

Safe Grain Storage in Flood Prone Area

Practical Action: Transforming lives, inspiring change

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Introduction

This technical brief describes methods and techniques that can be used to improve existing grain storage structures as well as to construct low cost water impermeable grain storage in flood prone areas. Existing grain storage structures used by the communities are often traditional and primitive, which are less durable and highly subjected to significant damages during floods and other natural disaster situation. This technical brief outlines several methods to make existing grain storage structures water impermeable and resilient to floods.

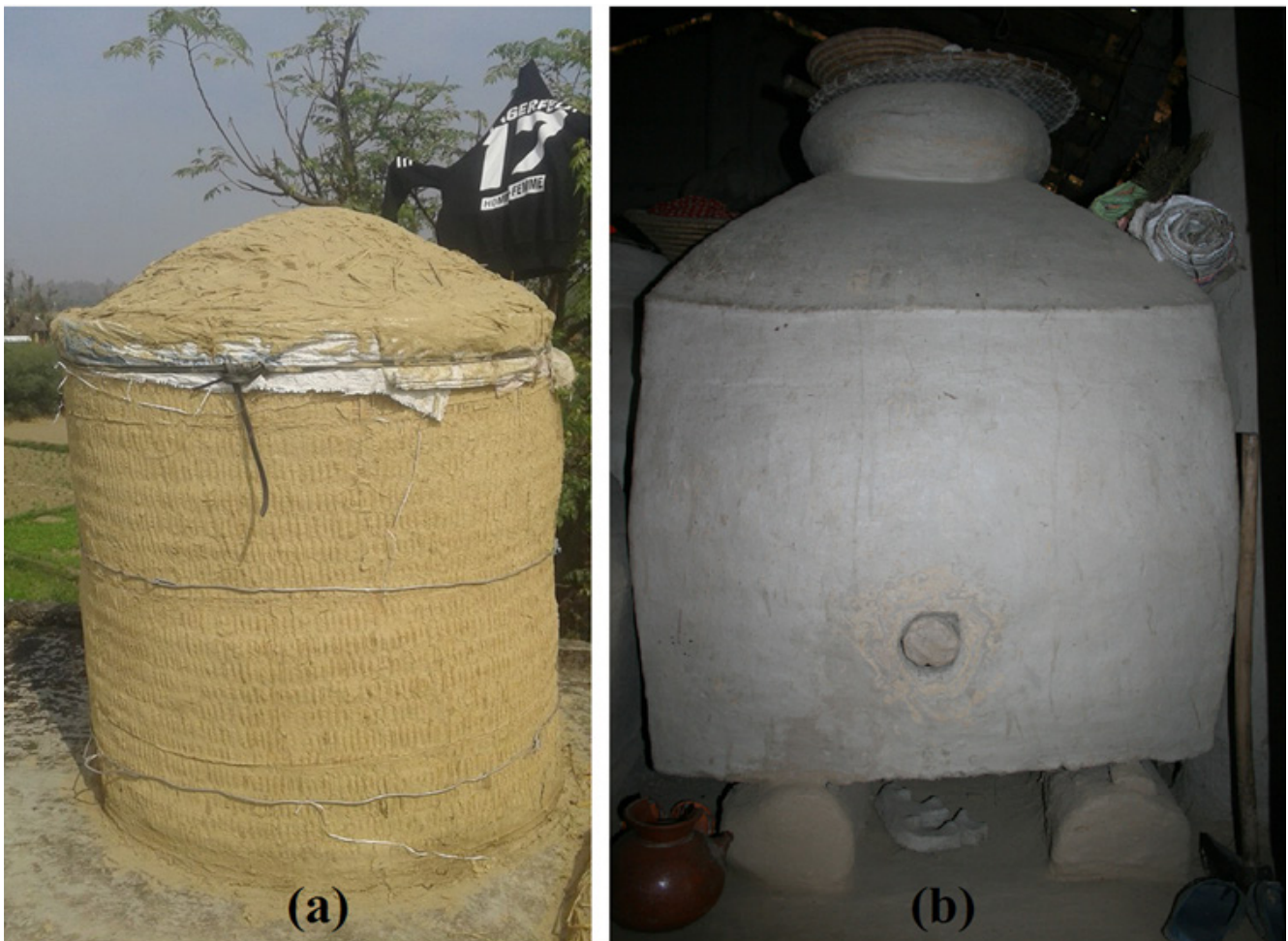


Photo 1 Traditional Grain Storage Structure (a) Bhakari (b) Dehari



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Problem/Context

Every year, communities living in flood prone areas experience huge loss of life and infrastructure. Not only flood brings risk to life of people but also threatens livelihood by damaging infrastructure, agricultural land and stored food grains. Usual practice of grain storage all over Nepal and developing world is almost of similar kind. Most common practice includes storage of seed and food grain in jute sack, mud house and in earthen pot or plastic/metal bin. However, these traditional practices of storing seeds and grains are always not successful to save it during extreme condition like flood.

The traditional mud houses and mud grain storages in the flood affected communities are at a high risk of damage during flood as water can easily cause mud to erode. The stored seed and food grains in such type of storage can be easily damaged. This loss of seed and food grains due to flood may raise food insecurity issues during the disaster and seed related issues after the disaster.

Based on the product volume, need, affordability and availability of finances, different types of seed and grain storage system like storage by farmers individually, storage by small commercial farms or cooperatives, large commercial storage and government storage can be developed. However, construction of large commercial storage and government storage is not always practical. In such situation, farmers can either reinforce existing individual storage structure by raising platform and plastering wall with water impermeable paste or building water impermeable storage for collective storage of seed and food grains of the community.

How to re-inforce existing seed and grain storage structure or build new storage?

Raised Platform

Slight increment in platform height along with storage wall plastered with water impermeable paste can save seed and food grains to a greater extent. So at first, platform needs to be raised up to considerable height (height that will not be easily affected by flood water). Platform can be constructed either by using concrete and bricks or by using wood and bamboo. Concrete platform is firm and stable compared to wooden/bamboo platform, but cost of construction is quite expensive. Choice of construction material depends upon the volume of seed or grains to be stored. If the volume of seed and grain to be stored is larger, it is better to construct concrete platform. If platform needs to be constructed outside the house, higher place should be chosen.

Construction methods:

i. Concrete platform

Construct 3-4 ft tall concrete pillar for a leg of platform. Height normally depends upon the past experience of flood in the area. Platform can be made up with rod and concrete or bamboo slats and wooden planks.

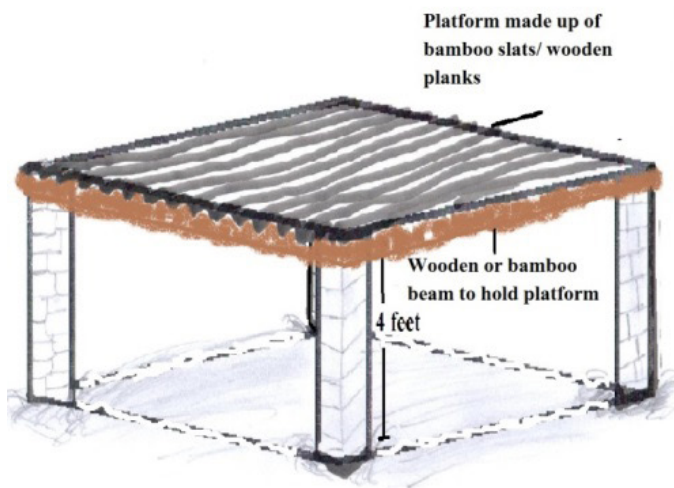


Photo 2 Concrete platform to raise storage

ii. Bamboo/wooden platform

Erect 4 bamboo/wooden pole which have 8 ft height and 4 feet deep for the leg of platform. Number of poles for legs depends upon the size of platform. If the size of the platform is larger than 1 m², then additional poles should be placed in between ½ to 1 m apart as shown in Photo 3. Make a notch on the upper part of bamboo pole to lock horizontal beam to be placed above the poles. Platform floor can be made with bamboo slats or wooden planks.



Photo 3 Construction of bamboo raised platform

Storage structure

In general, community constructs seed and grain storage by interweaving bamboo slats to form a storage wall. The base is usually round and has a wide opening at the top. The height varies. The storage is plastered with mud, cow dung and wheat/rice chaff mixture to prevent spillage and pilferage of grains. After storing seed and grains, top of storage is also plastered with mud and cow dung mixture or covered with paddy straw or gunny bag. This type of storage can provide good storage environment in normal condition. But during extreme condition like rainfall and flood, plaster will be easily eroded by water and stored seed and grains will ultimately get damaged. To overcome these constraints of traditional seed or grain storage, we need to either build new storage or reinforce existing storage. If we already have grain storage then we do not need to make new one.

Construction methods

Storage can be constructed in different shapes, round or square but if we need to store multiple crops in single storage, then we have to build storage house. Storage can be built using different materials like concrete, bricks, bamboo or wood but choice depends upon affordability of the materials. Concrete storage is stronger and resistant but much expensive when compared to bamboo and wood. In this technical brief we describe methods to build low cost seed or grain storage using bamboo and or wood.

i. Construction method of common seed/grain storage

- Normal grain storage is round in structure, 5 to 6 ft in height and 5 to 9 ft in diameter. Below steps should be followed for construction of common seed/grain storage as per volume of seed or grain required to store, analyse the size of storage to be built.
- Draw a circle on the ground with a required diameter and calculate its circumference. Formula is $C=2\pi r$ (C stands for circumference and r for radius, value of pie π is 3.14159)
- Collect the required number of bamboo and cut it into pieces of size that equals to circumference and two piece of size equal to the required height.
- Split each bamboo pieces to make four equal bamboo slats.

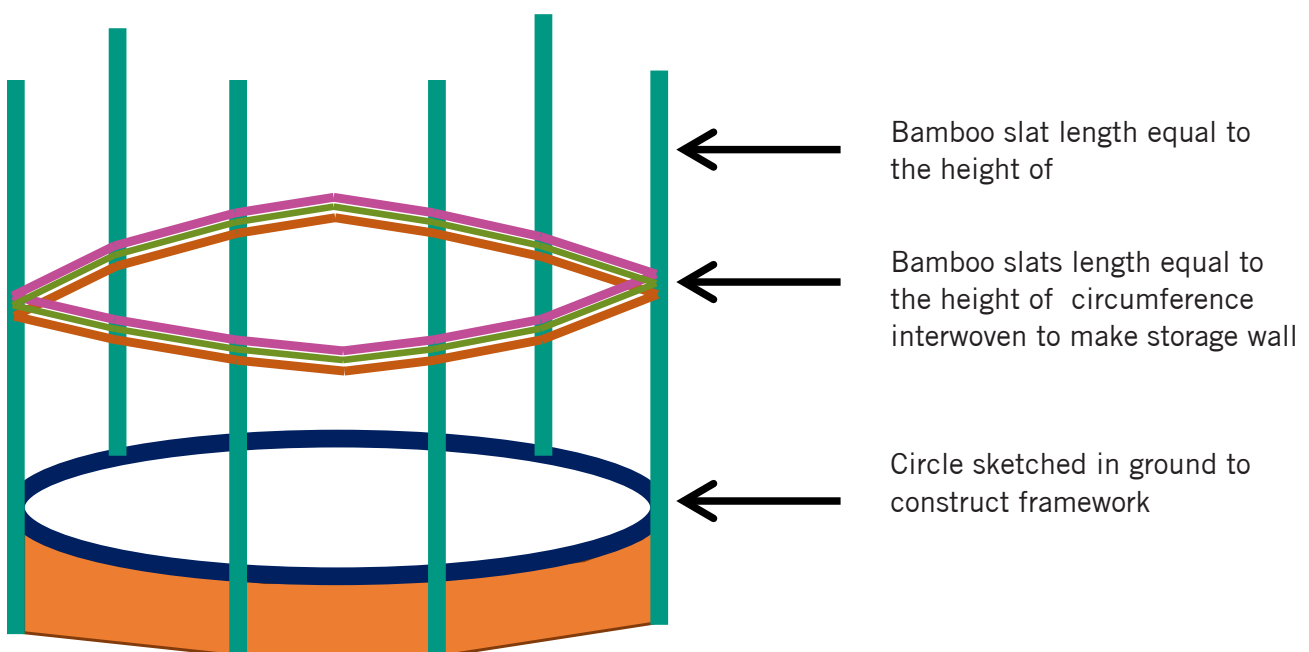


Photo 4 Schematic representation of construction design of circular grain storage/bhakari

- Scrap bamboo slats to make it smooth. Bamboo slats (size of circumference) should be thinner so that it could be easily interwoven to make a wall.
- Erect four to eight bamboo slats (slats of size equal to required height) in the circumference of circle on the ground and interweave bamboo slats to make a storage wall.
- Place the storage structure above the raised platform and fix the base of the storage structure to platform either by tying with GI wire or rope.
- For easier removal of seed/grain, make a vertically sliding door (15x15 cm) at the bottom of storage.
- Plaster wall and floor of storage using usual plaster made from mixture of mud, water, cow dung and wheat/rice chaff.
- Above usual plaster layer, plaster inner and outer wall and base of the storage with water impermeable paste.

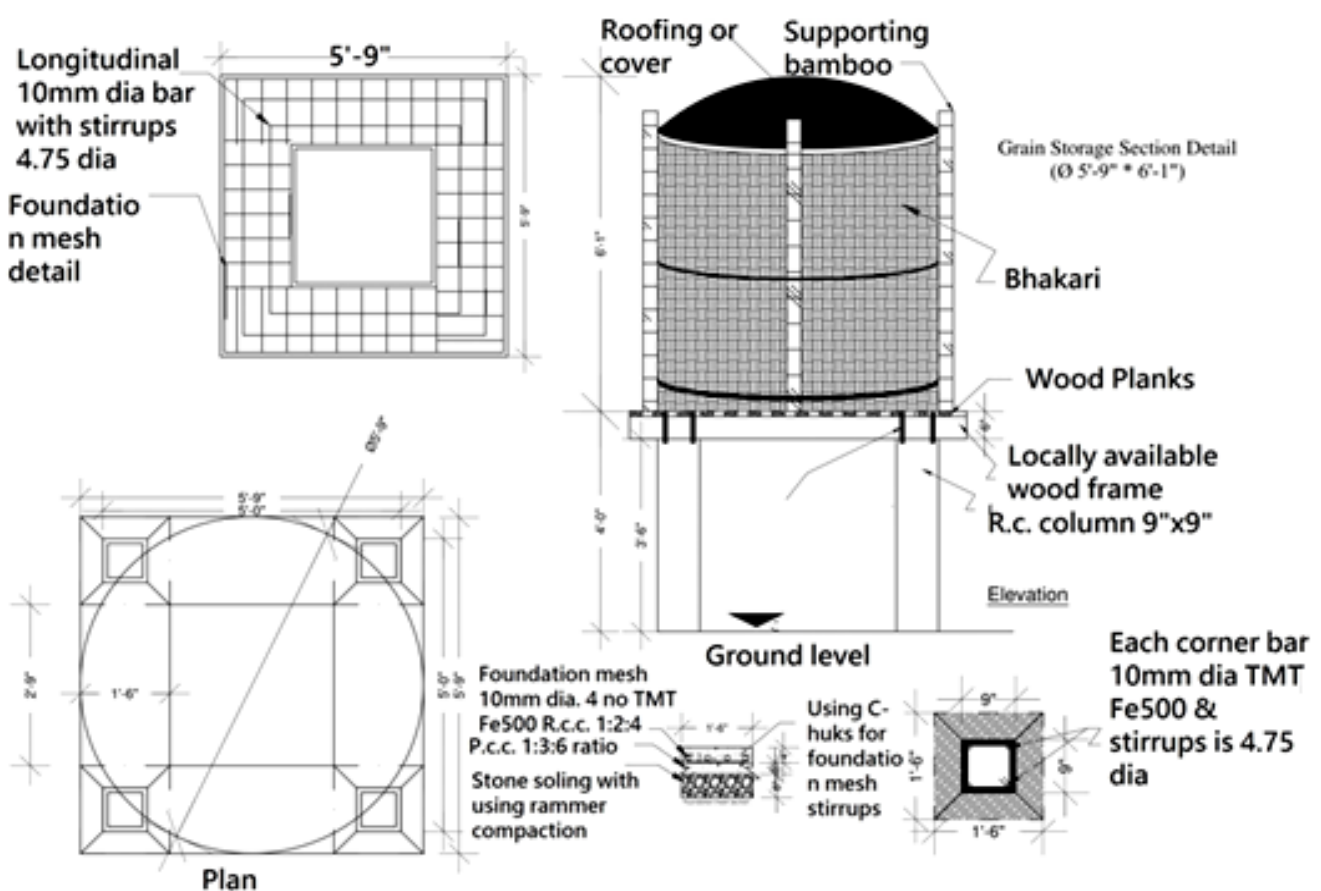


Photo 5 Diagrammatic representation of elevated grain storage construction design

ii. Construction procedure of seed/grain storage house

Seed or grain storage house is constructed when seed and grains of different crops need to be stored in a single storage. Size of house depends upon the space required for the storage. And seed and grains of different crops are kept in plastic coated jute or plastic sacks. Storage house can be built with or without the raised platform. But storage house should be located in higher elevation or the plinth level should be high enough to prevent flood water entering into the storage house. Construction procedure is similar to that of normal bamboo or wooden houses. First layer of plaster is done using traditional plaster (mixture of mud, water, dung and wheat/rice chaff). Above this layer, water impermeable plaster is used to make wall and floor of storage house water resistant. Diagrammatic representation of construction methods is given below.

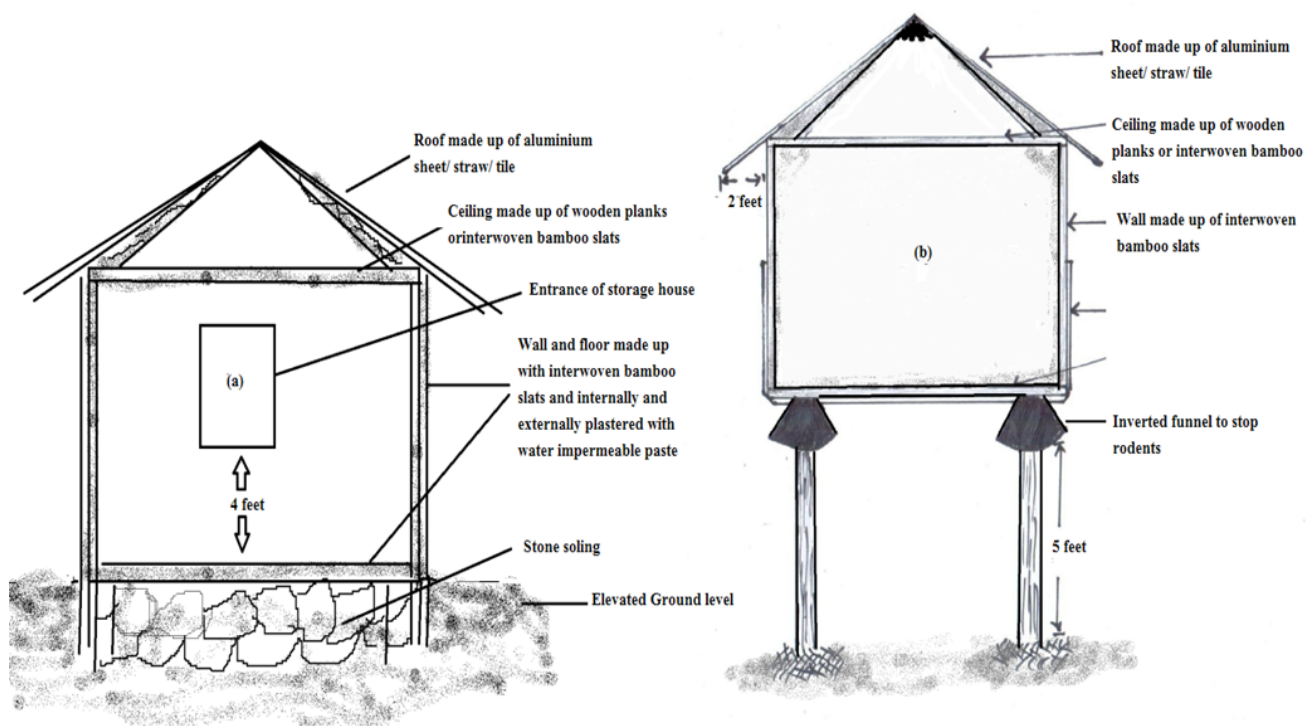


Photo 6 Diagrammatic representation of (a) Storage house constructed in higher elevation and (b) Storage house constructed with raised platform

Water impermeable plaster

Generally, mixture of mud, wheat/rice chaff and cow dung is used to plaster wall and floor of seed and grain storage house. However plaster made up of those materials is easily erodible when exposed to moisture and water. Thus it is important to use non erodible and water impermeable plaster for plastering walls and floor of seed/grain storage. Non erodible and water impermeable plaster can be prepared as described below.

Procedure 1 :

- 2 buckets (1.5 ft³) of mud should be mixed with 2 buckets (1.5 ft³) of fine sand to obtain mixture with 50 per cent sand and 50 per cent clay.
- Water should be added to the mixture and kneaded to obtain a uniform paste.
- 5.5 kg of wheat straw chopped into 20 mm lengths or paddy straw chopped into 50 mm lengths should be added to the mud paste and kneaded until the straw gets uniformly mixed.
- The mixture should be kneaded twice daily for 7 days to decompose the straw. Water should be added while kneading to prevent the mixture from drying.
- 10 kg of 80/100 grade bitumen should be taken in a barrel and heated till melted.
- The molten bitumen is then poured into another barrel containing 2 l of kerosene with constant stirring to prepare cut-back bitumen.
- 5 kg of the cut-back bitumen will be mixed with the mud and straw mixture prepared earlier and kneaded to obtain a uniform mix.
- Mud walls should be moistened by sprinkling water before plastering. Water will be allowed to be soaked by the all and moistened again.
- The water impermeable plaster should be applied on the mud wall up to 3' height from the base. The plaster of about 12 mm thickness should be applied with hand by starting from the top and proceeding towards the bottom.

- The plaster of about 12 mm thickness should be applied in the bottom/floor of storage as well.
- The plaster will be than allowed to dry for 3 days. If cracks is visible than cover the crack with plaster.
- Stabilised mud slurry should be prepared by mixing ½ bucket mud and ½ bucket cow dung with water to make uniform paste; 1.5 kg of cut-back bitumen should be added to the mixture.
- The slurry thus prepared should be applied over the plaster to give the plaster a smooth finish.

Conclusion

In general, grain storage practice is part of Nepal's primitive traditional culture. Community mostly store their grains in traditionally made mud houses and mud grain storage structures called Bhakari (interwoven split bamboo structure plastered with mud and dung mixture), Dehari (indoor structure made of a mixture of mud, straw pieces and dung), bamboo baskets, earthen pots, timber bins and or metal beans². Though these grain storage structures save grain to some extent, these structures are not durable enough and poor in providing optimum storage conditions. The grains stored in these structures are highly susceptible to damage by natural calamities like heavy rainfall, flood, cyclone and attack of microorganisms, insects and rodents causing considerable damage and loss every year³. However, such damages can be reduced or prevented to a greater extent by constructing grain storage with raised platform and plastered with water impermeable plaster. This intervention not only save grain/seeds from natural calamities but also maintain quality of grain/seed for longer period.

Case-study: “Saving seed and grains from flood”

Chandra Bahadur Rokka Magar and his neighbours, the residents of Tikapur Municipality of ward number 5 in Kailali District face the wrath of floods every year. Magar says, “Our village is adjacent to Karnali River, so we face flood very often. In some of the monsoons, the floods are more disastrous. In the year 2014, flood swept away all of our belongings and it took us more than a year to recover the loss.” Magar and his neighbours had lost their standing crops to floods. The stored seeds and food grains got soaked with flood waters. And due to stagnant water and prolonged rainy days, they were unable to dry the seeds and food grains on time and lost them completely.



Photo 7 Chandra Bahadur showing water level during flood

Thanks to a government river engineering project, they have not faced such disastrous floods since last three years. A dyke constructed along the river bank has protected the village from flooding. However, last year the floods damaged most of the dyke and the villagers are worried of flood occurrence this year. Magar says, “If the government does not repair the dyke on time, we’ll need to be prepared to face the flood consequences again.”

Learning from the previous flood damages and with the guidance of Nepal Flood Resilience Project (NFRP), Magar and his neighbours have planned to plant flood tolerant rice variety this season and have already constructed raised grain storage. Magar and his neighbours have built 6×6 sq ft concrete platform for storage, 4.5 ft above the ground surface. It can store 12 to 14 quintal of grains and seeds. Magar says, “Flood level is not always disastrous though we face flood regularly. Our seeds and grains used to get damaged every year. But with the guidance of NFRP staff, we have constructed raised grain storage. I can store 12 quintal (1 quintal equals to 100 kg) of grain in it, saving them from flood.”



Photo 8 Chandra Bahadur standing in front of his raised grain storage

Cost of solution

Cost of construction depends upon the type of grain storage, size and material used. *Bhakari* is the most common storage structure in rural communities. Since material used to construct *bhakari* is locally available, construction cost is lower compared to other storage structure.

Table 1 Tentative cost of construction of elevated circular grain storage (bhakari) with water impermeable plaster and concrete platform

Materials						
S.N.	Materials	Unit	Quantity	Rate/Unit (NPR)	Amount in NPR	Amount in USD (1 USD=116N-PR)
1	Sand	m3	0.54	444.00	239.76	2.350588
2	River sieving aggregate 20-10 down	m3	1.00	1834.00	1,834	17.98039
3	Stone	m3	0.50	440.00	220	2.156863
4	Soil filling work	m3	0.50	250.00	125	1.22549
5	Bamboo	no.	2.00	250.00	500	4.901961
6	Local wood Form work	Square feet	52.00	25.00	1,300	12.7451
7	Cement PPC (53 grade)	Bag	8	650	5,200	50.98039
8	Bairding wire	kg	1	110	110	1.078431
9	10mm dia	kg	47	85	3,995	39.16667
10	4.75mm dia (Tor Kari)	kg	14	90	1,260	12.35294
11	Nail	kg	0.5	110	55	0.539216
12	Bitumin	kg	10	120	1,200	11.76471
13	Kerosene	liter	3	100	300	2.941176
Total Cost (Materials)					16,338.8	160.1839
Labour						
	Particular	Number of Person	Number of Days	Rate per day (NPR)	Amount in NPR	Amount in USD
1	Skilled labour	2	2	800	3,200	31.37255
2	Unskilled labour	2	2	400	1,600	15.68627
Total Cost (Labours)					4,800	47.05882
Grand Total					21,138.8	207.2427

Contact for further info

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