SAARC J. Agric., 21(2): 119-129 (2023) *DOI: https://doi.org/10.3329/sja.v21i2.68578*

DIVERSITY OF PLANT SPECIES IN MORINGA-BASED HOMESTEAD OF JAINTIAPUR UPAZILA IN SYLHET DISTRICT

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ABSTRACT

Homestead agroforestry is crucial for food, fiber, and other necessities which are required outside the conventional forests. Thus, homestead agroforestry meets the criteria for a sustainable forest management scheme, providing a better way for biodiversity conservation. Moringa based homestead agroforestry in Sylhet has an opportunity to encourage species diversity for its various structural properties. This paper explores the plant species diversity of Moringa based homestead area at Jaintiapur upazila in Sylhet. Personal interviews were conducted from June 2022 to September 2022 with 40 randomly selected respondents who were involved in Moringa-based homestead agroforestry. Shannon-Wiener Diversity Indices (SWDI) was used to explore the plant species diversity index. In the study area identified plant species were 50.0% fruits, 26.3% vegetables, 15.8% timber and 7.9% medicinal plants. Among all the plant species, the higher diversity was found in fruit species followed by timber species, vegetable species and medicinal species. Most of plant species were found in boundary side of homestead area. Vegetable plant diversity was found high (H' = 0.94-0.72), fruit species was also high (H' = 0.99-0.69), medicinal species was medium to high (H' = 0.62-0.97) and timber plant species was high (H' =0.86-0.94) in different homestead areas. It may be concluded that plant species diversity as observed in Moringa based homestead area could be a good option for biodiversity conservation in Sylhet area of Bangladesh.

Keywords: Moringa, Homestead, Plant species diversity, Shannon-Wiener Diversity Index

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Received:02.06.2023 *Accepted: 17.12.2023*

INTRODUCTION

People in rural and semi-urban areas in Bangladesh cultivate a wide range of plants in their homestead lands to meet household needs for fuelwood, timber, fruit, and vegetables, as well as for profits and environmental conservation (Nath et al. 2015). A homestead is a type of land use where trees and shrubs that are close to fresh vegetables are intentionally managed so that they can serve multiple purposes (Ernesto Méndez 2000). In Bangladesh, a multistoried vegetation of trees, shrubs, palms, and bamboo surrounds homesteads and provides materials for a variety of uses, including fuel, shelter, fodder, resins, and medicines. This type of vegetation is referred to as "homestead agroforestry" or "home gardens." Agroforestry on a homestead upholds high standards of productivity, stability, and equity. A family's residence and an adjacent field make up Bangladesh's homestead agroforestry system (Shamsuddoha and Islam 2016).

As a safety net, homestead forests can offer alternative sources of income during times of adversity, such as natural disasters (Kabir and Webb 2009). Often referred to as the nation's "Biodiversity Island," these forests are also thought to preserve biodiversity (Alam et al. 2010). In accordance with the reports, 20 million homestead forests make up about 2% (0.27Mha) of Bangladesh's total land area and there is 0.3 million hectares of land under homesteads, engaging 15.4 million people (Islam et al. 2020).

Most of the local produce in Bangladesh, including fruits, vegetables, timber, and fuelwood, is grown in or near homesteads or in areas adjacent to or around them. The country's needs for firewood and bamboo are met to a large extent by homestead agroforestry, which provides about 70% of the country's needs for timber, 40% for vegetables, 70% for fruits, and 90% of its need for firewood (Ruba and Talucder 2023). In a typical Bangladeshi homestead area different size of herbs and trees are placed in a multistory format which has a greater biodiversity than tropical rain forests in terms of production, protection, amenity, and worth (Gu and Subramanian 2015). Moreover, the natural agroforestry that homesteads provide can conserve plant biodiversity that safeguards the climate and defends the environment from greenhouse gas pollution. The productivity, resilience, and adaptability of agricultural systems are supported by plant diversity, which is defined as the variety among plant species, their varieties, and/or individual genotypes and phenotypes (van de Wouw et al. 2010).

Most of the homesteads provide a spacious scope of producing fruits, vegetables timber and other species to supply the daily needs of the local community and there is an opportunity to encourage species diversity by various structural properties. With this view keeping in mind the present study was undertaken to observe the diversity of plant species at Jaintiapur upazila in Sylhet.

MATERIALS AND METHODS

The study was conducted in Sylhet's Jaintiapur upazila with 40 randomly selected respondents who were involved in Moringa-based homestead agroforestry. To get valid and pertinent information, the researcher made all possible efforts to explain the purpose of the study to the respondents. As a result, sound co-operation was obtained from respondents during data collection.

Data were obtained between June 2022 to September 2022. Several visits to the study site and individual interviews with respondents were made. After the data gathering, the data were coded, compiled, tabulated, and then analyzed to meet the study's objectives. Utilizing appropriate scoring, qualitative data were transformed into quantitative data. The Shannon- Wiener Diversity Index (H′) was used to measure the existing plant species diversity in the study area.

The H′ is the direct method of determining the diversity among the plant species. The H′ ranges between 0 to 1, with 1 indicating the greatest diversity. The higher the diversity index, the more is the diverse the population. The H′ was calculated by using the following formula (Islam et al. 2022)

$$H' = -\sum_{i=1}^{n}(pi \times lnpi)$$

Where, H' = Shannon diversity index, pi = proportion of i^{th} species in an entire community, n = individual of a given species, and N = total number of individuals in a community.

RESULT AND DISCUSSION

Plant species diversity: Diversified plant species were observed in the homestead area. Total 38 plant species were recorded, of which 19.0 (50.0%) fruit species, 10.0 (26.3%) vegetable species, 6.0 (15.8%) timber species and 3.0 (7.9%) medicinal species. Fruit species was dominant followed by vegetables and timber species compare to medicinal plant species (Table1).

Table 1. Plant species found at Jaintiapur upazila of Sylhet district

Plant species	No. of plant species	Per cent
Fruit	19.0	50.0
Vegetable	10.0	26.3
Timber	6.0	15.8
Medicinal	3.0	7.9
Total	38.0	100.0

Fruits species

Different types of fruits were found in the study area. A total of 19 fruits species were recorded in the homestead of the study area (Table 1). These species were banana (6.8%), barmis grape (1.9%), betel nut (10.7%), citrus (1.9%), coconut (3.9%), custard apple (7.8%), guava (4.9%), hog plum (1.0%), jackfruit (20.4%), jujube (1.0%), litchi (4.9%), malta (1.0%), mango (18.4%), olive (1.0%), orange (1.0%), papaya (8.7%), pumelo (1.9%), rose apple (1.9%), sapodilla (1.0%) (Table 2). Out of 19 types of fruits species, the dominants were jackfruit (20.4%), followed by mango and betel nut (18.4% and 10.7%, respectively).

Table 2. Major fruit species found at Jaintiapur upazila of Sylhet district

Sl. No.	Local Name	English Name	Scientific Name	Frequency	Per cent
1	Kola	Banana	*Musa spp*	7.0	6.8
2	Lotkon	Barmis grape	*Baccaurea ramiflora*	2.0	1.9
3	Supari	Betel nut	*Areca catechu*	11.0	10.7
4	Lebu	Citrus	*Citrus spp*	2.0	1.9
5	Narikel	Coconut	*Cocos nucifera*	4.0	3.9
6	Ata fal	Custard apple	*Annona squamosa*	8.0	7.8
7	Peyara	Guava	*Psidium guajava*	5.0	4.9
8	Amra	Hog plum	*Spondias mombin*	1.0	1.0
9	Kathal	Jackfruit	*Artocarpus heterophyllus*	21.0	20.4
10	Boroi	Jujube	*Ziziphus jujuba*	1.0	1.0
11	Litchu	Litchi	*Litchi chinensis*	5.0	4.9
12	Malta	Malta	*Citrus sinensis*	1.0	1.0
13	Aam	Mango	*Mangifera indica*	19.0	18.4
14	Jolpay	Olive	*Olea europaea*	1.0	1.0
15	Kamala	Orange	*Citrus sinensis*	1.0	1.0
16	Pempe	Papaya	*Carica papaya*	9.0	8.7
17	Jambura	Pumelo	*Citrus maxima*	2.0	1.9
18	Gulup-jam	Rose apple	*Syzygium jambos*	2.0	1.9
19	Sofeda	Sapodilla	*Manilkara Zapota*	1.0	1.0

Vegetable species

Among these 38 different species, the vegetable species were bean, bitter gourd, moringa, corm, cowpea, gourd, malabar spinach, red amaranth, snake gourd and sponge gourd (22.6 %, 7.8%, 19.1 %, 0.9 %, 9.6 %, 21.7%, 2.6%, 6.1%, 1.7%, and 7.8%, respectively) (Table 3). Bean (22.6%), kumra (21.7%), moringa (19.1%) and cowpea (9.6%) were the dominant species in moringa based homesteads.

Table 3. Major vegetable plant species found at Jaintiapur upazila of Sylhet district

Sl. No.	Local Name	English Name	Scientific Name	Frequency	Per cent
1	Sim	Bean	*Phaseolus vulgaris*	26.0	22.6
2	Karala	Bitter gourd	*Momordica charantia*	9.0	7.8
3	Sajna	Moringa	*Moringa oleifera*	22.0	19.1
4	Mukhi	Corm	*Colocasia esculenta*	1.0	0.9
5	Borboti	Cowpea	*Vigna unguiculata*	11.0	9.6
6	Kumra	Sweet gourd	*Cucurbita maxima*	25.0	21.7
7	Pui shak	Malabar Spinach	*Basella alba*	3.0	2.6
8	Lal shak	Red amaranth	*Amaranthus cruentus*	7.0	6.1
9	Chichinga	Snake gourd	*Cucumis sativus*	2.0	1.7
10	Jhinga	Sponge gourd	*Luffa aegyptiaca*	9.0	7.8

Timber species

Seven timber tree species were reported. These are banyan (4.2%), belgium (8.3%), bur flower (8.3%), eucalyptus (4.2%), raintree (58.3%) and toona (16.7%). Raintree was the dominant species in most of the respondents' homestead area (Table 4).

Table 4. Major timber species found at Jaintiapur upazila of Sylhet district

Sl. No.	Local Name	English Name	Scientific Name	Frequency	Per cent
1	Banyan	Banyan	*Ficus benghalensis*	1	4.2
2	Belgium	Belgium	*Fraxinus excelsior*	2	8.3
3	Kadam	Bur flower	*Neolamarckia cadamba,*	2	8.3
4	Eucalyptus	Eucalyptus	*Eucalyptus globulus,*	1	4.2
5	Raintree	Raintree	*Samanea saman,*	14	58.3
6	Kuma	Toona	*Toona sinensis*	4	16.7

Medicinal species

Three medicinal plant species were recorded in the studies area. Holy basil (68.4%) was dominant species followed by neem (28.9%) and arjun (2.6%) (Table 5).

Table 5. Major medicinal species found at Jaintiapur upazila of Sylhet district

Sl. No.	Local Name	English Name	Scientific Name	Frequency	Per cent
1	Arjun	Arjuna	*Terminalia arjuna*	1	2.6
2	Tulsi	Holy basil	*Ocimum tenuiflorum*	26	68.4
3	Neem	Neem	*Moringa oliefera*	11	28.9

Distribution of plant species in homestead areas

Trees/ plants present at different homestead area such as front yard of homestead, back side, boundary side, and corner side. It was revealed that the highest number of vegetables plants were present in front-yard of the homestead compared to back yard, Boundary side and corner side. Bean is the dominating species at the front yard and back yard side on the other hand bean, gourd, cowpea was dominated species at front yard, back yard, and boundary side of the homestead areas (Table 6).

Table 6. Distribution of existing dominant vegetable species at different homestead areas of Jaintiapur upazila in Sylhet

Homestead areas	Observed Species Number	Dominant species
Major Front Yard	5	Bean (18) , Gourd (10), Bitter Gourd (8), Cowpea, and Sponge Gourd (6)
Back Yard	5	Bean (8), Cowpea (6), Red Amaranth (3), Bitter gourd, Coriander (3)
Boundary Side	3	Gourds (4), Bean, Pumpkin (1)
Corner Side	2	Bean (1), Corm (1)

It was revealed that the highest number of fruit plants were present in front yard of homestead compared to back yard, boundary side and corner side. Mango (26), jackfruit (11), custard apple (5), betel nut, guava, papaya (4) were major fruit species in the homesteads (Table7).

Table 7. Distribution of existing dominant fruit species at different homestead areas of Jaintiapur upazila in Sylhet

Homestead areas	Observed Species Number	Dominant species
Major Front Yard	6	Mango (26), Jackfruit (11), Custard Apple (5), Betel nut, Guava, Papaya (4)
Back Yard	4	Jackfruit, Betel nut (7), Papaya (6), Mango (4)
Boundary Side	2	Banana, Jackfruit (3)
Corner Side	2	Betel nut (1), Guava (1)

Most of the medicinal plant species were found in front yard followed by back yard, boundary side and corner side. Holy basil was the dominating species at the front yard and boundary side, Neem in the back yard side and corner side (Table 8).

Table 8. Distribution of existing dominant medicinal species at different homestead areas of Jaintiapur upazila in Sylhet

Homestead areas	Observed Species Number	Dominant species
Major Front Yard Species	2	Holy Basil (24) > Neem (5)
Back Yard Species	2	Neem (4) > Arjun (1)
Boundary Side Species	1	Holy basil (1)
Corner Side Species	2	Neem (2) > Holy basil (1)

The highest number of timber species were found in front side followed by back yard, boundary side and corner side. Raintree > Toona > Bur flower were dominated species at front yard, back yard, and corner side of the homestead areas front yard, back yard, and boundary side of the homestead areas (Table 9).

Table 9. Distribution of existing dominant timber species at different homestead areas of Jaintiapur upazila in Sylhet

Homestead areas	Observed Species Number	Dominant species
Major Front Yard	4	Raintree (6) > Toona (3) > Bur flower, Belgium (2)
Back Yard	3	Raintree (4) > Bur flower, Toona (1)
Boundary Side	3	Raintree (3) > Eucalyptus, Toona (1)
Corner Side	4	Raintree (3) > Neem, Jujube, Bamboo (1)

Shannon-Wiener Diversity Indices of plant species at different homestead areas:

Considering plant species diversity high plant species diversity was found at different homestead areas in Jaintiapur upazila (Table10, Fig. 1 and Fig. 2). Among all the plant species, the highest diversity was found in fruit species (H' = 0.88) followed by timber species (H' =0.87), vegetable plant species (H' = 0.85) and medicinal plant species (H' = 0.81).

High Shannon-Wiener Diversity Indices (SWDI) of vegetable species was found (H' = 0.94-0.72) in different homestead areas. The highest vegetable species diversity was found in front yard and back yard (H' =0.94 each) followed by boundary side and corner side (H' =0.79 and 0.72, respectively). Shannon-Wiener Diversity Indices (SWDI) of fruit species was also high (H' = 0.99-0.69) at different homestead areas of the studied upazila. The highest fruit species diversity was found at boundary side (H' = 0.99) followed by back yard (H' = 0.96), front yard and corner side (H' =0.86 and 0.69) respectively.

For medicinal species Shannon-Wiener Diversity Indices (SWDI) was medium to high (H' = 0.62-0.97) in different homestead areas. The highest medicinal species diversity was found in boundary side (H' =0.97) followed by back yard (H' =0.86), front yard (H' =0.86) and moderately diversity was in corner side (H' =0.62).

Shannon-Wiener Diversity Indices (SWDI) of timber plant species was high (H' =0.86-0.94) in different homestead areas except back yard where low diversity was found (H' =0.79). The highest timber plant species diversity was found in front yard (H' =0.94) followed by corner side and boundary side (H' =0.90 and H' =0.86) respectively.

Considering different homestead areas of Jaintiapur upazila, the high plant species diversity (H' = 0.85) was found at different homestead areas except for the corner side, where a moderate plant species diversity H' = 0.73) was observed (Table 10, Fig.1 and Fig.2).

Table 10. Shannon-Wiener Diversity Indices (SWDI) of plant species at different homestead areas of Jaintiapur upazila at Sylhet

	SWDI (H') of Plant Species				
Different homestead areas	Vegetable species	Fruit species	Medicinal species	Timber species	Mean
Front yard	0.94	0.86	0.79	0.94	0.88
Back yard	0.94	0.96	0.86	0.79	0.89
Boundary side	0.79	0.99	0.97	0.86	0.90
Corner side	0.72	0.69	0.62	0.90	0.73
Mean	0.85	0.88	0.81	0.87	0.85

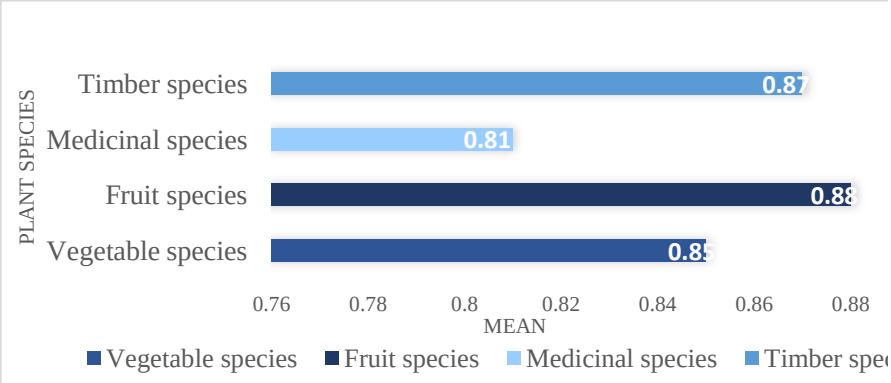

Figure 1. SWDI (H') of plant species in the study area

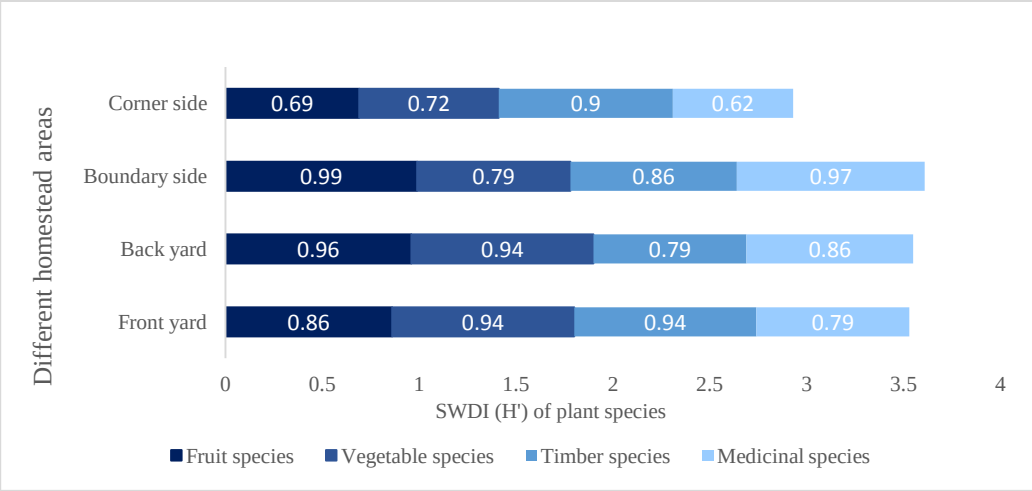

Figure 2. SWDI of plant species at different homestead areas

Hence, a good diversified plant species were observed in the Moringa based homestead area. Among the vegetable species, bean (22.6%) was the most dominant species followed by moringa (19.1), gourd (14.8%), cowpea (9.6%) and bitter gourd (7.8%) in most of the respondents' homestead area. Similarly, Suza et al. (2021) found country bean at most of the homesteads. However, Uddin et al. (2022) reported that chili was most dominant species found at 90.37% homesteads at Kamalganj of Moulvibazar district where as brinjal, papaya and tomato were found at more than 50% homesteads.

In the present study area, the most dominant fruit species was jackfruit (20.4%) followed by mango (18.4%) and betel nut (18.4%) and the diversity composition found up to 1.0-20.4%. At Teknaf peninsula, Nath et al. (2015) observed that Betel nut as the dominant species (63.0 %) followed by coconut, and mango. Holy basil (68.4%) was most dominant medicinal plant species followed by Neem (28.9%) in Moringa based homestead agroforestry in Sylhet. Rana et al. (2021) reported that three medicinal plant species tentul, neem and simul were the dominated in that study area. In timber species, raintree (56.0%) followed by toona (16.0%) and belgium (8.0) were the dominant species in most of the respondents' homestead area. Similar type of timber species diversity was observed by sultana et al. (2018). They observed akashmoni (12.53%), mahogany (8.43 %) and eucalyptus (7.29 %) as dominant trees in the studies area. In Moringa based homestead area Shannon-Wiener Diversity Indices (SWDI) of plant species was found high in fruit species H' = 0.88 and most of the species was found at the boundary side (H' = 0.90). Similarly , Uddin et al. (2022) found high timber species diversity (H' = 0.90) and most of the species were found at the approach road.

CONCLUSION

This study revealed the high biodiversity of plant species in Moringa based homestead in Jaintiapur upazila in Sylhet. Fruit species diversity was the highest followed by vegetables, timber species and medicinal plant species. The plant species were distributed in the front yard, back yard, boundary and corner side. Most of the species were found in boundary side followed by front yard, back yard and corner side.

ACKNOWLEDGEMENT

The first author is grateful to the Ministry of Science and Technology, Government of the People's Republic of Bangladesh for proving National Science and Technology (NST) fellowship 2020-21.

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