

DISPOSAL PATTERN OF COLD AND HOME STORED POTATO IN SOME SELECTED AREAS OF BANGLADESH

M.A. HOQUE¹, A. S. M. NAHIYAN² AND S. AKHTER³

Abstract

A questionnaire survey was conducted with 600 growers in six potato growing areas of Bangladesh viz. Munshiganj, Barisal-Patuakhali, Dinajpur-Thakurgaon, Joypurhat, Jamalpur-Sherpur and Jashore-Chuadanga to collect a detailed information about potato storage at home and in cold storages along with their disposal pattern. The survey revealed that 55.2% growers store their potatoes in the cold storages. Due to the proximity of cold storages (within 1-10 km from the home/field) majority potato growers of Munshiganj (82%), Dinajpur-Thakurgaon (81%) and Joypurhat (70%) stored in cold storages. On the other hand, majority growers of Barisal-Patuakhali (88%) and Jamalpur-Sherpur (73%) could not store due to lack or long distance of cold storages. The growers disposed up their cold stored potatoes mainly by selling to local *paikers* at cold storage gate or by using as seed. While considering all areas, 56.0 % farmers stored potatoes at home in the studied areas. Majority farmers in Dinajpur-Thakurgaon (91%), Joypurhat (98%) and Jamalpur-Sherpur (65.0%) areas stored potato at home. Farmers of these areas stored upto 150 days at home because of cultivation of local varieties. Regarding disposal of home stored potatoes, the growers mainly sold to local *paikers* or at local market or used for own family consumption or by other means.

Keywords: Potato, Scenario, Disposal pattern, Cold and home storage, Bangladesh.

Introduction

Potato production in our country is increasing day-by-day. During 2018-19, the total potato production raised upto 9.7 million metric tons and the area coverage raised upto 0.47 million hectares with an average yield of 20.6 t/ha (BBS, 2020). However, potato production in Bangladesh has increased manifolds but other facilities has not yet been developed like marketing system, storage facilities and awareness of the farmers regarding use of production inputs e.g. fertilizers, pesticides etc. As a result, cost of production increases and farmers do not get appropriate price of the produced tubers in the seasonal time (Hossain, 2016). They cannot even store the produced potato in the cold storage with a view to selling the tubers in off-season at a higher price. At present, 364 cold storages has in operation in the country with hardly a capacity of storing 2.8 million metric tons potatoes in those cold storages (Hoque *et al.*, 2018). Considering the total cold storage capacity and production of potato in the country, about 25-30% of

¹Professor, Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur- 1706, ²Senior Scientist, Advanced Seed Research & Biotech Centre, ACI Agribusiness, Dhaka-1212, ³Lecturer, Dept. of Pharmacy, BGC Trust University Bangladesh, Chattogram, Bangladesh.

the total produced potatoes can be preserved in the cold stores (Rabbani *et al.*, 2010; Hoque and Akter, 2014). So, storing potato is now-a-days number one problem in the country because of inadequate cold storages. Therefore, the growers sale their maximum amount of potatoes immediately after harvest or they preserve the products in the field or in their houses; where, they can hardly store for 2 months, but quality deteriorates. Different disease and insect attacks and greening of tubers increases, which is very toxic for human consumptions. The growers, however, still prefer to store the tubers at home even during the hottest period (April-August) in order to sell them gradually, and consequently at a high price (Bhattacharjee *et al.*, 2014). Regarding this issue, the Tuber Crops Research Centre (TCRC) of Bangladesh Agricultural Research Institute (BARI) has developed an improved technology of storing potatoes under natural condition where potatoes can be stored for 3-5 months with minimum loss and without deterioration of tubers quality (Hoque, 2014). Therefore, the present study was undertaken to generate information for the policy makers with a view to improving storage facilities of potato in Bangladesh.

Methodology

The present study was focused on the present status of potato storage at home and in cold storages in Bangladesh, emphasizing on amount stored, cost of storage, disposal pattern of stored potatoes, sale price and problem faced by the potato growers during storage etc. The study was consisting of interviewing potato growers of selected regions using a questionnaire. The questionnaire was first prepared in English bearing in mind the objectives of the study and then translated into Bengali for ease of the data collection. For convenience, availability of respondent farmers and better interpretation of findings, the following 6 areas of the country were selected for the study (Table 1).

Table 1. List of different study areas

Study regions	Area / District(s)	Upazilla
1	Munshiganj	Sadar and Tongibari
2	Barisal-Patuakhali	Babuganj and Golachipa
3	Dinajpur-Thakurgaon	Birol and Thakurgaon Sadar
4	Joypurhat	Kalai and Khetlal
5	Jamalpur-Sherpur	Bakshiganj and Sherpur Sadar
6	Jashore-Chuadanga	Jhikorgacha and Chuadanga Sadar

One hundred potato growers were purposively selected from each of 6 selected areas with the help of local DAE officers. Considering the land area under potato cultivation, the selected potato growers of 6 study areas were grouped into 3 categories, namely large, medium and small. The large potato growers had more than 2.00 acres of land under potato cultivation; medium growers had 0.51-1.99 acres; and small growers had less than 0.51 acres (Rabbani *et al.*, 2010). Six enumerators were recruited (one for each selected areas) from the students of the BSMRAU for collecting data from the potato growers, using the structured

questionnaire. The recruited enumerators were oriented through a training programme at Munshiganj. The questionnaire was elaborately presented to the enumerators; where, scientists, DAE personnel's and some elite farmers were present. A discussion on the questionnaire was held among the participants and the comments and suggestions were recorded. Immediately after the training, pre-testing of the prepared questionnaire was done through collecting data from 2-3 farmers from Katakhalī village of Munshiganj sadar upazilla by the selected enumerators. After pre-testing, the questionnaire was fine-tuned and was finalized. Information was collected by the enumerators using the finalized questionnaire during October 2017 from farmers of the selected areas through personal visit. Questions were asked in such a way as to create interest among the respondents avoid boring. In case of any inconsistency, data were rechecked and corrected through repeated visits or by mobile phone. Besides, secondary data like number of cold storages, total capacity and production etc. of different areas were collected from the respective offices of the Deputy Director, Department of Agricultural Extension (DD, DAE). The collected information was processed, compiled and analyzed using MS-Excel and SPSS-PC (Version 16.0).

Results and Discussion

The growers of Munshiganj area occupied the top most position to devote larger areas of land (>2.00 acres) for potato cultivation (64%) followed by Dinajpur-Thakurgaon area (37%). More than 50% farmers devoted to medium category in Dinajpur-Thakurgaon (58%), Joypurhat (72%) and Jashore-Chuadanga (57%) area. Small farmers those who devote to small category for potato cultivation, were the highest in Barisal-Patuakhali area (48%) and the lowest in Munshiganj (4%). On an average of all studied areas, large potato growers was 27%, medium was 50% and small was 23% (Table 2). Potato is the most important and dominating crop in the cropping patterns of Munshiganj district and cultivated commercially for long period compared to other areas. Farmers of Munshiganj are much more aware about potato cultivation than other areas.

Table 2. Distribution of potato growers under large, medium and small category

Study area	Number and percent of respondents		
	Large (>2.00 acres)	Medium (0.51-1.99 acres)	Small (<0.51 acres)
Munshiganj	64	32	4
Barisal-Patuakhali	17	35	48
Dinajpur-Thakurgaon	37	58	5
Joypurhat	14	72	14
Jamalpur-Sherpur	11	48	41
Jashore-Chuadanga	20	57	23
Total	163	302	135
(% of total)	(27)	(50)	(23)

Cold storage preservation

Number of cold storages, total capacity and production of potato in different areas are presented in Fig. 1. The highest number (69) of cold storages were in Munshiganj and the lowest (1) in Barisal-Patuakhali area. In the Joypurhat and Dinajpur-Thakurgaon areas, the total potato production is more than six times than that of total cold storage capacity. Production of potato in other areas were also much higher than the storage capacity. Since, potato planting and harvesting in the northern part of the country including these areas are completed more than a month ahead of the southern parts of the country; therefore, they get the opportunity to preserve their potato to the cold storages of other parts of the country. Among other causes, cold storage facilities are limiting the increase of potato areas.

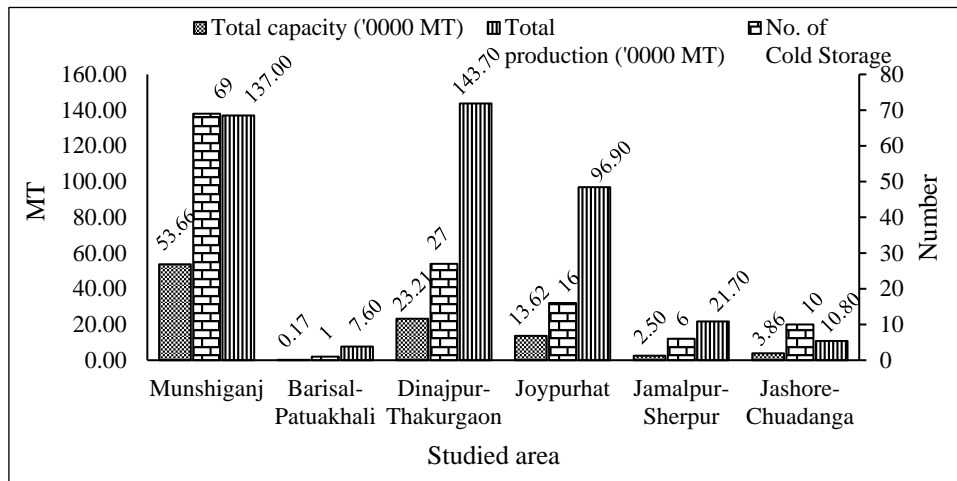


Fig. 1. Number of cold storage, total capacity and production of potato in studied areas in 2017.

Source: DAE office of respective district

Results regarding distribution of potato growers in different areas for amount preserved in cold storage are presented in Table 3. The table showed that maximum farmers of Barisal-Patuakhali (88%), Jamalpur-Sherpur (73%) and Jashore-Chuadanga (57%) did not store the potatoes in cold storage. Whereas, only a few farmers of Munshiganj (14%), Dinajpur-Thakurgaon (12%) and Joypurhat (25%) areas did not store at all in the cold storages in 2016-17 growing season. This was in agreement with the findings of Hossain (2016) who reported that 85.7% farmers of Munshiganj and 87.3% farmers of Bogura stored potato in cold storage. In general, it was observed that the areas where lower numbers of cold storages prevails where percentages of farmers not stored becomes higher in those areas. The availability and closeness of cold storages to the field in Munshiganj invigorated the farmers to store in cold storages (Table 3).

Table 3. Distribution of growers in different areas stored potato in cold storage

Amount (Kg)	Number/percentage of growers						All total (n=600)
	Munshiganj (n=100)	Barisal- Patuakhali (n=100)	Dinajpur- Thakurgaon (n=100)	Joypurhat (n=100)	Jamalpur- Sherpur (n=100)	Jashore- Chuadanga (n=100)	
Do not store	14	88	12	25	73	57	269 (44.8)
upto 4000	25	12	51	63	12	16	179 (29.8)
4001-20000	26	0	23	10	13	18	90 (15.0)
20001-40000	23	0	7	1	1	2	34 (5.7)
40001- 60000	4	0	5	0	0	3	12 (2.0)
60001- 80000	3	0	1	1	0	1	6 (1.0)
> 80000	5	0	1	0	1	3	10 (1.7)

Figures in the parentheses indicate percentage to total number of respondents.

Farmers in closed proximity of cold storage deposited potato in storage were maximum than distant proximities (10.1-20.0 km, 20.1-30.0 km and >30 km) (Table 4). Maximum farmers in Munshiganj (82%), Dinajpur-Thakurgaon (81%) and Joypurhat (70%) areas deposited potato in close proximity of cold storages that are situated within 1.0-10.0 km. All the farmers of Munshiganj, Dinajpur-Thakurgaon and Joypurhat areas had the opportunity to preserve in cold storage within 1.0-20.0 Km. For this reason, majority farmers of these areas preserved their potatoes in cold storages. In Jamalpur-Sherpur area, 27%; in Barisal-Patuakhali, 8% and in Jashore-Chuadanga, 4% farmers had to travel more than 30 km for preserving potatoes in cold storages (Table 4). A long travel from home/field to the cold storage uninspired the growers to store their produces.

Table 4. Distribution of farmers regarding proximity of cold storage

Distance	Number/percent of growers					
	Munshiganj (n=100)	Barisal- Patuakhali (n=100)	Dinajpur- Thakurgaon (n=100)	Joypurhat (n=100)	Jamalpur- Sherpur (n=100)	Jashore- Chuadanga (n=100)
Do not store	14	88	12	25	73	57
1.0-10.0 km	82	-	81	70	-	25
10.1-20.0 km	4	1	7	5	-	9
20.1-30.0 km	-	3	-	-	-	5
>30.0 km	-	8	-	-	27	4

In the study areas, average cost for carrying an 80 Kg bag of potatoes to cold storage ranged from Tk. 10/- to Tk. 250/-. The highest cost of Tk. 250/- to carry an 80 Kg bag was reported in Barisal-Patuakhali areas and the lowest cost Tk. 100/- . Similar trends was also for Jamalpur-Sherpur areas. The long distance of cold storages from field in these areas showed higher price. The lowest range of Tk. 10/- to Tk. 50/- was recorded in Jashore-Chuadanga area (Table 5).

Cold storage charge for an 80 Kg bag was also differed in different areas. The lowest charge of Tk. 200/- was recorded in Barisal-Patuakhali area and the highest of Tk. 370/- in Dinajpur-Thakurgaon and Joypurhat areas (Table 5). The highest charge in the studied areas did not vary considerably. Moazzem and Fujita (2004) reported a cold storage charge of Tk. 160.0 for an 80 kg bag of potato in 2000-2001 growing season. That means, the cold storages charges increased around 2 times over 16 years.

Storage period in preserving potatoes in the cold storage varies year to year or location to location. After storing potatoes, when the market price become higher farmers sale their potatoes. In 2016-17 growing season, farmers of Barisal-Patuakhali, Jamalpur-Sherpur and Jashore-Chuadanga preserved in cold storage for a maximum period of 10 months and in other locations this period was 9 months (Table 5). In a study at 6 important potato growing areas of Bangladesh, Hossain and Miah (2011) also found that farmers store their tubers in the cold storages for an average period of 9.3 months.

Table 5. Average carrying cost, storage fare and period of storing potatoes in cold storage in different areas

Potato growing area	Carrying cost (Tk/80 Kg bag)	Cold storage charge (Tk.)	Storage period (Months)
Munshiganj	25-150	300-350	06-09
Barisal-Patuakhali	100-250	200-350	08-10
Dinajpur-Thakurgaon	10-85	280-370	07-09
Joypurhat	20-50	220-370	04-09
Jamalpur-Sherpur	40-120	300-360	04-10
Jashore-Chuadanga	10-50	220-350	02-10

Average sale price of cold stored potatoes during 2016-17 was the maximum (Tk. 613/- per 40 kg maund) in Jamalpur-Sherpur area followed by Barisal-Patuakhali (Tk. 600/- per 40 kg maund), Joypurhat (Tk. 481/- per 40 kg maund) and Dinajpur-Thakurgaon (Tk. 419/- per 40 kg maund) area. Farmers in all studied areas sold to local *paikers* at cold storage gate. Except Barisal-Patuakhali area, farmers of all areas sold cold stored potatoes to other district *paikers* at cold storage gate. Growers of only in Jamalpur-Sherpur area sold their cold stored potatoes to the local markets at an appreciable high price (Tk. 641/- per 40 kg maund). Whereas, the growers of only Jashore-Chuadanga area sold their cold

stored potatoes through commission agents but the price was lower (Tk. 325/- per 40 kg maund) than other selling (Table 6). Many other authors reported from their studies to have variable prices of potato in different areas (Hossain, 2016; Hossain and Miah, 2011; Hoque *et al.*, 2018 and Hossain, 2012).

Table 6. Average sale price of cold stored potatoes in different area

Place	Sale price (Tk/ 40 kg maund)					
	Munshiganj (n=86)	Barisal- Patuakhali (n=12)	Dinajpur- Thakurgaon (n=88)	Joypurhat (n=75)	Jamalpur- Sherpur (n=27)	Jashore- Chuadanga (n=43)
Local <i>paiker</i> at cold storage gate	339	600	462	557	596	362
Other district <i>paiker</i> at cold storage gate	325	-	375	405	600	350
Sale at local market	-	-	-	-	641	-
Through commission agent	-	-	-	-	-	325
Average	332	600	419	481	613	346

Table 7. Distribution of farmers about disposal of cold stored potatoes in different area

Channels*	Number of growers					
	Munshiganj (n=86)	Barisal- Patuakhali (n=12)	Dinajpur- Thakurgaon (n=88)	Joypurhat (n=75)	Jamalpur- Sherpur (n=27)	Jashore- Chuadanga (n=43)
Local <i>paiker</i> at cold storage gate	31 (36.0)	1 (8.3)	54 (61.4)	36 (48.0)	9 (33.3)	22 (51.2)
Other district <i>paiker</i> at cold storage gate	0 (0.0)	0 (0.0)	7 (8.0)	5 (6.7)	2 (7.4)	4 (9.3)
Sale at local market	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (25.9)	0 (0.0)
Sale through <i>Arat</i> / commission agent	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.3)	0 (0.0)	2 (4.7)
Use as seed	86 (100.0)	9 (75.0)	12 (13.6)	21 (28.0)	6 (22.2)	12 (27.9)
Own family consumption	19 (22.1)	8 (66.7)	14 (15.9)	24 (32.0)	6 (22.2)	8 (18.6)

*Some farmer respondent for more than one disposing channel.

Figures in the parentheses indicate percentage to total number of respondents of that area.

A disparity in distribution of farmers in the study areas concerning disposal of cold stored potatoes was observed. In Munshiganj, majority farmers (100%) disposed up their cold stored potatoes by using as seed; because, their own seed quality is better as they use lots of imported seed in the previous years. Of them, 36% farmers sold to local *paikers* at cold storage gate and 22.1% use for own family consumption. Farmers in all studied areas disposed up cold stored potatoes by own family consumption along with other disposal items. They also dispose by selling to local as well as other districts *paikers* (Table 7). The other district's *paikers* sometime store these potatoes to other districts cold storages. Hossain (2016) reported similarly that 20.8% potato growers in Munshiganj sold their produces to the *paikers*; whereas, Hajong *et al.* (2014) recorded 40.0% growers in Rangpur sold their potatoes to *paikers*.

Table 8. Distribution of potato growers in different studied areas according to their citation for problems for storing potato in cold storage

Problems*	Number and percent of Growers						
	Munshiganj (n=100)	Barisal- Patuakhali (n=100)	Dinajpur- Thakurgaon (n=100)	Joypurhat (n=100)	Jalapur- Sherpur (n=100)	Jashore- Chuadanga (n=100)	All total (n=600)
Rot problem	13	7	64	8	19	25	136 (22.7)
Storing cost high	54	25	39	29	45	23	215 (35.8)
Lack of space/cold storage	49	64	15	27	31	35	221 (36.8)
No care by C/S owner	35	2	30	62	21	6	156 (26.0)
Others	7	0	10	0	0	0	17 (2.8)
No comments	8	18	11	9	21	31	98 (16.3)

*Some farmer respondent for more than one problem.

Figures in the parentheses indicate percentage to total number of respondents of that area.

At the time of interview, the maximum potato growers (36.8%) opined that the lacking of cold storage or space as a major problem irrespective of locations (Table 8). Although, the number of cold storages was the highest (69) in Munshiganj (Fig. 1) but they had a scarcity of space in the cold storages (39.12%). They opined that potato planting is somewhat late at Munshiganj due to the late removal of flood water compared to northern part of the country. As a result, harvesting also become late for more than a month and their potato reaches to the cold storages at the end of March or beginning of April. But the cold storages open in the February and potatoes from northern parts occupies the spaces of cold storages to a great extent. Hence, they do not get sufficient space.

They cited the storing cost (35.8%) as the 2nd most important problem followed by no care by cold storage owner (26.0%) and the rotting problem (22.7%). The potato growers of Munshiganj and Dinajpur-Thakurgaon area only cited some other problems like harassment by the middleman, poor management, misbehave by the cold storage personnel, giving less importance to the small farmers and delay entrance of bags within the storage etc. Organizing farmers' cooperative may be helpful to solve these sorts of problems as suggested by Hoque *et al.* (2018).

Home storage

Regarding home storage during 2016-17, farmers in different studied areas were distributed in a different manner. In Munshiganj, a few farmers (16%) stored potato at home but in Dinajpur-Thakurgaon, Joypurhat and Jamalpur-Sherpur, more than 60% farmers stored at home. While considering all areas, 56.0 % farmers stored potatoes at home (Fig. 2) in the studied areas. Majority farmers in Dinajpur-Thakurgaon (91%), Joypurhat (98%) and Jamalpur-Sherpur (65.0%) areas stored potato at home because of cultivation of local varieties as they have high storage capability under natural condition. In other areas, high yielding potato varieties are mainly cultivated that limited the home storage.

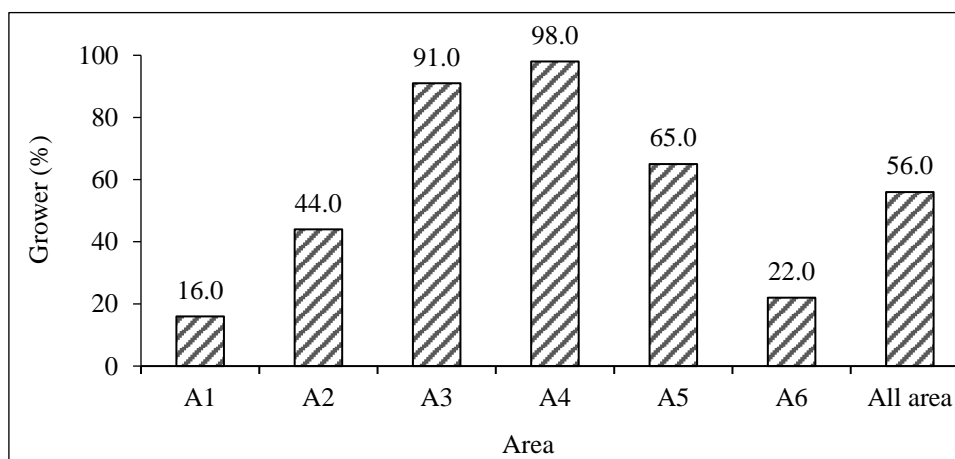


Fig. 2. Distribution of potato growers in different studied areas regarding home storage.

A₁= Munshiganj, A₂= Barisal- Patuakhali, A₃= Dinajpur-Thakurgaon, A₄= Joypurhat, A₅= Jamalpur-Sherpur and A₆= Jashore-Chuadanga.

In home storing methods, farmers of Munshiganj stored mainly in bags (16%) and in other areas, they stored mainly in heap. A few (5%) farmers in Munshiganj stored in field by covering with straw. In all areas, several farmers stored potatoes on *macha* made mainly by using bamboo. Hoque (2011) stored several high yielding varieties of potato under natural condition using different

methods and obtained the best result when stored on bamboo made *macha* with 15-20 cm height of tubers. Farmers of Dinajpur-Thakurgaon (12%), Joypurhat (36%) and Jamalpur-Sherpur (12%) stored on *attic* (Table 9). The *attics* are specially made by the farmers in their living mud house that are available in those areas. In Munshiganj, the farmers store in the field for a month or more covering with straw or dried water hyacinth that they used as mulch. Sometimes they use polyethylene sheet to cover the potatoes to get rid from rain. In that case, rottage loss become higher as internal heat of the tubers increases due to respiration that creates suitable environment for micro-organism.

Table 9. Distribution of potato growers in different studied areas regarding method of home storage

Method*	Number and percent of growers					
	Munshiganj (n=16)	Barisal- Patuakhali (n=44)	Dinajpur- Thakurgaon (n=91)	Joypurhat (n=98)	Jamalpur- Sherpur (n=65)	Jashore- Chuadanga (n=22)
In heap	5	44	79	32	64	18
In bags	16	5	25	24	23	10
On <i>macha</i>	3	3	16	16	16	6
On <i>attic</i>	-	-	12	36	12	-
In field covered with straw	5	-	-	-	-	-

*Some farmer respondent for more than one method.

The survey result regarding distribution of potato growers for days of home storage in different areas revealed that farmers in all areas stored up to 120 days; although, the number of farmer was very low in Munshiganj (1.0), Barisal-Patuakhali (3.0) and Jashore-Chuadanga (3.0). Cultivation and storage of high yielding potato varieties in these areas might be a cause of shorter period preservation under ambient condition (Hoque *et al.*, 2018). Hoque (2011) suggested a method for preserving potatoes under natural condition; where, several HYV's of potato comparatively performed better upto 150 days of storage. In this method, a store house was made at Munshiganj using locally available materials like straw, bamboo etc. and potatoes were stored on bamboo made *macha* with 15-20 cm height of tubers. The method was then tested in other potato growing areas of the country and found effective (Hoque, 2014). Farmers in Dinajpur-Thakurgaon (3.3%), Joypurhat (8.2%) and Jamalpur-Sherpur (7.7%) areas stored even up to 150 days (Table 10). The reason behind this fact was that in these areas, indigenous potato varieties (IPV's) are grown in a large scale; which have a longer storability under natural condition compared to high yielding varieties (HYV's). The IPV's are stored in these areas for a longer period for using as seed in the next year; although, the tubers become shriveled or sprout come out of tubers. Sometimes, they use earthen pots for storing potatoes.

Table 10. Distribution of potato growers regarding storage period

Storage period (days)	Number of growers					
	Munshiganj (n=16)	Barisal- Patuakhali (n=44)	Dinajpur- Thakurgaon (n=91)	Joypurhat (n=98)	Jamalpur- Sherpur (n=65)	Jashore- Chuadanga (n=22)
1-30	3 (18.8)	12 (27.3)	35 (38.5)	24 (24.5)	12 (18.5)	6 (27.3)
31-60	10 (62.5)	18 (40.9)	22 (24.2)	30 (30.6)	18 (27.7)	10 (45.5)
61-90	2 (12.5)	11 (25.0)	18 (19.8)	24 (24.5)	20 (30.8)	3 (13.6)
91-120	1 (6.3)	3 (6.8)	13 (14.3)	12 (12.2)	10 (15.4)	3 (13.6)
121-150	0 (0.0)	0 (0.0)	3 (3.3)	8 (8.2)	5 (7.7)	0 (0.0)

Figures in the parentheses indicate percentage to total number of respondents of that area.

Table 11. Distribution of growers regarding loss during home storage of potatoes

Loss up to 90 days of storage	Number of growers					
	Munshiganj (n=16)	Barisal- Patuakhali (n=44)	Dinajpur- Thakurgaon (n=91)	Joypurhat (n=98)	Jamalpur- Sherpur (n=65)	Jashore- Chuadanga (n=22)
0- 10.0%	0 (0.0)	5 (11.4)	6 (6.6)	6 (6.1)	3 (4.6)	1 (4.5)
10.1- 20.0%	10 (62.5)	23 (52.3)	46 (50.5)	48 (49.0)	33 (50.8)	12 (54.5)
20.1- 30.0%	6 (37.5)	14 (31.8)	32 (35.2)	38 (38.8)	27 (41.5)	8 (36.4)
>30%	0 (0.0)	2 (4.5)	7 (7.7)	6 (6.1)	2 (3.1)	1 (4.5)

Figures in the parentheses indicate percentage to total number of respondents of that area.

While storing potatoes at home, data on distribution of farmers regarding loss up to 90 days of storage was taken and presented in Table 11. From the Table showed that majority farmers of the studied areas lost 10.1-20.0% of their stored tubers during home storage up to 90 days. Farmers those who had lost 20.1-30.0% tubers up to 90 days of storage included 37.5% in Munshiganj, 31.8% in Barisal-Patuakhali, 35.2% in Dinajpur-Thakurgaon, 38.8% in Joypurhat, 41.5% in Jamalpur-Sherpur and 36.4% in Jashore-Chuadanga areas (Table 11). Hossain (2016) reported to have 7.8% loss in home stored potatoes at Bogura; while,

Hossain and Miah (2011) recorded a total of 31.5 % loss in home stored potatoes from 6 important potato growing areas of Bangladesh. Hoque *et al.* (2016) calculated 7.6% and Azad *et al.* (2017) calculated 18.7% loss in potato tubers of different varieties at 120 days after storage due to rot when stored under natural condition. Raghav and Singh (2003) involving 12 potato varieties under room temperature, also found various rottage percentages in their varieties.

Average sale price of home stored potatoes in different areas was found to be varied. In Dinajpur-Thakurgaon, Joypurhat and Jamalpur-Sherpur areas, the highest sale price for a 40 kg maund was recorded within 121-150 days after storage (DAS). In other locations, farmer did not store after 120 days at home (Table 12). The higher sale price after 120 days of storage might be due to the use of stored potatoes as seeds. Except this time duration of storage, the highest sale price for a 40 kg maund was recorded when the potatoes sold within 31-60 days of storage in Munshiganj (Tk. 345/ 40 kg maund), Jamalpur-Sherpur (Tk. 400/ 40 kg maund) and Jashore-Chuadanga (Tk. 550/ 40 kg maund). In other three areas, the highest price was recorded at 61-90 DAS. On an average, the farmers of Jamalpur-Sherpur area earned the highest money (Tk. 462.7/ 40 kg maund) from home stored potatoes. Price fluctuation of stored potatoes in different areas might be due to demand and availability of that localities.

Table 12. Average sale price of home stored potatoes in different studied areas

Storage duration	Sale price (Tk/40 kg Maund)						Average
	Munshiganj	Barisal-Patuakhali	Dinajpur-Thakurgaon	Joypurhat	Jamalpur-Sherpur	Jashore-Chuadanga	
Within 30 DAS	200.0	NR	350.0	356.5	420.0	481.0	361.5
Within 31-60 DAS	345.0	387.5	352.3	402.0	400.0	550.0	409.9
Within 61-90 DAS	265.0	450.0	440.0	416.9	390.0	345.0	384.5
Within 91-120 DAS	240.0	355.0	320.0	380.0	373.3	380.0	341.4
Within 121-150 DAS	NR	NR	800.0	755.0	730.0	NR	761.7
Average	262.5	402.5	452.5	462.1	462.7	439.0	413.5

DAS= Days after storage; NR= Not Reported.

Local *Pikers* plays an important role for dispose up of home stored potatoes in all studied locations. The highest number of respondents (87.5%) in Munshiganj area sold their home stored potatoes to local *Paikers* followed by Joypurhat (85.7%), Dinajpur-Thakurgaon (73.6%) and Barisal-Patuakhali (54.5%) areas. Majority of farmers in Munshiganj (31.3%) sold their home stored potatoes to other district *Paikers* in comparison to rest of the studied areas. In all studied areas, potato growers were found to sale their home stored tubers at local

markets. Only the growers of Joypurhat (3.1%) and Jashore-Chuadanga (18.2%) area sold their home stored tubers through *Arat* or commission agents (Table 13). Growers of Munshiganj, Barisal-Patuakhali and Jashore-Chuadanga did not use the home stored potatoes as seed. This might be due to the storage of tubers of high yielding varieties that cannot be stored upto next season. In other areas, some farmers used the stored potatoes as seed; where, they stored local varieties that had longer storability. In case of disposal through own family consumption, it was found that most farmers in the studied areas used home stored potatoes for own family consumption. Availability and easy access to tubers when needed might be the reason behind this. Another reason might be like that when they sort the home stored potatoes, they discard some tubers which had been started to rot. These tubers were also used for family consumption. Hossain (2016) reported that 2.14% of total produced potatoes were used as family consumption in Bogura and Munshiganj. Among others- distribution to relatives, donation to local mosque/school/beggars, sale to *Faria* (Petty traders) or to hawkers for buying groceries, vegetables, spices or other goods that needed for daily consumption in a farm family were included. More than 90% farmers in all studied locations except Jashore-Chuadanga areas disposed up their stored potatoes by other means. This implies that the home stored potatoes play a vital role for maintaining the social norms of farm families.

Table 13. Distribution of farmers on disposal of home stored potatoes

Channels*	Number of growers					
	Munshiganj (n=16)	Barisal- Patuakhali (n=44)	Dinajpur- Thakurgaon (n=91)	Joypurhat (n=98)	Jalalpur- Sherpur (n=65)	Jashore- Chuadanga (n=22)
Sales to local <i>paiker</i>	14 (87.5)	24 (54.5)	67 (73.6)	84 (85.7)	11 (16.9)	9 (40.9)
Sales to other district <i>paiker</i>	5 (31.3)	0 (0.0)	7 (7.7)	8 (8.2)	1 (1.5)	1 (4.5)
Sale at local market	4 (25.0)	25 (56.8)	37 (40.7)	15 (15.3)	17 (26.2)	11 (50.0)
Sale through <i>Arat</i> / commission agent	0 (0.0)	0 (0.0)	0 (0.0)	3 (3.1)	0 (0.0)	4 (18.2)
Use as seed	0 (0.0)	0 (0.0)	3 (3.3)	8 (8.2)	5 (7.7)	0 (0.0)
Own family consumption	16 (100.0)	38 (86.4)	85 (93.4)	87 (88.8)	49 (75.4)	18 (81.8)
Others	16 (100.0)	42 (95.5)	85 (93.4)	98 (100.0)	60 (92.3)	19 (86.4)

*Some farmer respondent for more than one disposing channel.

Figures in the parentheses indicate percentage to total number of respondents of that area.

Regarding distribution of potato growers in different studied areas according to their citation of problems for storing potato at home, it was estimated that 47.5% growers cited weight loss as a problem. Rot problem was cited by 41.3% growers among the studied areas. While working with 120 farmers at Bogura, Hossain (2012) reported that all the studied farmers mentioned the rot problem as a challenge in home stored potato. Hoque *et al.* (2016) quantified and recorded an average of 7.63% rotting loss and 18.5% cumulative weight loss at 150 DAS in 15 high yielding potato varieties irrespective of size. They also reported that large and medium sized potato could be stored under natural condition for 150 days with 13.9 and 5.9% total rotting loss, respectively. Disease as a problem for home stored potatoes was cited by 38.3% growers (Table 14). In Munshiganj, 80% growers cited the weight loss as a major problem for home stored potatoes. In Barisal-Patuakhali (46%) and Dinajpur-Thakurgaon (76%) areas, most growers cited the rot as major problem; while, majority growers of Joypurhat cited the rodent as major problem (56%). Disease as a major problem was cited by the growers of Jamalpur-Sherpur areas (93%) but the growers of Jashore-Chuadanga areas cited disease as well as insects as problem for storing potatoes at home. These sorts of discrepancies might be attributed due to prevailing weather condition of that area, places of home where the potatoes were stored and management followed by the growers during storage.

Table 14. Distribution of potato growers in different studied areas according to their citation of problems for storing at home

Problems*	Growers (%)						
	Munshiganj (n=100)	Barisal- Patuakhali (n=100)	Dinajpur- Thakurgaon (n=100)	Joypurhat (n=100)	Jamalpur- Sherpur (n=100)	Jashore- Chuadanga (n=100)	All (n=600)
Weight loss	80	32	52	1	24	96	285 (47.5)
Rot problem	12	46	76	14	6	94	248 (41.3)
Rodent	15	12	2	56	1	8	94 (15.7)
Disease	10	24	2	1	93	100	230 (38.3)
Insects	18	10	14	3	5	100	150 (25.0)

*Some farmer respondent for more than one problem.

Figures in the parentheses indicate percentage to total number of respondents of that area.

Conclusion

- More cold storages need to be constructed in Barisal-Patuakhali, Jamalpur-Sherpur, Jashore-Chuadanga and other areas.
- Farmers' cooperative may be organized involving DAE and Department of Agricultural Marketing (DAM) personnel to solve various problems in cold as well as home storage.
- Stored potatoes both in cold and home storage are at present disposed up mainly to the local *paikers* and the farmers do not get expected price of their products. Therefore, respective organization should take initiative to ensure a good price for the farmers.

Acknowledgement

The authors acknowledge the Authority of ACI Agribusiness, Dhaka, Bangladesh for providing fund to carry out this research work successfully.

References

- Azad, A.K., H. Kabir, T.E.J. Eaton and E.B. Soren. 2017. Storage potentialities of some exotic potato varieties at farmers' condition in Bangladesh. *Agricultural Sciences*, **8**: 183-193 [<https://doi.org/10.4236/as.2017.82013>].
- BBS. 2020. Yearbook of Agricultural Statistics-2019. 31st Series, May 2020. Bangladesh Bureau of Statistics (BBS). Statistics and Informatics Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh. pp: 367-374.
- Bhattacharjee, A., T. S. Roy, M. M. Rahman, M. N. Haque and U. Rahima. 2014. Influence of variety and date of harvesting on post-harvest losses of potato derived from TPS at ambient storage condition. *Int. J. Sustain. Agril. Tech.* **10**: 08-15.
- Hajong, P., M. Moniruzzaman, M.I.A. Mia and M.M. Rahman. 2014. Storage system of potato in Bangladesh. *Universal Journal of Agricultural Research*. **2**(1): 11-17 [DOI: 10.13189/ujar.2014.020102].
- Hoque, M. A. 2011. Final Report on "Increasing storability of potato in natural storage and income generation through small scale processing of potato" Project, BARI, Munshiganj. May 2011. Krishi Gobeshona Foundation (KGF), Phase-I Project, Bangladesh Agricultural Research Council, Farmgate, Dhaka.
- Hoque, M. A. 2014. Final Report on "Piloting for upscaling the technology of potato storage under natural condition" Project. Department of Horticulture, BSMRAU and Krishi Gobeshona Foundation (KGF), CGP Project, Bangladesh Agricultural Research Council, Farmgate, Dhaka.
- Hoque, M. A. and K. T. Akter. 2014. Local improved method for home storage of potato (*In Bengali*). Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706 and and Krishi Gobeshona Foundation, BARC Campus, Farmgate, Dhaka. Pp. 1-16.
- Hoque, M.A., A.S.M. Nahiyen, M.A. Siddique, L. Rahman and A. Raihan. 2018. Production, storage and marketing of table potatoes in selected areas of Bangladesh. ASRBC-ACI Agribusiness, Dhaka and BSMRAU, Gazipur. 36p.

- Hoque, M.A., T. Yeasmin and N.U. Ahmed. 2016. Storability of different sizes of potato tubers under natural condition. *Annals of Bangladesh Agriculture*. **20**(1&2): 75-85.
- Hossain, M.A. 2012. Postharvest challenges on potato in northern area of Bangladesh. An unpublished MS Thesis. Submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka-1207.
- Hossain, M.A. 2016. Value chain analysis of potato in selected areas of Bogra and Munshiganj districts of Bangladesh. An unpublished MS Thesis. Submitted to the BRAC Institute of Governance and Development, BRAC University, Bangladesh.
- Hossain, M.A. and M.A.M. Miah. 2011. Assessment of post-harvest losses of potatoes in Bangladesh. *Asia-Pacific Journal of Rural Development*. **XXI**(2): 79-94.
- Moazzem, K.G. and K. Fujita. 2004. The potato marketing system and its changes in Bangladesh: from the perspective of a village study in Cumilla district. *The Developing Economies*. **XLII**(1): 63-94.
- Rabbani, M.G., M.A. Siddique, M.M. Islam and M.S. Islam. 2010. The Potato Sector in Bangladesh: Its Challenges and Opportunities. Katalyst, Dhaka, Bangladesh.
- Raghav, M. and N.P. Singh. 2003. Differences among potato cultivars for their storability under room temperature. *Progressive Horticulture*. **35**: 196-198.