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29 MAY SESSION C

GLOBAL STATE OF BIOENERGY

TRADITIONAL HOMEGARDENS AND DOMESTIC BIOMASS FUEL CONSUMPTION PATTERN IN THE DEVELOPING WORLD: THE CASE OF A SOUTH-CENTRAL RURAL VILLAGE OF BANGLADESH

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ABSTRACT: Peoples living in most developing countries meet majority of their biomass fuel requirements from the forest. However, this usual practice becomes difficult to maintain as the forest of this region decreases in an alarming rate. In such context, homegardens will have to play the key role in near future where in many forest poor regions it's already playing the vital role. An exploratory study was conducted in a south-central rural village of Bangladesh to realize this potential contribution of homegardens to households domestic biomass fuel supplies, which is as well a virtually forest poor region of the country. Households were grouped into three different land holding categories and a total of thirty respondents, 10 from each category were selected randomly to understand their domestic biomass fuel consumption pattern as well as the role of homegardens to meet this fuel supply. Study suggested that, majority (87%) of the households of the area rely extensively on their homegardens to meet their domestic cooking energy requirements. During the study 47 homestead species were identified having fuel value of which 12 were identified as the most preferred species in the area. The contribution of wood fuel in households domestic energy sharing was reported as 56% followed by dried leaves (21%), dung cake/sticks (14%), crop residues (6%) and others (3%). Study finally concluded for a rich homegarden system in forest near regions to conserve country's remaining forest by providing an alternative source of biomass fuel. A participatory management of governments' fallow and *khas* lands, public places including road, railway and canal banks for tree farming to benefit rural land-less and marginal people were also recommended.
Keywords: agricultural residues; biomass resources; cooking; developing countries; forestry; tropical homegardens.

1 INTRODUCTION

About 2.3 billion people worldwide - every two in five rely on biomass fuel, mostly fuelwood as their main or soul sources of domestic energy requirements [1, 2]. In last years, although economic development in many developing countries has been rapidly progressed but alternatives to biomass fuels are still scarce in many rural areas [3, 4]. In fact, forests are still among the vital sources and are providing majority of the biomass fuel required in most developing countries. Extraction of such kind of fuel also one of the major causes of depletion forest in that particular region [1]. The projected biomass fuel consumption in south Asia- one of the world's main developing region- by the year 2010 is 372.5 million cubic meters which is second most all over the world [5, 6]. This figure suggests that, biomass fuels will continue to play a major source of energy in rural areas of this region, for many years ahead. However rapid deforestation in the developing countries questioning this prediction and alternative sources are therefore recommended.

Homegardens on the other hand, consists of an assemblage of plants and include trees, shrubs, vines, and herbaceous plants, growing in or adjacent to a homestead or home compound [7]. Homegardens represent a well-established traditional land-use system in many developing countries which play an important role in the livelihoods and economy of rural people. These also play a potential role in forest conservation by providing for subsistence needs of local populations, which they may otherwise have derived from the forest [8]. In context of rapid losses of forest vegetation in the developing world, homegardens will have to play an important role as a substitute source of natural forest products including biomass fuel. In fact, in some areas where forest has become scare homegardens already playing a noteworthy role in meeting households' domestic fuel requirements for processing of food.

Bangladesh, representative of the worlds' developing countries, characterized by a relatively low natural resource base and a huge population of nearly about 150 million. The economy of the country is mainly agrarian with per capita income of around 389 US$ (in 2002/03) [9]. The per capita consumption of wood fuel (0.1 m^3) in Bangladesh although one of the lowest in the world but there is a big shortfall of supply compared to demand. The natural forest in the country occupies nearly about 17% of the land surface (with per capita forestland of around 0.02 ha) and not in a balanced condition. Again, due to poor per capita income, dense population, rural poverty and unemployment the deforestation rate in the country is highest among the south-east Asian countries and was 3.3% during 1990-1998 [10]. Most of country's state forests are unevenly distributed (out of the total 64 districts of the country, 28 districts have no forests) and are devoid of any true forest vegetation [11]. In the northern and south-central regions, the country has no productive public forest from where people could meet their fuel requirements. In such situation it has perceived that homegardens being playing the vital role in meeting households demand for biomass energy [11]. This assumption is also evident from several studies conducted in some forest poor areas of the country. In fact, in the country still more than 77% people live in rural areas and about 80% of them possess small to medium homegardens from where they may get their domestic fuel [11]. The present paper here describes a case-study carried out in a south-central rural village of Bangladesh where attempts have been taken to understand households' domestic fuel consumption pattern and the potential contribution of homegardens as their primary source of biomass fuel. The study will be helpful to understand the probable value of homegardens as an alternative energy source and to promote this productive system in areas where there has a fuel shortfall for domestic use or where deforestation taking place due to the collection of biomass fuel from forests.

2 MATERIAL AND METHODS

2.1 The case study area

The study was conducted in *Sadar* upazila (administrative entity, sub-districts) of Noakhali district, Bangladesh. The area is virtually free from all kind of public forests (except some mangrove plantations in the coastal areas) and famous for its homestead resources (i.e. diversity and species richness). The district was selected purposively and the upazila was selected randomly from a list of six upazillas (i.e. Begumganj, Chatkhil, Companiganj, Sadar, Senbagh and Subarnachar) comprising the district. Geographically the upazila lies between $22^{0}34^{/}$ to $22^{0}54^{/}$ N latitude and $90^{0}53^{/}$ to $91^{0}18^{/}$ E longitude and crossed by *Meghna* river [12]. Bay of Bengal borders the upazila on its southern portion.

2.2 Methodology

The survey was performed in the *Lalpur* village of *Binodpur* union. A sequence of field visits was arranged during January, 2006 to August, 2006, within an eight month time span. A multistage random sampling exercise was applied to locate the village and households, with upazila as the primary sampling unit and the households of the villages as the ultimate sampling unit. For household selection I have categorized the households into three distinct land holding category, i.e. landless to marginal (<0.50 ha), small (0.51-1.00 ha) and medium to large (1.00> ha), through a preliminary socio-economic survey. Both agricultural lands and homesteads were considered for this classification. Finally, I have randomly selected thirty households of the village (taking ten from the each) for the present study (**Table 1**).

Table 1: Classification of the households and sampling intensity

Land holding category	No. of households (N)	Sampling intensity (n=10)
Landless to marginal (<0.50 ha)	N = 49	20%
Small (0.51-1.00 ha)	N = 52	19%
Medium to large (1.00> ha)	N = 21	48%

Data's were obtained by taking interviews of the selected households. A number of field visits towards homegardens of the selected households were also arranged to assess the situation and composition of their homegardens. For interviews, a semi-structured questionnaire was used where the details about household's homestead situation (i.e. homestead size, species composition etc), species preferences and quality, domestic fuel consumption pattern, quantity consumed, sources of biomass fuel etc were recorded. Additional data regarding household's demographic and socio-economic status were also gathered. On each topic the respondents were free to express his/her views.

3 RESULTS AND DISCUSSION

3.1 Structure and composition of the homegardens

The average homegarden size observed in the area for three different land holding categories (i.e. landless to marginal, small and medium to large) were, 0.07 ha, 0.14 ha and 0.19 ha respectively. The species composition of the homegardens was varied among the homegardens of different sizes and owned by different income groups. It was found that the homesteads of wealthier households were much more rich and diverse than that of other households. The homegardens of poorer households on the other hands were characterized by low yield and productivity, closer spacing and abundance of inferior quality tree species. The homestead species reported having fuel values in the area were includes; *Acacia auriculilformis*; *Aegle marmelos*; *Albizzia lebbeck*; *Albizzia procera*; *Albizzia saman*; *Alstonia scholaris*; *Anthocephallus chinensis*; *Areca catechu*; *Artocarpus heterophyllus*; *Artocarpus lakoocha*; *Averrhoa carambola*; *Azadirachta indica*; *Baccaurea ramiflora*; *Bambusa balcooa*; *Bombyx ceiba*; *Borassus flabellifer*; *Butea monosperma*; *Cassia fistula*; *Citrus acida*; *Cocos nucifera*; *Delonix regia*; *Dillenia indica*; *Diospyros discolor*; *Diospyros embryopteris*; *Elaeocarpus robustus*; *Erythrina variegata*; *Eucalyptus camaldulensis*; *Ficus roxburghii*; *Garcinia cowa*; *Lannea coromandelica*; *Mangifera indica*; *Melia azedarach*; *Melocanna baccifera*; *Moringa oleifera*; *Musa* spp.; *Odina wodier*; *Phoenix sylvestris*; *Phyllanthus acidus*; *Psidium guajava*; *Schumannianthus dichotoma*; *Swietenia macrophylla*; *Syzygium cumini*; *Syzygium grandis*; *Tamarindus indica*; *Terminalia catappa*; *Typha elephantine* and *Zizyphus mauratiana*. Majority of these species were tree (37 species) followed by some palms (4 species) grasses (3 species), shrubs and herbs. Fig. 1 depicts a typical homegarden of the area.

Figure 1: A typical *'homegarden interface'*- represents a secured and alternative fuel source for the future

3.2 Biomass fuel used for domestic purpose

Firewood was the most frequently used biomass fuel by the respondents– contributing around 56% of total annual consumption. Other kinds of fuels used by the local households were, dried fallen leaves- collected also from the homegardens, followed by dung cake/sticks, crop residues and others; e.g. bio-gas, saw mill residues etc. Fig. 2 represents the energy mix-up in the area by total consumption. During the study a different trend of

consumption was also observed among the households which differ considerably by their wealth status, seasons, and availability of different kinds of fuels. Wealthier households were more likely to used firewood and consumed the highest proportion of it. Poorer households on the other hand, prefer mainly dried fallen leaves and dung cake/sticks as their domestic fuel because of their availability. Agricultural residues, like rice husk and straw being extensively used by the households just after the harvesting period took place. The use of leaves as fuel rose during the winter due to its superior availability where the use of firewood drowned during the monsoon because of their incombustibility for the presence of higher moisture in it.

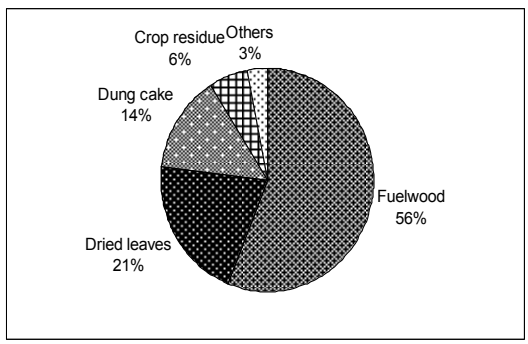

Figure 2: Energy mix-up in the case study area by consumption

3.3 Sources of and preferences of biomass fuel by the households

Homegardens were the major sources of biomass fuel (to 87% respondents) in the locality and was found contributing about 56% of the households total energy requirements. The respondents also collected biomass fuel from neighbors (16%), public or governments waste land (14%); mainly from the road sides plantations and from nearby markets (Fig. 3). The most preferred fuel species, parts consumed and their abundance in local homegardens being listed in **Table 2**. Households mainly prefer the species, light in weight and have higher calorific value.

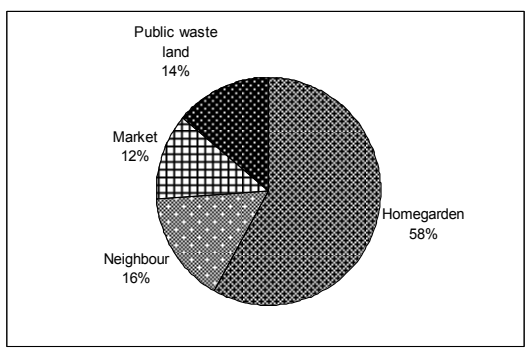

Figure 3: Different sources of biomass fuels in the locality

Table 2: Species mostly preferred by the people as biomass fuel

Botanical name	Local name	Parts used	Preference*	Occurrence
Albizzia spp.	Koroi	Leaves, Wood	++	+++
Areca catechu	Supari	Petiole	+++	+++
Bambusa spp.	Bansh	Sheath, twigs	+++	+++
Bombyx ceiba	Simul	Wood	+++	+++
Borassus flabellifer	Tal	Sheath, petiole	+++	++
Cocos nucifera	Narikel	Petiole, Fruit	+++	+++
Erythrina indica	Madar	Wood	+++	+++
Mangifera indica	Am	Leaves, wood	++	+++
Oryza sativa	Dhan	Husk, Straw	+++	+++
Terminalia catappa	Katbadam	Leaves, wood	+++	+++
Typha elephantina	Hogla	Grass	++	+++
Zizyphus mauratiana	Boroi	Wood	+++	+++

* Ranked by respondents as: +++ high; ++ moderate, and + low

3.4 Collection pattern and storage of biomass fuel

Mainly women and children were responsible for the collection of biomass fuel for domestic consumption. There was no systematic way of collection of biomass fuel. In case of plants they usually prefer those parts of the species that are defected, having no alternate or better use. Households mainly stored fuel for their future use during the rainy season. There is no specific place for storage- any unused or vacant place having roof facility might be used. In Fig. 5 biomass fuel been stocked inside of a kitchen.

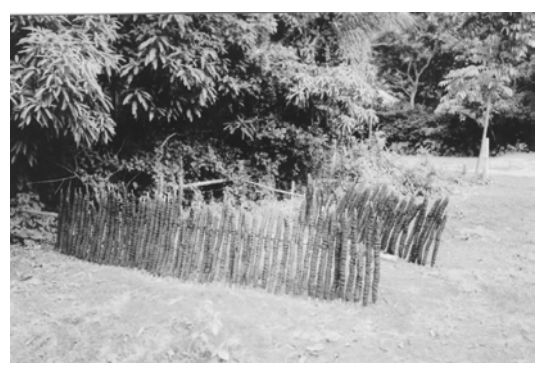

Figure 4: Drying of dung-sticks for domestic use

Figure 5: Fuelwood storage for future consumption

4 CONCLUDING REMARKS

In Bangladesh, an estimated 88% supplies of all wood products are still drawn from homegardens depicts a very productive system [10]; and suggest that trees outside of the forest can provide a significant proportion of wood and other sort of biomass fuel [1]. The present study conducted in a disregarded village of the country supported by the findings of several other authors who have also accomplished their survey in some other forest poor regions of the country (see for example Jashimuddin et al [13], Miah et al [14] and Miah et al [15]). Study also recommended for a rich homegarden system in forest near regions to conserve the remaining forests by providing an alternative source of biomass fuel.

In developing countries with high population density, gathering of biomass fuel may cause serious deforestation as majority of the forests here are still communal and unregulated [1]. Collection of biomass fuels also promotes gathering of litter from forests and woodland sites and the complete removal of biomass at the time of harvest– sometimes including stumps– and thus aggravates site decline through nutrient depletion, soil erosion and poor regeneration [16, 17]. Since the supplies of firewood from public forests diminish, rural households are now required actively growing more of their own biomass fuel [17, 18]. Governments could also provide logistic supports to land-less and marginal peoples to meet the increasing demand of biomass fuel through raising plantations of fast growing species with high calorific values in governments' fallow and *khas* lands, public places including road, railway and canal banks through a participatory management regime to secure a the highly productive system.

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