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Status of juice and gur production from *Tal* Palm (*Borassus flabellifer*) based homestead agroforestry in southern Bangladesh

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ABSTRACT

The study was carried out to study age-gradation, production, marketing and income from the sale of palm products with special reference to homestead of Barguna district. A total of 100 homesteads (4 from each village) were interviewed by using a pre-tested questionnaire to collect data. From each village and the farmers were interviewed and asked about their *tal* trees, their management, tapping, yields, processing and marketing the produce and prices. The annual production of *tal* at six upazilas of the district is about 5,996 metric tons with 25.67 metric tons of *tal* and 50 metrics of juice is produced in each hectare. Sixty percent of the trees in the selected villages grown on *ail* (agriculture land divider) or roadsides, 14% trees were distributed on homesteads and 15% on pond banks. Farmers said that *tal* generally starts fruiting at age 14-15 years, but productivity declines after 60 years. Trees aged 30-45 years produce the most juice and fruit. Farmers in the study area had *tal* palm of different age-classes, with the highest number of individuals (39%) in the 0-14-year age-class. As the middle-aged trees (30^4 years old) produce most juice and *tal* annually, the annual yield in the near future depends on the number of middle-aged trees in the area. The highest frequency of individuals in the lowest age-class (39%) indicates that there has been continuous regeneration to sustain the yield of *tal* palms in the study area. The average rate of juice production per tree in the study area for *taulla* and *jaudda* was 956 and 448 kg, respectively. *Taulla* was yielded almost twice as much as *jaudda*. Trees of the middle age class (30-44 years and 45-59) of both sexes produce the most juice. The production of fresh (gur, juice, tal candy) and dry product (fuel wood, building raw material, saw dust) in local market, city and abroad are average 0.9, 0.312,0.162,0.37,1.634 and 1.006 (Ton) respectively. The mean gur production per season across the household categories was 545 kg. The income from palm products increased with the increase in land holding size. Average annual income from the sale of *tal* products varied from Tk. 45,000 to Tk. 1,50,000 per household in the different household categories; mean Tk. 64,000. More than 85% of the income came from the sale of gur. Income per tree irrespective of sex was about Tk. 4000 per season. Considerable differences between the households in strategies for marketing and selling of palm products were encountered. Indigenous techniques in tapping and *gur* processing, and farmers experience in managing palm were applied. The study found that the employment and income generated from the traditional *tal* palm husbandry plays a vital role in the rural economy—especially among the poor. There it is recommend increasing the cultivation of *tal* pals in other parts of Bangladesh to increase the livelihood throughout income generation.

INTRODUCTION

Tal (*Borassus flabellifer* linn.: Arecaceae) is a tree with a stout, straight, unbranched cylindrical trunk having short internodes covered with leaf-scars and ending at the top in crown of large leaves closely packed together. The tall plant can attain the height of 25-30 m. Trunk can be 1 meter across. Its original home is South and Southeast Asia. It is found in rural areas, on pondside and roadside in Bangladesh. *Tal palm* is considered a valuable economic palm of rural Bangladesh. The plant serves various ecological, medicinal, economical and sociological benefits to the society. The plant has a very close connection with the rural livelihood and cottage and agro based

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industries of Bangladesh economy. The utility of the plant could be widely classified into Non-edible, edible and value addition-based uses (Sadebeck 1899).

In Bangladesh, the palm tree it is also called Tal and in locality like village of Barguna district called Tal Gush and before ripen stage called *Pani Tal* (Jerry, 2018). It is a perennial plant that grows up to 30-35 meters and has a maximum life span of 100 years and starts yield from 15 years in the area with plenty of water source and within 25 years in the arid regions (Veilmuthu 2020). Despite the Palmyra trees are being destroyed like never before. When fertile agricultural lands or sand dunes are being traded by land sharks and real estate brokers, the *tal* palm trees in these parcels of land are also sacrificed. We are witnessing the tragedy of the *tal* palm trees being cut to be used as fuel for brick kilns. When we are facing heating of the earth and depletion of ground water resources, we must pay attention to one of our hopes, bestowed by nature - the palm trees.

Tal has widest distribution across the country and its undeniable contribution in rural and cottage industries and the impact on rural livelihood. It is a plant that can grow in adverse and diverse agroclimatic conditions ranging from seashores, plains, valleys and hills up to an altitude of 762 meters above sea level. *Tal* has been in touch with Bangladesh culture since time immemorial. The ancient sages, rishis and scholars used the matured leaves of palmyra as writing materials to engrave ancient scriptures to pass on their acquired knowledge and wisdom over more than 2500 years.

This palm has many uses. In Bangladesh, it is important for the juice which is used for the manufacture of concentrated semi-solid juice (gur). The gur is a traditional sweetener used in cakes, sweets and a host of other foodstuffs, including oral saline. Beside gur, the palm provides nutritious edible fruits both green and ripe. The sweet sap from the inflorescence is a source of crude sugar, which, when fermented, forms toddy, a popular beverage which may be distilled to produce palm wine (a form of brandy). The peeled seedlings are edible and are a source of starch; the terminal bud (known as palm cabbage) is also edible and highly valued. The largeseeds, when immature, contain jelly-like kernels that are pleasant to taste and exceedingly refreshing; they may be canned in thin syrup. Gola (the juice of ripen fruits) is usually used for making different types of pastry for household consumption. The leaves are used as paper or woven for making matting, hand fans, baskets etc.; older leaves are used for fencing or as a source of fibre. The trunk is used for timber. Various parts of the plant have medicinal properties (Blatter 1978, CISRO 1985, Morton 1988). The root is considered cooling and restorative. Juice of the young root is used in cases of gastric catarrh and to check hiccups. A decoction of the bark, with a little salt added, is a good astringent for strengthening the gums and the teeth (Caius 1986). Apart from these commercial and local uses, palms are extensively planted for its amenity values and as indoor plants when a tropical effect is desired. This palm provides a handsome income to the land owners as well as to the tenants (Abedin & Quddus 1991). Besides income from juice, the tree provides fuel from the fronds cut off before tapping, and generates employment and income for artisans in making canoes and timber for housing, etc and in the marketing of palm products (e.g., gur. fruits).

Recently, the commercialization potential of palm sugar as an important alternate sweetener has become an attractive prospect. However, these products are not currently popular. The price of palm sugar is often decided by its quality, as well as by its colour, flavour, and texture. *Tal* provides the nectar and pollen source which is essential for the honey production as well as brood development in the colonies of all honey producing bees. This tree can be utilized in the landscape as important bee flora besides its other important utility. The *tal* palm based agro-industries also plays a considerable role in environmental preservation. Palm gur or karupatti is the best alternative to white sugar and was used as the major sweetener by our forefathers. The white sugar industry causes an extensive level of pollution and natural resources exploitation. Canes need a lot of water to cultivate, high level of fertilizers and agro-chemicals, transport intensive leading to greater GHG emission and releases huge amount of effluents from processing into the

environment. While gur production uses traditional methods for processing, molding and packing which is not chemical-intensive. Moreover, the processing areas are installed near the Palm fields and the products are sold in nearby areas using bus or cycle or even in the village itself, thus the GHG emission sue to transportation is also very much low.

Scientists quote that this devastation could have been controlled in the coastal districts like Barguna if the natural barrier *tal* tree had not been cut. Scientific evidence state that many of the strong and sturdy palmyras stood strong and tall even withstanding Tsunami in 2004, while many age old trees and buildings were flattened to the ground. Which intrigued Bangladesh government to take emergency measures to replant a large number of felled plants as a natural barrier? This plant even has the potential to block and reduce the speed of the storms and hurricanes and could also prevent soil erosion to a greater extent. The present study was, therefore, carried out to assess the production of juice and fruits on different sites and age-classes, and to gather indigenous knowledge about tapping, processing of products, the management of the palm and marketing of its products. Finally, an attempt was undertaken to evaluate the contributions of *tal* palm to the income of rural farmers.

MATERIALS AND METHODS

Study area

The study was carried out in different upazillas (Amtali, Taltali, Pathorghata, Betagi, Bamna) of Barguna district in south western Bangladesh. The land of the district is composed of alluvial soil of the Meghna basin and of a number of small char lands. The soil is saline and well supplied with potash and phosphate; salt efflorescence occurs during the dry period. The pH of the soils is neutral to slightly alkaline (Hussain 1992). Average annual rainfall is about 2,000 mm and the average monthly maximum temperature ranges from 12 to 33“C.

Sampling

The present study uses both primary and secondary data. The primary data have been collected from the farmers cultivating *tal* palm and their problems involved in the *tal* palm marketing in the Barguna coastal region. The size of the sample was 100 farmers. In each village studied, a preliminary socio-economic survey was conducted before dividing farmers into five categories, based on the size of their land holding- landless (up to 0.20 ha total land); marginal (0.21-0.50 ha); small (0.51-1.0 ha); medium (1.01-2.0 ha) and large (>2.0 ha)(BBS 2011).

Data collection

The primary data for the study were collected through the semi-structure questionnaire. The researcher met the formers and collected the required data from them. The researcher interviewed 100 farmers in Barguna district, the respondents those who have given complete information were chosen for the study. The respondents those who given incomplete information were not included in the study. Secondary data were collected from different sources according to the requirement of the present study. Secondary information were collected from Bangladesh Bureau of Statistics (BBS), District and Upazilla Agricultural Extension Office, Department of Agro forestry and PSTU, previous research, survey report, and Department of Agricultural Extension and Rural development.

Data analysis

A variable file was created on SPSS software (Statistical Package for the Social Sciences). The statistical packages SPSS 16 and SAS version 9.3 was applied for data analysis. P-value of 5% was considered to be statistically significant. Percentages, means and standard deviations (SD) were calculated for all quantitative parameters. Chi-square test was performed to determine if there was a significant relationship between two nominal (categorical) variables.

Technique for tapping palms

On male trees, the flowering shoots, which are finger-like growths on the main stalk, are bruised by rubbing them between flat, wooden sticks. After a couple of days, they are scraped with a tapping knife; then their tips are pared back daily.

The secretion (juice) begins to ooze out within a week after bruising and then several 'fingers' are tied together and bent into an earthen pot to catch the drip. The inflorescence of female trees are tapped when the fruits are still very small, and only their very tips are squeezed and beaten. They are then pared as in the case of male trees. The gachi climb twice a day, once in the morning and once in the evening. In the morning, the gachi goes up with his spare pot for bringing down the sweet liquid. He empties the juice into the collecting pot, dresses the cut by paring off a slice, limes (locally manufactured by burning the shells of molluscs) the pot and replaces it. Liming is done to prevent the juice from rapidly becoming sour. In the evening, the juice is not collected since the quantity collected during the day is small, but the cut is dressed and the pot is given a shake. Since the trees are tall, a climbing ladder is built by placing a couple of bamboos alongside the trunk to assist in climbing.

Juice collection technique

The inflorescences of the male and female palms are bound, beaten and then sliced for approximately 5 to 8 consecutive days before juice can be collected. The tapping process is repeated every 2-3 days during the production season. The inflorescences can also be preserved for later use after being prepared according to the above-mentioned procedure. A pair of rounded wooden or bamboo mallets are used for female inflorescences and flat wooden tongs are used for the male inflorescences. The small fruits 9 around the female inflorescences should not be crushed during the preparation. The juice is channeled into a bamboo or plastic collector. The bamboo collector is called an *Ampong* and has a diameter of 10-15 cm, a height of about 30-40 cm, and can contain 2-4 kg of juice. For each tree an average of 4-6 collectors are used according to the number of inflorescences coming up at the same time. The collection is done twice daily (morning and afternoon) in order to limit the exposure of juice to contamination by yeast and other fermenting micro-organisms. Farmers believe that pruning negatively affects the juice production.

Climbing technique

Cambodian tappers use long bamboos poles with the stumpy remnants of leaf bases at the nodes which serve as rudimentary steps for climbing. These are riveted permanently to the base of the trunk. When palm trees are close to each other, one to two long bamboo stairs are used to keep the investments down and to save time for climbing. Most tappers collect juice only once daily (in the morning), because according to their experience during the day time the temperature is too high for the palm to produce quantities of juice. Tappers are capable of tapping more than 20 palm trees twice a day when one assistant is available at the base of the trunk.

Gur processing

Gur making is one of the oldest cottage industries of the country generating employment for the local people. Storage of fresh juice at local level is not possible as fermentation occurs rapidly—even if delayed by the addition of chemicals. Therefore, processing the juice into gur begins immediately. After collecting the juice from all the tapped trees, the gachi brings it home. It is strained into the boiling pan (tafal), leaving behind a sediment of lime. Some 15-20 minutes after the commencement of boiling, a white scum rises to the surface; this is skimmed off and a few castor beans are crushed and put in to reduce frothing. When the colour of the boiling juice becomes dark brown, it is poured off into a comparatively small aluminum or earthen pot (patil). After a further two or three hours, the fire is lowered, the contents of the patil stirred and a small quantity of syrup poured into cold water. If it hardens quickly, it is considered to have reached the desired consistency. The gur thus prepared, is a dark brown, condensed product with a characteristic flavour. Farmers of the medium and large landholding categories usually process juice into gur daily. Other farmers accumulate and store partially boiled juice for three or four days, before the final boiling.

RESULTS AND DISCUSSION

Distribution of *tal* palm

Tal trees were found over the entire study area on all the five different sites identified by farmers as

suited to planted *tal* trees. 60% of trees in the sampled villages were found to occur on ail or roadsides (Table 5). Among others, 14% trees were distributed on homesteads and 15% on pond banks. This pattern matches the relative extent of these sites. Not surprisingly, the mean number of trees per household increased with the increase in landholdings (Table 1).

Table 1: Distribution of *tal* palms on the rural landscape in the study area.

Household category	Homestead	Pond bank	Canal	Bank	Road side	Mean household
Land less	55	12	22	30	102	11.05
Marginal	28	33	100	14	60	13.8
Small	11	14	62	39	90	12.2
Medium	36	65	70	20	74	14.8
Large	70	72	166	11	68	17.6
Percentage	14	15	35	11	25	
Total	200	196	420	114	394	1324
Mean	40	39	84	23	79	13.24

Table 2: Distribution of *tal* palm in different age-classes.

Household category	Age-classes (years)					
	0-14	15-29	30-44	45-59	>60	Mean household
Land less	120	39	55	28	9	48.6
Marginal	105	56	40	25	8	50.2
Small	90	36	35	37	20	40.8
Medium	75	58	70	35	25	55.6
Large	100	50	78	76	65	70.4
Total	490	239	278	201	127	
Percentage	39	19	20	13	9	
Mean No. of trees	98	48	56	40	25	

Frequency distribution of *tal* palms

Farmers declared that *tal* generally start fruiting at age 14-15 years, but productivity declines after 60 years. They also reported that trees aged 30-45 years produce the most juice and fruit. Farmers in the study area had *tal* palm of different age-classes (Table 2), with the highest number of individuals (39%) in the 0-14-year age-class. The number of over-mature (more than 60 years old) trees was less than the numbers in the younger and middle-aged trees due to the felling of over-mature trees. When trees become over-mature, usually at age of more than 60 years, farmers fell them for sale or home use. As the middle-aged trees (30 years old) produce most juice and *tal* annually (Table 2), the annual yield in the near future depends on the number of middle-aged trees in the area. Frequencies of individuals in the middle-aged classes (1529, 30-44 and 45-59) were 52 percent (19, 20 and 13% respectively). The highest frequency of individuals in the lowest age-class (39%) indicates that there has been continuous regeneration to sustain the yield of *tal* palms in the study area.

Production of *tal* and juice

The *tal* palm usually starts flowering at an age of fifteen-seventeen years. Male and female inflorescences are borne on different plants. The male tree is locally known as jaudda and the female as taidla. Jaudda does not bear fruit (*tal*) and yields only juice; while taulla is utilized for both fruit and juice. The tree flowers from February to March and fruits ripen from July to August. According to farmers, yields of *tal* (fruit) vary considerably with tree age and site quality. On an average, each tree produces 15-20 pir (bunch) and a pir gives 15-22 *tal* (Table 3). Younger and over-matured trees produce fewer *tal* than the middle-aged trees. Farmers believe that trees near water and road side where wind flow as much as high produce bigger and more fruits than those on drier sites, hence the choice of pond bunds and canal banks for planting *tal*. Tapping of the palm for juice normally begins from March and lasts up to the month of May and sometimes into June if the monsoon is late. Both taulla and jaudda produces juice (ros). The men who tap ros are locally known as gachi and, generally, are the male member of poor farmers. According to farmers, the yield of juice varies considerably with tree age, sex, site condition and tapping skill. The average rate of juice production per tree in the study area for taulla and jaudda was 956 and 448 kg, respectively (Table 3), taulla yielding almost twice as much as jaudda. In both sexes, trees of the middle age class (30-44 years) and (45-59) both produce the most juice per season. Trees growing close to water yield more juice than those growing on other sites. The juice of the trees growing on canal banks is very sweet and considered very suitable for making gur. The juice of jaudda is said to be sweeter than that of the taulla. Farmers emphasise the importance of a gachi"% tapping skill and sharpness of the tapping tool. By using a sharp tapping tool (gachi's dao), a skilled gachi can slice the stalk very thinly and uniformly, increasing the duration of juice production. They believe that the yield of juice and duration of production could be increased by using the best tapping techniques and tools. All the juice produced in the study area is used for making gur by taking 3-5 kg of juice to produce 2-2.5 kg of gur.

Table 3: Average production of juice per season by male and female palms in different age-classes

	Average juice production per season (Kg)		
Age-Class (year)	Per male	Per female	Average Tal production per
0-14	0	0	0
15-29	480	1000	170
30-44	700	1422	290
45-59	350	950	290
>60	260	450	130
Mean	448	956	220

Marketing of products

Fruits (*tal*), both green and ripe, gur, fuel wood and juice are the main products for the market. When the fruit is half-ripe (in April-May), the seeds consist of soft, sweet, moist, gelatinous pulp. Farmers sell these half-ripe fruit as green *tal*. These *tal* are cut from the trees and stripped of their outer skin; the shell is then perforated with the finger, and the soft kernel sucked up. When ripe (June-August), the fruits vary in colour from a light gold at the end which is attached to the spadix, to brown or nearly black at the other. The soft, yellow, pulpy tissue under the outer skin of ripe fruits is squeezed out by hand to separate its juice (gola).The average prices of each green and ripe *tal* in the study villages were Tk. 8 and Tk.15, respectively, whereas in town/city areas, the average price rose to Tk.4.00 and Tk.5.00, respectively. The price of gur varies from Tk.100 to Tk. 120 per kg. In the study area the production of fresh (gur, juice, *tal* candy) and dry product

(fuel wood, building raw material, saw dust) in local market, city and abroad are average 0.9, 0.312,0.162,0.37,1.634 and 1.006 (Ton) respectively (Table 4). It implies that the study area's farmer are owned maximum facility by the selling of *tal* palm fresh and dry product and also selling handicraft from palm tree. According to the DAE Barguna district guide line 2020, the production of perennial tree species like palm tree have the great demand to selling fresh and dry product and also handicraft product to city and abroad. Arifuzimman (2013) shows that the demand of dry product of *tal* palm have a great demand and its value reach in superior level day by day. He also shows that a landless and a marginal family can obtain maximum demand through *tal* cultivation. By this cultivation a farmer can earn maximum opportunity that cannot possible other perennial species it's a source of series of income like green *tal*, ripen *tal*, juice, gur, dry wood, fuel wood building materials and other product.

Table 4: Average production of fresh and dry product and handicraft

Land holding category	Selling fresh product (gur, juice, *tal* candy) (Ton)			Selling dry product (fuel wood, building raw material, saw dust (Ton)			Selling handicraft from palm tree (Tk.)		
	Local market	City	Abroad	Local market	City	Abroad	Local market	City	Abroad
Land less	0.25	0.10	0.01	0.33	1.25	0.75	2500	3000	-
Marginal	0.75	0.12	0.10	0.21	1.22	0.66	3000	4500	-
Small	0.95	0.22	0.12	0.36	1.40	0.95	3200	5200	-
Medium	1.2	0.50	0.25	0.45	1.80	1.23	4000	5500	3500
Large	1.35	0.62	0.33	0.50	2.5	1.44	4500	6000	5000
Total	4.5	1.56	0.81	1.85	8.17	5.03	17200	24200	8500
Mean	0.9	0.312	0.162	0.37	1.634	1.006	3440	4840	4250

Table 5: Distribution of *tal* based on the farming type of the vegetation

Land holding category	Farming type of the vegetation (%)				
	Fruit				
	Tal	Other	Total	Vegetable	Mixed
Land less	3	5	8	12	80
Marginal	4	7	11	17	72
Small	5.5	7.5	13	21	66
Medium	8	9	17	28	55
Large	8.5	10	18.5	31	50.5
Total	29	38.5	67.5	109	323.5
Mean	5.8	7.7	13.5	21.8	64.7

Farming type

Farming type shows the distribution of respondents based on the opinion on the type of vegetation in which the *tal* being cultivated. It is found that 13.5% of the respondents expressed that among the vegetation *tal* was cultivated under five household categories and agriculture (vegetable and mixed). Large land holding farmers cultivated *tal* 8.5% and landless cultivated 3%.

Production and income from palm products

The average number of fruiting palms varied from 6 to 14 (Table 5). Farmers reported that they kept 50% of their female trees for the production of green *tal*, with 30 % for juice and 20 % for ripe *tal* production. Green *tal* is in great demand and provides cash at the beginning of the season. The production period runs from April-August. The selection of trees for the production of the different products is based on the experience of which trees are best suited. The male trees are entirely used for the production of juice as they do not bear fruit. All the juice is used for making gur. Farmers concentrate their efforts on gur production as it is the most profitable product. Irrespective of sex, each tree yields about 150 kg gur per season. The mean gur production per season across the household categories was found 545 kg. Farmers also reported that they only consumed only a very small portion of their production at home. The income from palm products increased with the increase in land holding size. Average annual income from the sale of *tal* products varied from Tk. 45,000 to Tk. 1,50,000 per household in the different household categories; mean Tk. 64,000. {Tk 85.00= 1US$} (Table 6). More than 85% of the income came from the sale of gur. Income per tree irrespective of sex was about Tk. 4000 per season.

Table 6: Average number of palms owned, harvestable palm, production of different products and income from the sale of palm products per year in the study area. [* Tk. 85.00= 1US$]

Land holding category	Average no. of palm owned	Average no. of harvestable palm		Total of Production			Sale value (Tk. *)			
		Male	Female	Green *tal* (No.) 1	Ripen *tal* (No.) 2	Gur (Kg) 3	1@TK. 8/*tal*	2@TK. 15/*tal*	3 @Tk. 100.00/ kg	Total income per season per household
Land less	11.05	1.5	5.5	430	180	385	3440	2700	38500	44640
Marginal	13.8	1.4	5.0	550	210	465	4400	3150	46500	54050
Small	12.2	1.2	5.7	525	200	398	4200	3000	39800	47000
Medium	14.8	1.8	8.0	700	275	562	5600	4125	56200	65925
Large	17.6	5.0	11.0	1000	360	915	8000	5400	91500	104900

DISCUSSION

Planting trees in homestead and retaining naturally occurring trees in crop fields is part of the traditional farming systems of rural Bangladesh. Farmers raise trees in their homesteads, on the banks of their ponds, canal banks, roadsides and ail by planting wildings. Generally, homesteads, pond banks and ail are owned by the farmers and the owners have rights over both trees and land. 61% m/ trees growing in homesteads and on pond banks and ail were owned by farmers. Farmers had rights to the trees (40%) growing along roadsides and canal banks even though they did not have tenure on these lands that are government property. The customary law of the country provides for access to trees growing on government land. *Tal* palms grow erect and are sufficiently tall after 10 years to have little effect on the growth of crops underneath (Chowdhury 1995). Yield reduction of agricultural crops was found to be insignificant beyond 2-3 m distance from the tree (Roy & Islam 1997). The distribution of *tal* palm throughout the rural landscape suggests that it has a wide ecological amplitude with a capacity to grow on biotically disturbed sites such as roadsides or canal banks that, in addition, are normally used for grazing. Maintaining a 'normal' set of age-classes is important for sustainable production. If the trees in a particular area consist entirely of mature and overmature trees, the trees will eventually go out of production. Younger age-classes are needed to replace over-mature trees over time, so an appropriate proportion of individuals of younger age-classes is required to make annual production sustainable (Kamaluddin

et al. 1998). Data on the age-class distribution in the sample villages indicate that the stock of trees (mostly planted) is balanced and sufficient to maintain the current rate of production. The southwestern region of Bangladesh is affected by cyclones almost every year. Farmers report that the number of trees in the middle age-classes was smaller than in the youngest age class because of cyclonic damage. Farmers believe that middle-aged trees are vigorous, healthy and the most productive of fruits and juice, so old trees are regularly removed. Farmers reported that taulla yields 50% more juice than jaudda. Rashid (1991) also mentioned a similar observation in southern region of Bangladesh. Tapping male tree for the extraction of juice is mostly practised in south western region of the country (Rashid 1991), but this practice could be extended to other parts of the country. The traditional agroforestry systems generate income not only for the land owner and the tenants but also, through employment and sales, income for other poorer people as well (Abedin & Quddus 1991). Farmers in the study area mostly depended on subsistence agriculture for their livelihood; a few being small trader as well. The income from the sale of palm products provides additional earnings to farmers. Abedin & Quddus (1991) mentioned that beside the income from juice and *tal*, about one mound (37.38 kg) of fuel (dry and fresh leaves) can be obtained from each tree during tapping. Though this fuel is generally used for household consumption, it would cost Tk. 100.00 to Tk. 150.00 per tree if sold in the market.

Hand-fans prepared from the palm leaves provide some income to poor families. Four to five fans can be prepared from one Borassus leaf and sold for Tk. 15.00 to 20.00 each, but for decorative one the price ri.ses to Tk. 30.00 or 50.00. Petty traders also benefit from marketing the hand-fans during the summer months. A huge number to tapping jars are used annually; hence the practice of tapping has a positive impact on the local pottery industry and trade. When mature, the trees are cut and used as construction material and for making canoes. Two canoes can be made from one full-grown tree and each canoe can be sold at Tk. 1500.00 (Abedin & Quddus 1991). In a Borassus economy in Indonesia, pigs are a prime means of converting palm products to protein. In eastern Indonesia, pigs are fed fresh sap throughout most of the tapping season and therefore fatten during the dry season while other livestock lose weight (Fox, 1977). Animal feeding systems based on palm/syrup favour stall feeding instead of grazing or scavenging. This protects livestock within an intensive farming system. Tapping palm trees also offer an easy source of sugar for bees which harvest all the wasted sugar. Honey production is therefore increased where palm trees are tapped (Fox, 1977). The potential of feeding goats and cows with palm sap, as the main source of energy for milk and meat production deserves investigation.

Palmyra production and processing industry ensure food security, livelihood security and ecological security of the country. However, the population of this *tal* is been on declining rate due to globalization, industrialization, urbanization, habilitation etc. Despite various benefits and utility these trees are destroyed like never before and never taken care of and were always taken for granted. Real estate industry also plays a major role in the eradication of these natures gift. Palmyra trees are unique in providing us with food and non-food products, suitable for the typical climate prevalent in Barguna. It provides an opportunity for the employment and welfare of society. Younger and younger trees are being cut and the growth of the trees is stunted and weakened because of excessive tapping or cutting of leaves. Efforts should be aimed at planting a greater number of trees, protecting existing trees, promote selfhelp groups for palmyra farmers or tappers, promote FPO based approach, encourage more research on developing advanced varieties, production and processing technologies and cultivation of more plant around water bodies to improve the underground water table. The government should focus on the living and health conditions of the tappers and their families. Line departments must take initiatives to create awareness among the people about the health benefits of Palmyra products. The yield of juice and brix varied considerably tree by tree, according to the sex of the tree and between individual farmers. Some trees produced up to 20-25 kg of juice per tree per day, but the other trees produce an average of 4-6 kg within a similar microclimate. The scarcity and high price of fire

wood at the present time greatly influences the cost of the sugar production from sugar palm juice. This critical situation will make sugar production from sugar palm juice unprofitable. However, it continues to be a valuable product for people who still have access to free fire wood. Growing this palm does not involve much labour, since it needs almost no maintenance. The tree is able to grow on almost any type of soil, and usually does not suffer from any serious pests or diseases. The number of trees that a farmer owned determined his income from *tal* palm products and. naturally, this was a function of the size of the land holding. Replacement of over-aged, or low yielding trees with new plantings has ensured a continuous and sustained yield and a sustained annual income. Juice extraction and gur making is usually done by a special group of technicians, who are usually poor farmers. Collection and marketing of the fruit also generates employment. These and other employment opportunities and income generating functions of the traditional *tal* palm husbandry play a vital role in the rural economy, ensuring the continuity of the industry. It is to be mentioned here that during last devastating Sidr cyclone and post cyclone period there was no relief support for couple of days in Sidr affected areas (including Barguna). At that time the affected people survived only by consuming different homestead plants. So, proper attention should be given for expansion and sustainable management of homestead plants in the whole coastal regions. Socio-economic development especially the betterment of livelihood in coastal areas has also been achieved by proper utilizing homestead plants. The role of plants is beyond of question as plants are the integral part of nature as well as human society. Improved homestead would enable people to become less vulnerable to scarcities and rising price of the forest products. Moreover, plants grown on the homesteads could provide a source of income both to individual and communities.

Prospects of *tal* palm products

We know Palmyra palm and date palm trees and its fruits and juice have different uses. In rural marshy areas dinghy boat is necessary thing in rainy seasons. Fishermen use it in marshy areas and different water bodies for fishing. Dinghy boat is widely used in the districts of greater Faridpur, Jashore, Bagerhat, Narail, Natore and haor (large water body) areas of north-eastern part of Bangladesh. Most of the cases dinghy boats are mainly made of Palmyra palm tree trunk. Furthermore, Palmyra tree leaves are also the material of hand-fan. In the summer this sort of hand-fan has got a good popularity. Hand-fan is also the important component of our rural culture. Palm tree trunk is also used as pillar for house construction in countryside and it is generally very strong and durable. Palmyra palm tree is very much supporting for ecological balance in our country. Nowadays, it is very rare to get weaver birds in the countryside. But we get this kind of birds if there is any Palmyra palm tree. Palmyra palm is very much fond of by weaver birds. Weaver birds generally make their nests in leaves of Palmyra trees. Even the vultures consider Palmyra palm tree is the support of them. Usually they take rest on the leaves of Palmyra trees. In this way Palmyra palm is maintaining the balance of ecology of our country. Moreover, it can also reduce the damages of the lightning. For this reason government is considering to plant Palmyra palm in large scale throughout the country. Juices and sauces extracted from ripened palm fruits are also very good items for producing cakes and different table items used as dessert. Palm juice extracted from palm trees is widely used for producing Gur and Patali (plated like gur). And it is used in the sweet shop for producing different kinds of sweet items in rural Bangladesh. Even palm fruit juice/sauces with puffed rice is very good table item for entreating guests at district and upazila towns and in rural Bangladesh.

- Problems of *tal* palm production
- From our primary data, we got the following problems in cultivation of *tal* palm
- Unavailability of good quality seed
- Lack of adequate funds
- Unavailability of quality fertilizers in time
- Disease infection
- Labor crisis
- Lack of storage facilities
- Low prices at peak harvest period
- High cold storage charge
- No purchase by the government

CONCLUSION

The study observed that most of the plants in homestead of this region are not planted in a planned way. Many species grow voluntarily without any management. There is enough scope to improve productivity in the homestead by selecting plant species in a systemic composition planting in planned ways and improving management practices. Therefore, there is a great opportunity to improve the prevailing homestead agroforestry practices in the selected area by using agroforestry technologies. *Tal* is a valuable palm of rural Bangladesh whose potential has not been fully exploited throughout its range in Bangladesh. *Tal* palm cultivation is an age-old practice in rural Bangladesh. So it is very important to develop a modern technology to develop *tal* farmer and utilization and management strategy which should be implemented through Agricultural Extension Department for the sustainable development of homestead biodiversity in Bangladesh.

RECOMMENDATION

In order to improve prevailing socioeconomic condition of the studied farmer, comprehensive initiatives are needed to be taken by the government organizations (GOs), non-government organizations (NGOs), development agencies, as well as rural society. So, the high-ups of the government, particularly in the agriculture ministry should underscore potentiality of these fruits and juice of the trees and in this way this indigenous fruits and trees have great potential to contribute to our economy. By considering the overall aspect of this present study the following points can be recommended:

- Increasing awareness, facilitating need-based training and improving and encouraging of homestead plantings become a vital activity as such activities already common and practiced by most of farmers
- It is very important to develop a modern technology to develop *tal* farmer and utilization and management strategy which should be implemented through Agricultural Extension Department for the sustainable development of homestead biodiversity in Bangladesh.
- To reduce the cost of seed, it will be necessary to produce sufficient quality seeds locally and make them available to the farmers in time at a reasonable price.
- Development of market infrastructures such as road communication and transport should be increased, because farmers get higher price at market than home.
- Government should reduce the pesticide and insecticide price.
- The awareness of the farmers needs to be increased. They may be provided adequate training so that they can produce *tal* properly.
- Modern technology should be undertaken for better labor cost control.
- Government should take necessary steps so that the market price of *tal* palm remains uniform all-round the year and all over the country. This may be possible through price control mechanism of the government.
- Agricultural credit facilities to be ensured easily.

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