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Hermetic Bag: A Farmers Friendly Paddy Storage Technology in Bangladesh

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ABSTRACT

In Bangladesh, most of the farm households store paddy to meet their own consumption, facing emergency needs and seeds for the next sowing season in traditional storage technologies which susceptible to insect, rodent and mold. Training and Focus Group Discussion (FGD) were conducted to disseminate hermetic (PICS and GrainPro) bag at Mymensingh and Jashore regions. The participants learned the use of moisture meter in paddy drying and safe storage. Pedagogical approach was followed in the FGD among 100 farmers of different age with their spouse. Farmers' perception about these bags was also taken. Traditional storage technologies namely, *Dole, Motka,* Guny Bag, *Bamboo Gola, Dhari, Bamboo Auri,* and *Berh* were identified which are not durable or functional in Bangladesh. Among these, *Dole* and Plastic Bag for consumption, and *Motka* and Plastic Drum were found suitable for paddy seed storage. Women taught to neighbors about the operation of moisture meter and HB. About 87, 13% farmers prefer 10-20 and 40-50 kg size HB in Mymensingh while 82 and 18% farmers of Jashore prefer corresponding sizes of bags for seed purposes. For sale and consumption purposes, about 40, 35 and 20% farmer preferred 500, 1000 and 2000 kg size HB in Mymensingh. On the contrary, about 26, 38 and 36% farmers prefer same size of HB in Jashore. Farmer shown keen interest about HB and concerned of its high price. They opined price of 40-50 and 500-2000 kg size HB should be within Tk. 20 and Tk. 200, respectively. Both female and male farmers can store paddy in it properly. Price of hermetic bag is high, ranked as no. 1 problem followed by its availability in different sizes locally. However, HB was found effective in paddy storage in Bangladesh.

Keywords: Hermetic bag, Farmers, Friendly, Technology, Paddy, Seed, Storage, and Consumption.

INTRODUCTION:

Bangladesh is the third largest paddy producer in the world (Statista, 2023). USDA reported Bangladesh to import around 100,000 tons of rice in 2015 (Sujan, 2014). The reason is huge population burden over the decreasing arable land and resources, increasing the climatic adversaries are the added issues too. The rate of population increase was 2.23 million a year since 1950 to till to date whereas rice production was at the rate of 0.03 million metric ton (Daily Sun, 2015). In present context, to fulfillment of uniform consumption throughout the year, storage of produced paddy is must require. Quality paddy seed is a prerequisite for stable paddy production in the country. Yearly demand of paddy seed in Bangladesh is about 3.583 million metric ton. The contributions of public sector (BADC, DAE, BMDA), private sector and farmers to farmers transaction are 26.09%, 18.08% and 55.83%, respectively (MoA, 2022). In Bangladesh, most of the farm households are using the traditional storage

systems, Dole, Motka and Gunny bag for their own consumption and seed purposes of rice (Hossain *et al*, 2020) to meet their own consumption, facing the emergency needs and seeds for the next sowing season by the existing traditional storage technologies *Gola, Dole, Motka, Dhari, Gunny bag or sacks* which are not durable or functional in Bangladesh. Stored paddy in such structures is proned to damage due to biological, environmental and other factors. Seed is basic input of agriculture for quality crop production.

Only 10% of certified seed is available in Bangladesh (Hossain *et al.*, 2020; Fakir *et al*., 2002). Hot and the humid weather favors the rapid insect population development and deterioration of seed in Bangladesh. Combined effort of public and private sectors had been able to meet on average only about 41% of the total requirement, indicating that, on average, about 59% seeds are being used from seeds retained by the farmers (http://www.thedailystar.net/dilemma-in-quality-rice-seed-production-37652). Loss in storage by various factors was reported to be 15% (Khan, 1991) in Bangladesh. Insects were the number one factor causing 10% losses in storage (Islam, 1984). Storage losses of paddy are higher in Bangladesh compared to other developing countries where better storage systems are available (Hossain *et al.*, 2020; Abedin *et al.,* 2012). Studies showed that the losses of rice in post-harvest operations in Bangladesh were more than 13% (Hossain *et al.*, 2020; Calverley, 1994; Quasem and Siddiquee, 2009). The net avail-ability of paddy is considerably less than its gross production due to all these factors. To meet up the food requirements of the ever growing population of the country, the quality seed and improved storage technology may contribute as vital factors. In Bangladesh, about 85 percent of country's seed system is managed by farmers storing in existing technologies which involve saving seed from own harvest, and using seed for re-sowing, sharing, exchanging and bartering (CUTS International, 2013). Seed comes from farmers own saved sources which are not standard in quality specially germination capacity is quite low compared to existing provision of seed standard of the country (Bashar & Nasiruddin, 1995; Hossain *et al*., 2021).

Hermetic bag is effective to control insects in stored paddy, without the use of the chemical pesticides (Hossain *et al.*, 2020). In this method the storage atmosphere is modified by the sealing the container hermetically, so that a low oxygen (O_2) and high carbon dioxide (CO_2) atmosphere is obtained after a few weeks of storage (Navarro and Donahaye, 1994). Rice seeds stored in airtight conditions remained with water content unchanged, free of infestation and viable for a period of 7 months, and presented a germination index between 30 and 70% higher when compared with non airtight controls (Hossain *et al.*, 2020; IRRI, 2013). Similarly, experiments showed in Mexico, the airtight storage kept the germination potential at levels greater than or equal to 85% during a storage period of > 9 months, while a reduction to levels between 14% and 76% in a period of 3 months were observed under the local traditional storage in jute sac reduces germination down by 14% to 76% within 3 months (Omondi *et al.,* 2011). In Rwanda, airtight storage during a period of 30 months did not affect grain appearance or the germination potential (Villers *et al.,* 2008; Navarro, 2012). Hermetic storage also preserves the germination power by effectively controlling the density of insects that would otherwise cause significant damage during storage (Weber, 2001; Hossain *et al.*, 2020). In Bangladesh, the technology is new and sophisticated to use and farmers are not aware about safe condition of storage. Therefore, Training and Focus Group Discussion (FGD) were conducted to disseminate of hermetic (PICS and GrainPro) bag and fulfill the following objectives;

1) To demonstrate hermetic (GrainPro and PICS) bag in farmer's level.
2) To know farmers perceptions about hermetic bag.

METHODOLOGY:

GrainPro bag, PICS bag, Moisture meter, Camera, Tie clip, Plastic rope, Laser pointer and a bangle poster technique and use of hermetic bag was used. Pedagogical approach was followed in the FGD among 100 farmers of different age with their spouse of the study areas as shown in **Fig. 1**.

Study site

Phulpur is located at 24.9500°N 90.3500°E of the Mymensingh district. It has 88,708 units of house hold and total area is 580.21 km². Mymensingh is one of the districts of Dhaka division, Bangladesh, located in between 24°15´ and 25°12´ north latitudes and in between 90°04´ and 90°49´ east longitudes and is bordered on the north by Meghalaya state of India and Garo Hills, on the south by the district Gazipur, on the east by districts of Netrokona and Kishoreganj,

and on the west by districts of Sherpur, Jamalpur and Tangail. Manirampur upazilla of Jashore district is located at 23.0167°N 89.2333°E. Manirampur, the second largest upazila of Bangladesh with an area of 444.72 square kilometres. Jashore is a district in the southwestern region of Bangladesh. It is located in between 22°48' and 23°22' north latitudes and in between the 88°51' and 89°34' east longitudes. It is bounded by Jhenaidah and Magura districts on the North, Satkhira and Khulna districts on the south, Narail and Khulna districts on the east, West Bengal state of India on the west. These study sites as shown in **Fig. 1** were selected with the facilities of adequate road facility, farmers' attitude to co-operation and availability of all storage structures used for storage by farmers.

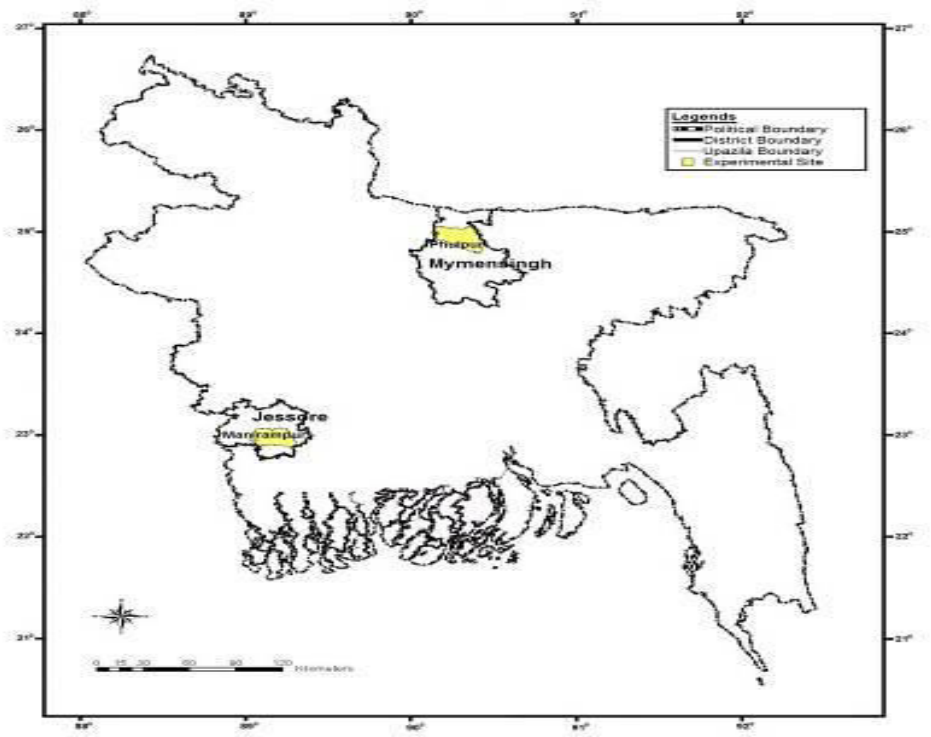

Fig. 1: Study sites at Phulpur, Mymensinh and Manirampur, Jashore.

Moisture meter

Moisture content of paddy and seed was determined at different stages of post-harvest operations such as harvesting, drying and storing using moisture meter (John Deere Moisture Chek PLUS^{TM}, SW08120) as shown in **Fig. 2**. Moisture content will be expressed as percentage on dry weight basis. The procedure of use of moisture meter was taught to participants as shown in **Fig. 3**. The cap of the moisture meter was removed. The test cell was checked for any seeds or other materials. The test cell was made free from all kinds of material and cleaned by tissue paper. Then the meter was started by pressing on/off. The monitor showed "ALWAYS AVERAGE 3 TESTS". Crop selection was made by pressing "selected'' button. For this study in case of rice large, medium or short was selected according to its varietal trait. Then the test cell was filled with sample to be tested, pressed test button and waited few seconds. Moisture content (%) and temperature (^{0}c) were displayed for about 10 seconds. The tester returned displaying the name of the last grain tested. Data were stored in memory and made average of those. After recording data in the register, memory must be cleared before taking next data. The test cell was refilled with a fresh sample and tested.

Fig. 2: John Deere Moisture Check Plus Grain Moisture Tester SW08120.

Fig. 3: Demonstration on operation of moisture meter in Jashore and Mymensingh.

GrainPro bag

GrainPro Bag as shown in the **Fig. 4** built on its innovation in hermetic storage, with a second generation of the ziplock Super Grain bags. Agricultural commodities stored in those bags develop a modified atmosphere of low oxygen and high carbon dioxide content. This hermetic storage is created by the respiration of the living organisms in the commodity such as insects and fungi. Commodities can be stored for prolonged periods without the use of chemicals and refrigeration and without the risk of moisture ingress. The result is that aroma, color, freshness and germination are preserved, rancidity is prevented and insect infestation and fungi are controlled. GrainPro storage products can safely carry a vast range of dry agricultural commodities (e.g., rice, corn, cocoa beans, coffee, barley and species).

Fig. 4: GrainPro Bag.

Procedure of GrainPro bag use

1) GrainPro bag was placed inside of a storage bag
2) GrainPro bag was filled with seed or grain
3) Make sure that you do not overfill, do not puncture or damage
4) Before sealing, it must be sure that the bag is airtight.
5) Then the outer bag should be closed.
6) It is not allowed to carry the grain by holding on to the GrainPro bag. The outer bag must be used for carrying grain bag.
7) Remove air above the grain by the twisting the upper portion of the bag
8) Seal properly, inspect the GrainPro Bag. If there are insects are crawling inside, check sealing.

Re-using the GrainPro bag

1) Re-use the GrainPro bag as long as it is airtight. To check for holes.
2) Fill the GrainPro bag with air, Seal it
3) Compress the bag and observe for air loss

PICS bag

Purdue Improved Crop Storage (PICS) bag provides a simple, low-cost method of the reducing post-harvest losses. A PICS bag as shown in **Fig. 5** consists of two layers of polyethylene bags, are surrounded by a third layer of woven polypropylene, thereby creating a hermetically sealed environment in which paddy is stored. After harvesting and thoroughly drying the grain, farmers place paddy into a polyethylene bag capable of holding 50 kg. The bag is then tightly sealed, the preventing air from entering. The first polyethylene bag is surrounded by a second identical bag, which is also sealed, making it airtight. The double-bagged cowpeas are then sealed inside a third woven nylon bag, which provides the mechanical strength for PICS bags. This method of triple bagging creates an airtight environment, and seals any crop inside the bag was described to participants as shown in **Fig. 6**.

Fig. 5: PICS Bag.

Method to use PICS bag

1) It should be sure, crop is completely dry and clean before storage.
2) Put the three bags together (one inside the other). Fill the inner bag with seeds/grain make sure no seed/grain gets between the bags.
3) Fill the PICS bag far enough so that the lips remains for tying. Pack the seeds and the grain tightly to remove air.
4) The lip of the first bag was the shut twisting tightly. It was folded over and tied firmly with a heavy string at the base of the twist and over the folded twist.
5) Pull the middle bag up over the first one so that it completely surrounds it. Fold and tie, as before, follow the same steps for the outer bag.
6) Keep it safely after a use. Reuse PICS bag for storage without chemical to safe and save grain

Fig. 6: Bengali poster on how to use hermetic bag.

Farmers' perception about HB

The facilitator prepared seven questions on hermetic (PICS and GrainPro) bags which were asked to the participants during the discussion. Farmers' perception about GrainPro Bag of the experimental areas was taken through FGD as shown in **Fig. 7**. Besides this, they learned the use of moisture meter in paddy drying and safe storage. A woman taught to her neighbor the operation of moisture meter as shown in **Fig. 8**.

Fig. 7: Demonstration about use of GrainPro bag and PICS Bag.

Fig. 8: Interview conducted for farmers' opinion taken about GrainPro Bag.

Fig. 9: Trainee teaches moisture meter and GrainPro bag use.

Fig. 9, 10, 11 and **12** showed about 87, 13% farmers prefer 10-20 and 40-50 kg size hermetic bag in the Mymensingh while 82 and 18% farmers of Jashore prefer corresponding sizes of bags for seed purposes. For sale and consumption purposes, about 40, 35 and 20% farmer preferred 400, 1000 and 2000 kg size hermetic bag in Mymensingh. On the contrary, about 26, 38 and 36% farmer prefer same size of hermetic bag in Jashore.

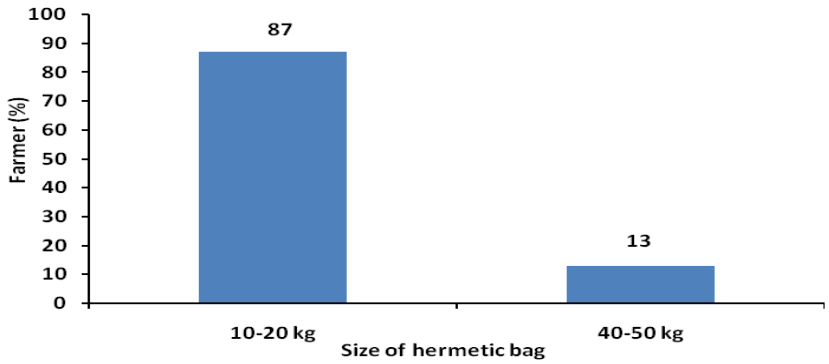

Fig. 10: Preference of storage bag size for seed purposes in Mymensingh.

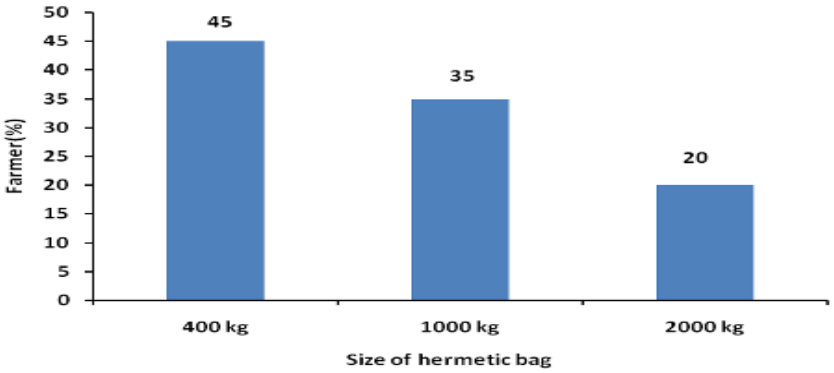

Fig. 11: Preference of storage bag size for sale and consumption purposes in Mymensingh.

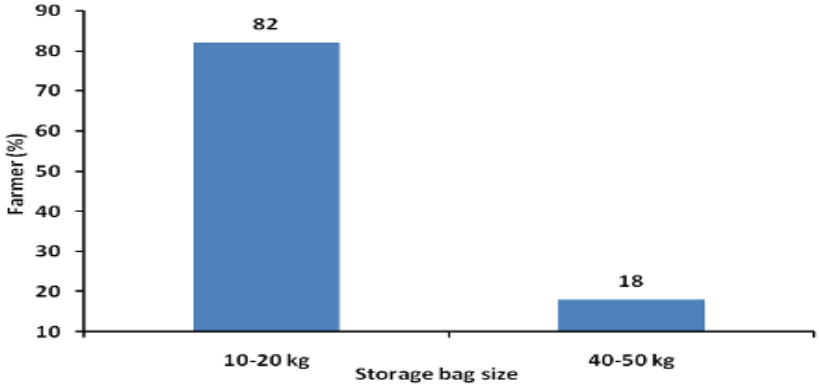

Fig. 12: Preference of storage bag size for sale and consumption purposes in Jashore.

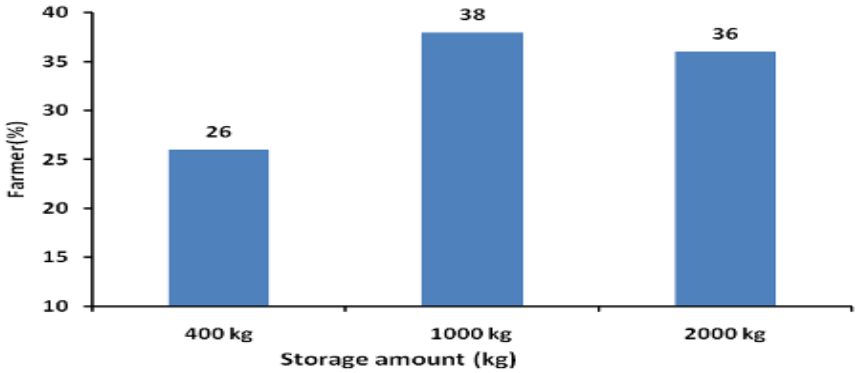

Fig. 13: Preference of storage bag size for sale and consumption purposes in Jashore.

Price of hermetic bag

Farmer shown keen interest about hermetic (PICS and GrainPro) bags and concerned of its high price. They think price of 40-50 kg size GrainPro bag should be within Tk. 20-25. Few farmers opined that its price may be maximum Tk. 100-120.

CONCLUSION:

HB emerged as an alternative of traditional technologies in the paddy storage. The participants gained knowledge about safe paddy storage and the drying techniques using moisture meters. *Dole* and Plastic bag for consumption, as well as *Motka* and Plastic drum, were shown to be suitable for storing paddy seeds. Women instructed their neighbors on how to use HB and the moisture meters. In Mymensingh, roughly 87, 13% of farmers choose 10-20 and 40-50 kilogram size HB, while 82, 18% of farmers in Jashore prefer comparable sizes of bags for seed. In Mymensingh, over 40%, 35%, and 20% of farmers selected 500, 1000, and 2000 kg size HB for sale and consumption, respectively. In contrast, farmers in Jashore prefer the same size HB by roughly 26, 38, and 36%. Farmer has expressed a significant interest in HB and is worried about its exorbitant price. They said that the prices of HB in the sizes of 40-50 kg and 500-2000 kg should be around the 20 and 200 Tk., respectively. In both locations, paddy stored in the GrainPro bag remained insect-free for six months of storage, whereas the traditional storage methods produced rice weevil and red flour beetle infestations. To prevent ant, insect, and rat attacks, about 27 and 13% of farm householders put GrainPro bags in drums or earthen pots that were hung to the roof of their homes. Farmers of any gender can store paddy in it effectively. The most significant issue with hermetic bags is their high cost, followed locally by their lack of availability in various sizes. However, HB was successful in Bangladesh in storing paddy.

CONFLICTS OF INTEREST:

The authors have no conflicts of interest about the manuscript publication.

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