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Indigenous storage of foodgrains and seeds in mid-hills of Jammu division, Jammu & Kashmir

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Indigenous grain storage practices are being followed by the farmers for long, especially in hilly remote areas. These traditional grain storage practices are location specific and economical for farmers, especially for resource-poor farmers. Therefore, a research pursuit was undertaken to identify, collect and document traditional storage practices followed by the farmers of Bachhal, Katwalt, Marothi, Chillar, Bashat and Gori Kund Sudh-mahadev villages of Chenani block of Udhampur District and Machhedi, Nongalla, Sukral, villages of Kathua District of Jammu and Kashmir. Data were collected from key-informants particularly from aged farmers by employing different participatory rural appraisal techniques. In the present paper, important existing traditional grain and seed storage practices adopted by the mid-hills farmers have been discussed in detail how these traditional practices help in keeping grains in good quality after harvesting.

Keywords: *Dall*, Indigenous technologies, Kothar, Post-harvest losses, Storage pests, Traditional storage

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Agriculture is the main source of livelihood for the vast majority of the rural population in India and especially in hilly areas where resources are very limited. Despite limited irrigation facilities, fragmented and small landholdings and non-availability of modern inputs, agriculture in Himalaya has supported its people for generations in adverse conditions and continued to remain, even today principal source of livelihood[1]. India's food grain production has increased manifolds, but the main issue which the Indian farmers are still struggling with is of proper storage after harvesting. Losses during storage, account for around 6% of the total losses as proper storage facilities are not available[2]. Food grain storage plays an important role in preventing deterioration which is caused mainly by fluctuating temperature and humidity conditions due to changing climate. Moreover traditional grain storage plays an important role in preventing losses, which are caused mainly due to weevils, beetles, moths and rodents[3]. Although, use of chemicals and improved iron structures have increased to a large extent for controlling stored food grain pests but still farmers in villages are practicing traditional practices based on their traditional knowledge for storing food grains especially in hilly remote areas. In the hilly area there is rich diversity of flora and fauna and local inhabitants based on the decade-old experience are using naturally available resources in the form of flora and fauna to their productive use. Farmers have developed their traditional ways especially in hilly and remote areas for carrying out their day-to-day activities and agriculture is no exception to this. Farmers are practically applying their traditional knowledge with a certain degree of success and failure and they rely fully on their indigenous knowledge. In the hilly remote areas there is always scarcity of resources due to tough hilly terrain sand farmers make maximum use of their traditional ways in agriculture right from sowing to storage and processing. Indigenous practices have advantages over outside knowledge; it is cost effective and readily available[4]. Indigenous practices are passed on from generations and an outcome of elder's wisdom and experience as a result of their close contact and deep knowledge of their environment[5]. Indigenous traditional knowledge should be documented at each and every instance which can be used by the present and next generation[6]. To make judicious and balanced use of valuable depleting natural resources; a sound,

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timely and need- based approach is undoubtedly a necessity of the day[7]. In this context, traditional/indigenous practices prevalent and practiced by the communities need to be preserved and practised[8]. Indigenous traditional methods have become essential component of sustainable agriculture and it varies from region to region[9]. Storing is an important activity in agriculture because it provides food grain for personal consumption throughout the year as well as seed for sowing next season crop. Healthy seed is the base for good future crop so traditional storage practices developed by the farmers help in keeping grain in good quality for seed purpose. Without high quality seed, other inputs and better technologies remain worthless[10]. Grain is also stored for seed and as inputs into household enterprises[11]. Grains are stored in different ways–indoors, outdoors or even underground[12].

Present study areas although rain-fed but rich in biodiversity and leading in vegetable production and farmers of this area follow different traditional practices of storing food grains and vegetable seeds. The prime objective was to document and highlight these traditional storage practices of farmers and bring them into main streamline of researchers, policymakers and to popularize these traditional practices among farming community through field extension workers.

Methodology

The present study was conducted to identify, collect and document the traditional storage practices of food grains and vegetable seeds in Bachhal, Katwalt, Marothi, Chillar, Bashat, Gori Kund Sudh-mahadev villages, of Chenani block of Udhampur District and Machhedi, Nongalla, Sukral, villages of Kathua District of Jammu and Kashmir. The study area falls in mid-hills of Shivalik range at an altitude of approximately 1225 m. Prior Information Consent (PIC) was obtained from the interviewee farmers before documenting their traditional knowledge regarding food grain storage. An open-ended questionnaire was developed for recording the views of farmers regarding traditional storage practices with proper photography. Participatory Rural Appraisal (PRA) techniques such as group discussion, transect walk were conducted to identify and gather detailed information about the indigenous food grain and vegetable seed storage being practiced by the local inhabitants in the selected villages. The detail information was collected from aged and experienced farmers practicing these traditional practices and local names of different tree species were also enquired from the informants. In total, 60 heads of farm families in different villages of Udhampur and Kathua districts constituted the sample as well as key informants of the study. Triangulation exercise was also done in the study villages to document valid, accurate and reliable information on traditional storage practices of farmers (Fig. 1). In-depth discussion was also held with field functionaries of agriculture and allied departments regarding traditional storage practices being followed by the farmers of study area.

Results

Traditional storage practices

A detailed description of the indigenous storage practices of different food grains and seeds being followed by farmers in mid-hills of Udhampur and Kathua districts of Jammu and Kashmir is presented below:

Traditional storage practices of maize (*Zea mays*)

Maize (*Zea mays*) is the major food grain crop grown in the study area and respondent farmers reported different traditional practices and structures associated with the safe storage of maize grains for personal consumption as well as for seed purposes.

1. *Use of grains of middle portion of maize cob as seed for sowing next season crop*

Respondent farmers reported that after harvesting of their maize crop, they store whole cobs of maize crop without shelling the grains in the jute bags for seed purposes. Farmers reported that they shell grains only at the time of sowing of maize crop in next season. Farmers further reported that they use grains of only middle portion of the stored cobs for sowing next season's crop. Farmers were of the view that

Fig. 1 — Triangulation of data

maize grains on unshelled maize cobs remain free from any sort of insect attack during the storage period. Further practice of using grains of the only middle part of stored maize cobs for seed purposes result in healthy maize crops having less height. Less height prevents the crop from lodging and it increases the productivity of maize crop as reported by farmers. Interviewee farmers further reported that using grains of the upper part of stored cobs results in weak crop plants and grains of the lower portion of stored cobs result in thicker cobs but shriveled grains.

2 *Use of Dyari* (*Toonaserrata*) *and Datura* (*Datura stramonium*) *leaves in stored maize grains*

Respondent farmers reported that they use leaves of *Toona serrata* locally known as *Dyari* for safe storage of foodgrains. *Dyari* tree is wild grown and abundantly available in the study area and farmers make maximum use of leaves of this tree for storage purpose (Fig. 2). Farmers were of the view that these leaves produce pungent smell which in turn repels the storage pests and thus saves their stored grains from any sort of insect attack. Local inhabitants also reported the use of leaves of *Datura stramonium* locally known as *datura* (Fig. 3) in stored grains for personal consumption as well as for seed purpose. Farmers reported that the use of these leaves help them to safely store their food grains for a period of approximately one year. In addition to maize, these leaves are also used for the safe storage of wheat and mustard. Farmers are using local flora and fauna for their productive use. Local communities over the period of time have developed inherent indigenous uses of the plant resources around them[13].

Fig. 2 — Leaves of Dyari tree (*Toona serrata*)

Fig. 3 —Leaves of Datura bush (*Datura stramonium*)

3. *Use of wooden bin* (*Kothar/Kothari*) *for storing maize and wheat grains*

Farmers in study area reported that they are using wooden bins locally known as *Kothar* and *Kothari* for storing grains especially of maize and wheat. *Kothar*and Kothari are the same structure but vary in size only (Fig. 4). As per farmers, capacity of *Kothar* ranges from 1200 to 1500 kg and in case of *Kothari* it ranges from 500 to 700 kg. Regarding the structure farmers shared their traditional knowledge that both *Kothar* and *Kothari* are completely made up of wood of locally available Kail and *Deodar* tree. Corner supporting four legs of *Kothar* is made up of *Deodar* tree (*Cedrus deodara*) and main body is made up of *Kail* tree. Services of local artisans are being utilized for giving shape to wood and preparing whole structure. Farmers were of view that wood of *Deodar* and *Kail* being insect resistant helps in long-duration storage of maize and wheat grains. These structures are very durable and once constructed farmers use it for storage purpose for more than 50 years. Farmers were of the strong view that grains stored in such traditional storage structures have more germination percentage. Farmers further reported that flour of food grains stored in these traditional structures is more nutritious and palatable.

4 *Use of Maldi* (*Rabdosia rugosus*) *leaves in safe storing of wheat grains*

Leaves of *Rabdosia rugosus* locally known as *Maldi* are used for storing wheat grains (Fig. 5).

Fig. 4 — Farmer showing maldi (*Rabdosia rugosus*) leaves

Fig. 5 — Kothar (Wooden storage structure)

Leaves of maldi bush are placed in the wooden box used for storing wheat grains. Farmers were of the view that maldi leaves help in storing wheat grains for more than six months. Leaves of maldi bush release a pungent smell which repels the stored pests.

Traditional practices of storing different vegetable seeds

I. *Use of earthen pit for storing potato seed*

Respondent farmers in study area reported that they use an earthen pit locally known as *Khatta* for storing potato for seed purpose. Farmers explained that they dig a pit of about 4x4x4 ft (lxbxh) in one corner of their field and also keep side walls of this pit erased by about 2 to 3 feet. After pouring loose potato seed in a pit and then they cover it with locally available grasses to prevent link of outer soil with potato tubers kept for seed purpose. Wooden logs are placed over grass cover to prevent the entry of any wild animals over the pit. In a pit of 4x4x4 ft size, about 800 kg of potato seed can be safely stored for a period of about 5 months from November onwards to March even during harsh snow-fall period. Farmers reported that they dig new pit every year and shared that inner cool temperature of pit help in safe storage of potato seeds.

II. *Use of Wood-ash for storing seeds of tomato, cucumber and bitter-gourd*

Respondent farmers in study area reported that they mix seeds of tomato, cucumber and bitter-gourd crop in wood-ash and then paste it on the wall and this traditional practice help them in safe storage of their important vegetable seeds for a period of 4 to 5 months. Farmers were of view that wood-ash helps to protect vegetable seeds from any sort of insect attack. The scientific rationale behind this is that ash contains silica which interferes with insect feeding and also hinders fungal pathogen multiplication. Ash dust reduces the relative humidity of the storage condition and also dries the seed surface. Egg laying and larval development of the storage pests could be hampered because ash dust covers the grain seeds. Also, this practice affects the insect movement to search for mating partners and friction of the dust particles with the insect's cuticle leads to desiccation and hampers the development of the pests[14].

III. *Traditional method of storing brinjal seeds*

Farmers reported that they cut brinjal fruit kept for seed purpose into four pieces and hang in downward position on the walls. Farmers were of view that cutting helps in loosing moisture from brinjal and this practice helps in saving the brinjal seed from pest attack and help in safe storage of brinjal seeds for a period of 4 to 5 months. Farmers further reported that they soak brinjal seeds in water for a period of 4 to 6 hrs before sowing for nursery.

IV. *Use of Earthen pot for storing turmeric and ginger rhizome for seed purpose*

Respondent farmers in study area reported that they use earthen pot locally known as "*Dall*" for safe storage of rhizome of turmeric and ginger. This traditional basket is totally airtight and helps in safe storage of turmeric and ginger corns for a period of about 4 to 5 months. Scientific rationale behind this is that earthen pot helps to keep optimum inner temperature and this prevents the attack of any insect pest inside the earthen pot.

V *Use of Deodar oil and salt for storing blackgram* (*Vigna mungo*), *lentil* (*Lens culinaris*) *and kulth* (*Macrotyloma uniflorum*)

Respondent farmers in study area shared their traditional knowledge that they make use of oil obtained from deodar tree (*Cedrus deodara*) and common salt for safe storage of pulses seed like blackgram, lentil and kulth and this practice help to protect their pulses seed from attack of storage insect-pest. Scientifically salt has a hygroscopic and insecticidal property[15].

VI. *Use of cloth bags for safe storage of Rajmash* (*Phaseolus vulgaris L*) *pods*

Respondent farmers shared that they keep rajmash pods in soft cloth bags after sun drying for safe storage. Farmers reported that they mostly practice this traditional technique for personal consumption because it saves the pods from insect attacks for a period of one year.

Constraints in conservation of traditional food grain and storage practices

A major constraint in conservation of traditional food grain and storage practices is the declininginterest of rural youth about natural biodiversity (flora and fauna) of their area. Forest resources are also depleting and many herbs and bushes having pesticidal properties are on the verge of extinction. Low degree of replication of traditional storage practices in other areas having the same agro-climatic conditions is also the major concern which needs to be addressed on priority basis. Changing food habits of people is also a major bottleneck in adoption of traditional food grain and storage practices.

Conclusion

The present study helps in understanding the rich knowledge of the local communities regarding traditional storage practices of different food grains and vegetable seeds. Utilization of the traditional wisdom of farmers in agriculture is very important and particularly in hilly areas where farmers are always in a resource deficit position. On the basis of above observations, it can be concluded that farmers possess rich knowledge regarding traditional food-grain and seed storage practices. These traditional practices are very relevant and useful for the safe storage of food grains and seeds in the changing climatic conditions. These traditional storage practices can be replicated in other areas having the same agro-ecological conditions and field extension functionaries have an important role to popularize these traditional practices. Extension methodologies such exposure visits, group discussion etc. can help in popularization and adoption of these traditional storage practices in other areas having similar agro-ecological conditions. Capacity building of field extension functionaries will accelerate the adoption of these indigenous storage practices. Print and electronic media can play a significant role in popularization of these traditional methods.

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Conflict of Interest

Authors declare that there is no conflict of interest in this article.

Author's Contributions

RK developed the questionnaire for collection of data. BCS, PSS, and RK executed the survey part of the study and the writing of the article; NP contributed in editing and review of the manuscript. All authors reviewed and approved the manuscript for final publication.

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