

## DIVERSITY OF PLANT SPECIES IN HOMESTEAD AREA OF MOULVIBAZAR DISTRICT IN BANGLADESH

M.S. Uddin<sup>1\*</sup>, S. Singha<sup>1</sup> and M.A. Kashem<sup>2</sup>

<sup>1</sup>Department of Agroforestry and Environmental Science

<sup>2</sup>Department of Soil Science

Sylhet Agricultural University, Sylhet, Bangladesh

### ABSTRACT

The study was conducted at Kamalganj Upazila of Moulvibazar district in Bangladesh during January to September 2015 to observe the diversity of plant species in the homestead area with their arrangement and to explore the relationships of plant diversity with the selected characteristics of the respondents. Face to face interview was performed with 135 respondents with the help of questionnaire. A total of 92 plant species, 45 vegetables species were recorded in the homestead of the study area. Out of different categories of plant species, 35 timber, 36 fruits and 21 medicinal and other plants were recorded. Most of fruit plants and medicinal and other plant species were found in front yard and backyard of homestead area. Timber trees were dominated at boundary side than any other side of homesteads. Diversity of fruit (0.79-0.99), timber (0.77-0.93) and medicinal plant species (0.77-0.96) were high in most of the unions. Mango Jackfruit, Papaya, Coconut were dominant fruit species. Acacia hybrid and Mehogany were dominant timber species. Coriander (*Coriandrum sativum*), Areca nut (*Areca catechu*), Tulsi (*Ocimum americanum*), Neem (*Azadirachta indica*), Bamboo (*Bambusa sp*), Pudina (*Mentha spicata*) and Bohera (*Terminalia bellerica*), were dominant medicinal and other plant species. There was a positive correlation between plant diversity with most of the selected characteristics of the respondents. Results conclude that plant diversity in homestead areas of Kamalganj upazila could be a good option for improving the livelihood of the respondents.

**Keywords:** Homestead, Plant species diversity, Shannon-Weaver diversity index.

### INTRODUCTION

Homestead can be defined as the land surroundings a house on which a mixture of annual and perennial plants are grown together with/without animals largely managed

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\* Corresponding Author: sharaf.aes@sau.ac.bd

by the household members for their own used or commercial purposes. It is one of the elaborate systems of indigenous agroforestry, mostly found in tropical and sub-tropical areas where subsistence land use system is predominated. Kumar and Nair (2004) defined it as a land use practice involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual houses, and the whole crop, tree-animal unit are being intensively managed by family labor. However, there is a consensus that the system is an intimate mix of diversified agricultural crops and multipurpose trees planted, maintained by members of the household and whose products are intended primarily for household consumption. In Bangladesh homestead agroforestry is referred to as 'Bosotvita Bagan' and is commonly considered as a small-scale enterprise established and maintained for household consumption, with additional household income through the sales of produce and environmental services (Alam, 2011). They constitute the most important source of food, fodder, wood, bamboo and other non-timber forest products in the country; attaining 15 to 25 times greater productivity than government administered forest lands (Miah and Hossain, 2002). Hence, home gardens in Bangladesh may act as refuges for many native and rare plants.

Homestead agroforestry systems attained international popularity because they represent good examples of sustainable and resilient farming systems (Kabir and Webb, 2008). A homestead is a unique combination of trees, shrubs, vegetables, livestock, animals, fishponds and human beings functioning as an ecosystem and maintaining the diversity of the life as well as the biological wealth. So, a rich homestead production system with plantations and other production enterprises provide immediate cash benefits as well as long term benefits for the farm families and thereby for the rural communities. Plant biodiversity is the variability between the plant kingdom and the ecosystem complex in which they occur. Plant diversity is defined as the variation among plant species, their varieties, and/or individual plant genotypes and phenotypes – underpins the productivity, resilience and adaptive capacity of agricultural systems (van de Wouw et al., 2010). This diversity is managed through farmers' cultivation and selection practices, with local exchange and gene flow among landraces encouraging genetic variation, and continued cultivation leading to local adaptation (Bellon, 1996; Louette et al., 1997; Mercer and Perales, 2010). Bangladesh has 15.4 million homesteads occupying 0.3 million hectares of land (Abedin and Quddus, 1990). Homestead represents a land use system involving deliberate management of multipurpose trees and shrubs in intimate association with seasonal vegetables (Fernandes and Nair, 1990). From the conservation point of view, homesteads are the in-situ conservation sites of wide range of plant biodiversity. Some time homesteads contained rare and very important materials. Most of the homesteads of landlord houses contained improved cultivars of different fruits, forest, medicinal and other aesthetic plants, which are very much important from horticultural and breeding point of view.

Most of the homesteads of Kamalganj upazila comprising of hills and hillocks and there is a vast scope of producing fruits and vegetable to meet up the nutritional demand of the people of the surroundings. There is a pressing need to study, the diversity of plant species in the homestead area of Kamalganj upazila. With this view keeping in mind the present study was undertaken to observe the diversity of plant species and their relationship with the selective characteristics of the respondents in Kamalganj area. Considering the above facts, the study was undertaken to study the diversity of plant species in homesteads and its relationship with the selective characteristics of socio-economic condition of the respondents in Kamalganj upazila.

### MATERIALS AND METHODS

The study was conducted in Kamalganj upazila of Moulvibazar district in Bangladesh during January to September, 2015. A total of 135 respondents were used for the study. Data were collected by using the individual questionnaire. Before going to make interview, each respondent was given a brief introduction about the nature and purpose of the study and the researcher assured them that, all information would be kept confidential. After the completion of each interview, each questionnaire was checked to be sure that information to each of the items had been properly recorded. After completion of collecting data from all the interview schedules were coded, compiled, tabulated and analyzed in accordance with objectives of the study. In this process, all responses in the interview schedule were given numerical coded values. Local units were converted into standard international units. Qualitative data converted into quantitative ones by means of suitable scoring. The Shannon-Weaver 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 from 0 to 1, where 1 indicates the maximum diversity. The higher the diversity index, the more is the diverse the population. The  $H'$  values  $\geq 0.75$  indicates the high diversity,  $H' = 0.50-0.75$  indicates moderate diversity and  $H' < 0.50$  indicates the low diversity (Jamago, 2000; Kete, 2001; Thuy, 2002; Uddin et al., 2006). Shannon-Weaver Diversity Index ( $H'$ ) was calculated by using the following formula of Yu Li et al. (1996):

$$H' = - \sum_{i=1}^n [(P_i * \text{Log}(P_i))] / \text{Log}(n)$$

Where,  $P_i$  is the proportion of the total number of entries belonging to the  $i^{\text{th}}$  class and  $n$  is the number of phenotypic classes of plant species. The relative frequencies for the different classes were used to calculate the diversity index. The  $H'$  for each of the unions, different homestead areas and plant species was calculated by using Microsoft Excel.

## RESULTS AND DISCUSSION

### Plant species diversity

Diversified plant species were observed in the homestead area. Total 137 plant species were recorded from the study area of which 35 (25.55%) timber species, 36 (26.28%) fruit species, 45 (32.85%) vegetable species and 21 (15.33%) medicinal and other plant species. Vegetable species was dominant followed by fruit and timber species compare to medicinal and other plant species (Table 1).

Table 1. Plant species found at Kamalganj upazila of Moulvibazar district during 2015

Plant species	No of existing plant species	Percentage
Timber tree	35	25.55
Fruit tree	36	26.28
Medicinal and other plants	21	15.33
Vegetables	45	32.85
<b>Total</b>	<b>137</b>	<b>100</b>

### Major timber, fruit, medicinal and other plant species

A total of 92 different types of tree species (fruit timber, medicinal and other plants) were observed in the study area (Table 1). Among these 92 different tree species mangos, jackfruit, mahogany, acacia and coconut were found as dominant trees in the Kamalganj Upazila. These fruit trees can tolerate the drought condition and also meet up the demand for food, fuel and wood. Out of 35 timber tree species Mehogany (66.67%) followed by Acasia hybrid (62.96%) and Shegun (51.85%) were the dominant species in most of the respondents' homestead area (Table 2). The topography of land and soil type is suitable for fruit and timber tree species and due to meet up the demand for food and fuel most of the respondents planted fruit and timber tree species in their homestead areas. Similar type of timber species diversity was observed by Sadaat (2007) in Gaibandha who observed total 21 timber species in his study area. The higher timber tree species was observed in the present study due to more suitability of the soil and topography of the study area and for growing diversified tree species by the respondents to meet up their demand for fuel and wood.

Among the 36 fruit species Mango (92.69%), Jackfruit (85.19%), Papaya (74.07%), Coconut (59.26%), and lemon (51.85%) were dominant and found up to 51.85-92.59% in the study area (Table 2). More or less similar type of fruit species diversity was observed by Belali (2011) and he observed total 28 fruit species at Narayanganj area. Uddin et al (2002) reported that coconut was found in 98.63% household at Noakhali. While mango, banana, betel nut and date palm, were found at more than 60% homesteads of Noakhali. Abedin and Quddus (1990) found mango at 95% homesteads of Tangail and at above 67% homesteads of Ishurdi, Jessore, and

Rangpur. Alam et al. (1990) observed that mango, jackfruit, coconut and banana were available at more than 65% homesteads of Jessore. Due to higher demand and price of the commodities the respondents in the present study planted more diversified fruits rather than the mono fruit crop either lemon or pumelo. Because their perception is that the other fruits are more profitable than the lemon or pumelo in respect of price.

Table 2. Major timber, fruit, medicinal and other plant species found at Kamalganj upazila of Moulvibazar district during 2015

Sl. No.	Local Name	English/ Common Name	Scientific Name	Respondents having tree species	
				No.	Percentage
1.	Mehogony	Mehogony	<i>Swietenia macrophylla</i>	90	66.67
2.	Acasia hybrid	Acasia hybrid	<i>Acacia hybrida</i>	85	62.96
3.	Shegun	Shegun/Tick	<i>Tectona grandis</i>	70	51.85
<b>Fruit Species</b>					
1.	Aam	Mango	<i>Mangifera indica</i>	125	92.59
2.	Kathal	Jackfruit	<i>Artocarpus heterophyllus</i>	115	85.19
3.	Pepe	Papaya	<i>Carica papaya</i>	100	74.07
4.	Kola	Banana	<i>Musa sapientum</i>	85	62.96
6.	Narikel	Coconut	<i>Cocos nucifera</i>	80	59.26
7.	Jambura	Pamelo	<i>Citrus grandis</i>	75	55.56
8.	Lemon	Lemon	<i>Citrus limon</i>	70	51.85
<b>Medicinal and other plant species</b>					
1.	Dhania	Coriander	<i>Coriandrum sativum</i>	120	88.89
2.	Supari	Areca nut	<i>Areca catechu</i>	105	77.78
3.	Tulsi	Tulsi	<i>Ocimum americanum</i>	100	74.07
4.	Neem	Neem	<i>Azadirachta indica</i>	92	68.15
5.	Bansh	Bamboo	<i>Bambusa sp</i>	90	66.67
6.	Pudina	Mint	<i>Mentha spicata</i>	80	59.26
7.	Bohera	Belaric myrobalan	<i>Terminalia bellerica</i>	70	51.85

Among the 21 medicinal and other plant species recorded in the studies area, Dhania/Coriander (88.89%), Areca nut (77.78%), Tulsi (74.07%), Neem (68.15%), Bamboo (66.67%) pudina (58.26%) and bohera (51.85%) were dominant and found in 51.85-88.89% of the respondent's house (Table 2). The diversity of medicinal plant species in the study area was lower compare to timber and fruit species. Mahogani, badhi and neem was found at 50% homesteads of the Noakhali district (Uddin et al., 2002). Abedin and Quddus (1990) found neem at 33% homesteads of Rajshahi and at 35% homesteads of Rangpur. Comparatively higher number of medicinal plant species

diversity was observed by Yasmin et al. (2010) at Tangail and they observed total 35 medicinal plant species. The smaller number of medicinal plant species was observed in the present study due to that the respondents may not be aware about the importance of diversified medicinal plants in their daily life. They are inherited from their ancestors to use some specific medicinal plants in their daily life. Awareness program for planting and using more medicinal plants may be initiated in the study area for the improvement which would be more helpful for their better health

As the same species was found at different respondents homestead, the total percentage was higher than 100

### Major vegetable species

Different types of vegetables were found in the study area. A total of 45 vegetable species were recorded in the homestead of the study areas (Table 1). Out of 45 vegetable species the dominants were Chili, Brinjal, Tomato, Cabbage, cauliflower, country bean. Chili, Brinjal, Papaya, Tomato, and Cabbage had maximum percentage (90.37%, 83.70%, 81.48%, 72.59% and 70.37%, respectively) (Table 3). Country bean was found at 81.96% homesteads of Noakhali. Whereas sweet gourd, brinjal were found at more than 50% homesteads of the study area (Uddin et al., 2002). Abedin and Quddus (1990) found country bean at 95% homesteads of Patuakhali and at 48% homesteads of Tangail.

Table 3. Major Vegetable species found at different homestead area of Kamalganj upazila during 2015

Sl. No.	Local Name/Bengali Name	English/Common Name	Scientific Name	Respondents having vegetable species	
				No. of Respondent	Percentage
1	Morich	Chili	<i>Capsicum annum</i>	122	90.37
2	Begun	Brinjal	<i>Solanum melongena</i>	113	83.70
3	Pepe	Papaya	<i>Carica papaya</i>	110	81.48
4	Tomato	Tomato	<i>Lycopersicon esculentum</i>	98	72.59
5	Badhakopy	Cabbage	<i>Brassica oleracea Le. Var. Capitata</i>	95	70.37
6	Plulkopy	Cauliflower	<i>Brassica oleracea Le. var. botrytis</i>	90	66.67
7	Sheem	Country bean	<i>Phaseolus sp.</i>	88	65.19
8	Zhinga	Ridged gourd	<i>Leuffa acutangula</i>	85	62.96
9	Alu	Potato	<i>Solanum tuberosum</i>	85	62.96
10	Gazor	Carrot	<i>Daucus carota</i>	85	62.96
11	Lal shak	Red amaranth	<i>Amaranthus tricolor</i>	85	62.96
12	Korolla	Bitter gourd	<i>Momordica dioica</i>	80	59.26
14	Pat shak	Jute Leaf	<i>Corchorus oletorius</i>	75	55.56

### Distribution of existing plant species in homestead areas

Trees/plants present at different homestead area such as front yard, back yard, boundary side, approach road and kitchen side are presented in Table 4, 5 and 6. From table 4 it is revealed that the highest number of fruit plants was present in front yard of homestead (23) followed by back yard (22) and kitchen side (22), compared to boundary side (21), approach road (20). Mango, Jackfruit, Lemon, Coconut was dominated at front yard, back yard and boundary side while in approach road coconut>mango>guava and in kitchen side papaya>lemon>mango, coconut, guava was dominating fruit species (Table 4).

Table 4. Distribution of existing dominant fruit species at different homestead areas of Kamalganj upazila during 2015

Homestead areas	No of species	Dominant species
Front yard	23	Mango (36)>Lemon (14)>Jackfruit (13)>Coconut (10)>Guava, Papaya (9)>Jamun (8)> Boro (7)>Pamelo (6)>Litchi, Orange, Dalim (5)>Amra, Kamranga (4)
Back yard	22	Mango (30)>Jackfruit (19)>Lemon (12)>Banana (7)> Litchi, Boro (6)>Coconut (5)>Jolpai, Jamun (4)> Bael, Amra, Pamelo, Papaya (3)> Pineapple, Kamranga (2)
Boundary side	21	Mango (46)>Jackfruit (30)>Coconut (13)>Litchi (10)> Guava (9)>Lemon (7)>Jamun (6)>Pamelo, Jalpai, Satkora(4)>Lotkon (3)
Approach road	20	Coconut (10)>Mango (9) >Guava (4) Jackfruit, Litchi, Papaya (3)> Bael, Banana, Boro, Lemon, Pumelo, Golapjam (2)
Kitchen side	22	Papaya (28)>Lemon (9)>Mango, Coconut, Guava (7)>Jackfruit (5) >Banana, Pamelo (3)>Pineapple, Dalim, atafal (2)

Timber trees were dominated at boundary side and backyard compare to any other side of homesteads. The highest number of timber species was found in boundary side (27) followed by back yard (25), front yard (19) and approach road (13) and lowest number of timber species was found in kitchen side (2). Koro>acacia was dominating timber tree species in front yard, Acasia>Mahogany>Koro were dominated in backyard, boundary and approach road (Table 5).

Table 5. Distribution of existing dominant timber tree species with their frequency at different homestead area of Kamalganj upazila

Homestead areas	No of species	Dominant species
Front yard	19	Koroi (9)>Acasia (6)> Kadam (4)> Shegun (3)
Back yard	25	Acasia (17)>Mahogany (10)>Koroi (6)>Shegun (5)> Mangium (4)>Babla, Kodam, Raintree, Debdaru, Eucalyptus (3)
Boundary side	27	Acasia (35)>Mahogany (24)>koroi (16)>Shegun (8)>Mangium (5)
Approach road	13	Acasia (6)>Mahogany (5)>Koroi (4)>Shegun (3)>Babla, Kadam (2)
Kitchen side	2	Bot (1) = Koroi (1)

Most of the medicinal and other plant species (20) were found in front yard followed by Back yard (17) and boundary side (12) compare to kitchen (9), and approach road (9) (Table 6). Tulsi was dominating medicinal plant species at front yard and kitchen side on the other hand neem>tulsi>arjun>mehedi were dominated species at back yard, boundary and approach road of the homestead areas (Table 6).

Table 6. Distribution of existing dominant medicinal and other plant species at different homestead areas of Kamalganj upazila during 2015

Homestead areas	No of species	Dominant species
<b>Medicinal plants</b>		
Front yard	20	Tulsi (52)>Neem (7)>Mehedi (4)> Amloki, Thankuni (3)> Basok, Chirota, Nayantara, Nemnaam-2
Back yard	17	Neem (15)>Tulsi (4)>Amloki, Ginger, Nishinda (3)>Asoke, Basok (2)
Boundary side	12	Neem (15)>Mehedi (5)>Arjun, Basok (4)>Tulsi (3)>Bohera, Chirota, Horitoki (2)
Approach road	9	Neem (8)>Arjun, Basok (3)>Mehedi (2)>Pudina, Tejpatha (1)
Kitchen side	9	Tulsi (13)>Ginger, Mehedi (2)>Kalomegh, Thankuni, Alovera, Ullotkambal, Bohera (1)
<b>Other plant species</b>		
Front yard	7	Bamboo (8)>Areca nut (5)>Bakul, Dumur, Ginger, Karpur (1)
Back yard	5	Bamboo (39)>Areca nut (6)>Betel leaf (3)>Agar, Gab (1)
Boundary side	16	Areca nut (17)>Bamboo (14)>Sajna (3)>Sonalu, Khoksha, Chalta, Hijol, Pitali (2)
Approach road	11	Areca nut (8)> Debdaru, Dumur (2)
Kitchen side	4	Pitali (2)> Sajna, Dumur, Gab (1)

### **Shannon-Weaver Diversity Indices of plant species in different unions**

Considering plant species diversity, high diversity ( $H' = 0.75-0.89$ ) was found in different unions of Kamalganj Upazila (Table 7). Among all the plant species, the higher diversity was found in fruit species ( $H' = 0.89$ ) followed by timber species ( $H' = 0.84$ ), medicinal plant species ( $H' = 0.82$ ), and other plant species ( $H' = 0.75$ ).

High Shannon-Weaver Diversity Indices (SWDI) of fruit species was found ( $H' = 0.79-0.99$ ) in all unions except in Kamalganj union where moderate fruit species diversity (0.73%) was observed. The highest fruit species diversity was found in Islampur ( $H' = 0.99$ ) followed by Alinagar, Madhabpur and Adampur ( $H' = 0.96, 0.95$  and  $0.94$ ) respectively. Uddin et al. (2006) found moderate to high diversity in coconut in the Philippines. Foale (1992) opined that many coconut populations had high diversity as a result of addition of new genetic materials.

Shannon-Weaver Diversity Indices (SWDI) of timber species was high ( $H' = 0.76-0.93$ ) in all unions except medium in Patanushar union ( $H' = 0.73\%$ ). The highest timber species diversity was found in Adampur ( $H' = 0.93$ ) followed by Islampur, Madhabpur and Alinagar ( $H' = 0.90, 0.90$  and  $0.88$ ).

For medicinal species Shannon-Weaver Diversity Indices (SWDI) was high ( $H' = 0.77-0.96$ ) in all unions except medium in Adampur ( $H' = 0.73$ ) and Munshibazar union (0.62%). The highest medicinal plant species diversity was found in Shamshernagar ( $H' = 0.96$ ) followed by Alinagar, Kamalganj, Patanushar and Madhabpur ( $H' = 0.90, 0.90, 0.87$  and  $0.86$ ).

Shannon-Weaver Diversity Indices (SWDI) of other plant species was high ( $H' = 0.75-0.96$ ) in all unions except medium in Kamalganj ( $H' = 0.67$ ) and Munshibazar ( $H' = 0.62$ ) and low in Islampur union ( $H' = 0.42$ ). The highest other plants species diversity was found in Shamshernagar ( $H' = 0.96$ ) followed by Rahimpur, Alinagar and Adampur ( $H' = 0.88, 0.84$  and  $0.84$ ).

Considering the unions of Kamalganj Upazila, the high plant species diversity was found in all the unions ( $H' = 0.77-0.90$ ), except Munshibazar union ( $H' = 0.73$ ) where moderate plant species diversity was found. Among all the unions, the highest plant species diversity was found in Alinagar ( $H' = 0.90$ ) followed by Shamshernagar ( $H' = 0.89$ ), Madhabpur ( $H' = 0.87$ ), Adampur ( $H' = 0.86$ ), Patanushar ( $H' = 0.83$ ), Rahimpur ( $H' = 0.81$ ), Kamalganj ( $H' = 0.78$ ) and Islampur ( $H' = 0.77$ ).

Measuring the Shannon-Weaver Diversity Indices (SWDI), the  $H'$  is the direct method of determining the diversity among the plant species which ranges from 0 to 1, where 1 indicates the maximum diversity. The higher the diversity index, the more diverse the population. The  $H'$  values  $\geq 0.75$  indicates the high diversity,  $H' = 0.50-0.75$  indicates moderate diversity and  $H' < 0.50$  indicates the low diversity (Jamago, 2000). Plant diversity was also measured in a similar way by Kete (2001), Thuy (2002) and Uddin et al. (2006) in coconut.

Table 7. Shannon-Weaver Diversity Indices (SWDI) of plant species at different unions of Kamalganj Upazila under Moulvibazar district

Union	SWDI (H') of Plant Species				Mean
	Fruit trees	Timber trees	Medicinal plants	Other plants	
Kamalganj	0.73	0.82	0.90	0.67	0.78
Alinagar	0.96	0.88	0.90	0.84	0.90
Islampur	0.99	0.90	0.77	0.42	0.77
Patanushar	0.92	0.73	0.87	0.80	0.83
Adampur	0.94	0.93	0.73	0.84	0.86
Madhabpur	0.95	0.90	0.86	0.75	0.87
Munshibazar	0.92	0.76	0.62	0.62	0.73
Shamshernagar	0.80	0.82	0.96	0.96	0.89
Rahimpur	0.79	0.80	0.77	0.88	0.81
Mean	0.89	0.84	0.82	0.75	0.83

#### Shannon-Weaver Diversity Indices of plant species at different homestead areas

Considering plant species diversity high plant species diversity was found at different homestead areas in Kamalganj Upazila (Table 8). Among all the plant species, the higher diversity was found in timber species ( $H' = 0.90$ ) followed by fruit species ( $H' = 0.82$ ), medicinal plant species and other plant species ( $H' = 0.76$  each).

High Shannon-Weaver Diversity Indices (SWDI) of fruit species was found ( $H' = 0.75$ - $0.89$ ) in different homestead areas in Kamalganj upazila. The highest fruit species diversity was found in approach road ( $H' = 0.89$ ) followed by front yard and Back yard ( $H' = 0.84$  and  $0.81$ ) respectively. Uddin et al. (2006) found moderate to high diversity in different coconut orchards in the Philippines. Foale (1992) opined that many coconut populations had high diversity as a result of addition of new genetic materials.

Shannon-Weaver Diversity Indices (SWDI) of timber species was also high ( $H' = 0.80$ - $1.00$ ) at different homestead areas of the studied upazila. The highest timber species diversity was found at kitchen side ( $H' = 1.00$ ) followed by approach road and front yard ( $H' = 0.93$  and  $0.90$ ).

For medicinal species Shannon-Weaver Diversity Indices (SWDI) was medium to high ( $H' = 0.61$ - $0.85$ ) in different homestead areas. The highest fruit species diversity was found in approach road ( $H' = 0.85$ ) followed by boundary and back yard ( $H' = 0.83$  and  $0.82$ ).

Shannon-Weaver Diversity Indices (SWDI) of other plant species was high ( $H' = 0.76$ - $0.96$ ) in different homestead areas except back yard where low diversity was found ( $H' = 0.48$ ). The highest other plant species diversity was found in kitchen side ( $H' = 0.96$ ) followed by approach road ( $H' = 0.84$ ).

Considering different homestead areas of Kamalganj Upazila, the high plant species diversity was found at different homestead areas except back yard where moderate plant species diversity was observed ( $H' = 0.74$ ). On an average high plant species diversity was found in different homestead areas considering different plant species in Kamalganj upazila ( $H' = 0.81$ ).

Table 8. Shannon-Weaver Diversity Indices (SWDI) of plant species at different homestead areas of Kamalganj Upazila under Moulvibazar district

Different homestead areas	SWDI ( $H'$ ) of Plant Species				Mean
	Fruit trees	Timber trees	Medicinal plants	Other plants	
Boundary side	0.75	0.80	0.83	0.76	0.79
Front yard	0.84	0.90	0.61	0.78	0.78
Back yard	0.81	0.86	0.82	0.48	0.74
Kitchen side	0.79	1.00	0.71	0.96	0.87
Approach road	0.89	0.93	0.85	0.84	0.88
Mean	0.82	0.90	0.76	0.76	0.81

### **Relationship between diversified plant species and selected characteristics of the respondents**

Table 9 represents the relationship between selected characteristics of the respondents and the plant species diversity observed in different homestead areas in Kamalganj upazila. Most of the studied characters of the respondents like annual income, farm size, socio-economic condition, homestead size, expenditure and education of the respondents were positively correlated with the number of diversified plant species except age and family size of the respondents.

#### **Plant species diversity and age of the respondents**

The results indicated that the computed value of  $r$  between plant species diversity and age of the respondents was  $-0.116$  indicated there was negative relationship between plant species diversity and the age of the respondents.

#### **Plant species diversity and education of the respondents**

The computed value of  $r$  between plant species diversity and education of the respondents was  $0.718$  at  $0.05$  level of probability indicated there was significant positive relationship between plant species diversity and the education of the respondents.

#### **Plant species diversity and family size of the respondents**

The results indicated that the computed value of  $r$  between plant species diversity and age of the respondents was  $-0.340$  indicated there was negative relationship between plant species diversity and the family size of the respondents.

**Plant species diversity and farm size of the respondents**

The computed value of  $r$  between plant species diversity and farm size of the respondents was 0.925 at 0.05 level of probability indicated there was significant positive relationship between plant species diversity and the farm size of the respondents.

**Plant species diversity and homestead size of the respondents**

The computed value of  $r$  between plant species diversity and homestead size of the respondents was 0.755 at 0.05 level of probability indicated there was significant positive relationship between plant species diversity and the homestead size of the respondents.

**Plant species diversity and annual income of the respondents**

The computed value of  $r$  between plant species diversity and annual income of the respondents was 0.956 at 0.05 level of probability indicated there was significant positive relationship between plant species diversity and the annual income of the respondents.

**Plant species diversity and family expenditure of the respondents**

The computed value of  $r$  between plant species diversity and family expenditure of the respondents was 0.727 at 0.05 level of probability indicated there was significant positive relationship between plant species diversity and the family expenditure of the respondents.

**Plant species diversity and savings of the respondents**

The computed value of  $r$  between plant species diversity and savings of the respondents was 0.328 at 0.05 level of probability indicated there was significant positive relationship between plant species diversity and the family savings of the respondents.

**Plant species diversity and knowledge on homestead agroforestry of the respondents**

The computed value of  $r$  between plant species diversity and knowledge on homestead agroforestry of the respondents was 0.467 at 0.05 level of probability indicated there was significant positive relationship between plant species diversity and the knowledge on homestead agroforestry of the respondents.

**Plant species diversity and socioeconomic condition of the respondents**

The computed value of  $r$  between plant species diversity and socioeconomic condition of the respondents was 0.896 at 0.05 level of probability indicated there was significant positive relationship between plant species diversity and the socioeconomic condition of the respondents.

Table 9. Relationship between the selected characteristics of the respondents with numbers of diversified plant species at Kamalganj upazila

	Respondents' characteristics	Pearson's Coefficient of correlation (r)
Plant species diversity Vs	Age	-0.116 (NS)
	Education	0.718 <sup>(**)</sup>
	Family size	-0.340 <sup>(*)</sup>
	Farm size	0.925 <sup>(**)</sup>
	Homestead size	0.755 <sup>(**)</sup>
	Annual income	0.956 <sup>(**)</sup>
	Expenditure	0.727 <sup>(**)</sup>
	Savings	0.328 <sup>(**)</sup>
	Knowledge on homestead agroforestry	0.467 <sup>(**)</sup>
	Socio-economic conditions	0.896 <sup>(**)</sup>

From the study it was found that the high plant species diversity was found in the study area which was positively correlated with education, farm and homestead size, annual income and expenditure, savings, knowledge on homestead agroforestry and the socio-economic conditions of the respondents. On the contrary, family size and age of the respondents negatively correlated with plant species diversity. This is due to that with the increasing of age and family size of the respondents they became much needier and their expenditure for the family needs were also increased. Due to increasing of family demand they cut down some of the trees and sold those to meet up their demand and thus the plant species diversity decreased and thus plant diversity was negatively correlated with age and family size of the respondents.

### CONCLUSION

In may be concluded that the high diversity of plant species was observed in Kamalganj Upazila. However, fruit species diversity was the highest among the three categories of plant species followed by timber species and medicinal plant species at Kamalganj upazila whilst considering different homestead areas diversity of timber species was higher. There was a positive correlation between numbers of plant species diversity with most of the selected characteristics of the respondents indicated the improvement of livelihood of the respondents due to presence of diversified plant species in the homestead area. Hence, increasing the diversified plant species in the homestead area could be an option to improve the food and nutritional security along with socio-economic condition of the respondents in the study area.

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