A Case Study on Production of Biochar to Enhance the Soil Fertility, Reduced Carbon Emission in Context of Climate Change in...

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A Case Study on
Production of Biochar to Enhance the Soil Fertility, Reduced Carbon Emission in Context of Climate Change in Western Nepal

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ABSTRACT

The fuelwood stock of Nepal is ever increasing and at the same time, consumption rate of fuelwood can be projected at a decreasing rate due to population expansion in the urban regions of Nepal and adaption of other alternative cleaner fuel options in the urban regions. Hence this is the high time for the Nepalese people to find better way to use the waste biomass resource in a sustainable manner. Biochar is proved to be a viable option for the sustainable use of biomass with multitude of benefits and it can be considered as both mitigating and adaptive tool for the climate change. Nepal is essentially an agrarian country with most of its population directly involved in the agriculture. Agricultural application of biochar can help farmers utilize waste biomass and at the same time amend the soil to increase its water holding capacity, enhance microbial activity, and help retain nutrients for better productivity. The training programs organized by the UNA-Nepal was able to explain about the basic concept behind the use of biochar and the method of preparation to the local people. The community forest user groups were provided by the biochar retorts for the production. Two biochar retorts a fixed type and a movable type retorts designed and manufactured in Kathmandu were handed over to the community. Biochar retorts were established in the field sites at Amarapuri VDC, Nawalparasi and Kusma, Parbat. Experimental plots were set and the baseline information on the soil is collected by laboratory analysis. Soil analysis report suggests that soil at the site has very low phosphorus content, moderate amount of organic nitrogen and potassium and low micronutrients. Appropriate soil amendment practice were recommended to the locals the soil nutrient management. The four meter square plots were set up for the research purpose in order to identify the actual effect of the biochar in local cultivars (in this case maize). Six experimental plots were set up with varied amount of biochar along with a control plot (without biochar). We can conclude that huge amount of waste biomass can be utilized by this charring technology, which otherwise can be one of the reasons behind the forest fire.

Key words: Biochar, Climate change, Community forests, Nawalparasi, Parbat, Soil Nutrients

1. Introduction

1.1 Background

Biochar is a carbon-rich product that results from the low temperature, low oxygen combustion (also known as pyrolysis) of carbonaceous biomass such as crop residues, stall bedding, cull timber and sawmill wastes (1). Although very similar to charcoal, evolving current technologies are carbon-negative since the volatile by products (mostly hydrogen, nitrogen, carbon monoxide and small amounts of methane) are gathered and used to fuel the making of biochar, and excess volatiles are recovered, filtered and used as 'synfuels or syngas' an increasingly promising substitute for fossil fuels, especially on a local scale (2-4).

The application of biochar (inoculated with favorable soil organisms – easily introduced with a small amount of healthy forest or farm soil – coupled with small amounts of nitrogen, and a carbonaceous material such as sawdust) can increase yields on formerly abused soils by as much as 300 percent or more (1). In case of Nawalparasi we inoculated it with the compost manure and soil. The use of biochar for soil nutrient enhancement and as a tool for climate change is ever increasing and an estimate suggests that one gigatonnes of carbon per year can be stored by 2050, mostly produced from agricultural residues and organic wastes. More ambitious estimate suggests that the amount may increase to 5-9 gigatonnes by 2100 (5).

1.2 Potentiality of Biomass Utilization in Nepal

Most of the land area is either too steep or not good enough for the agriculture. According to the latest data over 40% of the total land area of Nepal is forest. Ever increasing forest stock is a resource for the sustainable development and should be taken in that way. A vast land area of forest land is managed by the forest (6). Nepal is an agrarian country with most of its land covered with mountains.

Not only from the forests there is huge amount of biomass potential from agricultural residues of crops such as paddy, maize, wheat, millet, oil seeds, grain legumes, jute etc. This biomass in dry, solid form, had been an important alternative fuels to the traditional users of fuelwood for domestic energy for cooking and heating, primarily in rural areas. Agricultural residues production in Nepal is about 19411.8 thousand tons with energy production potential from agricultural residue 243812.5 GJ (7). The use of agricultural residues in the production of biochar can be a new avenue

to explore, and has a huge potential to enhance the soil quality and there is equal possibility to better utilize the resource. Better charring technologies can help to harvest syngas, bio oil etc. that can help in the harvesting of renewable energy.

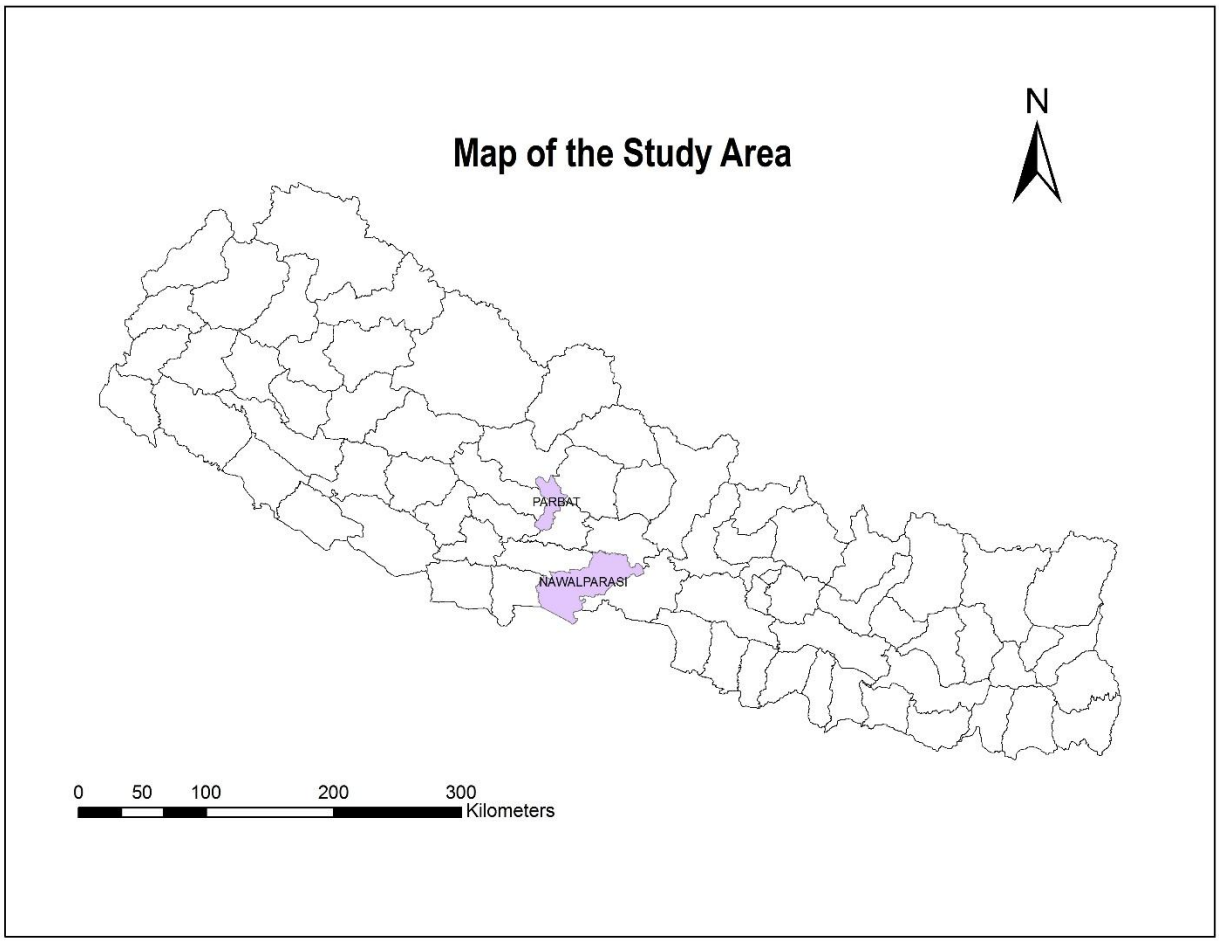

Figure 1 Map of Study Area

2.0 Project Progress

Log frame of the Project Events

S.N.	Program	Date of the event	Event Site	Achievements
1	Introduction and coordination program	31 August- 1 September, 2013	Parbat	Proper rapport was built with the local people and they were given overall introduction of the project. Site selection.
2	Introduction and coordination program	27-28 October, 2013	Nawalparasi	Proper rapport was built with the local people and they were given overall introduction of the project. Site selection.
3	Training program on biochar	3-5 January, 2014	Parbat	Introduction of biochar, its production, soil formation, nutrient management. Biochar retort establishment and production. Experimental plot setup.
4	Training program on biochar	13-15 January, 2014	Nawalparasi	Introduction of biochar, its production, soil formation, nutrient management. Biochar retort establishment and production. Experimental plot setup.
5	Crop plantation and experimental plots setup	31 January- 2 February, 2014	Parbat	Maize plantation, soil sample collection.
6	Crop plantation and experimental plots setup	3-5 February, 2014	Nawalparasi	Maize plantation, soil sample collection.
7	Training program on Impact of biochar on climate change and agriculture	24-26 February, 2014	Nawalparasi	Information on climate change impacts on agriculture, biochar a means of climate change adaptation and mitigation measure. Information on pervious soil test.

3.0 Experimental Design

The experimental plots were set up to access the in-field application of the biochar in soil. The experimental plots were amended for 5, 10, 15 tons. Compost six plots were set up compost, compost and biochar, local agriculture practice, and biochar application in 5, 10, 15 tons per hectare. Maize plant was planted in each of the experimental plots. And soil tests will be conducted to determine the change in the nutrients and carbon content in the soil.

4.0 Results and Discussion

Different parameters like average height diameter of stem, number of leaves, average length of leaves were measured on a daily basis to record the development of maize plant on the experimental plots. Other parameters to be used are plant parameters are crop grain yield and biomass yields at harvest. As of now the maize plants are about a month old now and initial results show that the biochar and compost plots and biochar at higher amount i.e. 10 tons/ha and 15tons/ha are showing better results.

Table 1 Maize plants development parameter

Soil amendment and parameters	**Nawalparasi**		**Parbat**	
	Average Height	**Diameter of Stem**	**Average Height**	**Diameter of Stem**
Plain soil	16.4	2.1	8.7	0.58
Biochar + Compost	20.3	2.2	11.4	0.82
Biochar (5 tons/ha)	22.0	2.4	11.4	1.1
Biochar (10 tons/ha)	24.2	2.7	11.6	1.0
Biochar (15tons/ha)	28.2	2.7	11.9	1.1
Normal practice	18.8	2.4	9.9	0.7

The soil test results were not very satisfactory the laboratory results showed very low amount of phosphorus, moderate amount of organic matter and moderate amount of nitrogen in the soil. The soil was ammended with the required amount of compost as suggested by the guidelines of Soil Management Directorate. The maize of Parbat site are still smaller in size due to colder climate in

the region. However we can see a visible difference between biochar ammended soil and non ammended soil.

Table 2 Test results for different soil parameters

Name of the field site	Total Carbon	Phosphorus	Nitrogen (%)	Potassium	Organic Matter
Nawalparasi	1.47	8.71	0.13	405.02	2.52
Parbat	1.46	12.29	0.12	161.76	2.51

In the days to come regular soil test will be carried out to monitor the effect of the biochar on the soil, and local people will be trained on the various aspects of climate change and sustainable agriculture.

Note: For in-depth information on the programs regarding the project kindly refer to the progress reports submitted to the MSFP, SSU.

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