Progressive Agriculture, Vol. 30, Suppl. 1: 51-56, 2019 ISSN: 1017 - 8139

Progressive Agriculture
Journal homepage:http://www.banglajol.info/index.php/PA

Efficacy of diversified rice storage technologies in Bangladesh

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Abstract

Storage of rice is crucial postharvest operation. Traditional rice storage structures vary over local resources, climate and culture in Bangladesh. This study was carried out to investigate the efficacy of diversified rice storage structures at farmer's level. Household survey was conducted through face to face interview of farmers using developed pretested questionnaire. Rice samples were also collected to test the quality of stored rice. Six different types of traditional structures namely *Dole*, Steel drum, Plastic bag, Plastic drum, Gunny bag and *Motka* for rice storage were identified. Maximum insect infestation in stored rice was observed in *Dole* followed by *Motka,* Plastic Bag and Plastic drum. This may be due to upper surface of *Dole* was open. Germination capacity went down to 68% in Plastic bag, 55% in *Motka*, and 80% in Plastic drum. Rice storage in Plastic drum was found effective in terms of insect infestation and germination capacity in comparison with other traditional storage structures *Motka*, *Dole* and Plastic bag. Therefore, Plastic drum can be an alternative option in rice storage.

Key words: Rice, storage, structures, diversified, effective

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Introduction

In Bangladesh, malnutrition rates is the highest in the world with more than 54% of preschool-age children (about 9.5 million) stunted and underweight, according to the FAO (World Grain, 2017). In Bangladesh, most potentially arable land is already in production, and future food needs can only be met through intensification (FAO, 2014). Bangladesh with an area of 1, 47, 570 sq.km is the most densely populated (about 1008 Persons per km) country of the world. Its present population is about 159 million which is increasing annually at the rate of about 1.42 percent (BBS, 2011). By the year 2050 AD, the population will increase to about 200 million (FAO, 2014). On the other hand, the cultivable land is decreasing by 1% every year. So Bangladesh has to produce additional food for millions of people every year. Bangladesh is predominantly a rice growing country and rice is the staple food. Rice occupies about 80 % of the total cropped area and is cultivated in three seasons a year. Thus, rice plays a vital role in the livelihood of the people of Bangladesh. Rice is the staple food and the agro climatic condition of Bangladesh is very much favorable for rice production. Moreover rice cultivation is cultural heritage of the country. Farmers grow Aus, Aman & Boro rice as a common crop in all the year round (BBS, 2008). It provides nearly 48% of rural employment, about two-third of total calorie supply and about half of the total protein intakes of an average person in the country. The food department of the government of Bangladesh recommends 410gms of rice per head per day. Total rice production in Bangladesh was about 10.59 million tons in the year

1971 when the country's population was only about 70.88 millions. Bangladesh is now producing about 27 million tons to feed her 139 million people. This indicates that the growth of rice production is much faster than the growth of population. This increased rice production has been possible largely due to adaption of modern rice varieties on around 66% of the rice land which contributes to about 73% of the country's total rice production (BBS, 2009)

The population of Bangladesh is growing by two million every year and may increase by another 30 million over the next 20 years. Thus, Bangladesh will require about 32.26 million tons of rice for the year 2020. During this time total rice area will be also shrinking to 10.28 million hectares. Rice yield therefore, needs to be increased from the present 2.74 to 3.74 t/ha (BBS, 2009)

At farm household level, storage is essential for food security or as a commodity bank for consumption into cash when required. Unfortunately, small scale or marginal farmers often lack of the resources to store large amounts of grain and do not have a large storage structures, they therefore are bound to sell their paddy to traders or buyers immediately after harvest. They carry out no further processing (drying, cleaning, grading) because of the immediate need for cash, and there is a lack of incentive to dry, as there is no significant difference in price between wet and dried paddy. The paddy is only dried for safe storage, and only the amount of necessary for consumption or a little more foe cash conversion or to sell at a better price.

According to Awal (2016), the losses of rice grain during processing and storage was as high as 22%. The losses were likely to be higher in Bangladesh in comparison with developed countries where better storage systems were employed.

In most of the areas of Bangladesh, the farmers and remote areas living people store food grains in most of their household traditional storage structures like Dole, Berh, Gola, Gunny bags, steel drum and Plastic Drum etc. These structures are not so durable and poor in providing optimum storage conditions. The grains stored in these structures are susceptible to damage by natural calamities like heavy rainfall, flood, cyclone and attack of micro organisms, insects and rodents which cause a considerable damage and loss every year. Storage loss in our country is relatively high due to improper storage structure, lack of knowledge about storage to the farmers and traders and improper management during storage period. The net availability of rice is considerably less than its gross production due to all these factors.

As storage is one of the most critical post harvest operations, it deserves special attention in order to estimate the economic magnitude of its negative impact. It may be interred that total post harvest losses around 14%, while the average losses in storage alone 4.5%. In fact, poor storage practices are one of the main causes of losses in the various stages of the post harvest system (Cleverly, 1994). The estimated total postharvest loss of rice paddy in Bangladesh was about 14%, of which drying and storage losses are 2.3% and 3.8%, respectively (World Grain, 2017).

Bala *et al.* (1993) found that paddy stored in a Dole was found to be good in terms of temperature, germination capacity and 1000-grains weight in comparison with paddy stored in a berh or Dhan gola.
Eswarappa *et al.* (1991) reported the germination of paddy grains stored in gunny bags under ambient conditions decreased rapidly stored in coulter drum or plywood bin for a period of six months storage. Pest infestation and temperature was higher in gunny bags compared with grain stored in other containers and moisture contents were similar in grain stored in the three containers.

Bhuiyan *et al*. (2006) found germination capacity of rice ranged from 96 to 94% in steel drum, 96 to 84% in Dole, 96 to 70% in gunny bag, while no change in germination was observed in plastic drum (96%). The level of insect infestation was greater with increased temperature. The study indicated that steel and plastic

drums may be used for the storage of paddy seeds for more than 5 months without much deterioration of seed viability and quality. Therefore, an attempt was carried out to identify existing storage technologies at farm level and determine efficacy of those for rice storage.

Materials and Methods

***Location*:** The experiment was carried out to identify the existing paddy storage structures and determine the efficacy of those collecting stored rice samples from the selected site of Phulpur, Mymensingh district. Phulpur is located at 24.9500°N, 90.3500°E of Mymensingh district as shown in Figure 1.

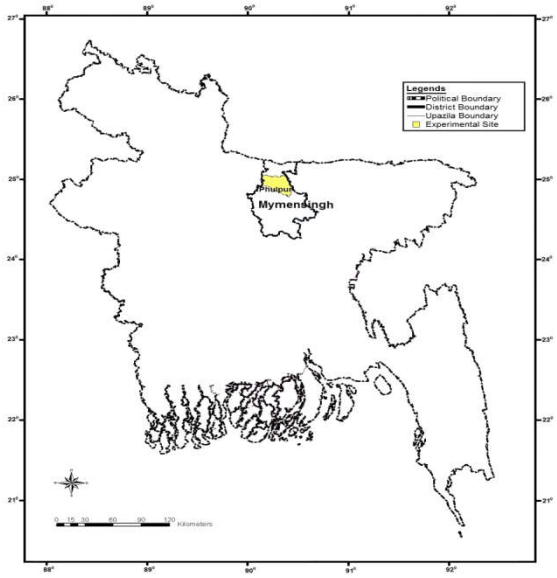

Figure 1. Location of research area at Phulpur, Mymensingh of Bangladesh.

***Household selection*:** Twenty five household was surveyed to identify traditional storage structures used by farmers through pretested questionnaire. Ten farmers were selected to evaluate rice stored in traditional storage technologies at farmer's houses at each villages of Phulpurupazilla in Mymensingh district, Bangladesh as shown in Table 1. Four village of this site was Nagua West, Nagua East, Chalk Nagua and Fatepur at Phulpur, Mymensingh.

Table 1. Field experimentation at farmers' house site.

Area/Site	Villages	No. Farm Household Survey	Sample Tested (House hold No.)
Phulpur, Mymensingh	Nagua East	25	10
	Nagua West	25	10
	Fatepur	25	10
	Chalk Nagua	25	10

***Insect infestation*:** Rice sample of 250 g was collected from the top layer of farmer's storage technologies (10-15 cm) by a sampler and kept in polythene bag with an identification card and tied with a thread as shown in Figure 2. The samples were separately selected from farm households from each area for the study. For easy identification and counting, samples were kept in deep freeze (2-4^{0}C) for few minutes to make insect immobile. Then total number of insect was counted for each sample. Different prevailing insects were identified based on their respective identifying character.

***Germination test*:** Germination (%) of stored rice was determined on sand media in plastic box following the International Seed Testing Rules (ISTA, 1999). Germination capacity was calculated by the following formula:

$$\text{Germination } \% = \frac{\text{Number of normal seedlings}}{400} \times 100$$

Figure 2. Germination test of stored rice sample.

Results and Discussion

Traditional storage technologies used at farmers' level: Six different traditional storage technologies i.e. *Motka,* Plastic bag, *Dole*, Steel drum, and Plastic drum were identified. Among these, Plastic bag was the mostly used storage containers by farmers for storing rice for short duration and also carrying rice from field to farmers' premises. On the other hand, *Dole, Motka,* Steel/Plastic drum were the containers used for long period of storage. Photographic view of storage technologies commonly used by farmers' in the study areas is shown in the following:

a) Motka: *Motka* is earthen container of varying sizes and made of clay, and burnt in kilns. It is made by potter and sold in the local markets and are used extensively by the farmers for storing rice seed and grains. Its capacity varies from 80-200 kg. Photograph of representative technology of *Motka* as found in the locality is shown below in Figure 3(a).

b) Plastic bag: Plastic bag is made of poly propylene as shown in Figure 3(b). Farmers get this in local market. It is cheap, light in weight and handy. Rice is popularly stored in Plastic Bag and heaped on a raised platform. Its' capacity ranges from 40-50 kg.

c) Dole: *Dole* is a cylindrical or oval shaped container with an open upper surface. It stands under cover on layers of straw or rice husk. To load and unload larger capacity *Dole*, sometimes ladder is used. Its usual capacity ranges from 180-1000 kg. Photograph of representative technology of *Dole* as found in the locality is as shown in Figure. 3(c).

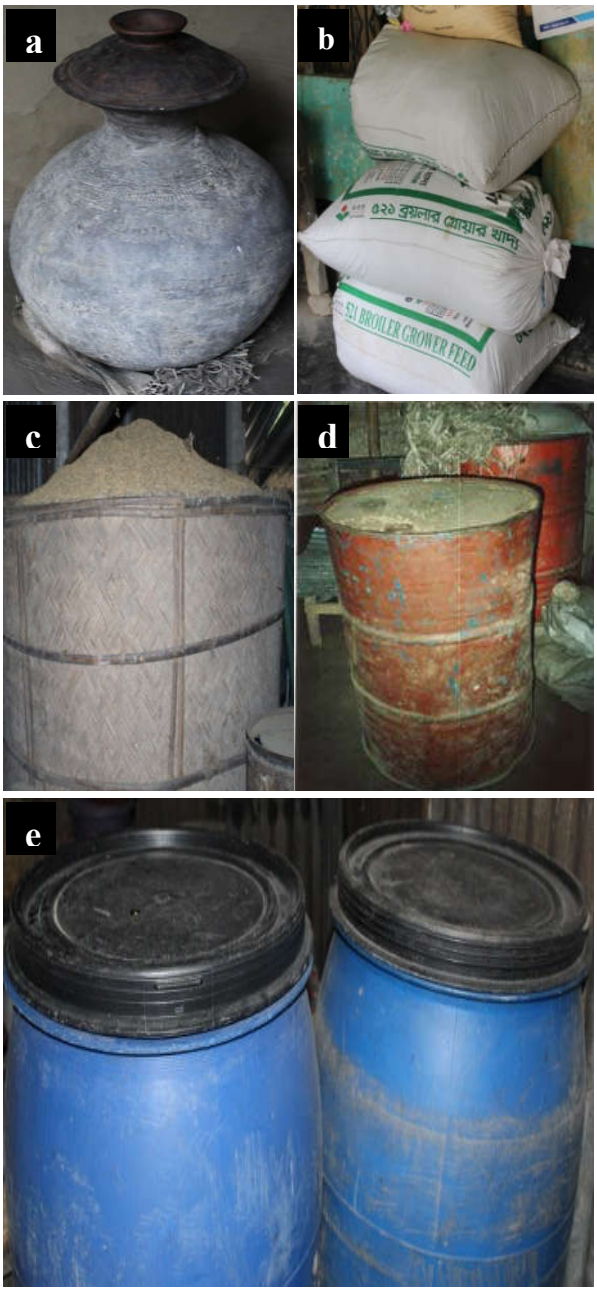

Figure 3. Traditional rice storage structures (a) Motka, (b) Plastic bag, (c) Dole, (d) Steel drum and (e) Plastic drum in Bangladesh

d) Steel drum: Steel drum is of cylindrical shape of steel. The materials are light in relation to their strength and their homogeneous nature. Steel Drum, after having filled with grains or rice seed, the top opening is kept closed by a lid. Its capacity ranges from 20-200 kg. Photograph of representative technology of Steel Drum as found in the locality is shown below in Figure 3(d).

e) Plastic drum: Plastic drum is cylinder with a narrow opening at the top. It is usually placed inside the room. Its capacity ranges from 20-40 kg. Photograph of representative technology of Plastic Drum as found in the locality is shown in Figure 3(e).

***Effect of storage structures and insect infestations on stored rice*:** Maximum insect infestation (142/ 250 g) of stored rice was found in *Dole* followed by Motka, and Plastic bag during five month of storage as shown in Figure 4. This may be due to upper surface of *Dole* was open. The least amount of insects was found in stored rice in Plastic drum.

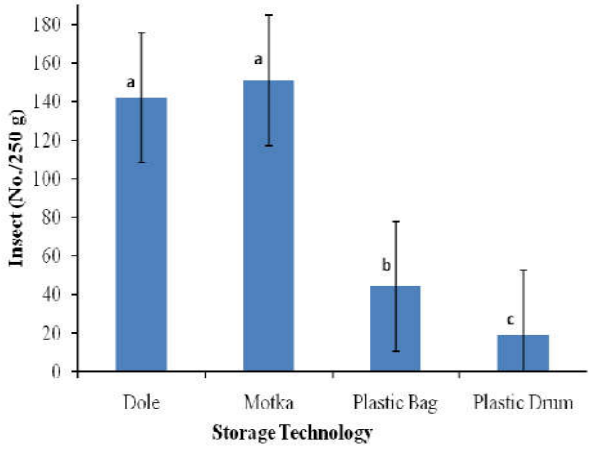

Figure 4. Insect infestation in stored rice in different technologies

***Germination capacity of stored rice at different traditional technologies*:** Germination capacity of stored rice was recorded 93% or above before storage in *Motka* and Plastic drum, Plastic bag, and *Dole*, respectively. Then it decreased moderately to 80% of rice stored in Plastic drum. In case of stored rice in *Dole*, Plastic bag and *Motka*, it declined drastically to 73%, 68%, and 55%, respectively as shown in Figure 5. Least germination percentage of stored rice was observed in *Dole* followed by plastic bag is undoubtedly due to persistence of high temperature, moisture content and insect infestation.

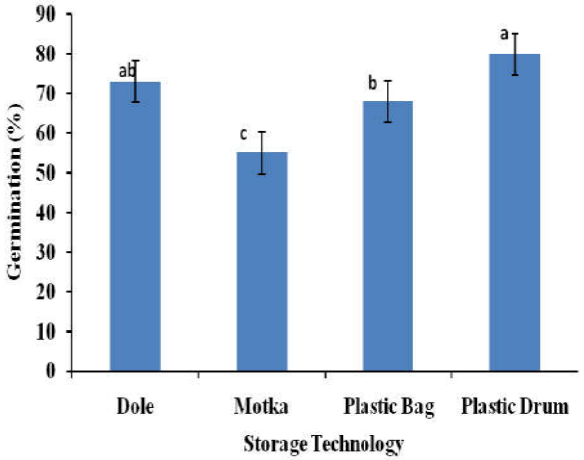

Figure 5. Germination (%) of stored rice in different technologies

Among the different storage structures, Plastic drum bag is the best storage structure for high germination capacity.

Conclusions

In Bangladesh, a fraction of population suffers food insecurity due to poverty, natural hazard, manmade calamity and unemployment of a group of people. A safe storage system of rice is important for ensuring food security especially for the people who are fully dependent on agriculture. Rice is generally stored by the farmers to meet their own consumptions throughout the year and seed for next sowing season. Six types of traditional rice storage structures were identified used by the farmers at Mymensingh District. This finding coincides with other researcher result (Hossain *et al*, 2015). Highest insect infestation of stored rice was found in *Dole* whereas the least amount of insect infestation was observed in Plastic drum after five

months of storage followed by plastic bag. It might be due to persistence of high moisture content and high level of oxygen. Due to open upper surface and porous behavior of *Dole,* favors of growth insects more than that in other structures. After five months of storage average germination capacity was fall down to 73%, 55% in *Dole* and Plastic bag, respectively but it was within seed standard (80%) in Plastic drum. Among the different storage structures, Plastic drum is the best storage structure for rice storage. This finding agreed with Bhuiyan *et al*. (2006). Therefore, Plastic drum can be an alternative option in rice storage.

Acknowledgement

This study is made possible by the support of the American People provided to the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss through the United States Agency for International Development (USAID). The contents are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

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