

PLANT BIODIVERSITY IN HOMESTEAD AREA AT SADAR UPAZILA OF RANGAMATI DISTRICT IN BANGLADESH

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ABSTRACT

Diversified plant species in homestead areas play an important role to ensure the food and nutritional security of rural communities. An exploratory survey and field observation was carried out at Sadar upazila of Rangamati district in Bangladesh to identify the existing plant biodiversity in the homestead areas of six unions along with municipal area of Rangamati Sadar upazila. A total of 120 households were randomly selected for collecting data using face-to-face interviews from July to September 2020. A total of 163 plant species were identified at different homesteads of the study area. Among different categories of plant species, 13 (7.98%) timber, 32 (19.63%) fruits, 19 (11.66%) medicinal species, 31 (19.02%) different vegetable species, 56 (34.36%) different flowering and ornamental species, 08 (4.91%) spices and condiments and 04 (2.45%) other plant species were recorded. The front yard was dominated by most of the plant species whereas the kitchen side was dominated by vegetables. The highest diversity was found in vegetables ($H' = 0.96$) followed by medicinal plant and fruit species ($H' = 0.83$), timber, and flower and ornamental species ($H' = 0.82$). A moderate diversity was found at the back side ($H' = 0.69$) followed by the boundary side ($H' = 0.68$), front yard ($H' = 0.65$) and, approach road ($H' = 0.60$). The study concludes that homestead agroforestry is a unique area for maintaining both plant diversity and productivity which could be a good option to meet up the demand of food and nutrition of the people in hilly areas.

Keywords: Homestead area, Plant diversity, Shannon-Weaver diversity index, Dominant species, medicinal plants.

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INTRODUCTION

Chittagong Hill Tracts is a special region in the southeastern part of Bangladesh, rich in hills, mountains, rhythms, diverse cultures, and people. This region is unique from other regions not only in terms of geographical location but also in terms of population and cultural diversity. Though earlier as one district, now the entire Chittagong Hill Tracts consist of three districts: Rangamati, Khagrachari, and Bandarban. In terms of area, the Chittagong Hill Tracts are one-tenth of the total area of the country; that is 13,184 square kilometers. In terms of biodiversity, Chittagong Hill Tracts are completely different from other districts (Banglapedia, 2021). There are 14 small ethnic groups living in Chittagong Hill Tracts, including Bengalis, speaking different languages. These communities are somehow dependent on forest resources. Generally, a country needs to have 25% or more forest area of its total land area (Huda and Roy, 2001), but forest area (% of land area) in Bangladesh was 14.47 % in 2021 (World Bank, 2024) as compared to 17.4%, five years back (Rahman, 2016). Bangladesh ranks lowest in per capita forest area, which is about 0.015 ha (Islam et al., 2012). The Chittagong Hill Tracts account for more than half of Bangladesh's forests (Baten et al., 2010). Rahman et al., (2017) reported that the CHT is one of the most biologically diverse part of Bangladesh which makes up almost 43% of total forestlands in Bangladesh.

Homestead agroforestry consisting diversified plant ecosystem plays an important role in the economy of Bangladesh. Plants and trees grown on the homestead areas are important source of food, fodder, fuel, and wood. About 25.49 million homesteads are present in our country. Most of the vegetables produced in Bangladesh come from those homesteads and 45.3% of the fuel sources are from wood/bamboo (BBS, 2020). Trees play an important role in the rural and national economy. The most of the rural people cultivate their homesteads with different fruits and woody perennials in an unplanned way. So, the identification and documentation of plant species is required to obtain a clear picture of the home gardens. The frequency and growth of a species are indicators for its adaptability and suitability to a site (Dutta and Iftekhar, 2004).

A large number of farmers in the hilly areas still depend on jhum cultivation, which they have been practicing since long. This type of farming system creates a severe disturbance in the soil through maximum tillage, rapid decrease in primary and/or secondary forest, landslides, and erosion of topsoil. (Rangamati Hill District Council, 2011). Repeated jhum cultivation replaced forest species with secondary vegetation such as shrubs, exotic weeds, and hardy grasses (Arya, 2000). Thus, it causes loss of plant biodiversity and reduction of forest area. Homestead agroforestry systems with diversified plant species can be a good option over conventional agriculture and monoculture of forest which can offer increased productivity, economic benefits and more biodiversity. A few studies have been conducted on homestead biodiversity in different parts of Bangladesh (Alam and Masum, 2005; Baul et al., 2021; Muhammed

et al., 2011; Roy et al., 2011; Prova et al., 2023). However, there is no systematic documentation of plant biodiversity at different homestead areas in Rangamati hill districts. Hence, the study was undertaken to estimate the existing plant biodiversity in the study area.

MATERIALS AND METHODS

The study was conducted in six (6) unions and one municipal area under the sadar upazila of Rangamati district from July to September 2020 to identify the existing diversified plant species in different homestead areas. Data were collected through personal interviews. A sample of 120 respondents was interviewed to collect data. Plant species diversity was measured using Shannon-Weaver Diversity Index (SWDI)-H' as stated below.

$$H' = - \sum_{i=1}^n P_i \times \log P_i$$

Where P_i is the proportion of the number of entries (plant species) belonging to the i th class and n is the number of phenotypic classes of plants. The H' ranges from 0 to 1, where, 1 indicates the maximum and 0 indicates no diversity. The H' value was calculated following Yu Li et al. (1996) modified by Uddin et al. (2021). The exact characters' were defined as the classes for qualitative characters, while the classes for quantitative characters were defined according to the procedure suggested by Yu Li et al. (1996). The relative frequencies of different classes were used to calculate the diversity index. The H' for each of the characters was calculated by using Microsoft Excel.

This index is the direct method of measuring plant diversity while other indices are indirect measures. The higher the diversity index meaning the more diverse the population. When the H' values are ≥ 0.75 means high diversity, if H' values are equal to 0.50-0.75 means moderate diversity and if the H' values are <0.50 means low diversity (Jamago, 2000; Kete, 2001; Thuy, 2002; Uddin et al., 2006).

RESULTS AND DISCUSSION

Plant species diversity

Diversified plant species were observed in the homestead area. A total of 163 plant species were recorded, including 13 timber species, 32 fruit species, 19 medicinal species, 31 vegetables, 56 flowering and ornamental plants species, 8 spices and condiments, and 4 other plant species (Table 1).

Table 1. Plant species diversity of Rangamati Sadar upazila under Rangamati district

Plant species	No of existing plant species	Percentage
Timber tree	13	7.98
Fruit tree	32	19.63
Medicinal plant	19	11.66
Vegetables	31	19.02
Flowering and ornamental plants	56	34.36
Spices & condiments	08	4.91
Other plant species	04	2.45
Total	163	100

The flowering and ornamental plant species were dominant, followed by fruit species compared to medicinal plant and timber species. Uddin et al. (2021) reported a total of 137 plant species in the Moulvibazar district which 45 were vegetable, 36 fruit species, 35 timber, and 21 medicinal and other plant species. Baul et al. (2021) reported a total of 71 tree and bamboo species of specific or multipurpose value, representing a rich reservoir of tree floral composition and diversity in the homestead forests of Bandarban district. On the other hand, Muhammed et al. (2011) reported that a total of 43 woody perennials and 38 vegetables species were found in the study sites of Mymensingh district. Banana, betel nut, jackfruit, mango, mahogany, teak and acacia constituted the major floral composition. The abundance of horticultural species was higher than that of the timber species in all the study sites. However, among the newly planted homestead plants, timber species are gradually increasing. This trend of floral dynamics indicates a probable change in future homestead plant structure and composition. Their study confirms that the homestead forests of Bangladesh are rich in plant species diversity even distributed sporadically in small areas. With appropriate models, based on both traditional and scientific knowledge, homestead forestry could emerge as an effective means for both economic well-being and biodiversity conservation in Bangladesh. While, Alam and Masum (2005) identified a total of 142 plant species belonging to 61 families in the offshore island of Bangladesh, of which 76 species were recorded as tree species, 25 shrub species and 41 herb species. Again, out of the plant species, 34 species were fruit producing species, 24 timber species, 21 fuel wood species, 15 medicinal species, 11 ornamental species, 32 vegetable species and 5 species of spices. Most of the farmer (76%) preferred to plant fruit tree species for future plantation followed by timber species (62%). Diversity and abundance of fruit species was found higher in all homesteads. Prova et al. (2023) identified 50.0% fruits, 26.3% vegetables, 15.8% timber and 7.9% medicinal plants in Sylhet district.

Major timber species at homestead

Out of 13 timber species Bamboo, Gamar (*Gmelina arborea*), Rajkoroi (*Albizia richardiana*), and Shegun (*Tectona grandis*) were found as dominant in the study area. Among the ten major timber species, Bamboo was found dominant (75%) followed by Gamar (69.17%), Albizia (65.83%), and Shegun (62.5%). Sadaat (2007) also reported similar type of timber species diversity and he observed a total of 21 timber species in Gaibandha district. Uddin et al. (2021) observed 35 timber species in Kamalganj upazila of Moulvibazar district. Muhammed et al. (2011) reported that a total of 43 woody perennials in Mymensingh district among which mahogany, teak and acacia constituted the major floral composition. While, Alam and Masum (2005) identified a total of 24 timber species, 21 fuel wood species in the offshore island of Bangladesh.

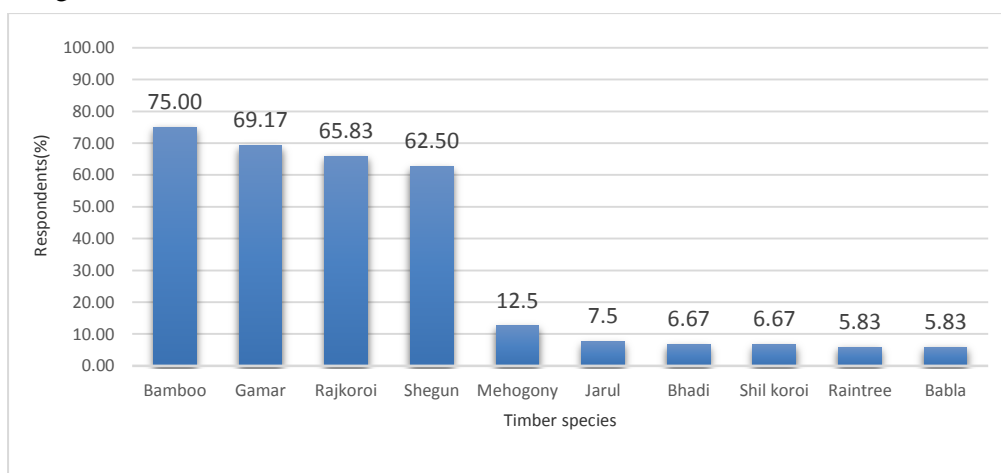


Figure 1. Major ten timber species in homestead of Rangamati Sadar upazila

Major fruit species at homestead

Among the 32 fruit species Coconut, Jackfruit, Java plum, Mango, Banana, and Litchi were dominant and found up to 70-80.83% in the study area (Figure 2). Belali (2011) observed a total of 28 fruit species in Narayanganj district which was more or less similar to the present study. Uddin et al. (2021) also observed 36 fruit species in Kamalganj upazila of Moulvibazar district. On the other hand, Alam and Masum (2005) identified a total of 34 species of fruits in the offshore islands of Bangladesh. Most of the farmers (76%) preferred to plant fruit tree species for future plantation followed by timber species (62%). Diversity and abundance of fruit species was found higher in all homesteads their studied areas.

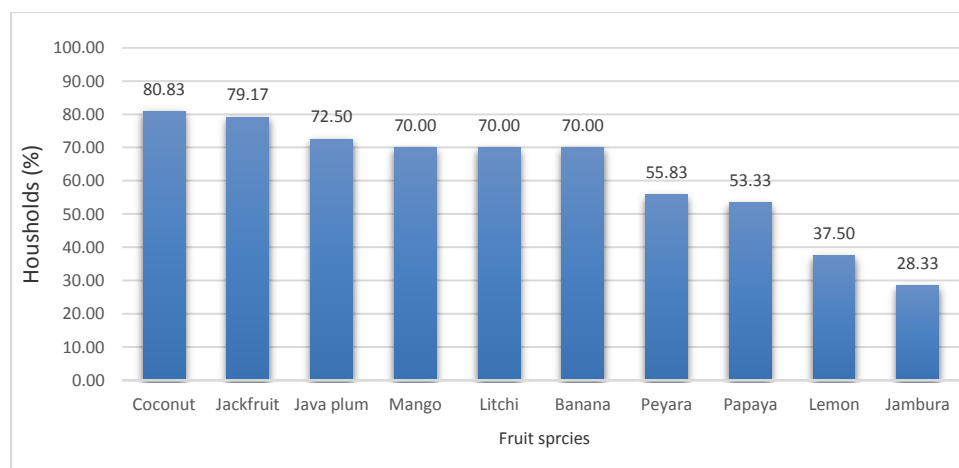


Figure 2. Major ten fruit species at homestead of Rangamati Sadar upazila

Major medicinal species at homestead

Among the 19 medicinal and other plant species Tulsi/Basil, Alovera, Neem, Turmeric, Basak, Mehedi and Drumstick were dominant and found in 18.33-94.17% of respondents' houses (Figure 3). A similar type of medicinal species diversity was by Yasmin et al. (2010) identified 35 medicinal species at Tangail district. Uddin et al. (2021) recorded 21 medicinal and other plants in the Kamalganj upazila of Moulvibazar district. While, Alam and Masum (2005) identified a total of 15 medicinal plant species in the offshore island of Bangladesh.

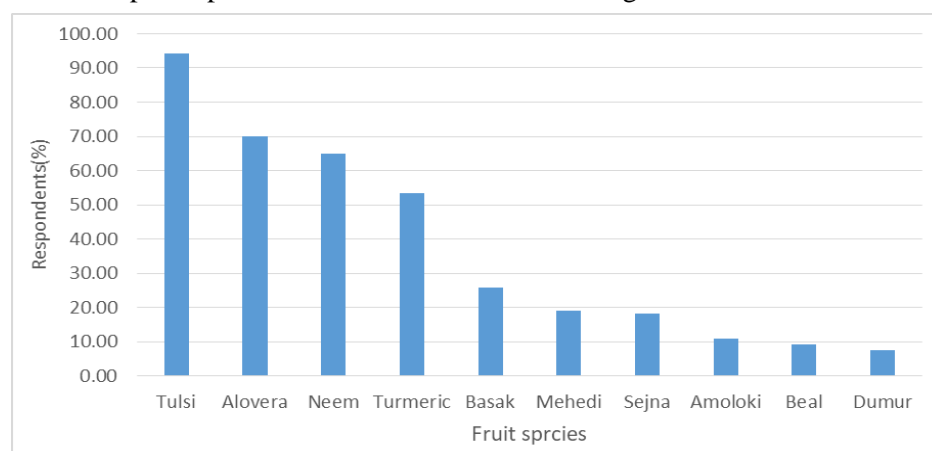


Figure 3. Major ten medicinal species at homestead of Rangamati Sadar upazila

Major vegetable species at homestead

A total of 31 different vegetable species were observed at different homesteads of the studied areas. Dominant vegetable species were Makoi (74.17%), Okra (65%) and Roselle, Indian spinach and Chili (63.33%) (Figure 4). Muhammed et al. (2011) reported that a total of 38 vegetables species were found in the study sites of Mymensingh district. The authors also reported that banana, constituted the major floral composition among vegetables. While, Alam and Masum (2005) identified a total of 32 vegetable species in the offshore island of Bangladesh.

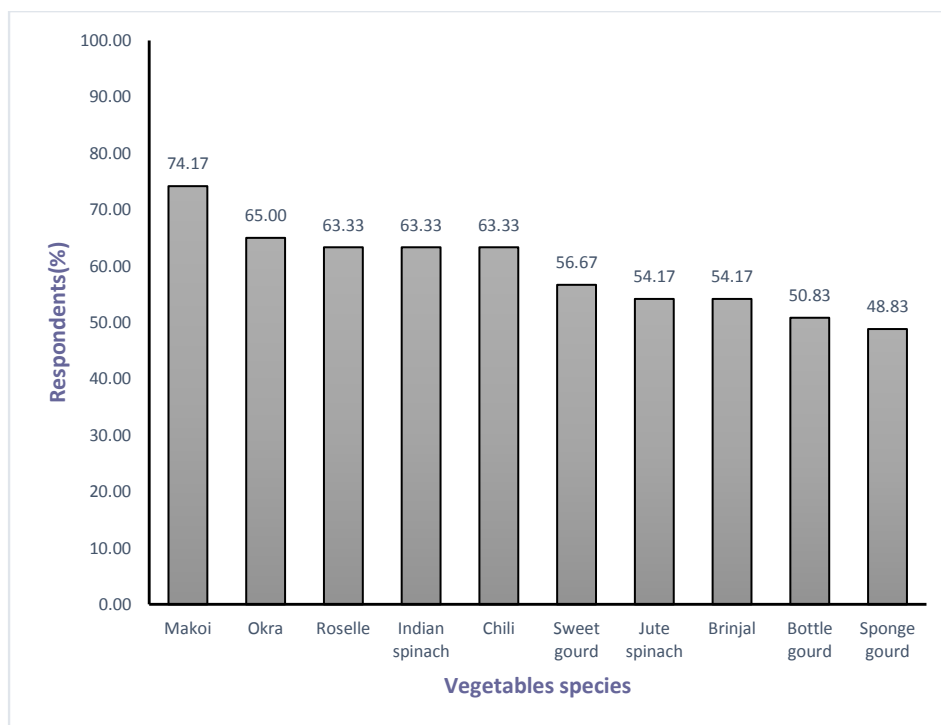


Figure 4. Major ten vegetable species at homestead of Rangamati Sadar upazila

Major flowering and ornamentals

Out of 56 different flowering and ornamental plant species, the dominant species were the Chinese rose (71.67%), Marigold (28.33%), and Zinnia (20.00%) (Figure 5). While, Alam and Masum (2005) identified a total of 11 ornamental plants species in the offshore island of Bangladesh.

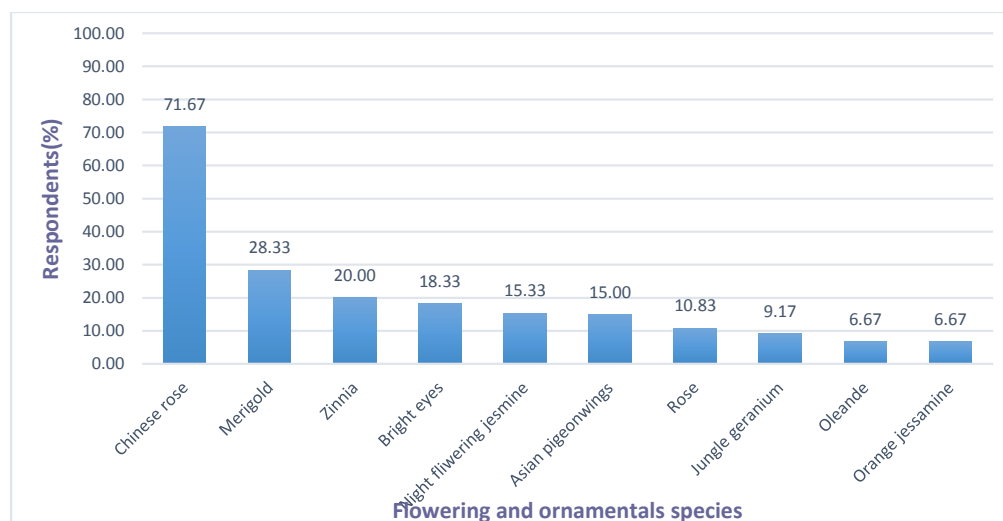


Figure 5. Major ten flowering and ornamentals species in homestead of Rangamati Sadar upazila

Spices and condiments and other plant species

The distribution of spices and condiments and other plant species is presented in. The table shows that a total of 8 species of spices and condiments were recorded and the presence of chili (63.33%) was the highest followed by turmeric (53.33%). A total of 4 other plant species was recorded and among them the Betel nut (74.17%) was the highest compared to Arabian coffee (7.5%) maize (6.67%) and cashew (4.17%) (Table 2). While, Alam and Masum (2005) identified a total of 5 species of spices in the offshore island of Bangladesh.

Table 2. Spices & condiments and other plant species present in Rangamati Sadar upazila of Rangamati district

SL. No.	Local Name	English Name	Scientific Name	No. of Respondent	Percentage (%)
Spices & condiments species					
1.	Morich	Chili	<i>Capsicum frutescens</i>	76	63.33
2.	Holud	Turmeric	<i>Cucuma longa</i>	64	53.33
3.	Bilati Dhania	Mexican Coriander	<i>Coriandrum sativum</i>	23	19.17
4.	Pudina	Fild mint	<i>Mentha spicata</i>	8	6.67
5.	Tej pata	Bayleaf	<i>Cinnamomum tamala</i>	7	5.83
6.	Ada	Ginger	<i>Zingiber officinale</i>	6	5.00

SL. No.	Local Name	English Name	Scientific Name	No. of Respondent	Percentage (%)
7	Daruchini	Cinnamon	<i>Cinnamomum verum</i>	3	2.5
8	Lemon grass	Lemon grass	<i>Cymbopogon citratus</i>	1	0.83
Other plant species					
1.	Supari	Betel nut	<i>Areca catechu</i>	89	74.17
2.	Arabian coffee	Arabian coffee	<i>Coffea arabica</i>	5	7.50
3.	Moikka	Maize	<i>Zea mays</i>	8	6.67
4.	Kajubadam	Cashew	<i>Anacardium occidentale</i>	5	4.17

Distribution of existing plant species in homestead areas

Distribution of different plants species at different homestead areas are presented in Tables 3, 4, 5, 6, 7, 8, and 9.

Table 3). The result revealed that a maximum number of timber tree species were present at the boundary side (6), followed by the front yard of the homestead (5), compared to the back side (3), approach road (3), and kitchen side (3). Mahogany (48.57%) and Bot (37.14%) trees dominated at the front yard while Bamboo (67.07%)>Shegun (28.04%)> at the backside and Gamhar (58.97%)>Jarul (12.82%)> at Boundary side (Table 3). Uddin et al. (2021) also reported that Koroi>Acacia dominated over other timber tree species in the front yard, and Acacia>Mahogany>Koroi was dominated at the backyard, boundary, and approach road. Prova et al (2023) observed raintree as a dominant timber species in all of the homestead areas in Sylhet district.

Table 3. Distribution of timber plant species with frequency at different homestead areas of Rangamati Sadar upazila in Bangladesh.

Homestead area	No. of species	Dominant species
Front yard	5	Mahogany (48.57%)>Banyan tree (37.14%)>Albizia (11.42%)>Shegun (Teak) (1.42%)>China banyan tree (1.42%)
Back side	3	Bamboo (67.07%)>Shegun (Teak) (28.04%)>Bhadi (<i>Garuga pinnata</i>) (3.65%)> Kodamba (1.21%)
Boundary side	6	Gamhar (58.97%)>Jarul (12.82%)>Rain tree, Tall Albizia, Mandar (7.69%)> Babla/ gum arabic tree (5.18%)
Approach road	3	Babla/ gum arabic tree (50%)>Rain tree (40%)>Kodomba (10%)
Kitchen side	3	Albizia (58.24%)>Bamboo (38.46%)>Mandar (3.29%)

Distribution of Timber species

A total of 13 timber trees were scattered and distributed in different homestead areas.

Distribution of fruits species

Table 4 revealed that the majority of fruit specie was observed in the front yard of the homestead (13) followed by the back yard (10), and kitchen side (10), compared to boundary side (9) and approach road (7). Mango (41.42%)>Jujube (24.28%)>Bullock's Heart (17.14%) dominated on kitchen side, Papaya (40%)>Coconut (21.17%)>Jackfruit (20%)> in boundary side and Banana (29.41%)>Java pulm (27.94%) >Pomelo (16.17%)> in approach road. Uddin *et al.* (2021) also reported that Mango, Jackfruit, Lemon, and Coconut were dominating fruit species in the front yard, back yard, and boundary side in the Moulvibazar district. The dominant fruit species were identified by Prova et al. (2023) which was mango at the front yard, jackfruit at the backyard and banana at the boundary side of homestead area in Sylhet district.

Table 4. Distribution of fruit plant species with frequency at different homestead areas of Rangamati Sadar upazila in Bangladesh

Homestead area	No. of species	Dominant species
Front yard	13	Jackfruit (18.71%)>Mango (16.20%)>Coconut (15.64%)>Java pulm (14.80%)>Litchii (12.29%)>Papaya (10.89%)>Pomelo (6.98%)> Rambutan (1.95%)>Olive (1.39%)>Hog Plum (0.55%)>Wax apple (0.29%)> Aonla (0.27%)
Back side	10	Banana (26.38%)>Papaya (21.29%)>Coconut (14.83%)>Bullock's Heart (10.32%)>Karambola (9.03%)>Olive (1.93%)>Hog Plum (1.29%)>Indian pulm (0.64%)>Aonla (0.64%)
Boundary side	9	Papaya (40%)>Coconut (21.17%)>Jackfruit (20%)>Pineapple (7.05%)>Indian persimmon (3.52%)> elephant apple, Tamarind, Pomegrante (2.35%)>Bermij fruit (1.17%)
Approach road	7	Banana (29.41%)>Java pulm (27.94%) >Pumelo (16.17%)>Lime (15.44%)> Orange (6.61%)> Karanda (2.20%)
Kitchen side	8	Mango (41.42%)>Jujube (24.28%)>Bullock's Heart (17.14%)> Passion fruit, Dragon fruit (5.71%)> Burmese grape (2.86%)> elephant apple (1.42%)> Tai tamarind (1.42%)

Distribution of medicinal plant species

A total of 19 medicinal plants were present in different homestead areas of Rangamati Sadar Upazila. Maximum medicinal plant species were identified in the front yard (7) followed by the back yard (5) and boundary side (5), approach road (5),

and kitchen (4). Tulsi/Basil (34.43%)> Neem (27.15%)> Alovera (25.16%) were dominating medicinal plant species in the front yard, approach road, and kitchen side. On the other hand, Turmeric (31.57%)> Malabar nut (26.31%)> Neem (21.05%)> were dominated species in the back yard, Malabar nut (39.25%)> Kalomegh/Green Chiretta (35.71%)> Cluster fig (17.85%) at the boundary of the homestead areas (Table 5). Uddin et al. (2021) also reported that Tulsi was the dominated medicinal plant species in the front yard and kitchen side of the Kamalganj upazila of Moulvibazar district. On the other hand, Prova et al. (2023) observed holy basil at the front yard and neem at the backyard as the dominated medicinal plant species in Sylhet district.

Table 5. Distribution of medicinal plant species with frequency at different homestead areas of Rangamati Sadar upazila in Bangladesh

Homestead area	No. of species	Dominant species
Front yard	7	Tulsi/Basil (34.43%)> Neem (27.15%)> Alovera (25.16%)> Wood apple (6.67%)> Gynura (3.11%)>false daisy (1.98%)> Devil's Cotton (1.32%)
Back side	5	Turmeric (31.57%)> Malabar nut (26.31%)> Neem (21.05%)> Mehedi (17.51%)> Green chireta (3.50%)
Boundary side	5	Malabar nut (39.25%)> Kalomegh (35.71%)> Cluster fig (17.85%)> North Indian rosewood, Golden shower (3.57%)
Approach road	5	Tulsi/Basil (50%)> Drumstick (31.57%)> Indian trumpet flower (26.31%)> Neem (21.05%)> Filed mint/Pudina (8.33%)
Kitchen side	4	Tulsi/Basil (49.20%)> Fild mint, Cluster fig (23.80%)> Drumstick (22.22%)

Distribution of vegetable species

A sum of 31 vegetable species were identified in different homestead areas. Among different homestead areas, most of the vegetable species were found in the kitchen side (14) followed by the front yard (8), back yard (8), boundary side (8), and 7 in approach road (Table 6). Bottle gourd was dominating vegetable species in the front yard, approach road, and kitchen side. Prova et al. (2023) reported 38 vegetable species in homestead areas of Sylhet district of which bean (22.60%), ash gourd (21.70%) and moringa (19.10%) were reported as dominated vegetable species in different homestead areas of their study area.

Table 6. Distribution of vegetables plant species with frequency at different homestead areas of Rangamati Sadar upazila in Bangladesh

Homestead area	No. of species	Dominant species
Front yard	8	Bitter gourd (26.89%)> Sweet gourd (24.46%)> Chilli (18.62%)> Sponge gourd (14.82%)> Jute spinach (10%)> Cucumber (2.7%)> Skunkvine (1.37%)> Amaranth (1.03%)
Back side	8	Bottle gourd (30.26%)> Raddish (19.73%)> Sweet gourd (18.42%)> Jute spinach (15.78%)> Salgom(6.57%)> Indian yam (3.94%)>Papaya, Snake gourd (2.63%)
Boundary side	7	Okra (24.34%)> Yard long bean (20%)> Spiny gourd (19.13%)> Country bean (17.39%)> Pathar kuchi, Red amaranth (6.95%)> Raddish (5.21%)
Approach road	7	Spiny gourd (43.33%)> Bottle gourd (16.75%)> Brinjal (16.12%)> Wax gourd (15.05%)> Ridged gourd (13.44%)> Potato (7.52%)> Tomato (4.83%)
Kitchen side	13	Makoi (22.08%)>Indian spinach (18.85%)> Roselle (11.41%)> Brinjal (8.68%)>Mexican coriander (5.70%)> Yard long bean (4.96%)>Bottle gourd (4.46%)> Mexican coriander (5.70%)>Sweet potato (2.72%)>Snake gourd, Sponge gourd (1.98%)> Skunkvine (0.99%)>Tara (0.49%)

Distribution of ornamentals and flowering plant species

A total of 56 ornamental and flowering plants were recorded in different homestead areas of Rangamati Sadar upazila. Maximum flowering and ornamental plant species were found in the front yard (22) and the next in kitchen side (14), boundary side (11), and approach road (11) and the lowest was at the Back yard (7) (Table 7). China rose was dominating flowering plant species in the front yard and boundary side.

Table 7. Distribution of flowering and ornamental plant species with frequency at different homestead areas of Rangamati Sadar upazila in Bangladesh

Homestead area	No. of species	Dominant species
Front yard	22	China rose (16.91%)> Bright eyes (14.66%)> Orange jessamine (0.75%)>Oleander (6.76%)> Parijat (6.01%)> Chrysanthemums (5.63%)>Night flowering jasmine (4.51%) > Red spider (3.38%)> Globe amaranth, Star flower (3.00%)>Hajaribeli (1.90%)> May flower (1.87%)> Champa, Beli(1.12%)>Erect prickly pear, Water lily, Orange jessamine, Adenium, Bougainvillea (0.75%)>Copperpod, Sacred tree, Spanish cherry (0.37%)

Homestead area	No. of species	Dominant species
Back side	7	Jasmine, Rongon/Ixora (23.80%)> Lotus, Night jasmine (14.28%)>Rain lily (9.52%)>Boss flower (4.76%)> Hazari mogra plant (9.52%)
Boundary side	11	China rose (40.19%)> Marigold (24.50%)> Dwarf white bauhinia (7.84%)>Indian shot (6.86%)> Oleander (4.90%)>Four o'clock flower (3.92%)> Jasmin (2.94%)>Yellow bamboo (1.98%)>Hiptage, Orange jasmine, Ruellia (1.96%)
Approach road	11	Pinwheel flower (50.61%)>Begonia (9.87%)>Dwarf white bauhinia (8.64%)> Daisy (6.17%)> Rose, Christ thorn (4.93%)> Morning Star lily, Tuberose (3.70%)>Plumeria, Water lily, Burflower tree (2.49%)
Kitchen side	14	Zinnia (23.33%)>Asian pigeonwings (22.87%)> Sun flower (11.17%)>Garden cosmos (9.57%)>Jungle geranium, Dolonchapa/ White Ginger Lilly (7.44%)> Cactus (6.38%)> Dog rose (2.65%) Violet lily (2.17%)>Copperpod, Bougainvillea, Gondoraj/Gardenia (1.59%)> Palm (1.06%)> Areca palm (0.53%)

Distribution of spices and condiments

A total of 8 types of spices and condiments were recorded in different homestead areas of the study area. Among these front yard and boundary side had three 3 types of spices and condiments while other homestead areas had 2 types of spices and condiments. Among the spices and condiments, cinnamon was most dominant followed by bay leaf (Table 8).

Table 8. Distribution of spices & condiments plant species with frequency at different homestead areas of Rangamati Sadar upazila in Bangladesh

Homestead area	No. of species	Dominant species
Front yard	2	Bayleaf (25%)> Cinnamon (25%)> Chilli (50%)
Back side	2	Cinnamon (60%)> Lemon grass (40%)
Boundary side	3	Bayleaf (50%)> Cinnamon (25%)> Lemon grass (25%)
Approach road	2	Ginger (88.23%)> Bayleaf (11.76%)
Kitchen side	2	Cinnamon (60%)> Mexican coriander (40%)

Distribution of other plant species

A total of 4 different types of other plants were recorded in different homestead areas of Rangamati Sadar upazila. Most of them were recorded in the front yard (3) and the lowest was in the approach road (2) (Table 9).

Table 9. Other plant species present at different homestead area of Rangamati Sadar upazila

Homestead area	No. of species	Dominant species
Front yard	3	Arabian-coffee (81.81%)> Maize (9.09%)> Betel nut (9.09%)
Back side	2	Betel nut (80%)> Cashew (20%)
Boundary side	2	Maize (75%)> Arabian-coffe (25%)
Approach road	1	Betel nut (100%)
Kitchen side	2	Maize (66.67%)> Arabian-coffe (33.33%)

Shannon-Weaver Diversity Indices of plant species in different unions

Considering SWDI, high plant species diversity was found in Rangamati Sadar Upazila. Among all the plant species, the highest diversity was found in vegetables ($H' = 0.96$) followed by fruit and medicinal species ($H' = 0.83$), timber, and flower & ornamentals species ($H' = 0.82$) (Table 10). Uddin et al. (2021) reported a high diversity of fruit, timbers, medicinal, and other plant species ranging from 0.74-0.89 in Kamalganj upazila of Moulvibazar district. Prova et al. (2023) reported the highest diversity in fruit species and next was timber species in Sylhet district.

Table 10. Shannon-Weaver Diversity Indices (SWDI) of plant species at different unions of Rangamati Sadar upazila under Rangamati district

Unions/ Municipal	SWDI of Plant Species							Mean
	A	B	C	D	E	F	G	
Pouroshova	0.65	0.71	0.79	0.89	0.74	0.90	0.96	0.81
Bandukbhanga	0.93	0.89	0.49	0.98	0.99	0.99	0.46	0.82
Jibtali	0.52	0.60	0.93	0.97	0.64	0.00	0.00	0.52
Mogban	0.96	0.89	0.91	0.99	0.79	0.79	0.34	0.81
Balukhali	0.89	0.92	0.98	0.98	0.90	0.00	0.34	0.71
Sapchari	0.96	0.96	0.87	0.97	0.78	0.00	0.52	0.72
Kutukchari	0.81	0.86	0.84	0.95	0.87	0.87	0.87	0.72
Mean	0.82	0.83	0.83	0.96	0.82	0.38	0.50	0.73

Note: A = Timber species, B = Fruit species, C = Medicinal plant species, D = Vegetables species, E = Flower & ornamentals species, F = Spices & condiments and G = Other plant species

Timber species were high ($H' = 0.81-0.96$) in all unions except in Pouroshova ($H' = 0.65$) and Jibtali ($H' = 0.52$). The highest timber species diversity was found in Mogban and Sapchari ($H' = 0.96$) followed by Bandukbangha and Balukhali ($H' = 0.93$ and 0.89). Uddin et al. (2021) and Prova et al. (2023) reported a high diversity of timber species in the Moulvibazar district and Sylhet district respectively which supports the present findings.

Fruit species were found highly diverse ($H' = 0.86-0.96$) in all unions except in Pouroshova and Jibtali unions where the diversity was moderate ($H' = 0.71$ and 0.60). The highest fruit species diversity was found in Sapchari ($H' = 0.96$) followed by, Balukhali, Mogban, and Bandukbangha ($H' = 0.92, 0.89,$ and 0.89) respectively (Table 10). High diversity ($H' = 0.79-0.99$) of fruit species was also reported by Uddin et al. (2021) in Kamalganj upazila, which was at par to the findings of Prova et al. (2023) in Sylhet district while, Uddin et al. (2006) found moderate to high diversity in coconut in the Philippines.

For medicinal species the SWDI was high ($H' = 0.79-0.98$) in all unions except in Bandukbangha ($H' = 0.49$). The highest medicinal species diversity was found in Balukhali ($H' = 0.98$) followed by Jibtali, Mogban, Sapchari, and Kutukchari ($H' = 0.93, 0.91, 0.87,$ and 0.84) (Table 10). Uddin et al. (2021) reported a high diversity of medicinal plants ($H' = 0.77-0.96$) in the Kamalganj upazila of Moulvibazar district in Bangladesh.

Shannon-Weaver Diversity Indices (SWDI) of vegetable species was high ($H' = 0.89-0.99$). The highest vegetables species diversity was found in Mogban ($H' = 0.99$) followed by Bandukbangha and Balukhali ($H' = 0.98$) and Jibtali and Sapchari ($H' = 0.97$) (Table 10).

The SWDI of flower & ornamentals species was high ($H' = 0.78-0.99$) in all locations except moderate in Pouroshova ($H' = 0.74$) and low in Jibtali ($H' = 0.64$). The highest flower & ornamental species diversity was found in Bandukbangha ($H' = 0.99$) followed by Balukhali, Kutukchari, and Sapchari ($H' = 0.90, 0.87$ and 0.79). The SWDI of spices & condiments species were high in four unions ($H' = 0.79-0.99$) and no was found in three unions ($H' = 0.00$). The highest spices & condiments and other species diversity were found in Bandukbangha ($H' = 0.99$) followed by Rangamati Pouroshova ($H' = 0.90$) (Table 10).

The SWDI of other plant species was high in Pouroshova ($H' = 0.96$) and Kutukchari ($H' = 0.87$) and was low in three unions ($H' = 0.34-0.46$) (Table 10).

Shannon-Weaver Diversity Indices of plant species in different homestead areas

Among all the homestead areas, the highest plant species diversity was found in the backside ($H' = 0.69$) followed by Boundary side ($H' = 0.68$), Front yard ($H' = 0.65$), Approach road ($H' = 0.60$) and Kitchen side ($H' = 0.57$) all of which were moderate diversity (Table 11). Among the different plant species, the highest diversity was recorded for vegetables ($H' = 0.82$) followed by fruit species ($H' = 0.80$). The lowest diversity was recorded for other plant species ($H' = 0.09$).

Table 11. Shannon-Weaver Diversity Indices (SWDI) of plant species at different homestead areas of Sadar upazila under Rangamati district

Homestead area	SWDI of Plant Species							Mean
	A	B	C	D	E	F	G	
Front yard	0.67	0.83	0.55	0.50	0.59	0.97	0.47	0.65
Back side	0.57	0.81	0.91	0.85	0.94	0.72	0.00	0.69
Boundary side	0.95	0.74	0.79	0.93	0.75	0.60	0.00	0.68
Approach road	0.85	0.85	0.80	0.97	0.74	0.00	0.00	0.60
Kitchen side	0.72	0.75	0.84	0.86	0.82	0.00	0.00	0.57
Mean	0.75	0.80	0.78	0.82	0.77	0.46	0.09	0.64

Note: A= Timber species, B = Fruit species, C = Medicinal species, D = Vegetables species, E = Flower & ornamentals species, F = Spices & condiments and G = Other species

CONCLUSION

The front yard was dominated by most of the plant species specially fruit, medicinal plants and flowering plants Timber in boundary side and vegetables were dominated in the kitchen side. The diversity of vegetable species was the highest among the seven categories of plant species. High diversity of plant species was observed in the studied area. Fruit species diversity was high in all of the studied unions of Rangamati district which could meet up the nutritional requirements of the peoples. Considering plant species diversity present in all the unions, the Jibitali, Bandukbanhga, and Sapchari unions could be improved through increasing planting of more spices & condiments and other plant species. This will increase the overall plant biodiversity and thus meet up of the nutritional requirements of the local community.

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