

Original Research Article

Homestead plant diversity at the ship breaking areas of Bangladesh

ABSTRACT

Unplanned ship breaking at the Sitakund coast in Chittagong, Bangladesh is contaminating the surrounding vegetation mainly through the discharge of heavy metals from the discarded ship paints. Therefore, the present study was conducted with an aim to explore homestead plant diversity in ship breaking areas at Sitakunda sub-district in Bangladesh from where Salimpur and Kumira union was selected as ship breaking areas (SBA) whereas Bansbaria and Barabkunda as non-ship breaking areas (NSBA). In total 104 households were surveyed to ascertain plant diversity. Present study revealed that NSBA have more plant diversity than SBA. A total of 27 tree species including fruits, timber, fuel wood, aesthetics and medicinal were found in SBA while 30 species were found in NSBA. Shanon Winner index value was 2.5 in SBA whereas in NSBA it was 2.7. Agro-crop diversity in both areas was almost same. A total 15 species were found in SBA and 16 species in NSBA. Average production of rice in SBA (2251.91 kg/yr/household) was quite higher compared to the NSBA (380.2 kg/yr/household). This study prioritizes the importance of soil properties analysis in both the areas to check if there is any significant relationship with the growth of vegetation.

22 Keywords: Diversity, Index, Household, Agri-crop, Tree species

23

24 **1 Introduction**

25

26 From ecological and conservation point of view assessment of biodiversity of any habitat or locality has been regarded as one of the
27 vital issue for careful preservation, promotion and management of the variety of life-forms. Increased human population and
28 associated development activities in the last few decades has resulted directly and indirectly in depletion of the natural vegetation
29 which in turn increase the pressure on the homestead forest specially in the developing countries to meet various needs of the human
30 beings. In this circumstances correct inventory and assessment of biodiversity in different habitats is necessary for evolving a long
31 term strategy for conserving the endangered species and improvement of the existing species.

32 Bangladesh is situated at the complex interface of the Himalayan and the Southeast Asian Bio-geographic regions, and historically
33 was well endowed with very diverse complements of terrestrial and aquatic flora and fauna. It has 15.4 million homesteads occupying
34 0.3 million hectares of land and are providing major requirement of food, fruit, vegetables, timber and fuelwood . Wide range of plant
35 biodiversity for timber and food crops was found in the homesteads.

36 Homestead is an operational unit in which a number of crops including trees are grown with livestock, poultry and fish production
37 mainly for the purpose of satisfying the farmer's basic needs. It is the most prospective form of production site along with the
38 seat/shelter of the family. Homestead fulfill basic needs of the people such as food, shelter, cash etc and high species diversity of the

39 homestead help to reduce the environmental deterioration commonly associated with monoculture production system. Moreover, they
 40 have been producing sustained yields for a century in a most resources efficient way.

41 Study on homestead forest was carried out in different regions of Bangladesh. But no study was so far carried out solely on the status
 42 of homestead forest biodiversity in the south-eastern coastal region specially Sitakund sub-district under Chittagong district of
 43 Bangladesh. From the conservation point of view, homestead forest can be considered as the ex-situ conservation sites for the wide
 44 range of plant diversity. The ecological merits of home garden are related to conservation of soil, water, nutrients and bio-diversity.
 45 Therefore this study will be baseline information for the policy makers to understand the species richness (timber, medicinal, fruit,
 46 fuelwood) species and composition, agro-crop diversity and socio-economic importance of homestead forest as well as to formulate
 47 biodiversity conservation planning highlighting homestead forest of Bangladesh for sustainable production and maintenance of
 48 biodiversity.

49 **2 Objectives**

50

51 The study was conducted with the following objectives.

- 52 1. To document the existing plant diversity in the homesteads of ship breaking and non-ship breaking areas of Bangladesh.
- 53 2. To assess the contribution of homestead plant diversity in rural household economy.
- 54
- 55 3. Identify the management system and the problems faced by the households in the growing/cultivating plants in the homesteads of
- 56 ship breaking and non-ship breaking areas.
- 57

58

59 **3 Methodology**

60 Sitakunda is an administrative unit in the Chittagong District of Bangladesh. It is a seashore area situated a few kilometers north of
 61 Chittagong where most of the ship breaking yards are concentrated. The Ship breaking area along the Chittagong sea shore is situated
 62 on 22° N Latitude and 91 ° E Longitude and at a stretched 14 kilometer form Fouzdarhat to Kumira under Sitakunda sub-district. The
 63 ship breaking industry has started its operation in Bangladesh in 60's and it was widely spread in 80's in Sitakunda, Chittagong,
 64 Bangladesh. In different years the industry broke the highest numbers of ships in the world. All the ship breaking industries of
 65 Bangladesh are located in this belt with more than 140 ship breaking yards in Salimpur, Kumira, Bhatiary, BarabKunda, Fouzdarhat
 66 zone in Chittagong. Therefore, this study was carried out to investigate the homestead plant diversity in Sitakund sub-district specialy
 67 near it's ship breaking areas along the Chittagong Sea shore from Bhatiary to Kumira. Ship breaking industry covers an area of about
 68 8 km² (Hussain, 1999). The study was conducted in Salimpur, Kumira, Bansbaria, Barabkunda unions under Sitakuda coastal area
 69 (Figure 1).

70 **List of Figure**



Figure 1 Map of Sitakunda Upazila showing the study area.

75 The area is subtropical with a long dry season extending from September to April and an unpredictable period of rain storm from May
76 to August. Mean annual rain fall in the study site is 3207mm and mean annual temperature is 26.24°C. Southwest monsoon air
77 provides about 94% of the total rain fall. This lead to a period of saturation and gives rise to a phase of intense plant growth.

78 The information and relevant literature that were required for preparing this paper were collected from different books, journals and
79 published papers of the library of Institute of Forestry and Environmental Sciences, University of Chittagong. Very recent and updated
80 information and literature were collected from Internet.

81 From a total of 20 upazila of Chittagong district, Sitakund upazila was selected purposively as this is the only upazila of Chittagong
82 district where ship breaking yards are established. Out of 09 unions in Sitakund upazila, four unions (Salimpur, Kumira, Bansbaria
83 and Barabkunda) were firstly selected randomly. Two unions were selected from ship breaking areas and two from non ship breaking
84 areas. Then two villages from each union were randomly selected. The total number of villages was twelve (08). The selected villages
85 were Uttor Salimpur, Moddom Salimpur, Boro kumira, Alekdia, Kazipara, Nonabil, Moddhom Mahmudabad, Mandaritola
86 respectively. Thirteen (13) households from each village (total households 104) were selected for interview under this study. Total
87 number of households in each village was obtained from the District census published by the Bangladesh Bureau of Statistics. Before
88 starting the actual survey, a reconnaissance survey was carried out at the study area. The objective of the survey was to get
89 familiarized with the community, to get some idea of vegetation composition from the rural people of the study area.

90

91

92 In order to collect relevant information, interview schedule was carefully designed keeping the objectives of the study in view. The
93 questionnaire contains both open ended and closed form of questions. All households were visited with the assistance of local student
94 living at the study area. Most of the information were obtained through interview with household members. The distribution of plant
95 species on the homestead was surveyed physically. Collected information was verified through discussion with the household
96 respondent. Information on agro-crop production cost, consumption, sale value per year was also collected from the household
97 member. Besides, information on particular issues like problems of home garden plantation, sources of seedlings, preferences of
98 species selection, farmer's recommendation was also collected from the household level. During taking interview, vegetation survey
99 was conducted at each household compound to ascertain plant diversity. The local name of the plant in the homesteads was collected from
100 the respondent. The number of plants and occurrence of that plant in number of homestead counted with the help of household member and
101 local students. Seasonal crops like vegetables of herb category were also included in the study. Secondary information and data were
102 collected from different organizations such as IFESCU library and from various scientific journals, articles etc. The identification of
103 the species was done with the help of specialist of Institute of Forestry and Environmental Sciences, University of Chittagong. Local
104 name were collected from local people and from different books.

105

106 *Species diversity index*

107 To ensure the abundance and diversity of different plant species. Shannon-Wiener species diversity index (H) as shown below was
108 used:

109 **Shannon Index (H)** = $-\sum (P_i \ln P_i)$

110 In the Shannon index, **p** is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of
111 individuals found (N), **ln** is the natural log, Σ is the sum of the calculations, and **s** is the number of species

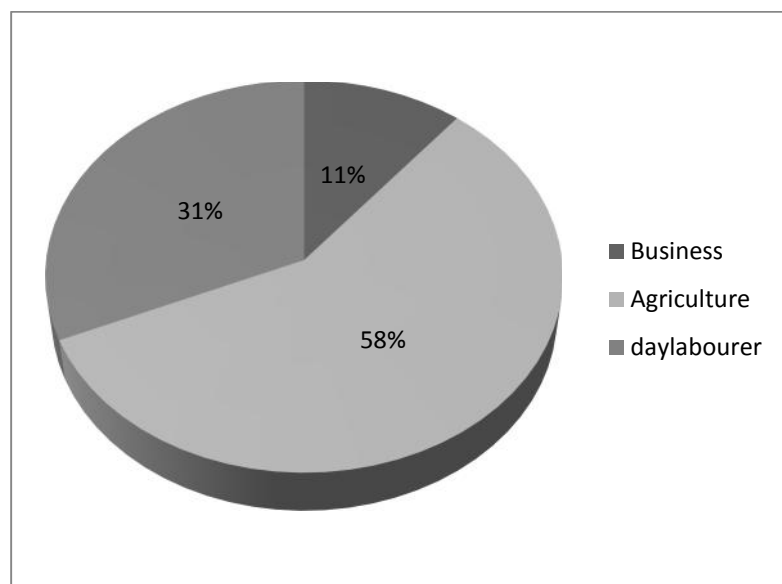
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113 4 Results

114 4.1 Distribution of households according to their occupation

115 There were three major types of occupations in ship breaking areas. These are agriculture, day labor, and business where agriculture
116 was the major occupation (58% people engaged in agriculture) followed by day labor (31%) and business (11%) shown in (Figure 2a).

117 On the other hand, four major types of occupations were found in non- ship breaking areas were agriculture, day labor, service and
118 business where agriculture was the major occupation (53% people engaged in agriculture) followed by day labor (29%) business
119 (10%) and service (6%). About 2% people engaged in other occupations shown in (Figure 2b).



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122 **Figure 2 (a) Occupational variation in percentage for ship breaking areas**

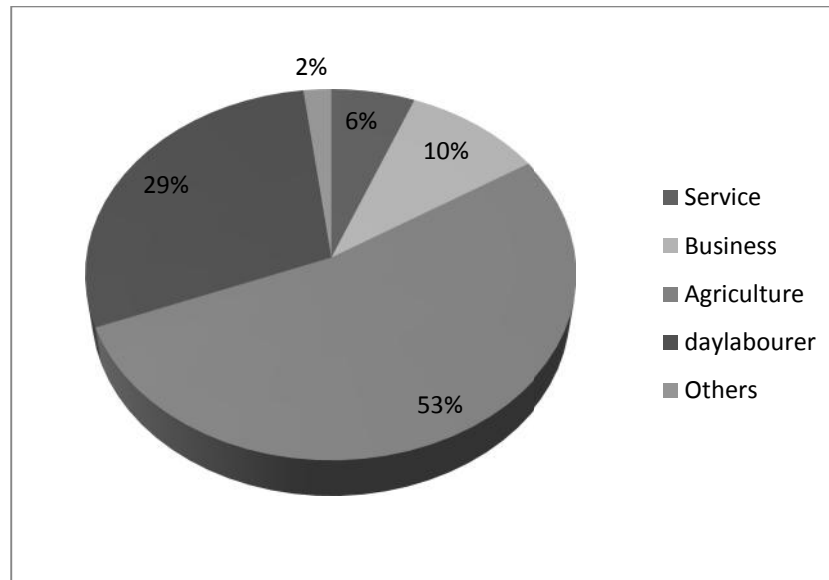


Figure 2 (b) Occupational variation in percentage for non-ship breaking areas

4.2 Plant diversity

A total 27 different species were found in ship breaking areas (SBA) Where *Cocos nucifera* (Coconut), *Eucalyptus camaldulensis* (Eucalyptus) and *Mangifera indica* (Mango) were found the most dominant (Table 1). On the contrary, a total 30 different plant species were found in non-ship breaking areas (NSBA) where *Eucalyptus camaldulensis* (Eucalyptus), *Cocos nucifera* (Coconut) and *Carica papaya* (Papaya) were found the most dominant (Table 1). Among the found species, 26 plant species were present at the both

134 areas where only one species *Achras sapota* (Safeda) was found only in ship breaking areas and three (3) plant species e.g. *Psidium*
 135 *guajava* (Guava), *Averrhoa carambola* (Kamranga), *Bombax malabaricum* (Shimul tula) found in non-ship breaking areas. Shanon
 136 Winner index for ship breaking areas show the value of 2.5 whereas in non-ship breaking areas it is 2.7 which present that there is less
 137 variation in plant diversity in both the areas (Table 2).

138 **Table 1 Plant diversity in both ship breaking and non-ship breaking areas**

Species Overlapped in both areas			
Local Name	Scientific Name	Local Name	Scientific Name
Acacia	<i>Acacia auriculiformis</i>	Kanthal	<i>Artocarpus heterophyllus</i>
Mango	<i>Mangifera indica</i>	Labu	<i>Citrus lemon</i>
Amra	<i>Spondia spinnata</i>	Litchi	<i>Litchi chinensis</i>
Banana	<i>Musa sapieantam</i>	Mehegoni	<i>Swietenia mahagoni</i>
Bilimbi	<i>Averrhoa bilimbi</i>	Coconut	<i>Cocos nucifera</i>
Eucalyptus	<i>Eucalyptus camaldulensis</i>	Ata	<i>Annona squamosal</i>
Gab	<i>Diospyros perigrina</i>	Papaya	<i>Carica papaya</i>
Gamar	<i>Gmelina arborea</i>	Segun	<i>Tectona grandis</i>
Ganda	<i>Polygala vulgaris</i>	Silkoroi	<i>Albizia procera</i>

Jaba	<i>Hibiscus rosa-sinensis</i>	Supari	<i>Areca catechu</i>
Jam	<i>Syzygium cumini</i>	Tulsi	<i>Ocimum sanctum</i>
Jambura	<i>Citrus grandis</i>	Boroi	<i>Zyzyphus Mauritania</i>
Jhau	<i>Casuarina equisetifolia</i>	Khejur	<i>Phoenix sylvestris</i>

Species found only in non-ship breaking areas

Local Name	Scientific Name
Guava	<i>Psidium guajava</i>
Kamranga	<i>Averrhoa carambola</i>
Shimul tula	<i>Bombax malabaricum</i>

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Table 2 Shanon Winner diversity index

Areas	Shanon Winner Index
Ship breaking	2.5
Non-ship breaking	2.7

142

4.3 Agriculture crop production status

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144 Agro-crop diversity in ship breaking and non-ship breaking areas were almost same. A total of 16 agri-crop species were found in
 145 non-ship breaking areas and 15 in ship breaking areas. Common species between these two areas were *Oryza sativa* (Rice), *Solanum*
 146 *melongena* (Eggplant), *Abelmoschus esculentus* (Okra), *Amaranthus gangeticus* (Red Amaranth), *Basella alba* (Spinach), *Phaseolus*
 147 *vulgaris* (Bean), *Solanum lycopersicum* (Tomato), *Brassica oleracea* (Cauliflower), *Lathyrus sativus* (Khesari dal), *Lens culinaris*
 148 (Mosur dal). Mean annual productions of rice per family among all crops grown in farms in ship breaking areas were the highest
 149 (2251.9kg/year) whereas it was (380.2 kg/year) in non-ship breaking areas. Production of rice in ship breaking areas was quite high
 150 compared to the non-ship breaking areas. Unique species for non-ship breaking areas were *Ipomoea batatas* (Sweet Potato),
 151 *Momordica charantia* (Bitter gourd) and *Trichosanthes cucumerina* (Snake gourd) while
 152 *Luffa cylindrical* (Sponge gourd) and *Brassica oleracea var capitata* (Badhakopi) for the ship breaking areas shown in (Table 3 &
 153 Table 4). Various agro-crops were found in the non-ship breaking areas such as *Oryza*
 154 *sativa* (Rice), *Solanum melongena* (Eggplant), *Trichosanthes cucumerina* (Snake gourd), *Abelmoschus esculentus* (Okra), *Momordica*
 155 *charantia* (Bitter gourd), *Cucurbita maxima* (Misti Kumra), *Amaranthus gangeticus* (Red Amaranth), *Lagenaria siceraria* (Bottle
 156 gourd), *Capsicum annuum* (Green Chili Pepper), *Basella alba* (Spinach), *Phaseolus vulgaris* (Bean), *Solanum lycopersicum* (Tomato),
 157 *Brassica oleracea* (Cauliflower), *Lathyrus sativus* (Khesari dal), and *Lens culinaris* (Moshur dal). Among them rice plays the most
 158 significant role in the rural economy of the non-ship breaking areas. Rice production in each family was 380 kg/yr where consumption
 159 was 344.2 kg/yr and production cost was 1908.6 BDT. Respondents got 835.3 BDT on an average by selling surplus rice. There were

160 no surplus for Spinach and Cauliflower after own consumption. These crops were grown only for own consumption shown in (Table
161 4).

162 **Table 3 Average production of agro-crop in ship breaking areas**

Name of the crops	Average Production (kg/yr) in each family	Average Consumption (kg/yr)	Average Production cost (Tk)	Average Sale value(Tk) for surplus crop)
Badhakopi	4.6	2.32	174.4	1325.5
Eggplant	3.13	3.9	16.2	11.6
Okra	16.69	3.1	7.8	258.2
Sponge gourd	50	1.04	139.53	979.06
Cauliflower	46.51	4.65	162.79	1046.5
Misti Kumra	11.16	0.69	26.74	156.97
Red Amaranth	3.83	0.58	8.37	65.11
Bottle gourd	66.86	8.48	377.9	715.11
Green Chili	2.39	1.46	110.9	18.6

Musur dal	3.48	0.81	23.25	76.16
Spinach	0.81	0.58	2.32	3.48
Rice	2251.9	320	4546.51	2401.39
Bean	30.81	5	124.41	610.46
Tomato	27.67	3.37	111.62	400
Khesari dal	4.18	1.27	46.51	93.02

163

164 **Table 4 Average production of agro-crop in non-ship breaking areas**

165

Name of the crops	Average Production (kg/yr)	Average Consumption (kg/yr)	Average Production cost(Tk)	Average Sale value for surplus crop (Tk)
Rice	380.2	344.2	1908.16	835.3
Eggplant	2.65	2.14	28.77	10.2
Snake gourd	0.918	0.71	5.1	4.1
Okra	14.69	2.65	6.83	217.34

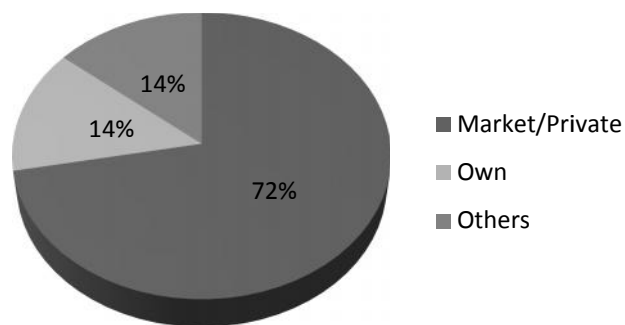
Bitter gourd	8.16	1.02	81.63	229.59
Misti Kumra	8.46	1.12	25.51	110.2
Red Amaranth	5	0.81	21.63	76
Bottle gourd	2.04	1.02	16.53	17.85
Green Chili	3.06	0.3	76.53	469.38
Spinach	0.61	0.61	2.04	0
Bean	23.46	6.02	105.1	348.9
Tomato	14.79	3.87	112.24	165.8
Cauliflower	1.63	0.51	10.2	0
Khesari dal	1.63	0.2	30.61	42.85
Sweet potato	6.12	0.61	20.4	82.65
Mosur dal	5.1	1.22	8.16	310.2

166

167 **4.4 Sources of seedlings**

168 Three different sources of seedling were found in ship breaking areas. These are private source, own production and other sources i.e
 169 bringing from relative, neighbors. Major seedling sources was private sources (72%) followed by others (14%) and own (14%)
 170 respectively shown in Figure 3(a). On the contrary, three different sources of seedling were found in non-ship breaking areas. These

are private source, own production and other sources i.e. bringing from relative, neighbors. Major seedling sources was private sources (86%) followed by others (8%) and own (6%) respectively shown in Figure 3(b).



3(a)

Figure 3(a) Seedling sources in ship breaking areas

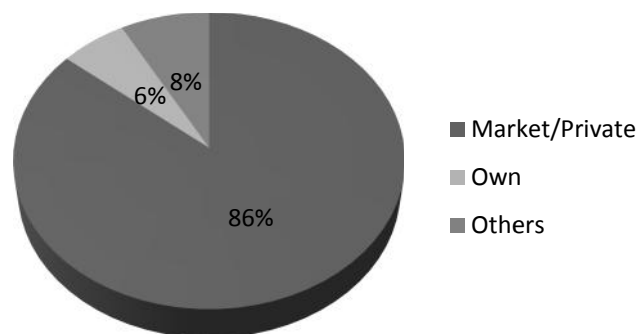
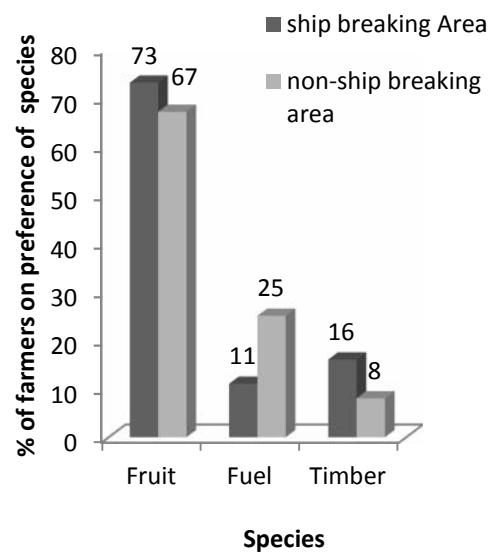


Figure 3(b) Seedling sources in non-ship breaking areas

4.5 Preference of species selection

Present choice of preference of species selection is confined to fruit, fuel and timber species for both ship breaking and non-ship breaking areas. Among them preference was given to the fruit tree species for both areas. However percentage varied from each other. In non-ship breaking areas 57% people chose fruit species while 73% people chose fruit tree species in ship breaking areas. After fruit species fuel species was given preference in non-ship breaking areas while timber was given preference in ship breaking areas (Figure 4a). Past choice of species were confined to fruit, timber, aesthetics and medicinal species for non-ship breaking areas and fruit, fuel, timber and aesthetics for ship breaking areas (Figure 4b). Among them preference was given to the fruit tree species in non-ship breaking areas while timber species was given preference in ship breaking areas. In non-ship breaking areas 57% people chose fruit species while 43% people chose fruit tree species in ship breaking areas. In ship breaking areas 45% people chose timber species while 35% people

193 chose timber species in non-ship breaking areas. Respondents of non-ship breaking areas were used to plant medicinal species, on the
 194 other hand respondents of ship breaking areas were used to plant fuel species (Figure 4b).



195
 196 **Figure 4(a) Percentage of farmers on present preference of tree species selection in both the areas.**
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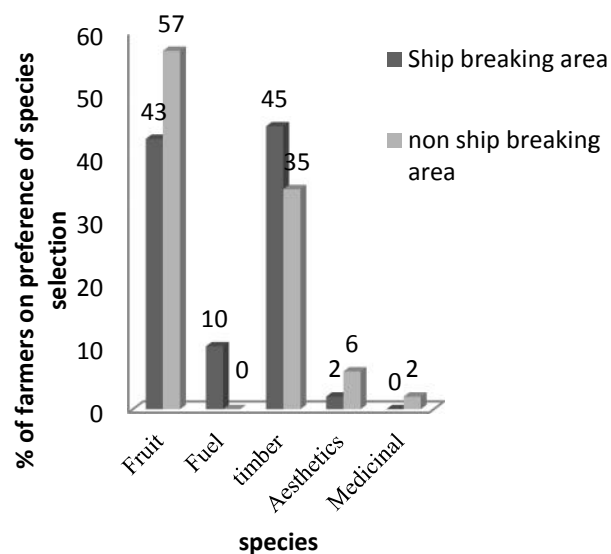


Figure 4(b) Percentage of farmers on past preference of tree species selection in both the areas.

4.6 Purpose of planting trees in home garden

Major purpose of planting trees in home garden were deposit, house construction, fuel wood, furniture and cultural activities for both ship breaking and non-ship breaking areas. Among them the most dominant purpose was deposit for both areas. However percentage varied from each other. In ship breaking areas 26% people's purpose was deposit while 33% people's purpose was deposit in non-ship breaking areas followed by fuel wood and furniture (Figure 5).

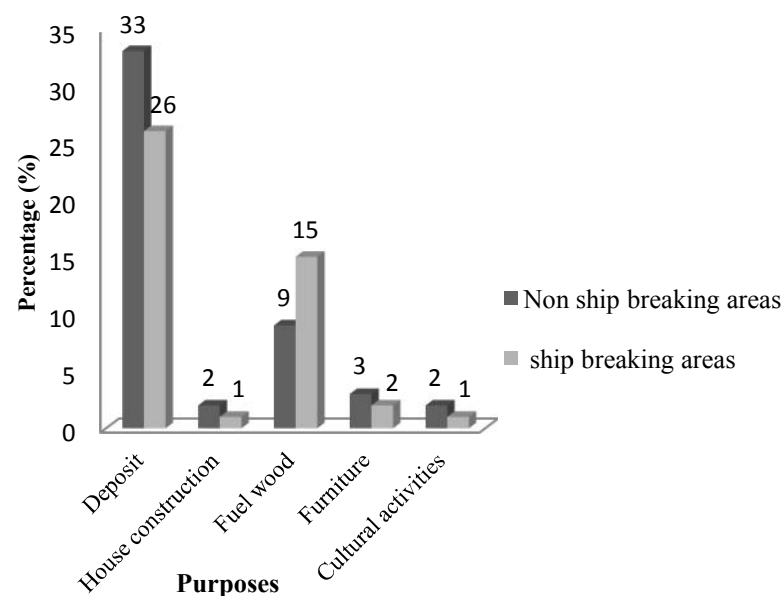


Figure 5 Various purposes of planting trees in home garden

4.7 Problems and Recommendations

Household members mentioned oil leakage from ship breaking yards to the agri-land may cause soil infertility. Moreover, they also mentioned crops damaged animals, storm, children, lack of technical knowledge, unavailability of space as major problems for cultivation of agri-crops and planting trees at the homestead level in both ship breaking and non-ship breaking areas. Household members suggested some measures against those problems which are mentioned below:

- 214 • Ship breaking industry should follow certain guidelines provided by Govt. so that it cannot effect negatively on cultivation
- 215 and production of agri-crops and plantation of trees.
- 216 • Use of multipurpose trees should be encouraged considering the increasing demand of forest resources.
- 217 • To ensure safe and reliable source of planting materials i.e. establishment of Govt. nursery.
- 218 • Indigenous techniques practiced by the farmers should be modernized.
- 219 • Use of species that can withstand stormy weather for protection and can survive in ship breaking areas should be planted.
- 220 • Proper training and technical support should be made available by appropriate authority about home garden management to
- 221 make home garden more productive.

222

223 **5 Discussions**

224 Vankatash *et al.* (2003) found that in tropical home gardens species diversity is generally believed to be very high. Home gardens

225 reached high levels of developments in terms of plant diversity, labor input and income derived from garden in region where

226 population densities are high and create a forest like multistory canopy structure. Moreover, species diversity sue, shape and plant

227 density also vary from place to place depending on cultural, ecological and socio economic factors which is consistent with the

228 findings of present study where a total of 27 tree species including fruits, timber, fuel wood, aesthetics and medicinal were found in ship

229 breaking areas while 30 species were found in non-ship breaking areas.

230 This study is consistent with Atta-krah et al. (2004), Acharya (2006), and Ouinsavi & Sokpon (2008), where
 231 traditional agro-forestry practices support biodiversity through in situ conservation of tree species on farms and
 232 the choice of integrated tree species in the farming systems is guided by many reasons peculiar to farmers. For the
 233 majority of respondents surveyed, the selection criteria of tree species in the system were dependent on cash income as output
 234 followed by house construction, fuel wood, furniture and cultural activities for both the ship breaking and non-ship breaking areas. It
 235 was expected that these species provide diverse and marketable products that generate additional income to resource households
 236 especially during the period of food scarcity of small land holdings.

237 In this study, the idea of food security, household wellbeing, and income generation were looked at from homestead level combining
 238 traditional agriculture and home garden. A previous study (Asare 2006) demonstrated similar findings, that is, potential of indigenous
 239 fruit and woody species in combination with food crops in various farming system in Cameroon. Farmers grew vegetable crops in the
 240 rice fields adjoining to the home garden. Although the high diversity of agricultural crops contributes directly to agrobiodiversity
 241 conservation and livelihoods, this study reported only sixteen crop species in the field. Due to land scarcity in Bangladesh along with
 242 its large population, major investments have been made to increase production of the country's staple crop, rice, to ensure that yields
 243 keep pace with the demand. Factors such as high population density, agricultural dependence, and dietary reliance on rice have made
 244 Bangladesh an appropriate candidate for the adoption of HV of rice. However, another study of Pandey et al. (2006) documented more
 245 diverse crops like rice, finger millet, maize, green gram, black gram, cassava, sweet potato, yams, elephants foot yams, taro, and coco

246 yam in the home gardens in the South Andamans. This highlights the
247 need for a coordinated and holistic team approach to the small farmers' fields with emphasis on increasing annual income.

248 **6 Conclusions**

249 Rural communities have developed a diverse resource base of cultivated trees, crops and management-specific knowledge, which has
250 enabled them to sustain and enhance their livelihoods. Plantations of large number of tree species to supply wood, fruits, fodder, fuel
251 wood, and medicine were maintained on farms as part of subsistence farming systems. The incorporation of these trees in agricultural
252 farms and home gardens has contributed in ensuring the sustainability of agricultural production and maintaining conservation of
253 agricultural biological diversity. However, domestication of fruit within the homestead level is one of the best options for satisfying
254 certain social, economic, and environmental benefits. Therefore, the inclusion of more MPTS, which can offer farmers with more
255 livelihood options in adverse condition, is indispensable on farms.

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