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Phytopathological Investigation of Underutilized Fruits in Southern Bangladesh

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ABSTRACT

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Malnutrition, poor health, hunger, and even starvation are still the worlds greatest challenges. In Bangladesh, there is also need to concentration in the underutilized fruits. Thus a survey was carried out following questionnaire to estimate the status of underutilized fruits in Bangladesh under different parameters viz., basic information, production problems, diseases, storage problems, loss percentage, and market value collected from underutilized fruits Ten growers, five shopkeepers and Key Informants, five KIs (Upazila Agriculture Officer) of Khulna, Shatkhira, Bagherhat, Barisal and Patuakhali. Survey finding reveals that the highest number of underutilized fruit trees was possessed by the farmers in Bagherhat (462) and the lowest number of underutilized fruit trees was in Patuakhali (182). Farmers informed five different types of diseases of underutilized fruit trees in their household viz. Leaf blight, Leaf spot, Fruit blight, Leaf curl and Die back which cause damage to plants. Maximum growers from Khulna (80%) informed leaf blight, from Shatkhira (90%) informed leaf spot, from Patuakhali (70%) informed fruit blight, from Bagherhat and Khulna (20%) informed leaf curl and from Barisal (50%) informed die back associated with underutilized fruit tree. There was no leaf curl disease found in Barisal and Patuakhali. Fruit drop problem was found in all the districts. The highest number of growers informed fruit drop problems in Bagherhat (90%). 40% farmers in Barisal found 10-20% loss of production due to disease was highest followed by Patuakhali (30%). 100% shopkeepers of Shatkhira sell Tamarind and Pomegranate, 100% shopkeepers in Khulna sell Pomegranate, 100% shopkeepers of Barisal sell Sapota and 80% shopkeepers in Patuakhali sell Tamarind. Most of the KI informed the similar status of underutilized fruit trees. Farmers in Bagherhat, Shatkhira and Khulna were good in controlling different diseases of underutilized fruits, where Barisal and Patuakhali have lower concept on the diseases of underutilized fruits.

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Introduction

More than 30,000 edible plant species have been identified, of which around 7,000 plant species have been used in the history of humanity to meet food needs (Biodiversity International, 2013). At present, however, not more than 150 species are commercially cultivated and, of these, just 103 crops provide up to 90% of the calories in the human diet (Prescott-Allen and Prescott-Allen 1990). Just four of these (rice, wheat, maize and potato) account for fully 60% of the human energy supply. A very small number of major crops have direct implications for both food security and nutrition. The lack of genetic diversity within the gene pools of these few crops leaves our agricultural systems vulnerable to pests and diseases, and to abiotic stress (Othman *et al.*, 2004). To prevent this and other food crop calamities,

there is clearly a need to maintain diversity both within and between crops in our production systems. Internationally (Subasinghe, 2014), there is rising interest in new foods and other products that can contribute in novel ways to human health and nutrition, (Sing *et al.*, 2011, Nandal *et al.*, 2014, Baldermann *et al.*, 2016). This interest can be exploited to develop markets for non-staple crops from which poor communities can benefit, providing incentives for farmers to plant these crops. Agriculture must go beyond the Green Revolution technologies of the last half century, which were based on genetic improvement and increased yields of the staple crops, but at high external cost.

Underutilized fruits are domesticated plant species that have been used for centuries or even millennia for their

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food, fibre, fodder, oil or medicinal properties (Hammer et al., 2001), but have been reduced in importance over time owing to particular supply and use constraints (Mayes et al., 2011). These can include, inter alia, poor shelf life, unrecognized nutritional value, poor consumer awareness and reputational problems (famine food or "poor people's food"). Other than that, with modernization of agriculture many of these crops have become neglected due to their being held in low esteem and some has become so severe that they are often regarded as lost crops (Williams et al., 2002). These species have to ensure food security, nutrition, health, income generation and environmental services.

In Bangladesh, many underutilized fruits are growing without much care largely in the homestead, fallow and forest areas as well as at the roadside and railway lines. Those fruits are well adapted to the local climate, are highly nutritious and contribute to poverty reduction and household food security of rural people and play a significant role in herbal medicine. Huge numbers of tribal people are also dependent on the underutilized fruits and vegetables. Underutilized fruit trees like river ebony (*Diospyros peregrine*), velvet apple (*Diospyros discolor*), Cowa (*Garcinia cowa*) and ber (*Zizyphus mauritiana*), Amlaki (*Phyllanthus emblica*) contribute to protection against natural disasters and balancing the coastal ecosystem (Rahim et al., 2009). Underutilized crops contribute a lot as risk buffers and ensure household food security. The basic objective of the research is to study about the status of the underutilized fruits of southern Bangladesh. The present research work will be carried out to achieve (i) to survey the status of underutilized fruit tree, fruit production and barriers of underutilized fruit tree establishment in coastal areas of Bangladesh, and (ii) to estimate the loss of underutilized fruits during and post harvest due to processing and phytopathological causes.

Materials and Methods

Baseline survey of the status of underutilized fruits

This research work was carried out at underutilized fruits garden in southern part of Bangladesh. A baseline survey was conducted for recording of underutilized fruit status, problems producing underutilized fruits production, woman participation in homestead gardening etc. in coastal areas like, Rupsha Upazilla-Khulna, Farikirhat Upazilla-Bagherhat, Tala Upazilla-Shatkira, Hizla Upazilla-Barisal and Dhumki Upazilla-Patuakhali. 10 growers, 5 shopkeepers and 5 KIs were selected randomly from each upazilla. The survey was done by door to door visit and taking interviews. Three questionnaires were made for this survey for growers, shopkeepers and Key Informants. Survey of the

underutilized fruits was done from February, 2019 to June, 2019.

Survey on phytopathological status of underutilized fruits

Each personnel was asked on the basis of their profession. The specific parameters were asked during the interview were:

- 1) Types of underutilized fruits cultivated by the farmers in different location
- 2) Percentage of Farmers facing problems cultivating underutilized fruits due to disease
- 3) Loss percentage due to disease at production
- 4) Percentages of Shopkeepers selling Underutilized fruits
- 5) Percentage of number of shopkeepers having different storage problems
- 6) Key Informants recommendation on underutilized fruits

Results

Status of underutilized fruits growers and shopkeepers

Basic information of underutilized fruit growers

A survey of underutilized fruit tree growers in Bagherhat, Shatkira, Khulna, Barisal and Patuakhali was carried out. 10 growers were selected randomly from each district (Table 1). There were 80% male underutilized fruit tree growers in Bagherhat, Shatkira, Barisal and Patuakhali. Only in Khulna, there were 90% male and 10% female (Table 1).

Basic information of shopkeepers

A survey of shopkeepers in Bagherhat, Shatkira, Khulna, Barisal and Patuakhali was carried out. Five shopkeepers were selected randomly from each district (Table 2). There were 100% male shopkeepers in all the districts (Table 2). During the survey all the types of underutilized fruits from each shop were counted (Table 3) Most of the types of underutilized fruits were same at all the districts. Maximum varieties of underutilized fruits were found in Bagherhat (13).

Phytopathological status of underutilized fruits

Types of underutilized fruits cultivated by the farmers

During the survey all the underutilized fruit tree from each grower were counted (Table 4) Most of the varieties of trees were same at all the districts. Maximum varieties of underutilized fruit trees were found in Barisal (17) and the lowest at Shatkira and Patuakhali (15). At the survey total number of each grower from each district were counted. Ten growers from each district were taken in this survey. Maximum number of underutilized fruit trees were found in Bagherhat (462 trees) and the lowest in Patuakhali (182) (Figure 1).

Table 1. Basic information of underutilized fruit growers in selective areas of five southern districts of Bangladesh

Gender							
Location (District)	Number of respondents (gender wise)			Gender %			
	Male	Female	Total	Male	Female		
Bagherhat	8	2	10	80	20		
Shatkhira	8	2	10	80	20		
Khulna	9	1	10	90	10		
Barisal	8	2	10	80	20		
Patuakhali	8	2	10	80	20		
Age							
Location (District)	Number of respondents in different age group						Avg. age of the respondents
	16-25 Year	26-35 Year	36-45 Year	46-55 Year	56-65 Year	66-75 Year	
Bagherhat	1	2	4	3	0	0	39.4
Shatkhira	0	0	3	5	2	0	48.7
Khulna	3	1	2	2	2	0	40.4
Barisal	0	3	4	0	2	1	46.5
Patuakhali	1	4	2	0	2	1	40.8
Total	5	10	15	10	8	2	
Educational qualification							
Location (District)	Number of respondents in different educational qualification group						
	Uneducated	Up to Class V	Up to Class VIII	Up to SSC	Up to HSC	Graduation	Master's Degree
Bagherhat	1	2	0	1	2	3	1
Shatkhira	2	1	0	2	4	1	0
Khulna	1	2	2	2	1	2	0
Barisal	1	1	1	1	3	1	2
Patuakhali	2	4	1	1	2	0	0
Total	7	10	4	7	12	7	3
Percent %	14	20	8	14	24	14	6
Land area of individual growers							
Location (District)	Land Area (Acre) of 10 selected respondents				No of Underutilized Fruit trees of 10 selected respondents	Ratio between number of underutilized fruit trees and Total Land Area	
	Cultivable Land	Home Yard Land	Total Land	Percent Home Yard Land			
Bagherhat	35	5	40	12.5	462	11.6	
Shatkhira	36	2.7	38.7	6.9	255	6.6	
Khulna	33	4.6	37.6	12.2	326	8.7	
Barisal	48	5.5	53.5	10.2	333	6.2	
Patuakhali	25	2.9	27.9	10.3	182	6.5	
Total	177	20.7	197.7	10.5	1558	7.9	

Table 2. Basic information of shopkeepers in selective areas of five southern districts of Bangladesh

Gender							
Location (District)	Number of respondents (gender wise)			Gender %			
	Male	Female	Total	Male	Female		
Bagherhat	5	0	5	100	0		
Shatkhira	5	0	5	100	0		
Khulna	5	0	5	100	0		
Barisal	5	0	5	100	0		
Patuakhali	5	0	5	100	0		
Age							
Location (District)	Number of respondents in different age group						Respondents' age (avg)
	16-25 Year	26-35 Year	36-45 Year	46-55 Year	56-65 Year	66-75 Year	
Bagherhat	1	1	1	2	0	0	37.6
Shatkhira	0	0	2	2	0	1	48.4
Khulna	0	4	1	0	0	0	30.4
Barisal	1	0	1	1	2	0	45.2
Patuakhali	0	1	2	2	0	0	43.6
Total	2	6	7	7	2	1	
Educational qualification							
Location (District)	Number of respondents in different educational qualification group						
	Uneducated	Up to Class V	Up to Class VIII	Up to SSC	Up to HSC	Graduation	Master's Degree
Bagherhat	1	1	2	0	1	0	0
Shatkhira	0	1	1	1	2	0	0
Khulna	0	0	1	1	3	0	0
Barisal	0	1	0	3	1	0	0
Patuakhali	1	0	1	2	1	0	0
Total	2	3	5	7	8	0	0

Table 3. Types of underutilized fruits found in 5 underutilized fruit selling shops in selective areas of five southern districts of Bangladesh

SI No.	Location (District)	Types of underutilized fruits	No of types of underutilized fruits
1	Bagherhat	Tamarind, Stone apple, Rever ebony, Anola, Hog plum, Carambola, Elephant apple, Wax jambu, Bullock's Heart, Pomegranate, Burmese grape, Olive, Sapota	13
2	Shatkhira	Tamarind, Stone apple, Hog plum, Pomegranate, Olive, Sapota, Longan	7
3	Khulna	Tamarind, Anola, Elephant apple, Bullock's Heart, Pomegranate, Burmese grape, Sapota	7
4	Barisal	Tamarind, Stone apple, Rever ebony, Hog plum, Bullock's Heart, Pomegranate, Sapota	7
5	Patuakhali	Tamarind, Rever ebony, Hog plum, Carambola, Elephant apple, Bullock's Heart, Pomegranate, Sapota	8

Table 4. Types of underutilized fruits cultivated by 10 farmers in selective areas of five southern districts of Bangladesh location

SI No.	Location	Types of underutilized fruits	No of types of underutilized fruits trees
1	Bagherhat	Fig, Rever ebony, Hog Plum, Carambola, Anola, Olive, Elephant apple, Jamun, Longan, Bullock's Heart, Wax Jambu, Lime, Sapota, Hortoki, Karanda, Stone apple	16
2	Shatkhira	Fig, Hog Plum, Carambola, Anola, Longan, Wax Jambu, Lime, Sapota, Cowa, Monkey jack, Malay apple, Bilimbi, Tamarind, Pomegranate, Karanda	15
3	Khulna	Fig, Rever ebony, Hog Plum, Carambola, Anola, Olive, Elephant apple, Jamun, Longan, Bullock's Heart, Wax Jambu, Lime, Sapota, Stone apple, Tamarind, Rattan	16
4	Barisal	Fig, Rever ebony, Hog Plum, Carambola, Anola, Olive, Elephant apple, Jamun, Bullock's Heart, Wax Jambu, Lime, Sapota, Stone apple, Karanda, Custard apple, Rattan, Malay apple	17
5	Patuakhali	Rever ebony, Hog Plum, Carambola, Anola, Olive, Elephant apple, Wax Jambu, Lime, Sapota, Malay apple, Cowa, Pomegranate, Custard apple, Monkey jack, Tamarind	15

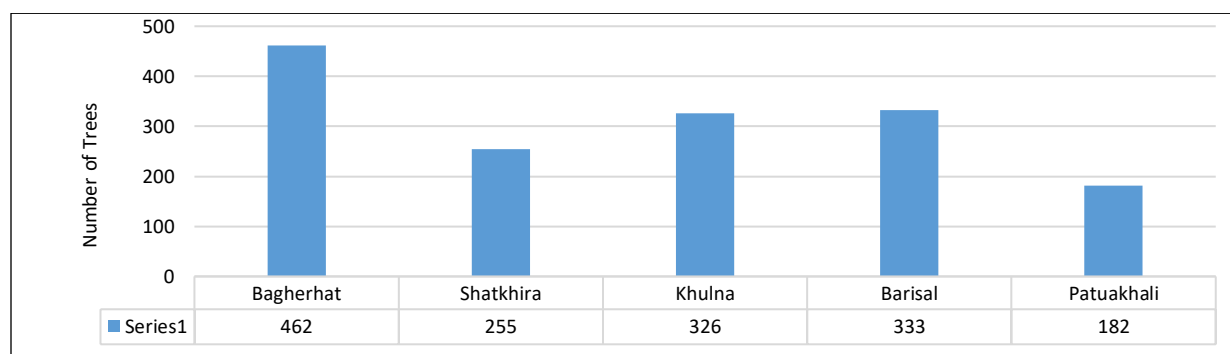


Figure 1. Total number of underutilized fruit trees in different district

Percentage of Farmers facing problems in cultivating underutilized fruits due to disease

There were different types of diseases and insects were found during the survey. The diseases are such as (i) Leaf Blight, (ii) Leaf spot, (iii) Fruit Blight, (iv) Leaf Curl and (v) Die back. In case of diseases maximum 80% percent of growers found leaf blight in Khulna, 90% growers face leaf spot in Shatkhira, 70% found fruit blight in Patuakhali, 20% leaf curl disease in Bagherhat and Khulna and 50% die back disease in Barisal 90% of farmers of Bagherhat mentioned that they are suffering from fruit drop problem, whereas in Patuakhali, only

40% growers mentioned about the fruit dropping (Table 5).

Loss due to disease at production, harvest and transport

Loss percent due to disease, insect, harvest and transport were categorized into five categories as 0%, >0-2%, >2-5%, >5-10% and >10-20% (Table 6). Maximum 50% growers in Bagherhat face >2-5% loss due to disease, 40% growers from Shatkhira face same loss. In Khulna, Barisal and Patuakhali there were average loss due to disease in all of the growers. Insect causes less percent of losses in every scale in different district. Insect

causes highest (>10-20%) damage in Khulna (20% growers). During harvesting fruit losses happens due to different reasons. Lack of good mechanical knowledge is one of the reasons. Losses at harvesting mostly happens in >2-5% scale in all the districts. Losses at transportation mostly happens in >2-5% scale in all the districts.

Percentages of shopkeepers sell underutilized fruits

During the survey five shopkeepers were selected from each district. In Bagherhat all the shopkeepers sell most of the underutilized fruits grown in Bagherhat (Table 7). Stone apple is the most common in this area. About 60% shopkeepers from this area sells stone apple. In Shatkhira 100% of the shopkeepers sell tamarind and pomegranate.

Percentage of shopkeepers having storage problems

During the survey there were four parameters such as (i) Disease, (ii) Insect, (iii) Shelf life and (iv) Physical disorder

(Figure 2). Most of the shopkeepers in all district had soft rot disease in there storage condition. 40% shopkeepers of all district face fruit blight, 52% shopkeepers face fungi and soft rot disease found in 64% shops (Figure 2). Ants were found in 44% shop and Fruit flies were found in 48% shops. Medium shelf life found in maximum (48%) shops. In case of physical disorder Discoloration was highest, found in 64% shops.

Key informants recommendation on underutilized fruits

During the survey five Key Informants (KIs) were selected from each district. Through the survey, 8 recommendations were come out from the KIs (Table 8). All the recommendations are very important to produce good quality of fruits.

Table 5. Percentage of Farmers facing problems cultivating underutilized fruits due to disease

Problems	Percent of the no of farmers					
	Bagherhat	Shatkhira	Khulna	Barisal	Patuakhali	
Diseases	Leaf Blight	70	50	80	70	70
	Leaf spot	70	90	50	70	80
	Fruit Blight	40	30	50	40	70
	Leaf Curl	20	10	20	0	0
	Die back	20	30	30	50	30
Fruit drop	90	70	80	70	40	

Table 6. Loss percentage due to disease and insect infestation at production, harvest and transport in selective areas of five southern districts of Bangladesh

Problems	Percent of the number of farmers					Average %	
	Bagherhat	Shatkhira	Khulna	Barisal	Patuakhali		
Disease	>0%	0	0	0	10	0	2
	>0-2%	40	30	30	10	30	28
	>2-5%	50	40	20	20	20	30
	>5-10%	10	30	30	20	20	26
	>10-20%	0	0	20	40	30	14

Table 7. Percentages of shopkeepers selling different types underutilized fruits in selective areas of five southern districts of Bangladesh

SI No.	Types of fruits	Bagherhat	Shatkhira	Khulna	Barisal	Patuakhali
1	Tamarind	40	100	40	60	80
2	Stone apple	60	60	0	80	0
3	Rever ebony	40	0	0	20	60
4	Anola	20	0	40	0	0
5	Hog plum	20	20	0	40	20
6	Carambola	20	0	0	0	20
7	Elephant apple	40	0	20	0	40
8	Wax jambu	20	0	0	0	0
9	Bullock's Heart	20	0	60	40	60
10	Pomegranate	40	100	100	80	40
11	Burmese grape	20	0	40	0	0
12	Olive	20	20	0	0	0
13	Sapota	40	20	80	100	60

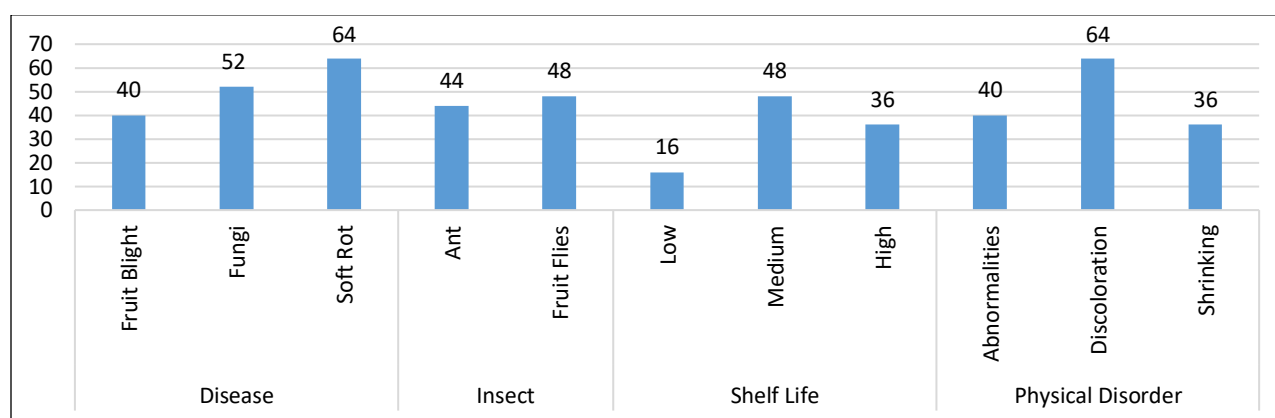


Figure 2. Percentage of underutilized fruits selling shops having different storage problems

Table 8. Key Informants Information (KII)'s recommendation on different parameter

Recommendation	Percent of the No of KI				
	Bagherhat	Shatkhira	Khulna	Barisal	Patuakhali
Need Technical Training	40	30	30	30	30
Development of Proper Treatment	50	50	40	40	40
Improvement of Treatment application	10	30	50	50	40
Increase Market Value	50	30	40	20	10
Improvement of Transport System	20	30	30	40	40
Increase Consumer's awareness	30	40	20	50	40
Increase No of Consumers	50	10	50	20	40
Improvement of Storage Facility	10	20	20	30	40

Discussion

From the survey on the status of underutilized fruits in Khulna, Bagherhat, Shatkhira, Barisal and Patuakhali it was found that all the districts have potentiality to produce underutilized fruits (Hossain *et al.*, 2018). Women contribution is very poor in gardening of underutilized fruits related to men in each district. Fruits types are varied district to district. Maximum varieties of underutilized fruit trees were found in Barisal and the lowest at Shatkhira and Patuakhali which is similar to the Bangladesh Bureau of Statistics (BBS) (2018). This also mentioned that the contribution in underutilized fruits is more in Khulna division than Barisal. This statement is similar as the survey found. Maximum growers in Bagherhat face loss due to disease which is similar to the statement of Rahim *et al.* (2009) in their book Underutilized Fruits and Vegetables in Bangladesh. According to the survey, leaf spot is the most common disease in underutilized fruits Padulosi (2017). During the survey, we found Leaf blight in different underutilized fruits such as in Golden apple (Rodrigues *et al.* 1999), Velvet apple (Elsworth, 2018; Spengler, 2016). Leaf spot found in Velvet apple (Yadav *et al.*, 2013), Carambola (Sonavane *et al.*, 2017) and Leaf curl viral disease in Fig which is similar to (Jelena *et al.*, 2015). Most of the shopkeepers face fungal problems at storage which has been described by Grantina (2015) is similar to the survey. Transportation problems are also a great obstacle for the increase of underutilized fruit market Othman *et al.*, (2004). According to the KIs, developing

of proper treatment model, making of good storage facility and minimizing of transportation problems are the recommendation for the development of underutilized fruits in Bangladesh.

Conclusion

In the sector of bio diversity underutilized fruits can a very important role. These are very nutritious and most of the underutilized fruits are medicinal fruits. That is why the production and the business of underutilized fruits are important. But in Bangladesh there are no such research documentation on the disease and other problems on the production and to sell such as storage problems, diseases, technical knowledge, transport etc. This survey at the southern part of Bangladesh, found that there is great opportunity to produce underutilized fruits and consumption would be high. All the districts in this survey research (Bagherhat, Shatkhira, Khulna, Barisal and Patuakhali) have a good number of underutilized fruits. This research worked on different parameters such as current general status, pathological status and other problems. As a result it can be concluded that all the districts are good for producing underutilized fruits. This survey finally opened a great opportunity to research on underutilized fruits.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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