Tribal Woman's Participation in Biochar Production and Preservation

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Abstracts

The main purpose of the study was to determine the extent of participation of tribal women in biochar promotion activities. Data were collected from the tribal women at Daudpur and Mahamudpur union of Nawabganj Upazila under Dinajpur district through personal interview method. A pretested and structured interview schedule was used to collect data from a sample of 102 tribal women during the period of 16 August to 17 September 2017. Descriptive statistics are estimated to explain the selected characteristics of the tribal women. Co-efficient of correlation (r) was computed in order to explore the relationship between selected characteristics including age, educational qualification, family size, farm size, annual income, cosmopoliteness, fatalism, training received, credit received, extension media contact and their participation in biochar promotion activities. Among ten selected characteristics of tribal women, four such as annual income, training received on Biochar, credit received and extension media contact had shown significant relationship with their participation in biochar promotion activities. Findings showed that less than half of the tribal women (41.2%) had low extent of participation compared to 30.4% medium and 28.4% high participation in biochar promotion activities. Among the problems faced by the tribal women in biochar production and preservation activities, "difficulty in fuel collection" was the top ranked problem. The lowest proportion of tribal women faced problems on 'market unavailability of *Akha Chula'* ranked as bottom.

Keywords: *Tribal women, participation, biochar, production and preservation.*

Introduction

Bangladesh is facing three major challenges: (a) a very high population density that will need increased demand of food and energy; (b) land degradation with low organic matter, and (c) greater vulnerability to climate change effect (MOEF, 2009). The government predicts that with a high growth rate of 1.59%, the total population will rise to approximately 265 million by 2050, putting increasing pressure on scarce resources (land and forest) for additional demand of food and energy (BBS, 2016). Energy sector is the second highest emitter (33% of total emission), while biomass fuel combustion is responsible for emitting 21% (USAID, 2016). Global climate change is another threat and it is frequently cited Bangladesh as one of the most vulnerable countries in the world (Karim, 2015; Rahman, 2010; Huq and Ayers, 2007; Karim and Thiel, 2017). Bangladesh's Intended Nationally Determined Contribution (INDC), published in September 2015 and puts forth an unconditional contribution to reduce GHG emissions by 5% within 2030 from existing mitigation actions, such as: renewable energy development, lowering emissions from agricultural land and waste as well as afforestation (MOEF, 2015).

About 72% of the population in Bangladesh lives in rural areas and annual household biomass consumption is around 44 million tons. Biomass covers 90% of household

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energy need, which accounts 68% of primary energy consumption of the country (BCAP, 2013). The common biomasses used for energy purpose are firewood, tree leaves or twigs, crop residues such as straw, rice husk, jute sticks, sugarcane bagasse, sawdust, cow dung and so more (Mamun *et al.,* 2009). Around 84% households use fuel wood and crop residues for traditional cooking stove locally known as *Chula*, while fuel wood constitutes 41% of total biomass energy (BCAP, 2013). Heavy reliance on fuel wood and crop residues is highly responsible for the reduction of forest and organic matter, respectively (Miah *et al.*, 2009).

The emergence of biochar technology has multiple opportunities to overcome many challenges such as efficient biomass management, enhancing organic matter and mitigating climate change. Biochar is charcoal made from organic residues that are carbonized at temperatures between 450-750°C in the absence of oxygen (pyrolysis) or with restricted oxygen (BBI, 2015). Biochar is produced in an environmentally friendly manner by recycling plant waste into fertilizer (Cui, 2015, Lehmann, 2009). Biochar systems are usually carbon-negative and sequestering carbon dioxide from the atmosphere. It increases the water-holding capacity, pore size and distribution on beneficial microbial communities in the soil (FAO, 2010).

In 2013, Bangladesh Biochar Initiative (BBI) is formulated to foster Biochar producing stove and its end product Biochar for smoke free cooking mechanism and agricultural sustainability. Canadian scientist Professor Dr. Julian Winter and CCDB (Christian Commission for Development in Bangladesh) Policy Advisor Md Mahbubul Islam recently invented low cost natural draft-Top-Lit-Up-Draft (TLUD) gasifier stove (local name *Akha Chula*) which is environment and agriculture friendly and can be used for cooking and heating with locally available biomass (BBI, 2015). Moreover, the development of biochar producing stoves, which provides energy efficient and healthy cooking resulting biochar used for soil improvement and Green House Gas (GHG) reduction (Barrow, 2012; Scholz *et al.,* 2014). The opportunities of biochar promotion using *Akha Chula* could be written as: a) *Akha Chula,* which produces high heat or renewable energy without smoking; and b) ensuring long term soil fertility (Karim, 2018$_a$). Using the biochar in small scale farming will have an immediate impact on household nutrition and income (Karim, 2018$_b$). Since 2013, CCDB has been fostering biochar applicable to small scale farms for promoting environment friendly agriculture. From that point of view, the researcher attempted the present study with the following objectives: a) to describe the selected characteristics of the tribal women; b) to determine the extent of participation of tribal women in biochar promotion activities; c) to explore the relationship between selected characteristics of the tribal women's and their participation in biochar promotion; and d) to assess the problems faced by tribal women in biochar promotion activities.

Methodology

Locale and sampling of the study: Bangladesh Biochar initiatives with the support of Christian Commission for Development in Bangladesh (CCDB) has been implementing in Nawabgang Upazila

under Dinajpur district. *Santal* and *Orau* tribal people lives in the study area. *Santal* and *Orau* tribal women are very poor with lacking of communication facilities and literacy contributes to low productivity. CCDB recognized that the ethnic communities would be further marginalized if appropriate development interventions are not made. Accordingly, CCDB initiated a biochar program in Nawabgang Upazila under Dinajpur district. An updated list of 355 tribal women was collected from CCDB office record. Out of them a sample of 102 tribal women was selected random sampling method.

Measurement of selected characteristics and focus issue: The selected characteristics of the tribal women such as age, educational qualification, family size, farm size, annual income, cosmopoliteness, fatalism, training received, credit received and extension media contact were measured by following appropriate techniques and standard scales. Participation of the tribal women in Biochar production and preservation was the focus issue of this study. Participation in biochar promotion was measured by twenty major activities with three (3) major aspects such as pre-production fuel collection activities, biochar production activities and biochar preservation activities. In addition, fuel collection activities were included under pre-production activities of Biochar production. Each tribal woman was asked to indicate how regularly she participated in each of 20 biochar activities along a 4-point rating scale. The scale responses were given score weights as 0 for 'not at all', 1 for 'seldom', 2 for 'often', and 3 for 'regularly'. Overall participation of tribal women in biochar production and preservation was determined by summing the score obtained for all the concerned activities. Therefore the composite

participation score of respondents in biochar promotion activities could range from 0 to 60, where 0 indicating no participation and 60 indicating very high participation. Participation Index (PI) for each activity of biochar promotion was computed by using following formula:

Participation Index (PI)= $N_{NP} \times 0 + N_{SP} \times 1 + N_{OP} \times 2 + N_{RP} \times 3$

Where,
   N_{NP}=Total number of respondents expressed 'not at all' participation for an activity
   N_{SP} = Total number of respondents expressed 'seldom' participation for an activity
   N_{OP} = Total number of respondents expressed 'often' participation for an activity
   N_{RP} = Total number of respondents expressed 'regular' participation for an activity

Thus PI could be ranged from 0 to 306, while 0 indicating no participation and 306 indicating very regular participation. PI on 20 activities of participation and their rank order was computed based on respective PI scores.

Measurement of problem faced by the tribal women in biochar production and preservation: Tribal women were requested to express problems in biochar production and preservation activities. The problems faced by tribal women in production and preservation activities were measured and ranked based on their citation on the specific problem. The highest number of citation indicated the top ranked problem faced by the tribal women, while the lowest citation score indicated the less ranked problem in biochar production and preservation.

Data collection, processing and analysis: Data were collected using structured interview schedule through face-to-face

contact. Collected data were coded, compiled, tabulated and analyzed in accordance with the objectives of the study. The analysis was performed using Statistical Package for Social Science (SPSS) computer package. Descriptive analysis such as range, number, percent, mean, standard deviation and rank order were used whenever necessary. For clarity of understanding tables were also used for presenting the data. Pearson's Product Moment Correlation Co-efficient (r) was used to examine the relationships between selected characteristics and focus issue. At highest 5 % (P=0.05) level of probability was used as a basis for rejection of the null-hypotheses.

Results and Discussion

Selected characteristics of the tribal women: The salient findings of the selected characteristics of tribal women have been presented in Table 1. Majority (81.4%) of the tribal women were young followed by 14.7% middle aged, while only 3.9% were under old aged category. The highest portion (49.0%) tribal women could sign only, while 28.4% had secondary level of education and 4.9% had above secondary level educational qualification. Majority (70.6%) of tribal women household had medium family size followed by 20.6% small and only 8.8% had large family size. Highest proportion (42.1%) respondents household were landless followed by 29.4% marginal, 14.8% small, 12.7% medium and only 1% large farm size. The highest (88.2%) of the respondents had medium annual family income, 10.8% had high income and 1.0% of the respondents had low income. Majority (77.5%) of the tribal women had low cosmopoliteness while 19.6% had medium and 2.9% had high cosmopoliteness. The highest (54.9%) proportion of the tribal women had medium fatalism while 28.4% had low and 16.7% had high. Majority (61.8%) of the tribal women had short training, 1.0% had short duration, 2.9% had medium and 34.3% did not receive any training. More than half (65.7%) of the tribal women had not received any credit, while 17.6% had taken low credit, 11.8% medium and only 4.9% had taken high credit amount from different sources. Majority (81.4%) of the tribal women had low extension media contact followed by 17.6% medium and only 1.0 % had high.

Overall participation of tribal women in biochar production and preservation

Participation in biochar promotion was considered as the focus issue of the study. The possible scores of the overall participation in biochar promotion activities of the tribal women could range from 0 to60 against observed scores of 2 to 54. The mean score is 26.05 having standard deviation of 13.279 (Table 2).

Findings showed in Table 2 that the highest proportion (41.2%) of the tribal women had low participation in biochar promotion activities as compared to 30.4% had medium and 28.4% high participation. It could be said that majority of the tribal women had low participation in biochar promotion activities. Sufian (2016) also found that majority of the respondents (33.3%) had low participation in agricultural activities which was similar to the findings of the present study.

Table 1 Distribution of the tribal women based on selected personal characteristics (N=102)

Personal Characteri s-tics	Scoring method	Range		Categories	Respondents		Mean	SD
		Possible	Observed		No.	%		
Age	No. of year	Unknown	18-60	Young (18-35)	83	81.4	31.91	7.704
				Middle (36 to 50)	15	14.7		
				Old (≥51)	4	3.9		
Education	Year of schooling	Unknown	0-13	Illiterate (0)	2	2.0	3.980	4.223
				Can sign only (0.5)	50	49.0		
				Primary level (1 to 5)	16	15.7		
				Secondary (6 to 10)	29	28.4		
				Above SSC (≥11)	5	4.9		
Family size	No. of members	Unknown	1-9	Small (up to 4)	21	20.6	4.66	1.432
				Medium (5 to 6)	72	70.6		
				Large (≥7)	9	8.8		
Farm size	Hectare	Unknown	0-3.34	Landless (≤0.02)	43	42.1	0.4853	0.622
				Marginal (0.021to 0.2)	30	29.4		
				Small (0.21to1.0)	15	14.8		
				Medium (1.01to3.0)	13	12.7		
				Large (>3.0)	1	1.0		
Annual income	('000' Tk.)	Unknown	33-585	Low (<33)	1	1.0	128.16	95.43
				Medium (33 to223)	90	88.2		
				High (>223)	11	10.8		
Cosmopol ite-ness	Score	0-18	1-15	Low (<7)	79	77.5	4.86	2.898
				Medium (7to12)	20	19.6		
				High (>12)	3	2.9		
Fatalism	Score	7-35	10-18	Low (≤11)	29	28.4	13.18	2.075
				Medium (12to15)	56	54.9		
				High (> 15)	17	16.7		
Training received	day	unknown	0-7	No (0)	35	34.3	2.05	1.631
				Very short (1 to 2)	1	1.0		
				Short (3 to 4)	63	61.8		
				Medium (>4)	3	2.9		
Credit received	scale	unknown	0-30	No (0)	67	65.7	4.61	7.922
				Low (1 to 10)	18	17.6		
				Medium (11 to 20)	12	11.8		
				High (>20)	5	4.9		
Extension media contact	score	0-36	1-24	Low (Up to 13)	83	81.4	8.90	4.509
				Medium (13to24)	18	17.6		
				High (>24)	1	1.0		

Table 2 Overall tribal women participation in biochar production and preservation

Range		Categories	Respondents		Mean	SD
Possible	Observed		No.	%		
0-60	2-54	Low (≤18)	42	41.2	26.05	13.279
		Medium (19-36)	31	30.4		
		High (>36)	29	28.4		

Rank-wise participation in biochar production and preservation activities: Participation of tribal women in Biochar promotion was composed of 20 major activities such as pre-production activities of fuel collection (6 activities), biochar production through *Akha Chula* (6 activities) and biochar preservation (8 activities).

Rank-wise participation in pre-production activities of fuel collection: Participation of tribal women in fuel collection for Biochar production composed of six (6) activities. Participation indices of these six activities related to biochar pre-production activities of fuel collection ranged from 192 to 265 against the possible range of 0 to 306 (Table 3).

Table 3 Rank-wise participation in pre-production activities of fuel collection

Sl. No.	Fuel collection activities	Frequency of respondents				PI	Rank Order
		Not at all (0)	Seldom (1)	Often (2)	Regular (3)		
1.	Collection of fuel wood	5	6	14	77	265	1st
2.	Cutting fuel wood	16	3	8	75	244	2nd
3.	Collection of bamboo	30	4	16	52	192	6th
4.	Collection of dry leaf	27	7	12	56	199	5th
5.	Collection of straw	18	1	12	71	238	3rd
6.	Collection of cow-dung	22	4	10	66	222	4th

Findings showed in Table 3 that the top ranked tribal women activity regarding participation in fuel collection for biochar production is 'collection of fuel wood' followed by 'cutting fuel wood; and 'collection of bamboo' is the bottom or six ranked fuel collection activities. It meant that tribal women mainly used fuel wood of tree branches for biochar production and they cut the fuel wood in smaller pieces suitable for using in *Akha Chula*.

Rank-wise participation in Biochar production activities through *Akha Chula* Participation of tribal women in biochar production through *Akha Chula* was measured considering six (6) activities. The participation indices of 6 activities for biochar production ranged from 92 to 171 against the possible range of 0 to 306 (Table 4).

Table 4 Rank-wise participation in biochar production through *Akha Chula*

Sl. No.	Biochar production activities	Frequency of respondents				PI	Rank Order
		Not at all (0)	Seldom (1)	Often (2)	Regular (3)		
1.	Cleaning the *Akha Chula*	46	4	4	48	159	4th
2.	Keeping fuel in *Akha Chula*	41	3	9	50	171	1st
3.	Firing fuel of *Akha Chula*	42	3	7	50	170	2nd
4.	Temperature control	47	32	9	14	92	6th
5.	Staying while cooking	47	2	3	50	158	5th
6	Collecting biochar after cooking	39	4	16	43	168	3rd

Findings presented in Table 4 showed that the top ranked tribal women activities regarding participation in biochar production was 'keeping fuel in *Akha Chula*' followed by 'firing fuel of *Akha Chula;* and 'temperature control' was the 6th ranked biochar production activities through *Akha Chula*.

Rank-wise participation in biochar preservation: Participation of tribal women in biochar preservation was composed of eight (8) activities. The participation indices of eight activities related to biochar preservation ranged from 15 to154 against the possible range of 0 to 306 (Table 5). Data presented in Table 5 revealed that the top ranked tribal women activities regarding participation in biochar preservation was 'preservation just after cooking' and 'preservation under roof' was 7th ranked and 'preservation in plastic pot was 8th ranked activities. It meant that tribal women timely collect and preserve biochar mostly in sake but it needs not to store under roof for quality control of Biochar. In addition, biochar needs to crush before application in the soil which was ranked as 3rd activities.

Table 5 Rank-wise participation in biochar preservation

Sl. No.	Biochar preservation activities	Frequency of respondents				PI	Rank Order
		Not at all (0)	Seldom (1)	Often (2)	Regular (3)		
1.	Preservation just after cooking	50	0	2	50	154	1st
2.	Preserving in a sake	50	3	7	42	143	2nd
3.	Preserving in polybag	79	3	4	16	59	5th
4.	Preserving in plastic pot	94	4	1	2	12	8th
5.	Preserving in ideal pot	71	0	2	29	91	4th
6.	Preservation under roof	95	3	4	1	14	7th
7.	Preserving in tin container	96	1	1	4	15	6th
8.	Crushing before use in soil	70	0	1	31	95	3rd

Relationship between selected characteristics of the tribal women and focus issue: The relationship between the characteristics of the tribal women and their participation in biochar promotion activities were computed by using the Pearson's product moment correlation co-efficient (r). The co-efficient of correlation is presented in Table 6.

Correlation test presented in Table 6 showed that four characteristics such as annual income, training received on biochar, credit received, and extension media contact had significant relationship with their participation in biochar promotion activities. It meant that these characteristics had significant influence on the extent of participation in biochar promotion activities. The rest of the characteristics of the tribal women viz. age, educational qualification, family size, farm size, cosmopoliteness and fatalism did not showed any significant relationship with their participation in biochar promotion activities.

Problems faced by tribal women in biochar production and preservation: Data presented in Table 7 showed that more than half of the tribal women cited their opinion to overcome the following

problems in response to 'difficulty in fuel wood collection' as 1st ranked problem followed by 'time consuming for cutting of fuel wood' as 2nd ranked problem.

Unavailability of *Akha Chula* was ranked 6th problems cited by the tribal women in biochar promotion activities.

Table 6 Relationships between the selected characteristics and focus issue

Focus issue	Selected characteristics	Computed 'r' with 100 d.f.	Tabulated value of 'r'	
			0.05 level	0.01 level
Tribal women participation in Biochar production and preservation	Age	0.076^{NS}	0.1946	0.2540
	Educational qualification	0.057^{NS}		
	Family size	-.097^{NS}		
	Farm size	0.141^{NS}		
	Annual income	0.205*		
	Cosmopoliteness	0.003^{NS}		
	Fatalism	-0.114^{NS}		
	Training received on biochar	0.728**		
	Credit received	0.281**		
	Extension media contact	0.323**		

*Correlation is significant at the 0.05 level of significance, **Correlation is significant at the 0.01 level of significance and NS= Not significant

Table 7 Rank order of problems faced by tribal women

Sl. No.	Problems	No. of Citation	%	Ranking
1	Difficulty in fuel wood collection	72	70.59	1st
2	Need of kerosene oil to start fire	40	39.22	4th
3	Only two food items can be cooked	62	60.79	3rd
4	Time consuming for cutting of fuel wood	65	63.73	2nd
5	Habit on traditional cook stove	37	36.28	5th
6	Unavailability of *Akha Chula*	30	29.42	6th

Conclusions

Majority of the tribal women had low extent of participation in biochar production and preservation activities. It might be concluded that there is ample scope to increase participation of rural women in biochar promotion activities. Therefore, programmers should be arranged to create awareness regarding benefit of biochar for clean energy and eco-friendly organic agriculture. Majority of the tribal women had low cosmopoliteness; low extension media contact; and one third tribal women did not receive any training. In addition, more than half of the tribal women had not received any credit. Hence, government, NGOs and other organizations should take

proper steps for increasing opportunities regarding these issues in the study area. For biochar production, tribal women generally used fuel wood which is difficult to collect and easily unavailable. Other fuel materials such as leaves, straw, jute sticks, dry cowdung or bamboo could be used as raw fuel materials for biochar production.

Considerable problem faced by the tribal women will therefore, adversely affect the effort of biochar production and preservation activities, it is recommended that steps should be taken on a priority basis to remove the problems causing hindrance to biochar production and preservation activities.

References

Barrow, C. J. 2012. Biochar: Potential for Countering Land Degradation and for Improving Agriculture. *Applied Geography*, 34: 21-28.

BBI. 2015. Bangladesh Biochar Initiative. (Available at: http://www.biochar-bangladesh.org).

BBS. 2016. *Statistical Year bank of Bangladesh.* Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

BCAP. 2013. Country Action Plan for Clean Cookstoves, Power Division, Ministry of Power, Energy and Mineral Resources, Government of the People's Republic of Bangladesh.

Cui, Z. 2015. A Review of Biochar Applications in the Soil Nitrogen Cycle, Department of Chemical & Material Engineering, New Mexico State University.

FAO. 2010. Climate Smart Agriculture; Policies, Practices and Financing for Food Security, Adaptation and Mitigation. Rome.

Huq, S. and J.M. Ayers. 2007. Critical list: the 100 Nations Most Vulnerable to Climate Change, in IIED Sustainable Development Opinion. London: International Institute of Environment and Development.

Karim, M. R. 2015. Adaptation to Climate Change through Participation in the Teesta Floodplain Area of Bangladesh. *MS Thesis*, International Master of Science in Rural Development, Humboldt University of Berlin, Germany.

Karim, M. R. 2018$_a$. Prospects of Biochar for Clean Energy, Organic Farming and Climate Change Mitigation in Northern Bangladesh. In: *A Closer Look at Climate Change (*Ed. Paredes, R.). Nova Science Publishers Inc. New York.

Karim, M. R. 2018$_b$. Prospects of Organic Farming for Sustainable Agriculture and Climate Change Mitigation in Bangladesh. *SciFed Journal of Global Warming*, 2(2), 1-10.

Karim, M. R. and A. Thiel. 2017. Role of Community Based Local Institution for Climate Change Adaptation in Teesta Riverine Area of Bangladesh. *Climate Risk Management*, 17: 92-103.

Lehmann, J. S. 2009. *Biochar for Environmental Management*. Earthscan, Oxford, UK.

Mamun, M.R.A., M.S. Kabir, M.M. Alam and M.M. Islam. 2009. Utilization Pattern of Biomass for Rural Energy Supply in Bangladesh. *International Journal of Sustainable Crop Production*, 4(1): 62-71.

Miah, M., A. Rashid, M.Y. Shin. 2009. World Fuel Use in the Traditional Cooking Stoves in the Rural Floodplain Areas of Bangladesh: A Socio-Environmental Perspective. *Biomass Bioenergy*, 33(1): 70-78.

MOEF. 2009. Bangladesh Climate Change Strategy and Action Plan (BCCSAP)-2009, Ministry of Environment and Forests, Government of the People's Republic of Bangladesh.

MOEF. 2015. Intended Nationally Determined Contributions. Government of the People's Republic of Bangladesh, Dhaka.

Rahman, M.R. 2010. Impact of Riverbank Erosion Hazard in the Jamuna Floodplain Areas in Bangladesh. *Journal of Science Foundation*, 8(1&2): 55-65.

Scholz, S. M., T. Sembres, K. Roberts, T. Whitman, K. Wilson and J. Lehmann. 2014, 'Biochar Systems for Smallholders in Developing Countries: Leveraging Current Knowledge and Exploring Future Potential for Climate-Smart Agriculture', World Bank Studies, Washington, DC.

Sufian, H. M. A., M. R. Karim, M. A. S. Mondol, M. S. Rahman and N. Muhammad. 2016. Participation of the Saotal Farmers in Agricultural Activities of CARITAS in Dinajpur District of Bangladesh. *Asian Journal of Agricultural Extension, Economics & Sociology*, 9(3): 1-10.

USAID. 2016. Greenhouse Gas Emissions in Bangladesh. Retrieved from: https://www.climatelinks.org/file/2339/download?token=5SyNi-T9