaka, 1972); ICCO — Interchurch Organization for Development Cooperation - Netherlands

2. Lehmann, J. and Joseph, S. 2015. Biochar for Environmental Management. Routledge - Earthscan, 928 p.