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DIVERSITY OF HOMESTEAD FRUIT CROPS IN THE SOUTH-CENTRAL COASTAL REGION OF BANGLADESH

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Abstract

South-Central Coastal region of Bangladesh rich in homestead forest as traditional multi-layered agro-forestry practices. With a view to assess the diversity, richness, distribution, and relative prevalence of fruits & agroforestry species, a survey was conducted during July 2021 to October 2021 in 300 households of five upazilas, Bakergonj, Dumki, Kalapara and Patuakhali Sadar and Amtali of Barishal, Patuakhali and Barguna districts consisting of nine major and 31 minor fruits existed in the south central coast of Bangladesh. The survey results showed significant variation amongst the studied upazilas in relation to fruit crops diversity. The largest household area (47.87 decimal) was noticed in Bakergonj with maximum number of fruits and timbers (75.1) where the numbers of fruit trees were 24.5 per household. The smallest household (30.82 decimal) was found in Kalapara with an accommodation of 34.92 numbers of fruit and timber having the lowest number of fruit trees (18.7). The maximum number of fruit species was observed in the households of Bakergonj (7.22) followed by Amtali (6.55) and the lowest (5.07) in Kalapara upazila. Among the major fruits, the maximum distribution in the homestead areas of five upazilas was recorded as mango (100%) followed by banana (98.67%), papaya (98.67%) and coconut (98.33%), whereas among the minor fruits the maximum distribution was found as velvet apple (98.67%) followed by seeded banana and golden apple (97.67%). The highest species diversity (0.825) of major fruits was recorded in Bakergonj and the lowest (0.773) in Kalapara upazila. But, in case of minor fruits, the highest (81.6) species diversity was recorded in Dumki and the lowest (0.771) in Kalapara upazila. Maximum diversity was found in banana, mango and coconut in respect of major fruits, whereas velvet apple and seeded banana in regard to minor fruit species. The mean dominance of the major fruit population showed that banana ranked top followed by mango and coconut whereas velvet apple ranked top followed by seeded banana among the minor fruits.

Keywords: Fruit species, homesteads, south central coastal areas, diversity,

Introduction

Bangladesh is a rich repository of plant genetic pools and has conceived more than 5000 species of higher plants (Rahman *et al.,* 2009). There are 321.74 lakh

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households in Bangladesh and three districts, namely Barishal, Barguna and Patuakhali comprise 10.76 lakh household. (Anon., 2023). Almost every household facilitates various fruits, mainly minor fruits and agroforestry tree species. The southern-central area of Bangladesh adjacent to the sea, the coastal region where about 20 percent of the country's land area is situated and about 30 percent of the total cultivable land is in the coastal areas (Anon., 2022). Due to the soil salinity in this region, which is inundated by the tidal waters of the sea, it is not possible to cultivate many kinds of crops and fruits like other parts of the country. Huge potentiality exists in the central coastal region for future agricultural development where fruits like guava, mango, coconut, jujubee, pummelo, malta, etc. have been helpful in changing the fortunes of many farmers (Anon., 2022).

Sarker *et al.* (2022) mentioned that Bangladesh has produced 51.4 lakh metric tons fruits from 4.02 lakh hectares of land and 14.3 lakh metric tons (28% of total production) contributed by the outside garden production (homestead and roadside plantation). A homestead is used as a dwelling place as well as a production unit for plants, animals and fish under an integrated farming system (Foysal *et al.*, 2013). In Bangladesh, there are varieties of local fruits with good nutritional values grown in homesteads, forest areas, roadsides and near railway without much care. These fruits are termed as minor/underutilized fruits because of less awareness to its nutrient value among the mass people. Meanwhile, fruits are rich in different vitamins and minerals to ensure food quality, dietary diversity and can also provide household income (Abebe *et al*., 2019; Elfrida *et al.*, 2020).

Rahim *et al.* (2011) reported 67 minor fruit yielding plants of Bangladesh that are being grown in the Germplasm Centre at Bangladesh Agricultural University. Rahman and Rahman (2014) reported that a total of 70 fruits are presently grown in Bangladesh; among them 42 are minor fruit species. From a survey of 80 homesteads Roy *et al.* (2013) obtained 62 plant species (trees, herbs and shrubs) belonging 36 families, among which there were only 21 fruit species (major and minor).

The identification of major and minor fruits species adapted to coastal saline affected areas and conservation of different major as well minor fruits germplasm in homestead areas helps not only to enrich their germplasm but also helps to protect them from genetic extinction. So the household survey was done with a view to identifying the promising fruit species (major and minor) which are not only adapted but giving maximum yield inhabitant to this climate change vulnerable coastal areas. Therefore, the study was carried out to update and provide the available information on species diversity, species richness and relative prevalence of fruits available in these vulnerable coastal upazilas of Bangladesh.

Materials and Methods

Experimental sites

The survey was conducted in the five upazilas (Bakergonj, Dumki, Patuakhali Sadar, Kalapara and Amtali) situated in central three coastal districts, namely

Barishal, Patuakhali and Borguna of Bangladesh during 2021. Ten farmers' households from each union were selected and finally 300 samplings (10 farmers for each union × 6 unions for each upazila × 5 upazilas) were taken for the study. Geographic position including Latitudes and Longitudes of the study areas are presented in Table1.

Table.1 Details of the study area

Sl. No.	District (3)	Upazila (5)	Union (30)	Latitudes and Longitudes
1.	Barishal	Bakergonj	Dudhal, Nalua, Padri shibpur, Rangoshree, Bhorpasha	22°14' and 22°29' N 90°12' and 90°28' E
2.	Patuakhai	Dumki	Angaria, Pangashia, Muradia, Lebukhali, Sreerampur.	22°23' and 22°30' N 90°17' and 90°27' E
		Patuakhali Sadar	Auliapur, Badarpur, Marichbunia, Kalikapur, Jainkati, Madarbunia	22°14' and 22°29' N 90°12' and 90°28' E
		Kalapara	Khaprabhanga, Dhankhali Chakamaiya, Tiakhali, Nilganj, Latachapli	21°48' and 22°05' N 90°05' and 90°20' E
3.	Borguna	Amtoli	Atharogashia, Amtali, Kukua, Gulishakhali, Chowra, Haldia	21°51' and 22°18' N 90°00' and 90°23' E

Fruit species percent in the homesteads

The total number of fruit species present in the homesteads of the study areas along with the total number of families of fruit species was identified. After that the total species and the total number of fruit plant populations were considered as the abundance.

Distribution of fruit species

The frequency of occurrence of a particular fruit species at the homesteads were measured. The distribution of fruit species was calculated in a particular homestead through interview schedule using a pretested questionnaire.

Percent homestead = (Particular existing fruit/No. of homesteads in an area) × 100

Species richness (SR)

The species richness is the number of species within an area, giving equal weight to each one as suggested by Heywood and Watson (1995). Fruits of the homesteads were grouped into two: major and minor fruits by personal communication with Chief Scientific Officer (CSO), Pomology Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI). After that the proportion of the two groups were calculated.

Species diversity (SD)

Species diversity was calculated following the formula of Simpson (1949). Where Simpson index (D) were used to calculate the species diversity, which is: $D = 1 - Pi^2$, where Pi is the proportional abundance of the *ith* species such as, $Pi^2 = Ni/N$, Where Ni = Fruit population of the *ith* species and $N = N_1 + N_2 + N_3 \ldots\ldots\ldots Nn$ where n = is the number of species.

Relative prevalence (RP) of the species

The percent of homestead containing a particular species is one of the indicator of the relative prevalence of the particular species in that area. The percent of homesteads having the fruit species was calculated for all species. Then the relative prevalence of a species was calculated using the formula:

RP = Population of the species per homestead × % homestead with the species.

The relative prevalence value was calculated to rank the species into different groups according to Millat-e-Mustafa (1997).

Dominance rank (DR)

The dominance rank of the fruit species was determined by pooling the entire set of data from the study.

Data analysis

Before each interview the interviewer informed the respondent about the purpose of the survey and ensured verbal and written consent. Also the confidentiality of all information released by respondent was assured. Data were analyzed using the Statistical Package for Social Science (SPSS) (IBM SPSS Statistics 23) and Excel software. Sixty samples (Household) were used as treatment from each upazila, where it was replicated in five upazila (viz. Bakergonj, Dumki, Patuakhali Sadar, Kalapara and Amtali). Randomized Complete Block Design (RCBD) with five replications was used to analyze household area, fruit species and total number of fruit species data and mean separation was done by HSD Tukey Test using JMP - 14 pro software.

Results and Discussion

Household size and fruit species distribution of five upazilas under south central coast of Bangladesh

Household area, fruit species and total number of fruit trees existed in the studied household of different upazilas are presented in Table 3. The largest household was identified in Bakergonj (47.87 decimal) upazila, closely followed by Amtali (35.45 decimal), and Patuakhali Sadar (33.78 decimal) and the smallest household (30.82 decimal) was found in Kalapara (30.82 decimal).

Table 2. Household area, fruit species and total number of fruit trees existed in the studied household of different upazilas

Upazila	Household area (decimal)	Fruit species (no.)	Total fruits and timbers (No.)	Total fruit trees (no.)
Amtali	35.45 ab	6.55 ab	63.80 ab	32.35 a
Bakergonj	47.87 a	7.22 a	75.18 a	24.52 b
Dumki	33.78 ab	5.88 b	45.40 ab	23.00 bc
Kalapara	30.82 b	5.07 c	34.92 b	18.72 c
Patuakhali Sadar	31.50 b	6.38 b	51.37 ab	23.75 bc
Level of significance	**	**	*	*

Figures in a column having same letter (s) don't differ significantly at 5% and 1% level of probability by HSD Tukey Test.*= Significant at the 5% level of probability **= Significant at the 1% level of probability.

Maximum number of fruit species (7.22) was recorded in the households of Bakergonj followed by Amtali (6.55) and very few species at Kalapara (5.07). Total number of fruit and timbers was found maximum (75.18) in Bakergonj which was closely followed by Amtali (63.80), Dumki (51.37) and Patuakhali Sadar (45.40) and the minimum observed in Kalapara (34.92).. The total number of fruit trees was maximum in Amtali (32.35) followed by Bakergonj (24.52) and it was minimum (18.72 in Kalapara homestead.

During survey nine major fruits viz., mango, banana, jackfruit, coconut, litchi, guava, papaya pineapple and jujube and 31 minor fruits, namely lime, Lemon, Velvet apple, Monkey jack, golden apple, pomelo, stone apple, wax jambu, Indian olive, sweet orange, sapota, aonla, tamarind, jamun, wood apple, pomegranate, cowa, bullock's heart, palmyra palm, dragon fruit, carambola, buttercup, custard apple, cane palm , bilimbi, river ebony, date palm, seeded banana, star gooseberry, boichi and Indian almond were identified (Table 3).

Table 3. English, Bengali, Scientific name and families of different fruit species found in the study area

Sl. No.	English Name	Local Name/ Bengali Name	Scientific Name	Family
	Major fruits			
1.	Mango	Aam	*Mangifera indica*	Anacardiaceae
2.	Banana	Kola	*Musa sapientum*	Musaceae
3.	Jackfruit	Kanthal	*Artocarpus heterophyllus*	Moraceae
4.	Coconut	Narikel	*Cocos nucifera*	Palmaceae
5.	Litchi	Lichu	*Litchi chinensis*	Sapindaceae
6.	Guava	Peyara	*Psidium guajava*	Myrtaceae
7.	Papaya	Pepe	*Carica papaya*	Caricaceae
8.	Pineapple	Anarosh	*Ananus comosus*	Bromeliaceae
9.	Jujube	Boroi/Kul	*Zizyphus jujuba*	Rhamnaceae

Sl. No.	English Name	Local Name/ Bengali Name	Scientific Name	Family
	Minor fruits			
10.	Lime	Kagojilebu	*Citrus aruntifolia*	Rutaceae
11.	Lemon	Lebu	*Citrus limon*	Rutaceae
12.	Velvet apple	Bilatigab	*Diospyros discolor*	Ebemaceae
13.	Monkey jack	Dewa/Deophal	*Artocarpus lakoocha*	Moraceae
14.	Golden apple	Bilati amra	*Spondias dulcis*	Anacardiaceae
15.	Pomelo	Batabilebu	*Citrus grandis*	Rutaceae
16.	Stone apple	Kodbael	*Feronia limonia*	Rutaceae
17.	Wax Jambu	Jamrul	*Syzygium samarengense*	Myrtaceae
18.	Indian olive	Jalpai	*Elaeocarpus floribundus*	Elaeocarpaceae
19.	Sweet orange	Malta	*Citrus sinensis*	Rutaceae
20.	Sapota	Shafeda	*Achras sapota*	Sapotaceae
21.	Aonla	Amloki	*Emblica officinalis*	Euphorbiaceae
22.	Tamarind	Tentul	*Tamarindus indica*	Fabaceae
23.	Jamun	Jam	*Syzygium cumini*	Murtaceae
24.	Wood apple	Bael	*Aegle marmelos*	Rutaceae
25.	Pomegranate	Dalim	*Punica granatum*	Punicaceae
26.	Cowa	Kaufal	*Garcinia cowa*	*Cluciaceae*
27.	Bullock's heart	Ata	*Annona reticulata*	Annonaceae
28.	Palmyra palm	Taal	*Brassus flabellifer*	Palmaceae
29.	Dragon fruit	Dragan Phal	*Hylocereus spp*	Cactaceae
30.	Carambola	Kamranga	*Averrhoa carambola*	Averrhoaceae
31	Buttercup	Mahua	*Madhuca longifolia*	Sapotaceae
32.	Custard apple	Sharifa	*Annona squamosa*	Annonaceae
33.	Cane palm	Bet phol	*Calamus tenuis*	Arecaceae
34.	Bilimbi	Bilimbi	*Avenhoa bilimbi*	Averrhoaceae
35.	River ebony	Deshi gab	*Diospyros peregrina*	Ebenaceae
36.	Date palm	Khejur	*Phoenix sylvestris*	Palmaceae
37.	Seeded Banana	Bichikola	*Musa spp*	Musaceae
38.	Star gooseberry	Arboroi	*Phyllanthus distichus*	Phyllanthaceae
39.	Boichi/ Madagascar Plum	Boichi	*Flacourtia indica*	Flacourtiaceae
40.	Indian almond	Kathbadam	*Terminalia catappa*	Combretaceae

Diversity of fruit crops grown in the households of south central coast of Bangladesh

Existing fruit species abundance at the homesteads

The total number of fruit species with the total number of their plants were considered as their abundance of the respective upazila. Forty fruit species including nine major and 31 minor fruits were noticed (Table 4). A total 19,947

number of nine major fruits plants in five upazilas were identified where banana (7047 plants) ranked first followed by mango (5339 plants). Among the total fruit species (both major and minor) (32,279), major fruits occupied 61.80% and minor fruits occupied 38.20%, respectively.

Among major fruits, in consideration of percentage total Banana ranked first (21.83%) while Mango ranked second (16.54%) of total population, respectively. In case of total minor fruit species (12,332) velvet apple (6.62%) ranked top followed by Date palm (5.35%), seeded banana (4.52%) and river ebony (3.94%). Islam *et al*. (2013) reported that among the fruit tree species, coconut, betel nut, mango, jackfruit, guava and velvet apple were found in more than 80% households. Maximum mango trees were recorded from Bakerganj (1149 trees) followed by Kalapara (1120 trees), Amtali (1099 trees) and Patakhali Sadar (1073 trees) and the minimum from Dumki (899 trees). Banana was found the highest in Kalapara (1575 trees) followed by Amtali (1464 trees) and the lowest from Dumki (1242 trees). Among major fruits, only pineapple was not found in all upazilas and among minor fruits, Indian olive, pomegranate, dragon fruit, crambola, buttercup, custard apple, cane palm, bilimbi, Madagascar plum and Indian almond were not found in all upazilas.

Table 4. Fruit species (number/population) present at the homesteads of study area

Sl. No.	Fruit Species	Amtali	Bakergonj	Kalapara	Dumki	Patuakhali Sadar	Total	% Category	% Total
				Major Fruits					
1.	Mango	1099	1149	899	1120	1073	5339	26.76	16.54
2.	Banana	1464	1379	1242	1575	1388	7047	35.31	21.83
3.	Jackfruit	282	117	278	54	215	945	4.74	2.93
4.	Coconut	498	504	336	348	371	2057	10.31	6.37
5.	Litchi	62	41	53	38	65	257	1.29	0.79
6.	Guava	180	395	513	200	333	1620	8.12	5.02
7.	Papaya	306	287	242	188	278	1299	6.51	4.02
8.	Pine apple	233	300	0	255	0	788	3.95	2.44
9.	Jujubee	137	132	87	119	123	597	3.00	1.85
Sub-total		4261	4304	3650	3897	3846	19947	100.00	61.80
				Minor Fruits					
10.	Lime	345	113	38	87	128	710	5.75	2.20
11.	Lemon	27	17	23	24	35	125	1.01	0.39
12.	Velvet apple	494	455	398	414	377	2136	17.32	6.62
13.	Monkey jack	113	98	143	126	96	575	4.66	1.78
14.	Golden apple	185	270	144	279	174	1052	8.53	3.26
15.	Pomelo	38	27	38	50	36	188	1.52	0.58

Sl. No.	Fruit Species	Amtali	Bakergonj	Kalapara	Dumki	Patuakhali Sadar	Total	% Category	% Total
16.	Stone apple	36	23	21	27	30	137	1.11	0.42
17.	Wax Jambu	72	69	53	89	57	339	2.75	1.05
18.	Indian olive	0	2	9	0	0	11	0.09	0.03
19.	Sweet orange	21	20	38	32	53	162	1.31	0.50
20.	Sapota	24	48	35	48	27	182	1.47	0.56
21.	Aonla	78	83	56	71	96	383	3.10	1.18
22.	Tamarind	48	41	54	117	53	312	2.53	0.97
23.	Jamun	21	29	20	33	17	119	0.96	0.37
24.	Wood apple	36	57	48	56	80	276	2.24	0.86
25.	Pomegranate	2	0	2	8	12	23	0.18	0.07
26.	Cowa	27	42	72	56	33	230	1.86	0.71
27.	Bullock's heart	26	21	18	24	18	107	0.86	0.33
28.	Palmyra palm	38	35	72	66	78	288	2.34	0.89
29.	Dragon fruit	12	18	0	23	38	90	0.73	0.28
30.	Carambola	18	3	0	2	0	23	0.18	0.07
31.	Buttercup	23	0	0	0	12	35	0.28	0.11
32.	Custard apple	0	0	18	0	0	18	0.15	0.06
33.	Cane palm plant	6	0	21	0	0	27	0.22	0.08
34.	Bilimbi	53	0	68	0	32	152	1.23	0.47
35.	River ebony	282	248	255	249	237	1271	10.30	3.94
36.	Date palm	383	312	282	428	324	1728	14.01	5.35
37.	Seeded Banan	332	303	318	318	189	1460	11.84	4.52
38.	Star goosberry	33	24	17	23	18	114	0.92	0.35
39.	Boichi/Madagascar plum	12	0	0	0	0	12	0.10	0.04
40.	Indian almond	23	12	0	0	21	56	0.45	0.17
Sub-total		2808	2370	2261	2650	2271	12332	100.00	38.20
Total		7067	6672	5909	6546	6114	32279		100

Distribution of fruit species

The frequency of occurrence of a particular species in an area is one of the indications of its biodiversity. Homesteads in Bangladesh are delighted with an integrated production system and a stable ecosystem that maintain the fruit diversity as biological wealth. Distribution of different fruits in the household areas has been presented in Table 5. All of the households of studied coast consisted of 100% mango plants in all upazilas. Coconut occupied 100% in different households of four upazillas viz., Amtali, Bakergonj, Kalapara and Patuakhali Sadar except Dumki upazila which contained 91.67% and papaya contained 100% households of all upazilas except Kalapara. The least amount of major fruit species

was litchi fruits with a range of 20.00 to 51.67% followed by pineapple which ranged from 16.67 to 66.67% in the studied coast. Based on average of five upazilas, it was observed that mango had the highest distribution (100%) followed by papaya (98.67%), coconut (98.33%), banana (96.67%) and guava (95.00%), ant the lowest distribution by litchi (37.33%) and jujube (39.67%). Among the minor fruits, velvet apple was found in 100% households of Bakergonj, Dumki, Kalapara and Patuakhali Sadar upazila except Amtali. Seeded banana was also very much location specific carrying huge production of native species in this region consisting 100% households in three upazilas viz., Bakergonj, Kalapara and Patuakhali Sadar. Based on the average values over three districts, the maximum distribution was noticed in velvet apple (98.67%) which was closely followed by seeded banana (97.67%) and golden apple (97.67%), moderate was found in lime. The remaining minor fruits had the lower distribution and the minimum distribution was found in bullock's heart (18%). The present research results are supported by Rahman *et al.* (2009) who observed that mango and jujube were in 100% homesteads in Hatiya island followed by coconut (98.7%), guava (97.5%), betel nut (96.2%) and jackfruit (95%). Mannan *et al*. (2002) recorded coconut at 98.6% followed by mango at 96.72%, banana at 90.16%, jujube at 86.88% and date palm at 80.32% of homesteads in Noakhali coast. Islam *et al.* (2013) found that coconut possessed the highest distribution (100%) at Bhola and Patuakhali, and mango (100%) at Barguna coasts. Alam and Masum (2005) noted that coconut, guava, date palm and mango were cultivated more than 75% of the homesteads. Sarker (2016) observed from the survey of six upazilas that all of the households contained mango and guava whereas jackfruit and coconut were found in 5 upazilas.

Species richness (SR)

Fruit species richness at the homesteads of south central coast is presented in Table 6. All of the homesteads accommodated 8 to 9 major fruit species (21.93%) and 32-34 minor species (78.07%) were available in the homesteads of five upazilas and produced fruit in this coast. The highest number of major fruit population was found in Bakergonj (4407) followed by Amtali (4224) and the lowest number of major fruit species was found in households of Kalapara upazila (3623). Meanwhile, maximum number of minor fruit species were recorded in Dumki (2645) followed by Bakergonj (2625) and it was found minimum in the households of Kalapara (2254). In terms of number of species (major and minor fruits), Dumki and Patuakhali Sadar facilitated the highest number of different fruit species (43) followed by Bakergonj (41) in their households and the lowest number of fruit species (33) was in Kalapara upazila which agreed with the findings of Alam and Masum (2005), who recorded 34 fruit species in the Sandwip offshore island. Similar results were also observed by Islam *et al.* (2013) who identified 69 tree fruit species in three districts, namely Bhola, Borguna and Potuakhali, of which 31 were found in Bhola, 30 in Borguna and Patuakhali. Suresh *et al.* (2014) reported only 21 species of minor fruit yielding plants from India.

Table 5. Distribution of fruit species at the homestead areas of five upazilas under south central coast of Bangladesh

Sl. No.	Fruit species	Amtali	Bakergonj	Kalapara	Dumki	Patuakhali Sadar	Average
1.	Mango	100.00	100.00	100.00	100.00	100.00	100.00
2.	Banana	100.00	96.67	100.00	91.67	95.00	96.67
3.	Jackfruit	83.33	80.00	88.33	75.00	78.33	81.00
4.	Coconut	100.00	100.00	91.67	100.00	100.00	98.33
5.	Litchi	28.33	51.67	53.33	33.33	20.00	37.33
6.	Guava	91.67	100.00	100.00	83.33	100.00	95.00
7.	Papaya	100.00	100.00	100.00	93.33	100.00	98.67
8.	Jujubee	41.67	50.00	26.67	38.33	41.67	39.67
Sub-total		691.67	711.67	676.67	681.66	685	689.34
9.	Lime	100.00	100.00	33.33	83.33	100.00	83.33
10.	Lemon	25.00	16.67	25.00	26.67	33.33	25.33
11.	Seeded banana	96.67	100.00	100.00	91.67	100.00	97.67
12.	Dewa	75.00	41.67	50.00	50.00	66.67	56.67
13.	Golden apple	96.67	96.67	95.00	100.00	100.00	97.67
14.	Pomelo	25.00	26.67	41.67	55.00	41.67	38.00
15.	Wood apple	33.33	26.67	20.00	26.67	33.33	28.00
16.	Wax Jambu	25.00	75.00	58.33	45.00	58.33	52.33
17.	Sweet orange	20.00	20.00	33.33	33.33	51.67	31.67
18.	Sapota	25.00	41.67	33.33	50.00	30.00	36.00
19.	Aonla	33.33	20.00	25.00	25.00	36.67	28.00
20.	Tamarind	16.67	41.67	25.00	26.67	25.00	27.00
21.	Jamun	23.33	25.00	20.00	36.67	16.67	24.33
22.	Bael	33.33	58.33	50.00	60.00	70.00	54.33
23.	Cowa	25.00	41.67	66.67	56.67	33.33	44.67
24.	Custard apple	10.00	18.33	20.00	25.00	16.67	18.00
25.	Palmyra palm	36.67	33.33	66.67	66.67	83.33	57.33
26.	River ebony	70.00	91.67	83.33	58.33	91.67	79.00
27.	Date palm	96.67	100.00	91.67	100.00	100.00	97.67
28.	Velvet apple	93.33	100.00	100.00	100.00	100.00	98.67
29.	Star goosberry	33.33	25.00	16.67	20.00	20.00	23.00
	Total	993.33	1100.02	1055	1136.6	1208.34	1098.67

Note: The fruit pineapple was excluded from list of major fruits because it was not found in all upazilas. Ten minor fruits found in all upazilas were excluded from the list of minor fruits.

Table 6. Fruit species richness at the homesteads of south central coast in Bangladesh

Fruit Type	Bakergonj		Amtali		Kalapara		Dumki		Patuakhali Sadar		Total	
	Pop^n (no.)	Spp (no.)	Pop^n (no.)	Spp (no.)	Pop^n (no.)	Spp (no.)	Pop^n (no.)	Spp (no.)	Pop^n (no.)	Spp (no.)	Pop^n (no.)	Spp (no.)
Major	4407	9	4224	8	3623	9	4040	9	4014	8	20307 (62.56%)	43 (21.93%)
Minor	2625	32	2364	29	2254	24	2645	34	2267	34	12155 (37.44%)	153 (78.07%)
Total	7032	41	6588	37	5877	33	6684	43	6281	43	32462 (100%)	196 (100%)

Pop^n = population, spp. = species and no. = number

Species diversity (SD)

Species diversity of fruits cultivated in the homesteads of south central coast are presented in Table 7. As per Simpson (1949) index, the species diversity and variation were found among the different groups of species. The highest average genetic diversity of different major fruits was recorded in Bakergonj (0.825) followed by Dumki (0.809) and Amtali (0.800), whereas it was the lowest in Kalapara upazila (0.773). The maximum average genetic diversity of different minor fruits was recorded in Dumki (0.816) followed by Bakergonj (0.811) and the minimum from Kalapara (0.771). The average genetic diversity of minor fruits was found equal in both Amtoli (0.801) and Patuakhali Sadar (0.801). This result is supported by Sarker (2016) who reported that maximum diversity was found in banana (0.989) followed by mango (0.923), papaya (0.921) and coconut (0.901).

Table 7. Diversity of fruit species at the homesteads of south central coast in Bangladesh

Sl. No.	Fruit species	Amtoli	Bakergonj	Dumki	Kalapara	Patuakhali Sadar
Major Fruits						
1	Mango	0.785	0.790	0.832	0.794	0.799
2	Banana	0.804	0.777	0.824	0.792	0.803
3	Jackfruit	0.876	0.943	0.706	0.702	0.773
4	Coconut	0.755	0.831	0.837	0.758	0.820
5	Litchi	0.842	0.854	0.795	0.760	0.749
6	Guava	0.871	0.821	0.766	0.839	0.703
7	Papaya	0.779	0.856	0.814	0.764	0.786
8	Jujubee	0.779	0.802	0.854	0.771	0.794
Average		0.800	0.825	0.809	0.773	0.793

Sl. No.	Fruit species	Amtoli	Bakergonj	Dumki	Kalapara	Patuakhali Sadar
Minor Fruits						
9	Lime	0.789	0.685	0.930	0.837	0.761
10	Lemon	0.867	0.783	0.819	0.807	0.723
11	Seeded banana	0.787	0.769	0.814	0.806	0.824
12	Dewa	0.830	0.804	0.752	0.781	0.833
13	Golden apple	0.743	0.825	0.863	0.735	0.835
14	Pomelo	0.856	0.800	0.800	0.736	0.808
15	Stone apple	0.835	0.736	0.846	0.802	0.780
16	Wax Jambu	0.796	0.788	0.845	0.739	0.832
17	Sweet orange	0.880	0.870	0.769	0.806	0.676
18	Sapota	0.736	0.868	0.810	0.736	0.851
19	Aonla	0.784	0.796	0.855	0.816	0.749
20	Tamarind	0.870	0.846	0.827	0.625	0.832
21	Jamun	0.759	0.823	0.835	0.722	0.861
22	Wood apple	0.793	0.870	0.826	0.799	0.712
23	Cowa	0.817	0.882	0.686	0.758	0.856
24	Custard apple	0.803	0.761	0.831	0.775	0.831
25	Palmyra palm	0.880	0.870	0.750	0.771	0.729
26	River ebony	0.805	0.778	0.799	0.804	0.813
27	Velvet apple	0.819	0.779	0.837	0.753	0.813
28	Date palm	0.792	0.773	0.782	0.782	0.871
29	Star gooseberry	0.789	0.711	0.855	0.803	0.842
Average		0.811	0.801	0.816	0.771	0.801

Note: Pop^n = population. The fruit pineapple was excluded from list of major fruits because it was not found in all upazilas. Ten minor fruits not found in all upazilas were excluded from the list of minor fruits.

The results of Sarker (2016) also revealed that among the major fruits the highest genetic diversity estimated in Kalapara (0.935) upazila and it was lowest in Dumki (0.702). A good genetic diversity also exists in minor fruits spp. in the study areas.

Relative prevalence (RP) of the species

The relative prevalence of the fruit species was notable in the studied (300) homesteads (Table 8). Among the 40 species of both major and minor fruits, 29 (major-8 and minor-21) were common at all of the studied upazilas. The results revealed that, in respect of the relative prevalence, the most prevalent species was

mango followed by banana, coconut, velvet apple and seeded banana, whereas less common species were papaya, pineapple, lime, river ebony, date palm, lemon and golden apple. The present findings are in line with the findings of Sarker (2016), who opined that 36 species were common out of 57 in the studied upazilas and most prevalent species were found mango, banana, velvet apple, coconut and guava while less common species were papaya, pineapple, river ebony and monkey jack. Total 28329 fruit tress of both major and minor fruits of 29 fruits were recorded in the studied coast, where 19955 trees of 8 major fruits and 10322 trees of 21 minor fruits were identified. Meanwhile, the result revealed that most prevalent major fruit spp was banana (7047) followed by mango (53375) and among minor fruit spp, the most prevalent fruit sp was velvet apple (1949) followed by coconut (1800) but jamon (135) was the least prevalent fruit sp counted in the study. Similar results were recorded by Sarker (2016) where mango (5947) ranked top followed by banana (5059). In case of minor fruit population velvet apple (3798) ranked top and most prevalent ones but lemon (2) was the least one.

Table 8. Relative prevalence of fruit species at the homesteads of south central coast in Bangladesh

Sl. No.	Fruit species	Bakergonj	Amtali	Dumki	Kalapara	Patuakhali Sadar	Total
		Pop^n	Pop^n	Pop^n	Pop^n	Pop^n	Pop^n
Major Fruits							
1	Mango	1099	1149	899	1120	1073	5337
2	Banana	1464	1379	1242	1575	1388	7047
3	Jackfruit	282	117	277	54	215	945
4	Coconut	498	395	336	200	371	1800
5	Litchi	62	40	52	38	65	257
6	Guava	180	185	188	105	255	913
7	Papaya	306	157	177	188	278	1106
8	Jujubee	137	132	87	119	123	598
Sub- total		4308	4056	3782	3709	4100	19955
Minor Fruits							
9	Lime	208	132	56	102	187	685
10	Lemon	55	27	33	39	64	218
11	Seeded banana	207	286	336	348	278	1455
12	Dewa	65	32	47	50	62	256
13	Golden apple	187	125	177	165	125	779
14	Pomelo	42	35	53	70	55	255
15	Wood apple	55	32	35	43	55	220

Sl. No.	Fruit species	Bakergonj	Amtali	Dumki	Kalapara	Patuakhali Sadar	Total
		Pop^n	Pop^n	Pop^n	Pop^n	Pop^n	Pop^n
16	Wax Jambu	72	107	88	72	65	404
17	Sweet orange	26	30	56	47	75	234
18	Sapota	45	78	58	84	55	320
19	Aonla	88	57	68	77	92	382
20	Tamarind	25	40	35	43	48	191
21	Jamun	23	30	28	35	19	135
22	Bael	55	74	65	87	102	383
23	Cowa	34	55	76	55	42	262
24	Custard apple	18	25	51	55	53	202
25	Palmyra palm	55	65	70	75	66	331
26	River ebony	105	112	130	145	104	596
27	Velvet apple	280	504	525	310	330	1949
28	Date palm	188	153	145	187	175	848
29	Star goosberry	34	33	50	56	45	218
	Sub total	1867	2032	2182	2145	2097	10323
	Total	5895	5584	5439	5544	5867	28329

Note: Pop^n = population. The fruit pineapple was excluded from list of major fruits because it was not found in all upazilas. Ten minor fruits which were not found in all upazilas were excluded from the list of minor fruits.

Dominance rank (DR)

The mean dominance rank of the fruit species was determined pooling the entire set of data (Table 9). The mean dominance rank among all the studied fruits revealed that dominance rank (DR) of the banana population (1) ranked first followed by mango (2), velvet apple (3) and coconut (4) while jamun (27) was at the bottom line of ranked order.

Table 9. Dominance rank of fruit species at the homesteads of south central coast in Bangladesh

Sl. No.	Fruits species	Amtali	Bakergonj	Dumki	Kalapara	Patuakhali Sadar	Total
		Pop^n	Pop^n	Pop^n	Pop^n	Pop^n	Pop^n
1	Mango	2	2	2	2	2	2
2	Banana	1	1	1	1	1	1
3	Jackfruit	11	5	5	20	6	7
4	Coconut	3	3	6	5	3	4

Sl. No.	Fruits species	Amtali	Bakergonj	Dumki	Kalapara	Patuakhali Sadar	Total
		Pop^n	Pop^n	Pop^n	Pop^n	Pop^n	Pop^n
5	Litchi	19	17	20	25	15	20
6	Guava	6	11	7	11	5	8
7	Papaya	7	4	8	6	4	6
8	Jujubee	9	12	12	10	10	12
9	Lime	9	7	18	12	7	11
10	Lemon	24	18	25	24	16	25
11	Seeded banana	5	8	4	3	4	5
12	Dewa	22	16	23	21	17	21
13	Golden apple	10	10	8	8	9	9
14	Pomelo	20	20	19	17	18	22
15	Wood apple	22	18	24	23	18	24
16	Wax Jambu	13	15	11	16	15	14
17	Sweet orange	23	22	18	22	13	23
18	Sapota	14	19	17	13	18	18
19	Aonla	17	14	15	14	12	16
20	Tamarind	19	23	24	23	20	26
21	Jamun	23	24	26	26	23	27
22	Bael	15	18	16	12	12	15
23	Cowa	18	21	13	19	22	19
24	Custard apple	25	25	21	19	19	25
25	Palmyra palm	16	18	14	15	14	17
26	River ebony	12	13	10	9	11	13
27	Velvet apple	4	6	3	4	4	3
28	Date palm	8	9	9	7	8	10
29	Star goosberry	21	21	22	18	21	24

Note: Pop^n = population. The fruit pineapple was excluded from list of major fruits because it was not found in all upazillas. Ten minor fruits which were not found in all upazillas were excluded from the list of minor fruits.

Among the minor fruits, velvet apple ranked top (3) followed by seeded banana (5) while bullock's heart, tamarind, jamun ranked low. These results correlate with

the findings of Sarker (2016) who opined that mango (1) ranked top followed by banana (seedless) (2), coconut (3) and velvet apple (5) and jackfruit and guava lower at the population level.

Conclusion

The identification of the most prevalent and dominant fruit species was a significant finding of the study. Only a fewer number of fruit species such as mango, coconut, banana of both seedless and seeded, velvet apple and golden apple were identified in homesteads of south central coastal regions of Bangladesh. In addition of land improvement, homestead forestry ensures biodiversity conservation, environmental sustainability and economic security. Homesteads of interior coastal regions were found comparatively rich in diverse fruit species than those of exposed coasts. This diversity of homestead fruits could provide a prime opportunity for the inhabitants of the studied coast. A comprehensive homestead space planning, proper scientific management of fruit plants using diversified fruits of both major and minor cultivars are needed to promote homestead plant diversity and their productivity in central coast. As a result, a policy guideline is to be developed for production, distribution and plantation of fruit species which thrive best in the coastal region to enrich plant diversity of this region. Government should launch a program for conservation of homestead plant biodiversity at local and regional levels.

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