

*Towards a Sustainable Future
Build Back Safer with Vernacular Methodologies*

THE GREEN MANUAL



Yasmeen Lari SI, HI



Sayani DRR Park, Kot Diji.

*Towards a Sustainable Future
Build Back Safer with Vernacular Methodologies*

THE GREEN MANUAL

Yasmeen Lari *SI, HI*

© HERITAGE FOUNDATION OF PAKISTAN
E-6, 4th Gizri Street, DHA 4, Karachi
www.heritagefoundationpak.org info@heritagefoundationpak.org

Table of Contents

Preface	ii	Safe KaravanShelters	6.1 - 6.10
Message from Emirates	iv	Karavan Handpumps	7.1 - 7.6
Background	1 - 6	Karavan ChaatBageecha	8.1 - 8.8
Mud Brick Making	1.1 - 1.6	Raised Bed Farming	9.1 - 9.6
Lime Slaking	2.1 - 2.8	Livestock Enclosures	10.1 - 10.4
Earthen Platforms	3.1 - 3.6	Rainwater Harvesting	11.1 - 11.4
Karavan Pakoswiss Chulah	4.1 - 4.10	Organic Fertilizer	12.1 - 12.4
Eco-Toilets KaravanLatrine	5.1 - 5.12	Organic Soap	13.1 - 13.6

© HERITAGE FOUNDATION OF PAKISTAN 2015

*This publication and its content are copyright of “Heritage Foundation of Pakistan.”
All rights reserved.*

Any redistribution or reproduction of part or all of the contents in any form is prohibited. You may not, except with our express written permission, distribute or commercially exploit the contents.

ISBN 978-969-8655-24-2

Preface

Heritage Foundation of Pakistan (HF) established in 1980 is a not-for-profit, social and cultural entrepreneur organization engaged in research, training, publication and conservation of Pakistan’s cultural heritage. Since the Earthquake 2005, it is also engaged in providing humanitarian assistance in disaster and conflict affected areas.

HF continues to conduct heritage safeguarding activities around the country – from cataloguing and documentation, to providing first-aid through Lari-Emergency Preventive Intervention, to conservation and preservation of important historic monuments. It also conducts advocacy campaigns for stewardship of heritage along with conducting training at various levels from architects to artisans and community members including women.

Over the years, HF has promoted the use of sustainable flood & seismic resistant zero carbon footprint construction methods in disaster affected areas: in earthquake affected Siran Valley and Azad Kashmir (2005-2009) with support from Nokia; in flood-affected Swat (2010) with support from Scottish Government International Fund and the University of Glasgow, and Google’s TIDE Foundation; in flood affected Sindh (2011 to 2015) with the support of Swiss Pakistan Society, Architecture for Humanity (USA) and Ms. Safeeyah Moosa (South Africa); and in earthquake affected Awaran (2013-2014) with the help of Swiss Development Corporation. In 2009-10 in partnership with UNESCO, it conducted craft-based livelihood programmes for marginalized women in Swat and Mansehra.

From 2011 as Technical Advisory partner of International Organization for Migration (IOM), HF has trained over 450 IOM’s teams and Implementing Partners (IP) using its DRR-driven program *Build Back Safer with Vernacular Methodologies*. Through HF’s Technical Support Manuals, Training of Trainers (ToT) sessions and Mentoring and Monitoring Teams, 40,000 shelters have been built in over 1700 villages in Sindh, thus placing Pakistan in the lead as the largest zero carbon footprint shelter program in the world.

In collaboration with International Labour Organization (ILO) HF has developed training modules for a large number of DRR-compliant green skills which help communities to prepare for disasters. HF has devised Women-centred Community Based Disaster Resistant Management programs, implemented in a 7-village pilot with support from IOM, which promotes women as agents of change. The program for Barefoot Village Entrepreneurs (BVE) trained in 13 green skills, aimed at technical capacity building, is helping rural women in undertaking Disaster Risk Reduction (DRR)-compliant tasks leading to disaster preparedness and self-reliance.

By undertaking the program ‘Eye on Corruption – Women as Agents of Change’ in collaboration with Transparency International-Pakistan, HF has been able to make functional a large number of dysfunctional government schools in remote areas of Sindh through formation of Maa (Mothers’) Committees.

We are grateful for the award of USD 25,000 from Emirates which has enabled us to transform an entire village in Sindh using green methodologies. My thanks are due to Mr. Naheem Shah and his field teams and Ms. Mariyam Nizam’s team in Karachi who have worked hard in order to spread the knowledge in one of the remotest and marginalized sections of the country.

Yasmeen Lari, SI, HI
Chair & CEO
Heritage Foundation of Pakistan
Karachi, February 2015

Message from Emirates “A Greener Tomorrow”

Since its establishment in October 1985, **Emirates** has become one of the fastest growing and innovative international carriers in the world. Emirates now operates a fleet of over 230 Airbus and Boeing aircraft currently serving 147 destinations in 84 countries.

In 2013 Emirates launched an environmental initiative ‘A Greener Tomorrow’. The aim was to support not-for profit environmental or conservation organisations by providing a funding award of up to USD 150,000. The money for ‘A Greener Tomorrow’ was raised through employee recycling programmes across the Emirates Group, ranging from paper recycling in the offices, to clothes recycling at home, to the recycling of seat components on board our aircraft.

We are proud to be associated with Heritage Foundation, one of the joint winners of this initiative. The prize money helped fund a variety of projects within the Foundation, from the installation of Eco-Toilets to providing material as start-up kits for rainwater harvesting; green roofs, smokeless stoves for all households and start-up seeds and plants for environmental greening.

Additionally, the Heritage Foundation-Emirates Literacy and Women’s Centre is currently being used by women for regular meetings and trainings and also by approximately 50 children who are being taught by a locally appointed school teacher.

Emirates consciously strives to improve its economic, environmental and social impact in a meaningful way. One of our key focus areas has always been the management of resource consumption. Reducing unnecessary consumption not only reduces environmental impact, but also has a direct benefit on our bottom line.

Jenny Johnstone
International and Government Affairs Manager
International, Government and Environment Affairs
Emirates ‘A Greener Tomorrow’
February 2015

Glossary

BBSVM	HF's Build Back Safer with Vernacular Methodologies
BVE	Barefoot Village Entrepreneur
Chaura	Circular form with conical thatched roof
Chulah Adhi	Stove Sister
DRR	Disaster Risk Reduction/Resilience
Emirates	Emirates Airline
HF	Heritage Foundation of Pakistan
ILO	International Labour Organization
IOM	International Organization for Migration
ChhatBagheechea	Vegetable roof garden
Karavan Hand pump	HF's handpump on earthen platform
Karavan Pakoswiss	HF's smokeless fuel efficient earthen stoves
Chulah	
KaravanLatrine	HF's Eco-toilet
KaravanShelter	HF's lowcost sustainable shelter
Katcha Kot	Unfired Clay Fortress, name given by villagers to KaravanShelter
Kela Chakkar	Banana Circle for biological treatment of gray water
Khad Adhi	Compost Sister
KPC	Karavan Pakoswiss Chulah
L-LoR	Lari-Levels of Resilience
Maa Committee	Mothers' Committee
Machan	Look out
MDGs	Millennium Development Goals
ORS	One Room Shelter
Patharwala Choona	Quick Lime lumps
Reetha	Soapnut
TI-P	Transparency Internaional-Pak
W-CBDRM	Women-centred Community Based Risk Management



The Green Manual

Background

Introduction

To tackle issues of core poverty, communities must be engaged in training and capacity building, enabling them to be set on a path of self reliance which is key to strong and resilient communities. The Lari Levels of Resilience (L-LOR) are divided into three phases and are structured to gradually make up infrastructure and social deficits.

The Women-centred Community Based Disaster Risk Management (W-CBDRM) program developed by Heritage Foundation of Pakistan (HF) and implemented as part of HF-IOM 7-village pilot in Tando Allahyar in 2013, focuses on women as agents of change. Often they are the worst sufferers, and need to be trained to adopt practices which would lead to improved lifestyles for themselves and their children, at the same time improving coping capabilities of communities. The *Greener Tomorrow 2014* Emirates Award, has enabled the concepts to be implemented with great success in 80-house-



Moak Sharif DRR Centres built as a part of HF-IOM Women-centred CBDRM 7-village pilot.

hold village of Hashim Macchi, which is among the poorest and most deprived communities in Pakistan.

Although issues related to safety of life and health of marginalized households and vulnerable groups are essential for normal living conditions, such elements assume even greater significance in the aftermath of disasters. As is usually the case, in order to avoid spread of disease, emergency response actions after dis-

aster incorporate the provision of safe drinking water, sanitation arrangements and instilling hygiene procedures.

If these are already incorporated as part of disaster preparedness, there will be limited requirement for these provisions at the time of emergency, thus obviating the need for large scale expenses on temporary arrangements which are the norm during an emergency phase.

It is increasingly accepted that funding directed towards disaster preparedness and disaster coping strategies is the need of the day. The 'No-cost, Low-cost' strategies developed under L-LoR program are providing solutions which can be implemented through training and provision of minimal funding to communities. Such a strategy fosters community ownership of coping mechanisms through the use of locally available resources.



Village women mud carving on their Karavan SafeShelters fostering ownership and pride.

LARI-LEVELS OF RESILIENCE (L-LOR)

Lari - 1st Level of Resilience (L-1LoR)

Being able to recover pre-disaster status of shelter, making up losses of goods and field produce.

Lari - 2nd Level of Resilience (L-2LoR)

Application of safe construction methods for achieving safety of life and goods, water and sanitation, linkages with public sector DRR institutions, NGOs, formation of community committees.

Lari - 3rd Level of Resilience (L-3LoR)

Achieving self-reliance by addressing core poverty and social deficits e.g. literacy, hygiene, health, income generation with community effort and by getting government Institutions functioning with community/public pressure.

Once various steps defined in L-LoR are incorporated for disaster preparedness, it will lead to the creation of healthier environmental conditions, as well as fostering greater confidence in communities' own abilities.

In order to overcome gaps and deficits, Disaster Risk Reduction (DRR)-compliance must be built into long term interventions for development. In fact disaster risk mitigation should be the

cornerstone on which the targets for redemption of deficits are built up.

As is known, for achieving Millennium Development Goals (MDGs) water supply and sanitation services are considered to be critical for sustainable development.

Among other benefits are increased food security, support to environmental protection, empowerment of women and reduction of productivity losses due to morbidity and malnutrition (EcoSanRes 2006).

Strategies devised by Heritage Foundation of Pakistan focus on women as agents of change where their own and their children's health are paramount. L-LoR places great emphasis on the following aspects:

- a. Safe structures particularly safe shelters and toilets.
- b. Preventing open defecation and distancing of animals from humans for better hygienic conditions.
- c. A regimen of hand washing as preventive measures.
- d. Avoiding water borne diseases by providing safe water resources for potable water.
- e. Better nutrition and food security through farming: Karavan Chhat-Bagheecha (roof garden).

LARI DRR PRINCIPLES

- **Utilize heritage and tradition** for fostering pride and self confidence.
- **Use sustainable materials** to prevent environmental degradation.
- **Use local skills & techniques** for speedy delivery.
- **Incorporate DRR-driven methodologies** to withstand next flooding.
- **Utilize provision of shelters as an entrée** into communities for larger benefits and women's economic empowerment strategies.
- **Develop holistic models aiming at MDGs:** literacy, hygiene, WASH, food security etc.

The above requirements are translated into the following elements that, in addition to safe shelter, are considered prerequisite:

- a. Building eco-toilet KaravanLatrine to fulfil the following purposes:
 - Skill development for small scale safe construction leading to safe shelters.
 - Prevention of open defecation.
 - Emphasis on and provision for regular hand washing.
- b. Building Livestock Enclosures for the following objectives:
 - To separate livestock area

from human living for preventive health and containment of livestock excreta.

- Encourage plantation of trees for improved environment which screen livestock and allow better care for them.
- c. Provision of safe drinking water
- Building hand water pumps that are on elevated platforms for safety during floods.
 - Building raised earthen *tibbas* (platforms) for purifying drinking water through solar treatment (suraj pani) which is safe during floods.
- d. Treatment of gray water
- Biological treatment of gray water in the form of Kela Chakkar (Banana Circle) for preventive health and food security by growing fruit and vegetables using gray water.
- e. Rain water harvesting
- For conserving and storing rain water for diverse uses.



Kela Chakkar (Banana Circle), a gray water bog prevents diseases caused by standing water.

Strategy

Construction of Eco-toilets and clean water availability are among key elements for disaster preparedness and in order to make communities self reliant in the face of disasters. It is well known that all disasters, particularly flooding poses greater health threat if there is a lack of sanitation or non-availability of clean drinking water.

Due to increasing poverty levels and existing deficits in social infrastructure, unless emphasis is placed on making up the deficits it will not be possible to augment the ability of communities to deal with disasters themselves. Clearly, investment in building up capacities of communities will increase the level of preparedness and consequently reduce the level of investment in relief operations after a disaster strikes.

Among the greatest challenges in the rural areas of Pakistan is the curse of open defecation. Where all suffer from unhygienic practices, it is the health of women and children that is affected the most. Due to various social taboos, women are forced to use unsuitable places such as bushes and fields, while most open spaces are utilized by men and children, creating unhygienic conditions within homes and in surrounding areas.

In view of lack of potable water in most rural households, concerted efforts are required to provide clean water supply for communities. Where on the one hand water sources must be at an elevated level to withstand flooding, on the other water contamination in all forms must be avoided. To decrease the incidence of disease, hygienic conditions and most of all the importance of a hand washing regimen needs to be enforced.

Ailments that are related to unhygienic practices include serious diseases such as cholera, while worms, dysentery and diarrhea are commonly encountered.

In order to adopt preventive health practices, emphasis must be placed on refuse disposal as well as separation of livestock from living areas of rural families. The present status of poor health in Pakistan, and particularly rural Sindh, is due to the close proximity of livestock and humans. It is also to be understood that livestock is among the most prized possessions of any household.

More attention is given to animals than their own children as their very life depends upon the well being of their livestock. Considering the high cost of cattle it is not surprising that the owners want to keep an eye on them at all times.

As is evident from the foregoing, *Lari*



Village women discussing Karavan Pakoswiss Chulah training modules using Tablets.

Principles for DRR and related strategies that have been developed are essential for improving technical capability of rural communities for a range of outputs through a structured framework with the cross cutting theme of disaster preparedness.

I. Construction of Eco-Toilets

The use of eco-toilets obviates the necessity for septic tanks and pits which get filled with water during flood disasters. The structure should be flood-resistant, using BBSVM techniques based on the use of lime with mud and bamboo.

II. Provision of Safe Water – Construction of Elevated Water Pumps

All water pumps must be placed on raised platforms in order to continue to use them during flooding. If the platform is at least 2'6" above ground, the

GREEN SKILLS & PRODUCTS

level of the tap would be 5'0" above adjacent ground level. Precautions should be taken to keep drinking water source at the highest level. Safety of children and protection from livestock should also be provided. Arrangement for treatment of gray water by draining into a Kela Chakkar (Banana Circle) should be made.

III. Clean Drinking Water

Where the above can provide assurance that water will be available even during floods, the quality of water for drinking purposes cannot be guaranteed. A regimen of inexpensive methods of water treatment must be put in place that can be initiated during the period in between disasters and can vary from boiling water, the use of clean containers and solar treated water.

IV. Hygiene Training

Remaining healthy, and avoiding diseases in the aftermath of disasters, is essential. Handwashing training particularly for women and children is essential. Insistence upon using soap needs to be coupled with availability of inexpensive soap e.g. herbal reetha soap, in order to encourage hand washing by all family members. For children, being extremely vulnerable in marginalized communities, hand washing itself provides safety from diseases.

Green Skills are central to sustainable development and respond to the global challenges of environmental protection, economic development and social inclusion (ILO).

The training by HF is based on technical skills, knowledge, values and attitudes required by human resources to develop and support sustainable social, economic and environmental outcomes. Thus, training comprises reading and understanding of technical details, selection and preparation, production and construction using environmentally friendly materials.

Materials used for HF's green products are locally sourced and are biodegradable. The processes do not require chemicals or harmful elements. There are no special health risks that cannot be countered by following safety and health procedures.

Only zero energy or low energy is consumed in products.

Water conservation is rigorously followed, and residual water evaporates without causing any contamination.

1.1 Why should mud brick be used?

Earthen structures and products can be fabricated in a variety of ways. In Sindh alone, techniques vary from layered mud, cob, mud blocks, mud lumps as well as mud brick. Although all techniques provide acceptable standards of construction, mud brick has the advantage as it can be prepared in advance and may be used as and when required, without having to resort to procuring earth at the last moment.

Unfired clay construction has many advantages:

- It is low cost, as earth is readily available in all rural areas.
- It has low energy and there is low transportation cost.
- It regulates relative humidity naturally without resorting to the use of energy.
- Since mud building tradition exists in rural areas, all manner of earth construction can be undertaken by households themselves and thus promote self building.



Women being trained in mud brick making.

- Earthen walls provide thermal mass for protection from the intensity of the sun.
- Earthen structure maintains a balanced indoor climate controlling temperature extremes.
- Mud is a renewable resource which is also nontoxic; it can be recycled easily.
- Mud is non-combustible and thus presents a low fire risk.
- Mud carries natural texture and colour and does not require painting.
- Earthen walls lend themselves to orna-

mentation and decoration using local craft skills.

- Mud provides opportunity for speedy construction.

With all the advantages that earth construction possesses, it is important to provide it protection from rain and floods.

HF methodology of lime stabilized earth stipulates that lime be mixed with earth for construction of bases as well as in plasters and renders. Lime stabilized mud is among the best bulwarks against rains and flood.



Mud brick making yard.



HF's Master Trainer for mud brick making teaching her fellow village women the craft.

1.2 What is mud brick?

This is the most widely practiced earth building technique. In most villages in Pakistan, earth bricks are made with ease, producing 1,000 bricks per day by one person. These are unfired clay bricks and the size varies from place to place, however, the usual size is 3" x 4.5" x 9". Usually mud brick is made with rich clay soil and water and normally it is fabricated without any other additions. The mixing of straw with mud is also seen in many places.



Mixing earth with lime and other ingredients.



Ready to place mixed soil in brick moulds.

For making bricks, usually wooden moulds are used, although steel moulds are also often seen. The moulding is carried out after the mix has been thoroughly mixed, many a time, using feet for mixing to achieve an even consistency. The bricks are dried in the open in the brick making yard. The drying is slow depending upon the weather. Normally, during summer months in Pakistan, bricks are ready for use within 7 to 10 days, however, during the monsoon season when the air is damp, it is a much slower process.

Hand made bricks need to be carefully turned and stacked for air to pass through them in order to dry them fully. Mud bricks are usually laid with mud mortar. Usually, if care is taken in proper mixing, the bricks provide thermal mass and are used in load bearing walls. Where layered mud or mud balls can

have issues of shrinkage and settlement, the mud bricks are free from such drawbacks, and are particularly suitable for use during winter and monsoon months. The advantage of mud bricks is that they can be moulded by even those who are unskilled or semi skilled. Bricks can be made prior to undertaking work at site, so that once the work starts, it can be finished comparatively quickly. Mud brick laying requires hardly any equipment, except moulds as mentioned above and basic tools for mixing, which are freely available in the local market.

1.3 What are the ingredients of mud brick?

1.3.1 Soil

Mud bricks are made with clean soil, which should be free of stones, leaves and debris. It is worthwhile to crush bigger lumps with compactors or by beating with an implement.

Once the soil has been cleaned, it should be pressed through a sieve to ensure that all pebbles, stone and bigger lumps of soil have been eliminated.

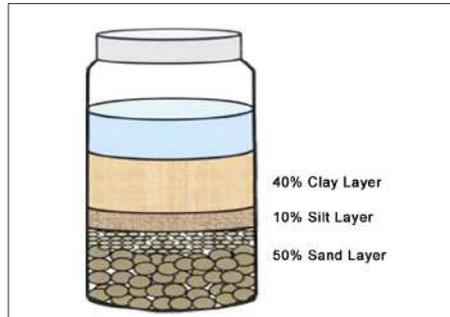
The soil should consist of 20% to 40% clay. A bottle or a coil test is recommended to ensure that the soil is good for making mud bricks.

1.3.2 Tests for Clay Content

Bottle Test

This test is carried out in a clean bottle, consisting of a cup of soil and two cups of water. The mixture is shaken up and then left for a few minutes. It is shaken and thoroughly mixed again and allowed to settle down for 8 hours.

When examined, layers of clay, silt, sand and gravel will become visible. These layers can be measured with a ruler. If required extra sand can be mixed.



Soil Test to ensure proper mix of soil for bricks.



Women mixing earth for placing in moulds.

Coil Test

A coil of size 1/8" dia. thick should be made of the soil by rolling between the palms. If the shape can be retained and does not break when rolled into 1/8" dia, the soil is fit for making bricks.

1.3.3 Water

Water for mixing should be clean potable water and should be free from all impurities.

1.4 What is the procedure for making mud brick?

1.4.1 The desired mix of soil should be soaked in water for a week, and should be turned regularly in order that water seeps thoroughly and it is evenly mixed with soil. The soil should be kneaded in a comprehensive manner. Many a time mixing with feet helps to ensure that the entire mix is properly prepared.

1.4.2 The wooden or steel moulds should be dusted with sand and shaken to ensure that the entire mould including the corners are covered with sand. The mould should be inverted so that it is cleared of all loose sand.

1.4.3 Lumps of kneaded soil should be prepared and used to fill one mould at a time in one quick movement, removing extra soil from the top of the mould.

1.4.4 Mud bricks should be taken out by turning the mould over on the ground dusted with sand. The mould should be carefully lifted straight up in order that wet bricks are not disturbed or damaged.

1.4.5 The bricks should be allowed to dry for 48 hours before being turned on their side for drying. They should be left in the sun for 7-10 days, after which they can be stacked in large stacks.



Mixing soil thoroughly by turning over.



Placing mud lumps in mould.



Rural women making bricks.

1.5 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.8

MUD BRICK MAKING مٹی کی لٹس بنانا



Mud is easily re-cycled, re-useable and bio-degradable. Mud can be used effectively for the purpose of speedy construction.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.2

METHOD OF FABRICATION STEP 1 & 2: PREPARING & SCREENING SOIL

مٹی کو تیار کرنا اور چھاننا



STEP 1: PREPARING SOIL

STEP 2: SCREENING SOIL

Mud Bricks are made with clean soil. Crush bigger lumps of soil with a compactor. Pass the soil through a sieve to eliminate pebbles/stones.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.5

METHOD OF FABRICATION STEP 5 & 6: PLACING AND TAMPING MUD IN THE MOULD

مٹی کو فرسے میں ڈالنا اور دبانا



STEP 5: PLACING MUD IN MOULD

STEP 6: TAMPING MUD IN MOULD

Make a lump of kneaded mud and fill the mould in one quick movement. Compact before removing the excess mud from the mould..

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.1

METHOD FOR FABRICATION CHECKING OF SOIL



Soil should be checked with tests to ensure that the soil has clay content of 20%-40%. Methods for testing are Bottle Test and Coil Test.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.3

METHOD OF FABRICATION STEP 1 & 2: PREPARING & SCREENING SOIL

مٹی کو گوندھا اور فرسے کو تیار کرنا



STEP 3: MIXING & KNEADING MUD

STEP 4: DUSTING BRICK MOULD

Soak soil for a few days, preferably one week. Mix and knead the soaked soil well. Dust the brick mould with sand.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.6

STEP 7, 8 & 9: PLACING AND TAMPING MUD IN THE MOULD

پیشیں فرسے سے نکالنا، سلگانا اور محفوظ کرنا



STEP 7: TAKING OUT MUD BRICKS

STEP 8: PLACING ON GROUND

STEP 9: STACKING BRICKS FOR DRYING

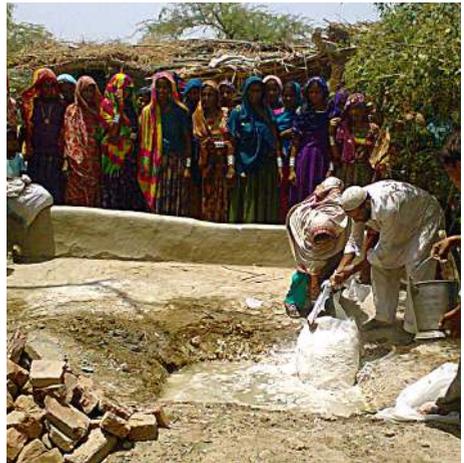
Invert the mould on the ground with sand, carefully lift the mould. Let the bricks dry for 48 hours. Stack dry the bricks for 7-10 days.

2.1 Why use lime?

The research carried out by Getty Foundation shows that lime has minor affect on the strength of masonry, but it increases the ability of masonry to withstand deformation and shock.

Lime has a natural ability to both hold and evaporate moisture from the walls and is able to maintain a state of balance. It provides effective thermal performance. It is part of traditional building techniques in the country and can easily be taken forward.

During the work that Heritage Foundation of Pakistan (HF) carried out where villagers have been introduced to the use of lime, even women can now carry out slaking and mixing with mud and thus make their structures water resistant. During the scaling up of one-room-shelters (ORS), and after training has been provided to the implementing partners of International Organization for Migration (IOM), almost



Women being trained on how to slake lime.

40,000 shelters have been constructed. After seeing the performance of lime stabilized mud walls and the use of lime render on external faces of walls, which stood as a bulwark against rain and flooding, the villagers have dubbed the structures *Katcha Kot* or 'unfired clay fortress'. Thus, it is clear that once mud is stabilized with slaked lime, it becomes DRR-compliant, i.e. it is able to withstand flood disasters. Therefore lime is being used in all earthen struc-

tures being promoted by HF. In addition to its use in bases and walls of Karavan-Ghar (shelters), it is equally beneficial in other structures, e.g. KaravanLatrines (eco-toilets), earthen platforms for storing grain, water, livestock feed and livestock itself, Karavan Handpump (hand water pump) platforms, side walls of raised beds for farming, Karavan Pako-swiss Chulah (fuel efficient stoves) and scores of other structures which need to withstand rain, flooding or earthquake jolts.



Lime slaking demonstration during training.

Due to the capacity being built for slaking lime, particularly among women, it can replace cement easily when construction work in rural areas is undertaken.



Mixing slaked lime for laying PLC for foundations.

2.2 What is lime?

Limestone is the raw material which is required for the production of lime and is widely available in Pakistan. It is produced by breaking limestone into lumps and heating it in a kiln. In Pakistan the kilns are small and rudimentary in their construction. Contrary to the production of lime in industrially developed countries, Pakistani kilns use waste agricultural material for firing the raw product and thus avoid destruction of trees. The expected temperature is less than 900 degree C. In the burning process carbon dioxide and any water in the raw material is driven off.



'Patharwala Choona' before slaking.



Mixing lime slurry for smooth plaster finish.

The end product is 'quicklime' or calcium oxide. This product is referred to as 'Quick Lime', 'Unslaked Lime' or even 'Lump Lime'. In Pakistan it is referred to as Patharwala Choona.



Mixing lime and mud for brick making.

2.3 What are the components of lime?

Quicklime is available in lumps and must be stored in water proof bags before slaking. It is best if is used fresh and is usually available in 25 kg polythene lined bags.



Lime renders provide protection from water.

The bags should be placed in a dry place on an elevated platform in order to avoid being affected by flooding or ingress of moisture from the ground. Only dry quicklime should be used. Any lumps that have become wet should be discarded and must not be used.



Choona Adhi selling slaked and unslaked lime.

Only clean potable water should be used for slaking.

Although lime can be slaked in concrete or steel containers, however, HF promotes slaking in pits dug in the ground, which are easy to handle by rural households as well as women.



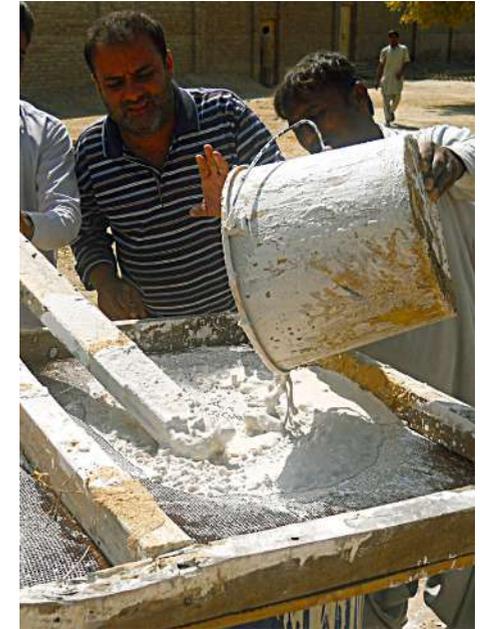
Mixing straw and dung in mud-lime plaster for wall finishes.

It is advisable that the pits dug in the ground are in a safe place and surrounded by a fence or bushes to keep children and animals at bay.

The pits should also be lined with lime mud plaster in order to prevent the loss of water from the mix.

2.4 What is the procedure for slaking lime?

Choose an elevated area for making the pit for slaking lime. The pit should be of approximately 4'x4' and 4' deep for household use. Larger pits of size 5'x9' and 4' deep should be made for community use.



The pit should be filled with water and allowed to be absorbed in the sides of the pit. Once water has been absorbed, the sides and bottom of the pit should be treated with lime-mud plaster. After allowing the plaster to set for 3-4 hours the pit should be filled with water.

It is important that lime lumps from bags are poured into the water, rather

Passing slaked lime through a sieve.



Mixing soil and lime thoroughly by turning over.

than the other way round. Water must never be poured over quicklime. The mixture should be carefully stirred with a wooden stake, while taking all safety precautions, since a huge amount of heat will be generated.



'Patharwala Choonna' being slaked.

The mixture should be slaked for at least a week before being used in construction. The longer the time for slaking the better would be the results.

Precautions must be taken so that lime putty is always covered with layer of water and never exposed to the sun or get dried.



Ensure that the pit is full of water before adding lime for slaking.

It is important that eyes, hands and face are always protected and children are kept away from the pits for 24 hours after lime is poured in the pit.



For a finer finish the lime slurry can be passed through a sieve.

2.5 What are necessary precautions?

While slaking process is being undertaken, it is essential that people, particularly children, are kept away from the slaking pit in order to avoid any accidents.

Those undertaking the slaking process, should protect eyes and hands and avoid any contact with the mixture as it will be very hot and likely to cause injuries. Buckets of water should be available for First Aid purposes and also to wash eyes thoroughly in case of any contact.

Lemon juice or vinegar should be kept at hand in case treatment for skin injuries is required.



Different ratios used for plaster produce results of varying strength and colour.



Lime renders act as a buffer from heat and cold.

2.6 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

1.0

LIME SLAKING

چونے کی تیاری



Lime is easily available. It is environmentally friendly as compared to cement. Lime gains strength over time and becomes stronger.

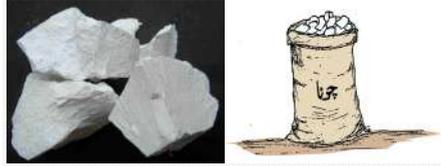
DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.1

PRECAUTIONS BEFORE LIME SLAKING

چونے کی تیاری سے پہلے احتیاط

STEP 1: PROCURING LIME



STEP 1: PROCURING LIME چونا حاصل کرنا

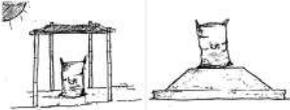
Lime should be in the form of lumps (Patharwala Choonā) available in 25 kg weather resistant bags lined with polythene.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.2

PRECAUTIONS FOR STORING LIME

چونے کو حفاظت سے رکھنا



STEP 2: STORE LIME SAFELY. PROTECT FROM DAMPNESS AND RAIN

چونے کو حفاظت سے رکھنا، نمی اور بارش سے بچانا



Lime bags should be placed in a dry elevated place to avoid dampness or water seepage. Damp lime should not be used for construction.

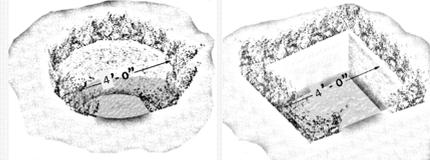
DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

3.1

METHOD OF SLAKING LIME

چونے کی تیاری کا طریقہ

STEP 1: MAKING THE LIME PIT



STEP 1: MAKING LIME PIT

چونے کا کرنا مانا

Make a 4'x4'x4' lime pit for households pit. Use lime mud plaster on sides of pits. Pour water and wait for it to absorb before pouring lime.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

3.2

WET METHOD OF LIME SLAKING

چونے کو پانی سے تیار کرنے کا طریقہ

STEP 2: POURING LIME IN THE PIT



STEP 2: POURING LIME IN PIT WITH WATER

گڑے کو چونے اور پانی سے بھرا



Fill the pit with water; pour 2 bags of lime into the lime pit; stir and mix the mixture with a wooden stake; allow for reaction for 3 hours.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

4.1

PRECAUTIONS DURING & AFTER LIME SLAKING

چونے کی تیاری کے دوران اور بعد کی احتیاط



PROTECTIVE GEAR FOR HANDS AND EYES



PROTECT CHILDREN AND ANIMALS

IN CASE OF CONTACT

Protect eyes and hands during handling lime. Surround lime pit with bushes. Keep away children and animals. Don't touch hot lime.

3.1 Why earthen platforms?

From time immemorial, earthen platforms or *tibbas* have been utilized in Sindh to provide protection from floods. Situated in flood prone low lying wetlands, the residents of Bronze Age Mohenjo-Daro learnt to thwart the hazard of flooding by building elevated platforms.

Drawn from tradition, the *Lari Principles for DRR* emphasize the need to place all valuables and goods, grain and food, drinking water, feed and livestock on raised platforms in order that the essentials are saved from being washed away during floods.

Since the introduction of lime stabilization of unfired clay by HF, these sustainable elements have become flood and rain resistant. As earth products they are economical to build, along with having zero carbon footprint attributes. Thus, lime stabilized earthen platforms are being promoted by HF in all villages in order to provide high level storage areas.



Demonstration for earthen platforms.

Although it is possible to build structures such as the bamboo *machan* (look out) consisting of a roof at a higher level which can provide sufficient storage for heavy household goods such as trunks and beddings etc., however, the cost of such structures is comparatively high and greater skill in construction is required.

On the other hand, earthen platforms can be constructed by using easily available earth and lime and local skills.



Women being trained to construct earthen platforms for disaster preparedness.

cost. It is often seen that because food and water is not stored at a high level they get washed away even when there is only 6" of flooding, displacing the family to a camp in search of food and water.

If all rural households make their own earthen platforms and ensure that they have sufficient reserves of food, water and livestock feed, they would be able to restart their lives as soon as the waters begin to recede.

Therefore, earthen platforms are an essential prerequisite for disaster preparedness and their introduction is imperative in as many villages as possible.

The platforms or *tibbas* are part of no-cost solution being promoted, which are part of coping mechanisms and important for the strategy being promoted by HF for disaster preparedness.

After providing training to *Barefoot Village Entrepreneurs* (BVEs), the technique of how to build strong and flood-resistant products including *tibbas* has become possible in many villages.

Since earthen platforms can be built by families themselves, the guidance provided by BVEs in the village results in safety to a family's valuables at a low



Platforms for storage of grain for disaster preparedness.

3.2 What is the advantage of earthen platforms?

Since it is imperative that all valuables and essential supplies for surviving the flood period are kept safe, lime-stabilized earthen platforms provide an economical solution.

Platforms are simple to make and can be constructed during the intervening period and at leisure, so that they are available when flooding takes place.

During normal periods of living, the *tibbas* provide a safe and hygienic place for storing water and food grain. By storing them at a high level, the essentials are removed from the floor where they are normally placed and are prone to dirt and other pollutants.

The platforms can be of varying sizes depending upon the space available and the nature of goods that need to be provided protection.

The mud-lime platforms can vary from small 2'0"x2'0" for household needs to much larger sizes for community use e.g. storing of straw for fodder 10'x10' or even 145'x100' for a sports field size for livestock safety. The community platforms act as cultural, social or sports nodes during



Women constructing a platform for solar treated water.

normal periods. Depending upon the need, earthen platforms can be built either by individual households or as a community activity for disaster preparedness.

It has been noted that in areas where HF has been able to create high level storage, families have been able to restart their lives as soon as the waters receded, for example in village Darya Khan Shaikh.

On the other hand, villages unaware of the advantage of high level storage suffer greatly, as all their valuables are washed away, forcing displacement from their homes and preventing them from re-starting their lives immediately after the waters recede.

3.3 How are the earthen platforms constructed?

Three types of earthen platforms are recommended for household use:

No. 1: Size 2'x2'x2'6" high. For placing drinking water pitcher.

No. 2: Size 3'x3'x3'3" high For placement of grain container.

No. 3: Size 2'6"x1'6"x2'6" high For treatment of solar purified water.

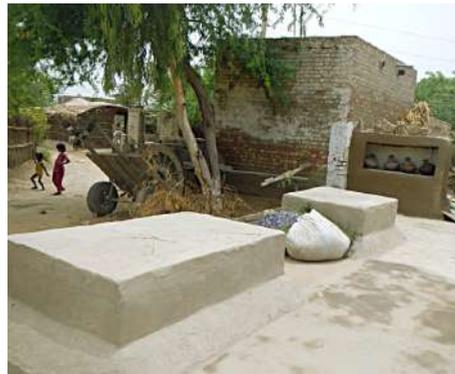
No. 4: Although the sports field platform is not part of training, however, it is also an essential component which can be built if there is space in the village.

The training modules provide the methodology for the construction of earthen platforms. It is important that all details and specifications are followed in order to make them strong and flood resistant.

Important aspects include excavation and correct layout. It is also essential that lime is used according to specified mix. It must be understood that unless lime is used, the *tibba* will not survive rain and flooding. Accordingly, layered mud, or in case mud brick is used, must carry specified content of lime.

Similarly, it is essential that all external surfaces are treated with a lime-mud render for extra protection to the inner core of mud-lime structure.

Since the top may be used in a rough manner, it is recommended that the top is treated with a layer of pozzolana i.e. a mix of lime, mud and brick dust. Care must also be taken to cure the structure for at least 7 days.



Construction of earthen platform.



Tibba for solar purified water.

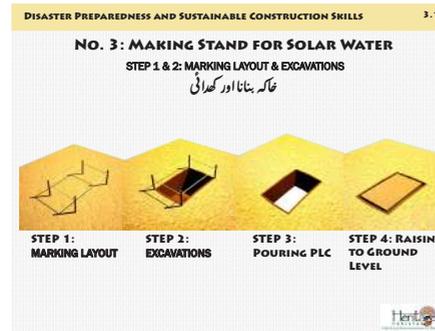
3.4 Training Modules



Flood preparedness involves building elevated earthen platforms for the safety of drinking water, food rations, livestock and its feed.



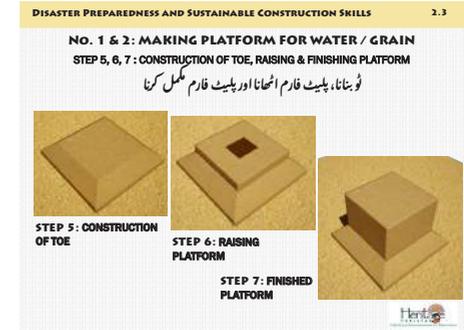
Mark layout 3'-6" x 3'-6"; dig 1'-6" after removal of 6" top soil. Place stakes on corners & pour 4" thick PLC. Raise wall in mud lime bricks.



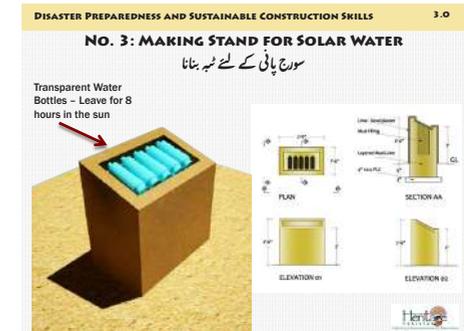
Mark layout 3'-0" x 2'-0" and excavate 1'-6" deep. Pour 4" thick PLC and fill excavated area with mud-lime. Raise wall with mud-lime bricks.



Features include PLC at the base and layered lime-mud at the base and toe. The platform is built with mud bricks and lime-mud plaster.



Raise wall for toe 1' thick along the edge of PLC and 1' above ground. Raise 13.5" thick wall on edge 2' above toe height. Render with lime.



Use PLC & layered mud-lime at base. Make sloped top & upstands rendered with mud-lime plaster for transparent water bottles for 8 hours in the sun.

NO. 3: MAKING STAND FOR SOLAR WATER

STEP 5 & 6: RAISING PLATFORM WITH UPSTANDS & FINISHING STAND

پلیٹ فارم اونچا کرنا اور پلیٹ فارم مکمل کرنا



STEP 5: RAISING PLATFORM



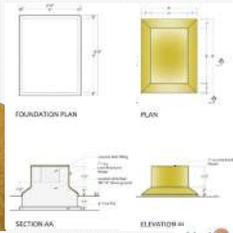
STEP 6: FINISHING PLATFORM



Raise stand height 2'6" in back and 2'0" in front and provide 4" thick PLC on top with up-stands. Render with lime:mud ratio 1:6 on walls and top.

NO. 4: MAKING PLATFORM FOR HOUSEHOLD GOODS

گھر کے سامان کے لئے ٹیہ بنانا



Use PLC at base and layered lime-mud in base & toe. Platform must be built with mud bricks with 4" thick PLC on top. Render with lime.

NO. 4: MAKING PLATFORM FOR HOUSEHOLD GOODS

STEP 1 & 2: MARKING LAYOUT & EXCAVATIONS

ٹماکہ بنانا اور کھدائی

STEP 1:
MARKING LAYOUTSTEP 2:
EXCAVATIONSSTEP 3:
POURING PLCSTEP 4: RAISING
TO GROUND LEVEL

Mark layout 6'-6" x 8'-8"; excavate 1'-6" deep after removing 6" top soil. Pour 4" thick PLC. Raise wall with lime-mud bricks ratio 1:6.

NO. 4: MAKING PLATFORM FOR HOUSEHOLD GOODS

STEP 5, 6, 7: CONSTRUCTION OF TOE, RAISING WALLS & FINISHING PLATFORM

ٹوٹنا، پلیٹ فارم اٹھانا اور پلیٹ فارم مکمل کرنا

STEP 5: CONSTRUCTION
OF TOESTEP 6: RAISING
PLATFORM, FILLING
WITH MUD/SANDSTEP 7: FINISHED
PLATFORM

Raise 1' thick wall for toe along PLC. Build toe 1' above ground. Raise 13.5" thick wall on edge 2' above toe height. Put 3" thick PLC & lime.



Platforms with lime-sand render for solar water and storage of goods.

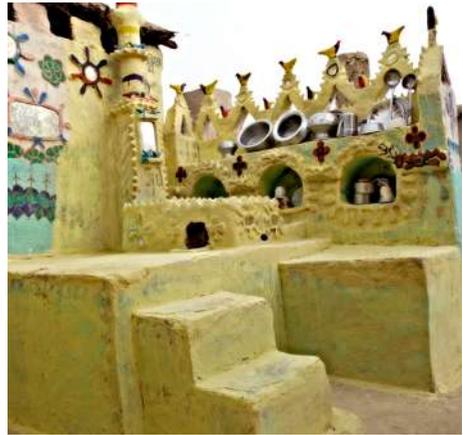
4.1 What is Karavan Pakoswiss Chulah?

The Karavan Pakoswiss Chulah (KPC) is a clean burning and fuel-efficient double stove which can use small sticks or twigs for fuel. Thus, KPC is more efficient than the traditional stove, which provides cooking on open fire. The KPC's ability to use small dried branches and twigs obviates the use of charcoal, and deforestation is avoided which has a destructive impact on the environment.

Other environmental benefits are the zero carbon footprint in its construction – the entire double-stove is built with earth, thus avoiding the use of metal or other unsustainable materials.

The KPC is built on raised earthen platform. It is Disaster Risk Resistant (DRR)-compliant as it is not within reach of flood water.

Similarly, the use of layered lime-mud in construction and lime-mud render pro-



Karavan Pakoswiss Chulah, Mirpur Khas.

ducts it from damage from rain or flood. Since a large number of villages in Sindh have become proficient with the use of lime due to joint HF-IOM *One Room Shelter* program, water resistant structures can be made in many villages.

Due to the placement of the double stove on earthen platforms, a hygienic environment for cooking is achieved. Animal droppings and dirt on the floor that is commonly seen in the case of floor mounted open fire stoves, can no longer contaminate the food.

The placement of the chimney, ensures that the smoke is emitted at a higher level, thus, providing a comfortable way of cooking as compared to the earlier practice where smoke is constantly getting into the eyes of the housewife.



Rudimentary stoves are a fire hazard.

The smoke-free arrangement helps avoid respiratory and eye diseases that are commonly found among rural women. The design of the stove allows cooking in two pots while firewood is used only for one. The heat from one stove transmits into the second and the smoke emits through a chimney.



Rural stoves pose danger for children.

KPC makes cooking with fire easier, safer and faster compared with open fire stoves. The double-stove is easy to start and because it can accommodate two pots, it takes less time to cook food. Being fuel efficient there is no requirement for blowing air for fanning the flame. Once lit, the fire will continue to burn as long as firewood is not withdrawn or burnt out. When compared to an open fire stove, the food is cooked in almost half the time.

status in the eyes of both the family and the community.

The entire concept has been developed in order to reach Lari-Levels of Resilience (L-LoR) in flood affected areas.

It is a well designed structure, that incorporates an elevated earthen platform and storage wall. Thus, KPC provides a clean family dining and socialising space. It creates a domain exclusively dominated by the mother, elevating her

Since each stove is the expression of the creativity of the housewife who has lovingly built it - not one being the same as another - these can be truly termed *Rural Designer Stove-Kitchens*.

4.2 Why Karavan Pakoswiss Chulah?

The Karavan Pakoswiss Chulah has been found to be ideal in its use for domestic cooking purposes by rural housewives. Since wood fuel is expensive, it is important that economical ways of cooking should be adopted. KPC uses less than half the amount of wood used in open fire stoves.



Training for KPC construction.

Since the firewood is burnt inside a combustion chamber which is constructed with mud, and thus is well insulated, it prevents any loss of heat.

Due to a small opening on the windward side, the air pushes the heat from one cooking chamber to another through an opening in the central mud partition.



Marking layout for the chulah.

The arrangement of good air flow pushes the smoke into the chimney which is also constructed with mud.



Karavan Pakoswiss Chulah, being constructed by a housewife in Mirpur Khas.

4.3 Main components of Karavan Pakoswiss Chulah?

The Karavan Pakoswiss Chulah comprises the following components:

- Lime stabilized Earthen Platform
- Washing Area
- Double Stove arrangement, Combustion Chamber, Chimney and Air Regulation Pipe (Designed by PakoSwiss Technology)
- Firewood & Utensils storage



Karavan Pakoswiss Chulah, Mirpur Khas.



Karavan Pakoswiss Chulah, Mirpur Khas.

4.3.1 Earthen Platform

Making the stove on an earthen platform helps reduce various hazards, such as animal contamination, flood risk, accidents due to fire etc. The platform also allows for a clean gathering space or a sitting space to have meals.

4.3.2 Washing Area

The installation of a washing area creates a hand washing regimen before cooking and eating.

4.3.3 Double Stove Arrangement

The double stove arrangement has been designed keeping in mind the work load on rural women. This arrangement saves time while allowing to cook food twice as fast with half the quantity of fuel.

4.3.4 Combustion Chamber

This is the chamber where wood is placed for burning. The chamber is interconnected with another chamber where the heat is transferred for the second stove.

4.3.5 Chimney

The chimney provides an outlet for smoke while keeping it away from getting into the user's eyes.

4.3.6 Air Regulation Pipe

The pipe regulates the air in the combustion chamber, by allowing the heat to transfer from the combustion chamber to the secondary chamber.

There is a high degree of heat transfer from one chamber to the next, so that while wood is burnt under one pot, the food in the other pot also gets cooked due to heat transfer. This allows a highly economic arrangements for fuel.

4.3.7 Storage

Within the platform, a space is created where firewood can be stored, while a wall provides arched alcoves for storing utensils at a high level. The arrangement for storage can be altered depending on space available. The creativity of the housewife transforms the ordinary storage alcoves into spectacular works of folk art.



Training for construction of Karavan Pakoswiss Chulah.



Discussing marking of layout for stove chambers on top of earthen platform during training.



Elevated status - lives of rural women have greatly improved with the smokeless earthen stove.

4.4 Key benefits of Karavan Pakoswiss Chulah?

4.4.1 Ease of Construction

The stoves are easily constructed using mud brick and local skills. Since women are proficient in the use of mud they are able to easily fabricate it as long as they are guided about the key elements. The use of lime is an added factor, however, wherever HF's methodology is being promoted, communities have learnt the use of slaking and mixing lime with mud.



Constructing double stove on raised earthen platform.

4.4.2 Saving on Fuel

The obvious saving on fuel is an incentive for marginalized communities where the saving of every rupee counts. The promotion of *Karavan Pakoswiss Chulah* through a network of trained Chulah Adhis – the StoveSisters – has shown that the methodology can easily be replicated. On the one hand rural housewives learn to make their own stoves, on the other the creation of entrepreneurs such as the StoveSister can spread the methodology rapidly to rural communities. Many of the trained StoveSisters have now become HF's *Barefoot Village Entrepreneurs* or BVEs and Master Trainers.

floor-level open fire Chulah. It also allows the use of smaller firewood and twigs, and as such is ideal for industrially less developed countries (LDCs) such as Pakistan, since it prevents deforestation.

Keeping trees from being destroyed also helps in preventing soil erosion and reduced danger from flooding etc.

4.4.3 Environmental Impact

The design of the Karavan Pakoswiss double stove allows saving of 50-70% of fire wood compared to the traditional

4.4.4 Improved efficiency

The design of the Karavan Pakoswiss double stove prevents loss of heat and

makes it possible for 80% of the heat to be used for cooking. It is calculated that only 10% to 40% of heat is used in the case of the traditional floor mounted open fire stoves. By improving the heat transfer from the fuel to the pot, there is considerable saving of the firewood.

The use of double collars in order that food could be cooked in two pots at the same time and with the same amount of firewood provides considerable reduction in overall cost of firewood.

4.4.5 Improved health

The highly insulated structure of the double stove as a result of its construction with mud and lime-mud render, allows the firewood to be fully burnt in the combustion chamber.

The reduction in harmful smoke and reduced carbon monoxide emissions due to the use of the chimney contribute to cleaner environment for women and children. The stove hardly produces any smoke, as it is produced only when the fire is lit. Women have found it a boon. Respiratory diseases due to inhalation of smoke and burning of eyes are avoided.

There are no longer tears or smoke saturated clothes. Since the Karavan Pakoswiss Chulah is constructed on an



Karavan Pakoswiss Chulah, Mirpur Khas.

earthen platform a couple of feet above the ground, it provides instant hygiene benefits. Crawling insects, dirt, filth, animal droppings, that the floor is normally littered with while cooking with traditional open fire stove, can no longer find their way into the cooking pot as it is well above the floor level.

Consequently, any cooking carried out in this stove is hygienic and has health benefits for the family, particularly women and children.

4.4.6 Disaster Risk Reduction

The construction of mud stove, elevated above the ground has the added advan-

tage that it is protected from flood waters. The *Lari Principles for DRR* are applicable in all constructions and the earthen platform provides space for placement of drinking water as well as pots and pans.

The construction therefore provides the possibility to restart the fires immediately after flood waters recede or rain water comes to a stop.

Karavan Pakoswiss Chulah is among key elements that can provide the impetus for the families not to have to move away from their homes, since their stoves will not be washed away as in the past. These will survive the flood and rain and will allow the housewife to continue to provide meals to the family when the rain stops.



Karavan Pakoswiss Chulah, Mirpur Khas.



Lime render helps protect the stove and washing areas and is also easier to manage.



Karavan Pakoswiss Chulah as a space for social interaction.

4.5 Training Modules for Karavan Pakoswiss Chulah?

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.1

TYPICAL STOVES IN RURAL AREAS



Typical Rural stoves are unhygienic due to close proximity to ground, and cause health hazards such as respiratory diseases and pollution.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.3

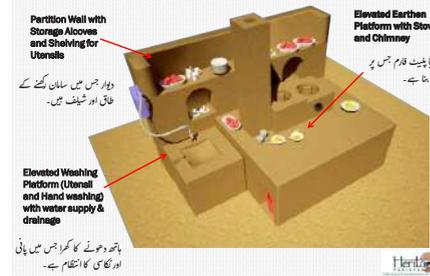
BENEFITS KARAVAN OF PAKOSWISS CHULAH :



Karavan Pakoswiss Chulah ses local mud brick and local skills. Saves 50-70% firewood. Chimney reduces carbon emissions.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.1

KARAVAN PAKOSWISS CHULAH : CONSTRUCTION



Understanding dimensions and standard heights, construction of platform, chulah with chimney, washing area and wall alcove.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.2

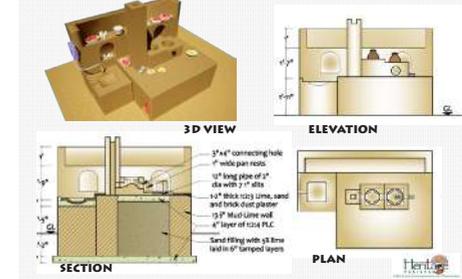
WHAT IS KARAVAN PAKOSWISS CHULAH EARTHEN SMOKELESS DOUBLE STOVE



Clean burning, fuel-efficient double stove; uses small sticks or twigs. Built on raised earthen platforms, it is DRR-compliant as it can withstand rain and floods.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.4

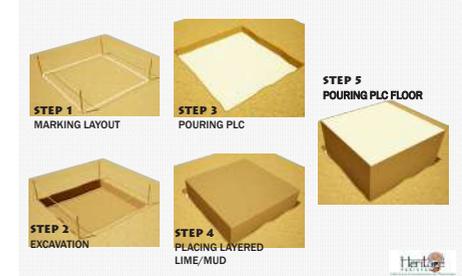
KARAVAN PAKOSWISS CHULAH : MAIN COMPONENTS



Double stove, combustion chambers, chimney, air regulation pipe, firewood storage, earthen platform, and washing area.

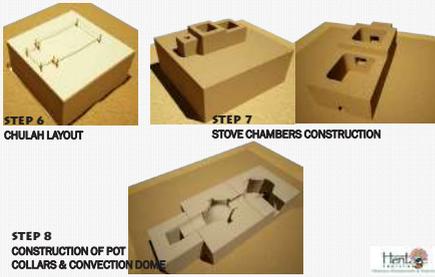
DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.2

CONSTRUCTION OF THE ELEVATED EARTHEN PLATFORM



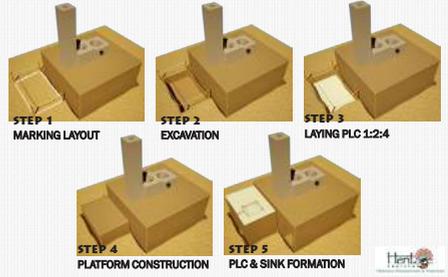
Construction of elevated earthen platform: marking layout; excavation; pouring PLC; placing layered lime-mud; pouring PLC floor.

CONSTRUCTION OF STOVE AND CHIMNEY



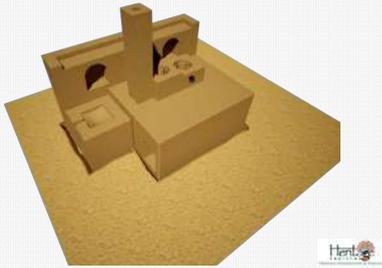
Construction of stove & chimney: chulah layout; stove chambers construction; construction of pot-collars and convention dome.

CONSTRUCTION OF ELEVATED WASHING PLATFORM



Construction of elevated washing platform: marking layout; excavation, laying PLC, raising platform; PLC and making sink with drain.

CONSTRUCTION OF ALCOVE WALL WITH ARCHES



Construction of alcove wall with arches: raising wall; making arches for storage.

COMPLETED KARAVAN PAKOSWISS CHULAH



Completed Karavan Pakoswiss Chulah.

COMPLETED KARAVAN PAKOSWISS CHULAH IN SINDH



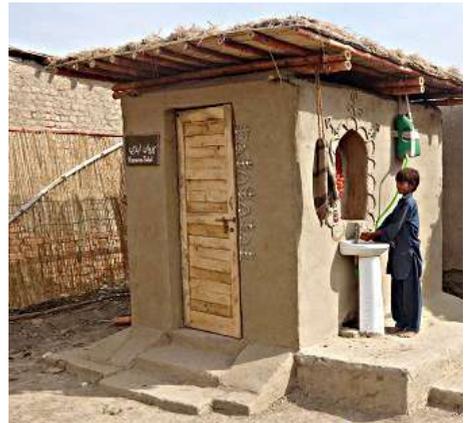
Karavan Pakoswiss Chulah constructed and decorated with folk imagery by rural women in Sindh as designer chulah kitchens.

5.1 Why KaravanLatrine ?

According to a UNICEF 2013 report, 43 million of Pakistan’s population practices open defecation. 320 children die every 24 hours from preventable diarrhoeal diseases. A WHO 2010 report places Pakistan third among countries with the highest incidence of open defecation. The worst sufferers are women, young girls and children.

Unless, a sustained effort is made for construction of toilets, communities and particularly children will continue to live under an imminent death threat.

Promoting the KaravanLatrine provides an alternative to households to avoid creating unhygienic conditions in their surrounding areas. The construction of toilet chamber provides privacy along with hygienic environment leading to better health and reduction in children’s mortality rates. It is a key element for reaching *Lari-Levels of Resilience (L-LoR)* in disaster affected areas.



Eco-toilet KaravanLatrine, Tando Allahyar.

The KaravanLatrine is part of HF’s strategy, which is based on green skill training that results in the construction of a small chamber built through household participation. The chamber immediately provides a private area for bathing.

As soon as the eco-toilet box is placed, it can be used, forestalling the social ills caused by open defecation. Since the excreta is collected and later removed for composting, the use of water is minimal as it is required for washing only. The

discharge of gray water and urine into a plantation bed prevents unhygienic sewerage from polluting the environment.

The KaravanLatrine provides income generation through sale of excreta/nightsoil. It addresses the WASH (Water, Sanitation, Hygiene) aspects by minimizing the use of water, clean sanitation and hygienic environment as part of *Lari Principles for Disaster Risk Reduction*.

The pilot in village Hashim Macchi shows that households can be encouraged to begin using the KaravanLatrine to gain privacy. At the same time they start earning income through sale of nightsoil to the designated Khad Adhi (Compost Sister).



Learning fabrication of Bamboo Roof joists.



Marking Layout for KaravanLatrine during training.

5.2 What is KaravanLatrine?

The construction of KaravanLatrine is based on methodologies that have been developed by Ar. Yasmeen Lari, CEO, HF, over the past several decades in working out ways to deal with human waste in areas such as the Siran Valley and Swat in the north and rural areas of Upper and Lower Sindh.

The construction methodology of KaravanLatrine is based on HF's *Build Back Safer with Vernacular Methodologies* that promotes the use of sustainable, low cost, zero carbon footprint structures. These are safe structures that are built using mud, lime and bamboo.

It provides a mechanism for urine diversion and separating solid faeces, in order that solid waste could be collected in a container for placing in compost pits, while urine is discharged into a plantation bed or receptacle. The KaravanLatrine also provides a bathing space as well as hand wash basin, a mirror alcove and shelving for storage of toiletries, while a platform provides space for placement of water bucket and a simple water tap, discharging gray water into plantation beds. The strong roof provides space for ChhatBagheechea (roof garden) that incorporates drip irrigation.



KaravanLatrine with hand washing platform.

KaravanLatrine is designed as an empowering structure which through its ready availability provides privacy for women and a much needed facility for children and men. It is designed as a composite sustainable structure for ease of construction at the same time incorporating all the key elements for its use for defecation, bathing, hand and face washing and grooming. As a well designed unit, it incorporates defecation box (with separate chambers for solids and liquids), hand wash basin and an earthen platform for storing water. A small alcove built within the KaravanLatrine provides storage and mirror space for ease of use for hand washing as well as fostering the habit of neatness (e.g. hair brushing and teeth brushing and shelving to store toothbrushes and soap). The separation of urine from faeces or

night soil improves the maintenance and workability procedures.

The addition of pegs on the door for clothes, rope loops for placing towels, niches for soap and oil and encouragement to building elevated storage shelves are elements that add to the usefulness of the KaravanLatrine and encourage its usage by households.



Teaching other households the method for fabrication of Karavan Bamboo roof joists.

The main components are as follows:

5.2.1 DRR-compliant Chamber

Chamber with internal size 6'x4' built with lime stabilized mud walls and bamboo roofs, its floor is raised at least 450 mm or 18" from the adjacent ground level.

- Stabilized lime-mud walls with extended toes at base.
- Bamboo reinforced lime concrete ring beams.
- Roofs with HF's multiple bamboo joists and projecting eaves.
- Earthen Platform for hand wash basin.

5.2.2 Twin WC Seats Toilet Seat Box

The wooden box consists of two separate sections and seat pans. The two seats have been devised in order to ensure separation of solid and liquid waste. One seat is akin to Asiatic squat type pan which is used for urine and washing as the liquid is then drained through a pipe into a bed of plantation or into a receptacle for urine collec-

tion. The second pan is akin to a Western WC with a lid. A receptacle or container is placed directly below for collection of faeces or night soil. Depending upon the quantity, customized management will be needed in order that the night soil is later transferred to a composting bin. This arrangement has been found to be the most economical method for disposal of waste, but requires proper composting conditions in order to avoid odour.

5.2.3 Bathing Space with Drainage

A bathing space is incorporated within the chamber. A mug is required for use in the liquids/urine Asiatic WC. The floor slopes to an outlet from where the gray water discharges into a plantation bed avoiding any cess pools of gray water which usually create unhygienic conditions.

5.2.4 Hand Washing Arrangement

Ceramic hand wash basin with alcove in-



Internal view of KaravanLatrine showing sanitary box.

corporating mirror and toiletries shelf, with basic water supply and drainage pipe. A basin, fixed to an external side of the chamber, provides easy-to-use hand washing facility, thus fostering hygienic practice and preventive health procedures. The arched alcove built into the wall is an essential component for placement of a mirror and shelving. While designing the

KaravanLatrine the procedure of hand-washing was carefully considered and the ways by which it could be encouraged after use of the toilet. The elevated platform in front of the alcove provides space for placing buckets with clean water needed for hand and face washing. Shelving and mirror have been provided to encourage personal grooming. Thus, the entire unit is a step toward not only better health, at the same time providing dignity and grooming, leading to character building, pride and confidence.

5.2.5 Waste and Gray Water Disposal

The bucket with faeces is sold to the Bare-foot Village Entrepreneur Khad Adhi (Compost Sister) while the gray water is discharged into a plantation bed where flowers and other plants can be grown.



Double Eco-Toilet Unit for larger family sizes.

5.3 Key Benefits of KaravanLatrine?

The key benefits of KaravanLatrine are as follows:

- a. It can be constructed easily by families themselves. The participatory approach results in low cost construction with zero carbon footprint as only mud, lime and bamboo are used.
- b. It does not contribute to environmental degradation or depletion of the resource base.
- c. It provides a private chamber which is especially important for use by women and children.
- d. The only space required is for the plan footprint; there is no other space required for making septic tanks or pits for latrines.
- e. It is particularly suitable for rural areas where it can be easily maintained. The waste can be utilized for agriculture by making organic fertilizer.
- f. Urine separation or urine diversion is also found to improve sustainabil-



Composting bins where faeces are deposited, Village Hashim Macchi, Tando Allahyar.



KaravanLatrine double unit, Tando Allahyar.

- g. There are no extensive diggings or holes that have to be made and no septic tanks which require especial expertise and cement and steel for construction, materials and skills that are not easily available in rural areas.
- h. These are very economical to construct and can be built with locally available materials.
 - Water consumption is limited for washing.
 - There is no water wastage due to flushing the toilet.
 - Hand washing basin provides hygiene training and grooming.
 - It prevents water source pollution and barrier to germs and water borne diseases.
- i. The sale of faeces for composting provides income generation for the family.
- j. The strong roof can be used as a roof garden thus introducing the concept



Village Barefoot Entrepreneurs train households to construct their own toilets.



Construction of KaravanLatrine is spreading through Village Barefoot Entrepreneurs.



Women observe the eco-toilet KaravanLatrine during training.

of food security and nutrition without need for extra land.

- k. It can be built in stages. For example the walls can be constructed to form the chamber and place the sanitary box with two WCs along with drainage.
- l. Once the urine and faeces are sold, the money generated can be used to add the hand wash basin and the KaravanRoof. The incremental methodology can allow families to gradually build up their eco-san facility.



Separate hand washing arrangement.



Roofs can be utilized as vegetable gardens.

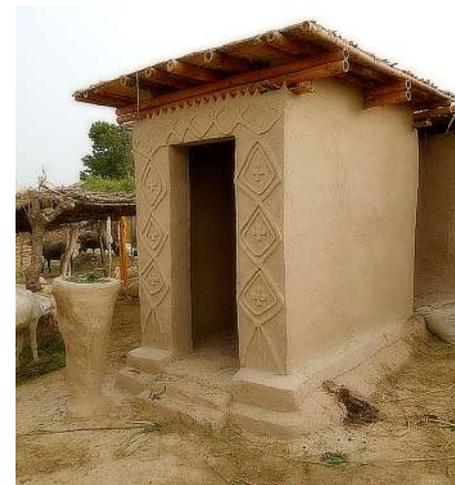
According to a report of Clivus Multrum, a composting toilet manufacturer, a single person using a compost toilet will produce 40 kg (88 lbs) of compost per year while refraining from polluting 25,000 litres (6,604 gallons) of water annually.

The experience of pilot programs shows an intense desire by women to adopt the eco-toilet in order to ensure privacy while bathing, since open defecation practices leave women in an extremely vulnerable state. However, for an effective use of the toilet, handholding of households by the Khad Adhi (Compost Sister) is essential, especially for achieving the cycle of income generation.

5.4 What precautions must be taken?

5.4.1 Siting and Orientation

- a. Place the toilet on raised ground; avoid low lying areas.
- b. In case high ground is not available, ensure that the plinth of the toilet chamber is raised well above the adjacent ground.
- c. Do not construct the chamber too close to the houses. Although there is no smell if the waste is properly protected, it requires open space around it for the following purposes:
 - Walking space to remove night soil box when it is filled.
 - Space for making vegetable beds at least 1'6" or 500mm away from the walls.
- d. As much as possible face the rear wall towards north in order that the excreta/night soil box remains cool.



KaravanLatrine with decorative mud patterns.

5.4.2 Management of Eco-Toilets

It is important that KaravanLatrine Eco-Toilets are managed effectively and safeguards should be applied in order to keep them functioning without any unpleasant smell.

As much as possible the faeces should not be mixed with any water, as too much liquid will create anaerobic conditions with consequent odours.

Similarly the use of a handful of saw dust or straw is essential after use in order that excreta is always covered.

In rural settings it is not difficult to allocate space for composting. The composting bins should be constructed using bamboo and matting cross braced construction and enclosing with usual HF's matting and mud and lime plastering inside and out.

Raising the floor of the composting bins with mud and lime, will provide protection from flood waters. The composting bin requires protection from dogs and other stray animals and must be covered by barbed wire to keep them away.

On the occasion of dumping faeces from containers, the wires can be removed and dumped material arranged in a manner that it is fully covered from all sides with straw or dried leaves etc. After dumping the faeces, the container must be washed thoroughly before its use, and once again covered with straw to avoid any smells.

5.4.3 Operation and Maintenance

The special value and significance of the KaravanLatrine should be made clear to households:

- It is part of HF's holistic model for sustainable living and can be used to provide a dignified way of life particularly for women.
- It is designed to avoid any pollution and has almost zero carbon footprint.
- It is important that a handful of straw placed in the chamber is used to cover the night soil in the container of the solids pan.
- No water should be used in the night-soil container.
- The lid must be always kept closed.
- The liquids pan should be washed down with water after use.
- Hands must be washed after the use of the KaravanLatrine for which a basin is provided on the external side of the wall.
- As much as possible the use of organic liquid soap being manufactured in HF villages should be encouraged.

5.4.4 Changing Night Soil Containers

- When the night soil container is full, it should be removed from the solids WC pan.
- Close observation should be made to ensure that no faeces have fallen into the section below the solids chamber. For good measure cover the ground with a handful of straw.
- The night soil container should be removed from the toilet and emptied in the area reserved for composting bin.
- Precautions must be taken that the night soil is fully covered by straw once it is emptied into the composting bin.
- The night soil container should be thoroughly washed and dirty water emptied into the composting bin.
- After a thorough cleaning the night soil container should be replaced below the solids WC pan in the KaravanLatrine chamber. The cleaning of the nightsoil container needs to be carried out on a regular basis.



Trainees observe eco-toilet construction.

5.5 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.1

TYPICAL WASHROOMS IN RURAL AREAS



Fields in rural areas used for open defecation. This causes environmental, health, hygiene and privacy issues.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.3

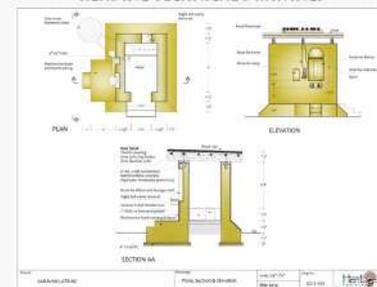
VIEW OF KARAVANLATRINE



There is a seatbox with separate space for solid and liquid discharge. There's a bathing area, a washing space, and a roof garden.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.1

READING TECHNICAL DRAWINGS



Plan/elevation/section of Karavanlatrine provides information about the seatbox, plumbing, gray water bogs, collection of night soil & roof garden.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.2

WHAT IS THE KARAVAN LATRINE?



KaravanLatrine is essential for hygiene and health. It is eco-sustainable and easy to build. It can be a source of earning through sale of excreta.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.4

BENEFITS OF THE KARAVANLATRINE



It is sustainable and inexpensive to build. The human excreta can be utilized for making organic compost, keeping the environment and people clean.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.2

METHOD OF CONSTRUCTION



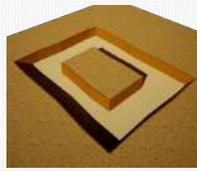
Mark the layout, Internal Edge of Wall: 3'-6" x 5'-6", External Edge for Toe: 9'-3" x 11'-3". Remove top soil & excavate 1'-6" below ground.

METHOD OF CONSTRUCTION



Steps showing stages of construction from lay out to excavation, foundations and plinth in order to build the KaravanLatrine.

METHOD OF CONSTRUCTION



STEP 3
POURING PLC



STEP 4
CONSTRUCTION OF PLINTH



Mix lime:sand:gravel 1:2:4 to make lime concrete. Pour PLC. Raise plinth height to 1'-6" Leave space for washing platform and steps.

METHOD OF CONSTRUCTION



STEP 5
CONSTRUCTION OF WALLS &
PLACEMENT OF SEAT BOX



STEP 6
ADDITION OF PLATFORM &
STEPS

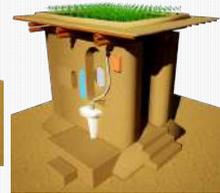


For Layered Mud raise wall not more than 1 foot per day for entire course. Place a seatbox & a gray water bog. Mark layout for steps.

METHOD OF CONSTRUCTION



STEP 7
RAISING WALLS &
CONSTRUCTION OF ROOF



STEP 8
CHHAT BAGHECHA &
PLUMBING



7'-2" wall height & placement of door lintel & ring beam at 6'-9". Install a bamboo roof & create roof garden on top. Make niches in walls.

COMPLETED KARAVANLATRINE



Completed KaravanLatrine.

6.1 Why Safe KaravanShelters?

According to published reports, over 800,000 households in Sindh alone have been without shelter as a result of recurring floods in 2010, 2011, 2012 and 2013. Only a small fraction of the required shelters have so far been built through combined efforts of donor agencies, INGOs and NGOs, leaving the majority without roofs over their head.

In addition to the requirement of making up the exorbitant level of social deficits, safe shelters are a basic necessity, without which it is not possible for families to re-start their lives.

In order to reach *Lari-Levels of Resilience*, a one-room shelter is essential for the family to withstand next flooding. It is part of a holistic approach developed under *Lari Principles for Disaster Risk Reduction* (DRR), which require that safe shelters must become available to each household that is destined to live in flood or seismic-prone areas.



Safe KaravanShelter, Tando Allahyar.

If the structure, even though it is only one room, can be safe, the family will not face displacement and thus able to re-start their lives almost immediately after the flood waters recede, as their household goods will also be safe.

6.2 What is Safe KaravanShelter?

Several kinds of shelters have been designed by Heritage Foundation of Pakistan (HF) for flood-prone areas. However, the one that can be built by families themselves due to its low cost, speedy and familiar construction incorporating DRR-compliant features, consists of a circular form with a conical roof. The KaravanChaura is based on traditional construction with technical interventions which have made it safe and sustainable at the same time providing safe habitat.



Safe KaravanShelter nearing completion in Tando Allahyar.

The selection of the design known as the *chaura* that is utilized both in the desert and other areas alike, has been found to be among the most economical and attractive structures. This is the reason why it is being promoted as the most appropriate structure to provide safe shelter.

The construction of KaravanShelter is based on research and studies carried out by HF teams in distant and far off areas in Sindh. Based on the analysis of the research data, a special program was developed by HF known as *Build Back Safer with Vernacular Methodologies*.

The program promotes the use of sustainable, low cost, zero carbon footprint structures. These are safe structures that are built using mud, lime and bamboo.

The most economical form is built with mud walls constructed on lime stabilized mud base and sun dried brick walls. The base is recommended to provide at least 18" high plinth. In case there is danger of higher flood levels, the base should be raised 6" above the highest recorded flood levels.

The placement of bamboo reinforced lime concrete ring beam at the top of the walls ties the entire structure as the roof joists are bolted through it to mud walls. The bamboo joists are brought to a single point at the top of the conical roof structure.

The joists themselves are tied together with woven straw ropes that act as purlins. These allow income generation for women, who have become skilled in the production of woven straw ropes.

The roof covering consists of thatch which is carefully tied to the purlins. The entire mud brick walls should be rendered with lime mud plaster in order to provide efficient water resistance. In case the flood levels require a base higher than 2'6", it is advisable that bamboo stilts are used to raise the plinth. However, the cost is then likely to increase and the improved Loh Khat construction will be needed rather than mud masonry walls.

The use of mud walls and the conical *chaura* roof can be built speedily and is also among the most economical and stable forms, able to withstand wind and rain onslaughts. This classical form has been tested over decades and has been further strengthened through HF's technical innovations.



Application of lime/mud/sand plaster mixed with chopped straw and dung.



Using local material and techniques lead to speedy construction.

6.3 Key Benefits of KaravanShelter?

The following are the benefits:

- a. It can be constructed easily by families themselves. The participatory approach results in low cost construction with zero carbon footprint as only mud, lime and bamboo are used.
- b. All materials are sustainable: mud can be sourced from the immediate vicinity, lime is low energy lime and is readily available, while bamboo is a highly renewable resource, since a fresh crop becomes available every 2 years.
- c. The mode of construction does not contribute to environmental degradation or depletion of the resource base.
- d. The one room shelter provides safe habitat and prevents displacement of families particularly women and children.
- e. Mud walls and mud lime render provide passive cooling as well as humidity control, thus providing comfortable living conditions.
- f. The use of lime provides a hygienic environment.
- g. Straw roof allows the structure to breathe and thus provides movement of air and cooling mechanism.
- h. The use of mud in walls and woven straw purlins that are used to tie the bamboo roof joists allow participation of women in construction.



Excavated foundation for Chaura construction.



Construction of mud walls and application of first layer of mud plaster.



KaravanChaura joists installed.

6.4 What Precautions must be taken?

6.4.1 Siting and Orientation

- a. Place the shelter on raised ground; avoid low lying areas.
- b. In case high ground is not available, ensure that the plinth of the shelter is raised well above the adjacent ground, and at least 6" above the highest recorded flood level.
- c. As much as possible face openings towards north in order that the shelter remains cool.

6.4.2 Follow specifications

- a. Ensure correct percentage of slaked lime, especially in the lower part in order to prevent water ingress even during heavy rains and floods.
- b. Ensure that all materials conform to specifications: lime to be slaked from fresh quicklime lumps; mud according to specified percentage after carrying out a bottle test; bamboo to be mature and of specified sizes.
- c. Ensure that the bamboo reinforced lime concrete ring beam and bamboo joists are according to drawings. Check that the joists are tied together well and are bolted securely to the ring beam.



Lime-mud rendered exterior protects the structure from water damage.



Safe KaravanShelter roof.

6.5 What is the procedure for building a KaravanShelter?

In order to enable households to build safe shelters, artisans known as Barefoot Village Entrepreneurs (BVE), have been trained to provide guidance and advice for construction. By following the BVE advice, households can carry out major part of the work themselves e.g. making lime-mud base, building mud brick walls and providing mud lime render themselves.



Using lime renders provides protection from water.

In order that the process should be carried out keeping in mind safety factors, the households should pay BVEs their cost at stages 6.5.1 and 6.5.2.

6.5.1 Guidance for Walls by BVE

a. BVE's guidance for Walls:

- Layout.
- Checking the base.
- Checking the top of wall.

b. The BVE provides guidance for the above and is paid for the above services according to specified and agreed rates.

6.5.2 Construction of Roof by BVE

a. The BVE has been trained to fabricate the ring beam, as well as bamboo joists. He/she needs to be paid for fabrication and supply of these items as well as guidance fee according to specified and

agreed rates:

- Providing and fixing bamboo reinforced lime concrete ring beam.
- Providing and fixing bamboo joists.
- Providing guidance for fixing woven straw purlins.
- Providing guidance for fixing straw on conical roof.

The present strategy provides a gift of bamboo roof from HF to households. Over time, due to low cost, the households are expected to be able to pay for the roof themselves by employing the BVEs in their village, as more and more BVEs are trained.

6.5.3 Construction Steps

a. Foundations

- After the layout has been made and after removal of topsoil, excavation should be carried to 1'6" depth and the base tamped.

- A plain lime concrete pad 4" thick 1:2:4 (lime:sand:aggregate) should be laid at the base.
- Checking with water level to ensure that the entire base is level.

b. Base

- The base should be constructed with layered mud-lime which should extend towards outside in order to make the toe of 4'6" width. A slope should be formed as shown in drawings in order to drain water away from the wall.
- The toe should be taken up to 1'6" height to form a plinth, in order that the floor is always higher than the adjacent ground.



Roof thatch installed.



Traditional motifs and designs decorate the interior of the chaura.

c. Wall

- Wall should be constructed of 1'6" thickness and care taken in order that it rises straight up by using a plumb.
- Mud-lime render should be applied to all external surfaces.
- Mud only render is needed to cover internal surfaces.
- All plasters/renders to include straw and cow dung while mortar mixing is carried out.



Lime-mud rendered walls provide a fine surface for decoration with rangoli paint.

d. Roof

- The roof should be tied to bamboo reinforced lime concrete ring beam which should be anchored to mud walls.
- The bamboo joists should be securely anchored using plates and bolts to ring beam and to mud wall, providing a conical configuration.
- The bamboo joists should be secured through the use of several woven straw purlins tied in concentric fashion.
- The entire roof should be covered with thatch which is secured to the bamboo joists and woven straw rope purlins.
- Care must be taken that the straw is laid in layers, starting from the bottom layer and concentric layers providing an overlap over the lower



Shelves and storage niches can be added in the interior of thick mud walls.

layers to avoid any water entering the roof.

6.6 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.0

SAFE SHELTER GIFT OF KARAVANROOF BY HF

مضبوط کاروان گھر
مہربان خانہ کی طرف سے جنت کا تحفہ
گھر والوں کی ذمہ داری

RESPONSIBILITY OF HOUSEHOLDS

1. Build Walls upto Roof.
2. Get checking done By VBE on fee payment.
3. Get HF roof installed by VBE on fee payment.



- دیواروں کو جنت تک بنائیں۔
- سب چیزیں گورنمنٹ یا پرائس اوٹی سے لیں، دسے کر چیک کرائیں۔
- جنت کو بننے یا پرائس اوٹی سے لیں، دسے لگائیں اور دسے دیں۔

پرائس یا پرائس اوٹی کی قیمتیں:
 ٹیکس 200 روپے
 پورے چیک 50 روپے
 دیوار کے اوپر چیک 50 روپے
 ٹاپ وال چیک 50 روپے
 چھت کو ٹیکس 400 روپے
 چھت کو ٹیکس 700 روپے

Fee of VBE:
 Layout: Rs. 200
 Base check: Rs. 50
 Top wall check: Rs. 50
 Roof fixing: Rs. 400



Safe KaravanShelter are constructed with a gift of KaravanRoof from HF. The household is responsible for building the walls by paying BVes for their help.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.2

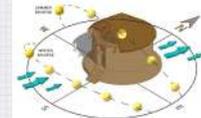
SITE SELECTION

جگہ کا انتخاب

ORIENTATION:

- TO AVOID STRONG SUNLIGHT AND HEAT NORTH-SOUTH ALIGNMENT IS PREFERRED
- TO AVOID HEAT AND SMOKE FROM STOVE INTO THE HOUSE
- TAKE BENEFIT OF TREES FOR SHADING

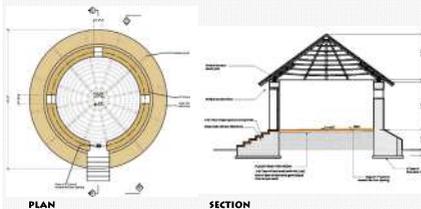
سمت کا متعین
 سورج کی تابش سے بچنے کے لیے
 شمال-جنوب کی سمت میں گھر بنائیں
 پختہ کی آگ اور دھواں سے بچنے کے لیے
 درخت کی چھاؤں استعمال کریں



Orientation of the Safe Shelter is to be north-south to avoid strong sunlight and smoke from the stoves. Position of trees for shade should be considered.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.0

READING TECHNICAL DRAWINGS



Reading and understanding drawings are important to follow through construction steps, especially use of lime and KaravanRoof joists.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.1

SITE SELECTION

جگہ کا انتخاب

- جگہ کے انتخاب سے متعلق اہم باتیں
- اونچے مقام پر گھر بنائیں
 - دریا کنارے سے گھر نہ بنائیں
 - اگر اونچی جگہ ہوتی ہے تو اونچے مقام پر استعمال کریں



Site selection criteria is of great importance for safe KaravanShelter. The site chosen should be on a higher ground away from river beds.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.3

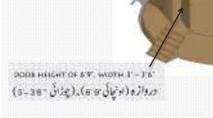
SITE SELECTION

جگہ کا انتخاب

DESIGN CONSIDERATION FOR SHELTERS:

DRS SIZE AND SHAPE RECOMMENDATIONS:

- MAKE CHAURA ROOF
- ROOM HEIGHT 8'
- MAKE TOE



گھر بنانے کے اصول
 ڈرس سائز اور شکلیں
 2-3 کھڑکیاں کریں تاکہ ہوا بہے
 چھت کی اونچائی 8 فٹ
 پائے بنائیں

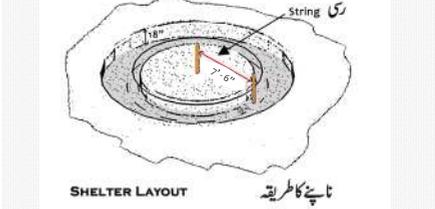
DOOR HEIGHT OF 8'6", WIDTH 3' - 3'6"
 دروازہ کی اونچائی 8 فٹ 6 انچ، چوڑائی 3 فٹ 3.6 انچ



Design considerations for One Room Safe KaravanShelter include; making mud-lime toe, height of 8', windows apertures and a chaura roof.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.1

CONSTRUCTION PROCEDURES - LAYOUT



Using a template to mark the centre of the chaura and the centre line of wall and toe. Remove 6" topsoil and excavate 1'6" deep.

PREPARING BASE پائیدگی کی تیاری

EXCAVATION CHECKLIST:

- REMOVAL OF 6" TOP SOIL
- FOUNDATION DIGGING UP TO 1' 6"
- COMPACT EARTH BY TAMMING

FOUNDATION PAD:

- PLC 4" WITH RATIO 1:2:4 (LIME : SAND : AGGREGATE)
- WATER LEVEL CHECKS

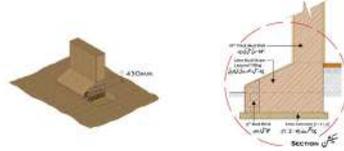


EXCAVATING, COMPACTING, EARTH COMPACTING CHECK, WATER LEVEL CHECK, START MUD WALL ON PLC, MUD WALL FOUNDATION 18" THICK

کھدائی کا سائیکل
 زمین کی اوپری 6" کو ہٹائیں
 پاسے کے لیے 1' 6" (450mm) کی گہرائی
 زمین کو کھرجھٹ سے مٹی کو مضبوط کریں
 پائیدگی
 4" PLC کریں جس میں چھٹائی 1:2:4 کا ریکٹ
 کی مقدار 1:2:4 ہے
 پائیدگی سے پانی کی سطح کو چیک کریں

CONSTRUCTION PROCEDURES

1'6" (450MM) TOE & PLINTH FOR ADOBE WALL



1'6" high toe for base. Make plinth of shelter at 1'6" height. Finish floors on completion of Safe KaravanShelter.

Removing 6" topsoil, foundation depth of 1'6", & compaction of earth, laying 4" plain lime concrete 1:2:4 (lime:sand:aggregate).

MUD BRICKS WALL & PLACEMENT OF LINTEL مٹی اینٹ کی دیوار اور لینٹل لگانا

- BAMBOO LINTEL 1FT OVERLAP ON BOTH SIDES
- KARAVAN ROOF W/ SLOPE FOR ROOF FRONT WALL @ BACK WALLS @ (SUN WATER LEVELS)
- MONO PITCHED ROOF FRONT WALL @ BACK WALL 1:1
- DOUBLE PITCHED ROOF FRONT @ CENTRE HEIGHT 1:2:2

آپ کے پاس لینٹل 1 فٹ دونوں طرف پر اوور لاپ رکھیں
 کاروان چھت کے لیے آگے کی دیوار اور پیچھے کی دیواروں پر (سورج کی پانی کی سطح کے لیے) سولہ پٹیوں کے ساتھ
 ایک طرف کی چھت کے لیے 1:1 کا سلاخ، دوسری طرف کی چھت کے لیے 1:2:2 کا سلاخ
 لینٹل 1 فٹ دونوں طرف پر اوور لاپ رکھیں

Bamboo lintel is placed above doors and windows with 1' overlap on both sides. Placement of bamboo ring beam is important for roof stability.

MAKING CHAURA ROOF

- THATCH ON ROOF
- BAMBOO PURLINS
- BAMBOO REINFORCED LIME CONCRETE RING BEAM

چھت پر گھاس لگائیں
 بانس کے پرلن
 چھت کے کمرے میں بانس کی رنگ

Roof components include lime concrete ring beam with bamboo reinforcement, woven straw purlins, Karavanjoists and thatch cover.



Completed KaravanChaura.

7.1 Why KaravanHandpumps?

Supply of clean potable water is essential for domestic purposes, drinking, cooking and for personal hygiene. *Water Aid* estimates that 15.9m people in Pakistan do not have access to safe water. Death of 40,000 children every year is attributed to diarrhoea caused by unsafe water and poor sanitation in Pakistan. Therefore emphasis on the availability of safe water is amongst the most important issues and must be pursued vigorously.

In most parts of Sindh, ground water can be made available through installation of hand pumps.

There is a critical need for water both for drinking, sanitary and cleaning use for families. Unless a reliable water supply is available, it is not possible to maintain a clean and healthy environment.

Clearly, clean and safe water is the need of the hour and all possible measures must be taken so that communities have



Raised KaravanHandpumps are raised to provide clean and safe water.

access to a reliable water source. It is due to lack of clean water supplies that waterborne diseases break out affecting the health of families particularly women and children.

A water source is required to be available at less than 1 km from households. During the onslaught of a disaster among the

most challenging tasks is access to clean water. It is ironical that during flooding, when communities are surrounded by water, there is no water that they could drink.

Furthermore, the water sources that were in existence prior to the disaster, also become inaccessible as they get submerged in flood water in the same way as houses and other facilities.

There are many ways to procure water, such as rainwater harvesting or catchment or utilizing ground water by boring a well or hand water pumps. Running water supply through taps for each household is a far dream.

In order to comply with *Lari Principles of DRR (Disaster Risk Reduction)*, in flood areas, the water source must be placed at a high level, to avoid being submerged during flooding.

Any hand pump that is placed at the ground level is likely to become dysfunctional during floods. All HF strategies are required to be DRR-compliant, i.e. all interventions must provide flood-resistance in order to avoid displacement of communities.

Thus, stoves, food grains and drinking water are required to use raised earthen



Common hand pumps are subject to contamination by being so close to the ground.



Traditional hand pumps are the source of pollutants in the form of gray water.



These cesspools of dirty water breed various insects and diseases.

platforms on which the various items can be placed, well above the highest flood levels.

The KaravanHandpumps provide water source on a raised platform which makes it safe from hazards, at the same time it is kept out of reach of animals and other polluting agents.

WASH sector being part of the *Lari Principles*, ensuring regular supply of clean water is essential to reach *Lari-Levels of Resilience (L-LoR)*. Keeping the water source at a high level also prevents pollution from the ground, allowing households to obtain clean water.



The raised platform and use of lime make the hand pump DRR compliant.



Last stages of construction of Raised KaravanHandpump, Tando Allahyar.

7.2 Main components of Karavan Handpumps?

The main components consist of the following:

- A water pump installed on a 3'0" high raised lime stabilized earthen platform, the top level of which is utilized for drawing water for drinking. The platform is accessed by steps.
- A lower platform provides arrangement for washing clothes and has drainage arrangement for gray water.
- Gray water plantation bed as a Kela Chakker (Banana Circle) which is planted with reeds, and banana.



The lower platforms acts as a wash area.



Kela Chakkar and Raised Karavan Handpump, Tando Allahyar.

7.3 Key benefits of Karavan Handpumps?

The following are key benefits of Raised Karavan Handpumps:

- Provides a raised platform for accommodating the water pump, thus keeping the water source safe during floods.
- The topmost platform is used for drawing water for drinking in order to prevent pollution.
- The lower level platform is used for washing clothes to avoid contamination with drinking water.
- The water source placed at a high level prevents animals from polluting the water, thus avoiding germs and waterborne diseases.
- The construction of platforms is low cost, and based on the use of sustainable materials and zero carbon footprint delivery.
- The Kela Chakkar (Banana Circle) allows gray water to collect and is treated biologically through plantation, avoiding cesspools or free flowing sewerage in order to create a hygienic environment.



Lime render provides protection from water and bacteria.



Banana circle helps treat stagnant water and avoids risk of insect infection.



The raised platform helps keep the hand pump area and water source clean.

7.4 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

1.1

WHAT SHOULD BE DONE?

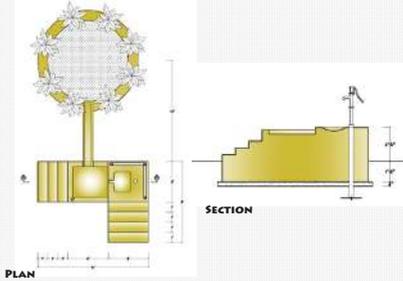


It features high earthen platforms that provide separate drinking & washing space as well as security from floods. Required is also a Kela Chakkar.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.1

READING TECHNICAL DRAWINGS



Its vital to understand the technical details of construction and how to make the Kela Chakkar and what materials to use.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.2

METHOD OF CONSTRUCTION: PHASE 1



STEP 1
MARKING LAYOUT



STEP 2
EXCAVATION



STEP 1
LAYING PLC

Mark the layout 7'-6" x 8'-6". Place the stakes on corners. Remove 6" top soil and excavate 1'-6" deep. Compact with tamp and pour PLC.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.3

METHOD OF CONSTRUCTION: PHASE 1



STEP 4
RAISING TO GROUND LEVEL



STEP 5
RAISING STEPS & PLATFORM



STEP 6
MAKING THE WASHING AREA

Make steps and platform height to 2'-6" above ground with mud lime wall. Make 3" high upstands for washing & drain for Kela Chakkar.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.4

METHOD OF CONSTRUCTION: PHASE 2



STEP 7
MARKING LAYOUT



STEP 8
EXCAVATION & RIDGE
MAKING

Mark layout for the Kela Chakkar, a circle with a 6' dia. Dig a dish shaped hole, 1m deep in the centre. Fill it with twigs and straw.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.5

METHOD FOR CONSTRUCTION

STEP 9
COMPLETING BANANA CIRCLE



Bank stones around the rim. Plant banana suckers at 60cm intervals into the raised soil rim.

8.1 Why Karavan ChhatBagheecha (green roof)?

World Food Organization defines food security “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.” A nutrition survey carried out in 2011 (Food Security in Pakistan by Dr. Ejaz Khan & Dr. Moazzam Khan) indicates that only 42% of Pakistanis have food security, while 10% are food insecure with severe hunger, 20% food insecure with moderate hunger, and 28% food insecure without hunger.

It is also clear that a large percentage of Pakistan’s territory suffers from either severe (Balochistan and Eastern Sindh) or moderate drought conditions (Sindh and Northern Pakistan).

Many rural communities suffer from food deficiencies and malnutrition. In flood affected areas of Sindh, severe conditions exist due to which women and children are the worst sufferers who have to survive on meagre food portions. The health of mothers needs to be given



Women discuss Karavan ChhatBagheecha.

particular importance if the community is expected to become strong. Family planning remains an elusive issue, with little information or persuasion provided to families with a large number of children – ranging from 5-6 to sometimes over a dozen.

With many mouths to feed, and meagre resources, children and their mothers continue to suffer from food deficiencies. Lack of emphasis on mother’s health leaves the mother weak and un-

able to fend to the needs of her children. An added difficulty is the lack of ownership of land. Even in the most fertile areas, the tenants are not allowed to grow any food themselves by the landowners.

Consequently, those who till the land, have limited access to the food they grow. In the midst of fertile land holdings and verdant orchard lands, most villages in Sindh present a desolate and unviable environment.

Because land is scarce and scarcer still for those who live on the mercy of the landlord, no cultivation is carried out by households themselves. This is often

for fear of the owner who may not wish them to grow anything for themselves. Since land technically does not belong to the tenants, however hard they may have worked to grow produce, it is for the benefit of the landlord.

ChhatBagheechea has been devised in order to tackle food security and alternative food production possibilities, especially in the face of floods.

The produce of ChhatBagheechea is on an elevated level, and thus it will be available even when the rest of the crop may be devastated as a result of flooding or crop failure. Accordingly, it provides food safety net for the family. Therefore, the



Vertical gardens at HF Training Centre in Moak Sharif, Tando Allahyar.

larger numbers of roof gardens that can be created the better the capacity will be for dealing with disasters.

Although home or roof gardens have been found in many parts of the region, gardening is not taken seriously in Pakistan. Even though the country's economy is largely agrarian, sufficient effort is not expended on encouraging households to grow vegetables and fruit for their own needs.

In most villages, except those suffering from drought, access to water is available and households can be encouraged to grow even on a small piece of land.

Seeds and saplings for vegetables and trees are found in abundance and thus the basic ingredients are available in order to develop food security mechanisms for the family and even for generating income from the produce.

There are many examples in the region of growing shrubs and vines as well as shade-tolerant perennials and the possibility of layering for biodiversity.

Thus, encouraging plantation of roof garden is essential for creating better living conditions. Since the tenants are not allowed to grow even vegetables in the vicinity of their houses, the Chhat



Inserting drip irrigation bottles in the bed.

Bagheechea (roof garden) has been created in order for them to grow vegetables on their roof.

Since a large number of households are adopting the construction of Karavan-Latrines, the DRR-compliant strong roofs are providing the possibility of growing vegetables.

Growing vegetables is critical for the health of women and children as well as income generating measures if extra produce becomes available.

Thus, more and more rural families can have access to nutrition if ways can be

found for them to grow food for themselves. And, ChhatBagheecha is a secure way to not only grow food but also keep the produce out of harm's way during floods.

This alternative arrangement for growing food is promoted as part of *Lari Principles for Disaster Risk Reduction (DRR)*. It is among the most important aspects in the pursuit of resilience for communities.

Along with growing food the imperative for storing food should also be pursued. Storage for grains and mechanisms for drying vegetables and their storage needs to be promoted in order to avoid displacement and foster self-reliance.



Laying the layer of coal for roof farming bed.



Training for Karavan ChhatBagheecha.



Green roofs, an efficient solution to circumvent land ownership issue.

8.2 What is the advantage of ChhatBagheecha?

Due to restricted space at the disposal of many small tenant farmers, the only place that they could consider their own is their shelter or house. Since most shelters are makeshift arrangements and even donor funded units are not always built to be strong or DRR compliant, HF has developed necessary techniques in order that strong structures could be constructed for shelters as well as toilets.



Green roof planted with vegetation.

The toilets are comparatively small chambers that can be built in a short span of time. The technique is based on HF's *BBSVM* program and as such its roofs are accessible and strong. Thus, the construction of KaravanLatrine provides an opportunity to households to begin their own ChhatBagheecha.

Although it is a comparatively limited space, however, it can be used in order to provide for day to day vegetables and herbs consumption of the family.

Combined with drip irrigation, using mineral water bottles, at the least families can begin to grow produce for their own use.

As part of the Disaster Preparedness, once the households begin to build Safe

KaravanShelters, they will have larger roofs on which more vegetables could be grown.

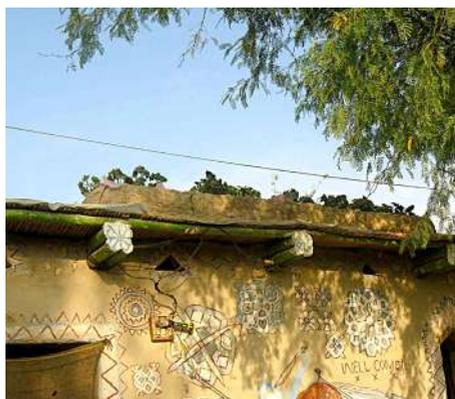
As part of a step-by-step strategy, the roof garden concept from the roofs of KaravanLatrines can be extended to safe shelters also.

The Karavan ChhatBagheecha is the starting point for many households in finding that they are indeed able to grow food for their own use.

HF sees the ChhatBagheecha as breaking the barrier of hesitancy and reluctance. Once the roof garden begins to be developed, the community is ready to begin plantation of trees and vegetables on available patches of land.

The key benefits of KaravanChhat-Bagheeche are as follows:

- a. Since it is close to the house, and it is small it is easy to maintain.
- b. It provides nutrition without spending money to purchase from the market.
- c. All kinds of vegetables that are in season can be grown and provide extra nutrition to family members.
- d. Since it is on a raised level, there is less likelihood of pest attack.
- e. Since drip irrigation is recommended, very little water is required to grow food.
- f. Locally made compost with cow dung can be used to grow organic food.
- g. If there is extra produce than can be consumed, it can be sold to neighbours or in close by markets.
- h. The best way to promote the Karavan ChhatBagheeche is to ensure that it becomes a source of income for the families by providing training for marketing the produce.



Karavan ChhatBagheeche, Tando Allahyar.



KaravanLatrine with Karavan ChhatBagheeche.



Green roof on a KaravanRoof One Room Shelter.

8.3 How is the ChhatBagheeche constructed?

The roof of KaravanLatrine is designed in order that a ChhatBagheeche can be accommodated. The final finish of the roof is of a mix of lime, sand and surkhi providing a weatherproof finish. On top of the roof finish is placed a layer of 5mm polythene extended well up on the side up-stands made up with lime-mud mix. The space is filled with 8" sweet earth mixed with organic fertilizer, suitable for growing vegetables and vines.

A drainage hole is provided on one side of the up-stand in order to drain excess water whenever required. The drip irrigation method using inverted mineral water bottles is integrated with the soil arrangement. This requires filling every 36-48 hours. In order to make the roof accessible, a bamboo ladder is placed on one side that provides for maintenance.

The main components consist of the following:

- a. KaravanLatrine as a sustainable low-cost structure with accessible roof, with earthen up-stands 8"-10" high on roof edge, incorporating an outlet for drainage.



Women observing Green Roof during training.

- b. Placement of tarpaulin/5mm polythene as a layer at the base to provide protection to roof structure.
- c. Placement of drainage layer of crushed charcoal above tarpaulin/polythene layer.
- d. Adding 8" layer of soil mixture above charcoal.
- e. Arrangement for drip irrigation through the use of inverted green mineral water bottles with a small puncture near the cap at the base.
- f. Nutritious vegetables for health e.g. green chillies, tomatoes, zucchini, spinach, brinjal (eggplant), pumpkin and gourds should be grown which will help to improve health of the family including children.

8.4 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

1.0

GREEN KARAVANLATRINE ROOF

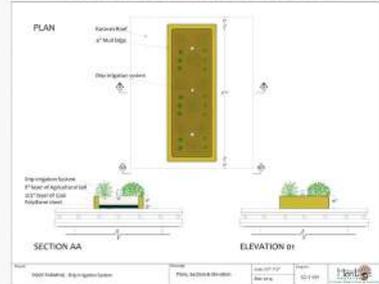


Rural women can produce vegetables for their family, Agricultural produce can be protected incase of floods, Improvement in family nutrition.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.1

READING TECHNICAL DRAWINGS



Making bed for plantation, polythene sheet, layers of coal, sweet earth, organic fertilizer, placing drip irrigation bottles, plantation.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

3.1

METHOD OF CONSTRUCTION



STEP 1
MARKING LAYOUT OF BED



STEP 2
MAKING UPSTANDS AROUND BED

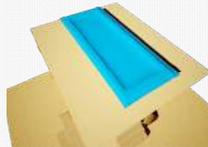


Layout dimension = 3'-6" x 10'-9", ensuring gunitiya 3:4:5, marking offsets. making 10.5" high upstands in 4" thick layered lime-mud.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

3.2

METHOD OF CONSTRUCTION



STEP 3
PLACING POLYTHENE SHEET



STEP 4
PLACING CHARCOAL LAYER



Place 5mm polythene sheet over entire bed extended well up on the upstands. Filling bed with 2.5" layer of coal over polythene sheet.

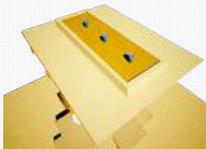
DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

3.3

METHOD OF CONSTRUCTION



STEP 5
FILLING WITH SOIL



STEP 6
INSERTING WATER BOTTLES/DRIP IRRIGATION



Placing layer of 8" of sweet earth with organic fertilizer over coal. Place inverted bottles with a hole in the cap filled with water for drip irrigation.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

3.4

METHOD OF CONSTRUCTION

COMPLETED GREEN ROOFS



STEP 7
PLANTATION WITH SEEDS/SAPLINGS



Completed Karavan Chhat Bagheechea (green roof). Construction technique can be applied to all sizes of roofs to grow more vegetables.

9.1 Why raised bed farming?

The method of raised beds for farming can lead to many benefits. This technique is particularly beneficial in areas that are prone to flooding or where saline soil has been encountered.

Raised bed prevents water seepage into the plants, thus protecting them from being destroyed during floods.

Among the worst calamities is the loss of all agricultural produce leaving communities shorn of their crops and livelihoods.

Raised Bed Farming is DRR-compliant, allowing shallow root crops to survive and thus, as the floodwaters recede, the community can begin to restart their lives as the produce has been saved from destruction.

Similarly, saline soil inhibits any growth of plants due to which a huge area of wasteland is a common sight in Sindh.



HF Master Trainer teaching the benefits of Raised Bed Farming.

By using the technique of Raised Bed Farming, since the actual bed of plantation is isolated from saline soil, vegetables can be grown easily within the parameters of elevated bed. The method has been devised to tackle issue of food security and provision of improved family nutrition along with ease of vegetable production for rural women. As is clear, there is environmental improvement because of vegetation.

9.2 What is raised bed farming?

Raised Bed Farming relies on construction of mud-lime side walls to provide an elevated bed for growing shallow root farm produce.

The principle is akin to raised platforms as part of *Lari Principles for DRR*, which help to keep goods, food and drinking water safe from flood water.

Growing vegetables at a higher level than the ground has been designed to isolate the layer of soil being used for growing vegetables separate from the ground soil. The isolation results in economic use of water.

The introduction of inverted bottles results in drip irrigation, conserving the use of water even further.



The bed is lined with a plastic sheet before being filled with sweet earth.



Training in building Raised Beds.

All elements that are used are green e.g. mud, lime and soil. The polythene sheet separating the natural soil from the upper soil, requires a few months for its degradation. It is important to use biodegradable polythene.



Demonstration on the method to cut bottles.

9.3 What are the components of raised bed farming?

Raised Bed Farming consists of the following:

- Beds that are elevated through the use of mud-lime walls built in rows. The height of the beds is designed to be 8" higher than the highest recorded level of flood waters.
- Once the side walls have been raised, the lower filling can be of any kind of soil including saline soil or waste material.
- It is important to introduce a polythene sheet in order to isolate the lower level poor or saline soil from the sweet earth soil that is needed for growing vegetables etc.

The polythene sheet needs to be large enough in order to provide upstands on the side to avoid any danger of saline or poor soil contaminating the sweet earth.

- 8" layer of sweet earth is essential, along with organic compost in which plantation can take place. It is advisable not to use chemical fertilizers.
- Water supply is through drip irrigation by using inverted mineral water



Demonstration of drip irrigation.



Training for growing plants in Raised Beds.

bottles. The bottles should preferably be green in colour. The methodology ensures that water is not wasted and only as much as is required for growing plants is used, thus conserving scarce water resource.

9.4 What is the procedure for raised bed farming?

It is important to understand the construction methodology so that all steps are executed carefully and following the instructions that are provided in the manual.

The construction should be carried out as per HF's laid down construction procedure which requires excavation according to correct layout, tamping, checking with water level etc. It is also important to make an extended base to protect the side walls from penetration of water.

The use of lime is also essential as a stabilizer for mud, in order to make the walls water-resistant.

As per the drawings, the base should be covered with plain lime concrete along with raising the sides for the toe with mud-lime bricks. The side walls should consist of 9" thick mud-lime brick which is laid in lime mortar.

The side walls should be raised a minimum of 2'0" above the ground, depend-



Completed Raised Bed with plants.

ing upon the level of flooding as mentioned earlier.

The lower part may be filled with any kind of soil including saline soil as the lower soil will be isolated through use of polythene sheets.

The sweet earth used for growing vegetables should be a minimum of 8" high.

A system of drip irrigation which requires very little water, can be introduced through placement of inverted mineral water bottles at 3'0" centres.

Each bottle is pierced with a small hole at the base of the cap, which releases small amounts of water for irrigating the raised beds.

By placing a lattice made with bamboo strips, vegetables can be grown horizontally as well. This allows possibility of different kinds of growth.

The raised bed is ready for farming.



Completed Raised Bed, Eco-Village Moak Sharif.



Raised Bed Farming, Tando Allahyar.



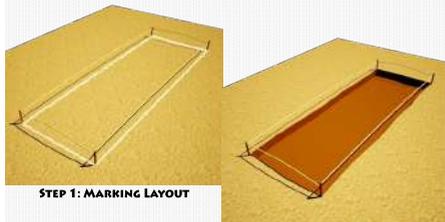
Vegetables being grown in Raised Beds.

9.5 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.2

METHOD OF CONSTRUCTION



STEP 1: MARKING LAYOUT

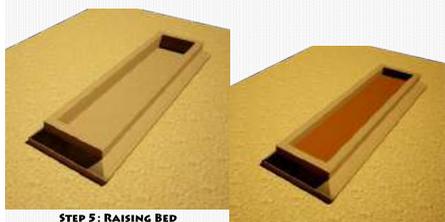
STEP 2: EXCAVATION

Mark layout and dig 1'-6" deep after removal of 6" top soil. Place stakes on corners & check right angles to ensure platforms are straight.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.4

METHOD OF CONSTRUCTION



STEP 5: RAISING BED

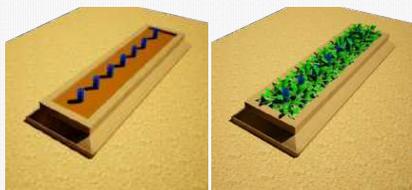
STEP 6: FILLING BED

Raise 9" thick walls 1'10" high above toe with 1:6 mud-lime bricks or layered mud. Fill cavity in bed with 1'-8" of soil, even saline soil

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.6

METHOD OF CONSTRUCTION



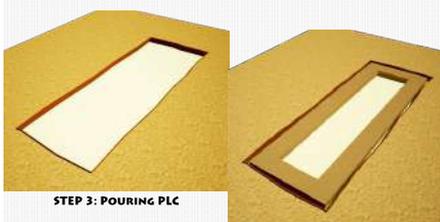
STEP 9: PLANTATION OF SEEDS/SAPLINGS

Cut bottle into half. Pierce plastic pet bottle caps with needle. Place inverted bottles in plantation bed at equal intervals of 3'-0".

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.3

METHOD OF CONSTRUCTION



STEP 3: POURING PLC

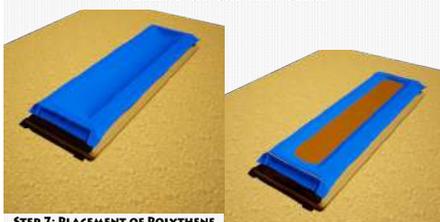
STEP 4: RAISING WALLS

Plain Lime Concrete is prepared with ratio 1:2:4 (lime: sand: gravel aggregate). 1'9" thick wall is raised 1' high with mud-lime brick outer edge.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.5

METHOD OF CONSTRUCTION



STEP 7: PLACEMENT OF POLYTHENE

STEP 8: FILLING WITH SOIL

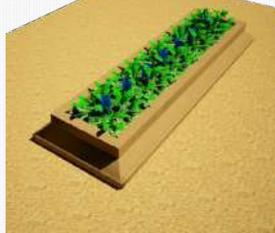
Place 3mm polythene sheet over entire bed. Fill cavity with 10" of NON-SALINE soil, over the polythene sheet.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.7

METHOD OF CONSTRUCTION

COMPLETED RAISED BED FOR FARMING



Plant bed with salad greens i.e. spinach, lettuce, cabbage, zucchini/ pumpkin/ cucumber/ gourds, eggplant, chili peppers, tomatoes etc.

10.1 Why livestock enclosures?

Livestock Enclosures are an important segment of HF’s strategy for hygiene and preventive health care. As livestock is considered of utmost importance, it is not possible to fully separate the cattle from its owners.

Thus, a midway solution that is acceptable to the community and provides a measure of separation, has been adopted by HF in its pilot villages.

Normally, there are 5-6 families that live in the same cluster. These families jointly own the cattle, and are prepared to create a livestock enclosure which is within easy reach of the families and can be supervised easily.

This solution has already created improved hygienic conditions where livestock dung is not strewn all over. Instead it is now found contained in a defined area.



Livestock Enclosure provides a safe haven for animals.



Limiting animals to a specific area helps keep the area clean and in control.

10.2 What are the advantages of livestock enclosures?

Depending upon the number of cattle, usually they are expected to be limited to a defined area and should leave the enclosure when they are to be taken out for fodder etc. Usually the size of the enclosure is approximately 15'x15'.

The separation of cattle has resulted in the following advantages:

- Area close to houses has been cleared thus providing more open space between houses/shelters, which can be utilized for growing trees and plants.
- The open central space is much cleaner which was once strewn with cow dung, resulting in more hygienic condition, especially for women and small children who spend most of their time here.

One of the objectives of defining the enclosures for livestock is also to encourage collection of cow/buffalo dung and cow/buffalo urine in order to make organic fertilizer. As women are taught to encourage animals to stay in the enclosure, they are being trained how to make floors with slopes and drains to facilitate the collection of dung and urine.



Hard core provides strength for flooring.



The low-cost Majandri tree fence allows for air to cross through.

In addition to a cleaner and more hygienic environment, the ease of collection of animal waste can lead to substantial earnings for the family by learning to make organic fertilizer. Households can also earn substantial income by selling the waste to organic fertilizer maker or Khad Adhi (Compost Sister) being created in Core Villages by HF.

10.3 What are the elements of these enclosures?

The following are the main elements of the Livestock Enclosure:

- Creating a defined area in order to contain the cattle.
- A sloping even surfaced floor which would drain urine into a channel which discharges into a pit with a removable container. The floor is finished smooth in order to collect the dung droppings from the floor.
- Planting at least one neem tree at one end of the enclosure.
- Erecting an inexpensive bamboo or a majhandari barr fence to provide barrier for the cattle within the enclosure.
- The collection of cow/buffalo dung and urine is essential in order to make organic fertilizer for use in farming.



The enclosure can also be covered with a low cost reed roof.



The collection pit with a removable container makes it easier to make compost using animal waste.

10.4 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

1.2

ADVANTAGES OF ANIMAL ENLOSURES

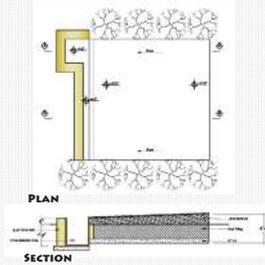


Additional income will be possible by selling organic fertilizer by collecting animal waste. Trees will improve the environment.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.1

READING TECHNICAL DRAWINGS



Technical details for Enclosure; flooring details, drains, accessible collection pit and the slope to ensure proper collection and cleaning.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.2

METHOD OF CONSTRUCTION: PHASE 1

STEP 1

MARKING LAYOUT



STEP 3

POURING PLC



STEP 2

EXCAVATION



Using a layout template, ensuring guniya 3:4:5; place stakes at 4 corners. Remove 6" top soil. Excavate 1'6". Lay PLC 1:2:4.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.3

METHOD OF CONSTRUCTION: PHASE 1

STEP 4

PLACING LAYERED LIME/MUD



STEP 6

FLOOR FINISHING



STEP 5

MAKING SLOPING FLOOR



Fill with layered/bricks lime-mud. Raise floor 10" above ground level on high end & 4" on low end. Lay 3" hard core, sub floor & plaster.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.4

METHOD OF CONSTRUCTION

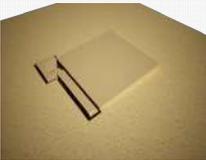
STEP 7

MARKING LAYOUT



STEP 9

RAISING WALLS



STEP 8

LAYING PLC



Mark layout, excavate. Start 9" wall from corner. Raise wall 2'-3" high, or 6" above ground level. The drain should be 6" below.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

3.1

METHOD FOR CONSTRUCTION - PHASE 2



STEP 10

URINE COLLECTION PIT



Drains will lead to a collection pit. Install an easy to remove container for collection of urine in the pit.

Rainwater Harvesting

11.1 Why rainwater harvesting?

Conservation of water is among the most important issues that is of global significance. The water that runs off from roofs, if collected, could be used for varied purposes such as irrigation, domestic use as well as for livestock. Water thus collected will result in saving of the more valuable potable water procured from hand water pumps or tube wells.

Even though water sources are becoming more and more scarce, often there may be excessive water one day due to rains and floods and water scarcity the very next day.

By using water effectively, this important resource can be saved for various household needs.

The system can be divided into a catchment area, the mechanism for drainage or transfer and the third part consisting of storage for use at a later stage.



Rain water harvesting installed on a KaravanRoof.

While some methods are expensive and may be out of reach of most villagers, HF has designed inexpensive solutions which can be easily implemented by villagers themselves.

The training in rainwater harvesting is being carried out which provides the required skills to Barefoot Village Entrepreneurs (BVE) in each village, thus providing services for the entire village to benefit from the expertise available.

11.2 How to carry out rainwater harvesting?

Usually rainwater harvesting can be arranged on any flat or sloping roof except roofs with thatch covering. The well built, strong and accessible Karavan Roofs that are constructed with strong Karavan Joists, lend themselves well for rain water harvesting

The flat KaravanRoof of HF's safe shelters or the KaravanLatrine provide the catchment surface.

The KaravanRoof is designed to be impervious to rain, it also drains the water along the slope of the roof. It is important to have a slope draining all the water to one side of the roof. This means that all the water drains to one side where it can be collected.

The lower end of the roof which is part of an overhang to keep water well away from the walls, is finished with half bamboo gutters. Water is carried through the gutter, which discharges into a downspout. The gutters are required also to be laid to a slope to collect water at one end.

The spout is connected with a drainage chain made up of interlocking bamboo rings, which discharges the water brought from the top of the roof into a



Rain water harvesting from eco-toilet roof.

large clay container. The clay container acts as a storage pot. In HF design, three large clay pots are placed on platforms in a descending arrangement so that when one pot gets filled, the extra water drains into the next and so on, until all three or four pots are full of water.

The cisterns should be kept covered in order to avoid any dust or other kind of

dirt getting into the water. As the number of clay pots used can be limited it is important that in the long term storage pits should be made so that larger quantities of rain water can be stored for longer periods.

Although rain water itself is high quality water, but once it is drained off a roof, it may carry a large number of impurities and as such may not be suitable for drinking since it is exposed to elements e.g. dust, leaves, insect bodies, bird faeces and airborne residues, which may be detrimental to health.

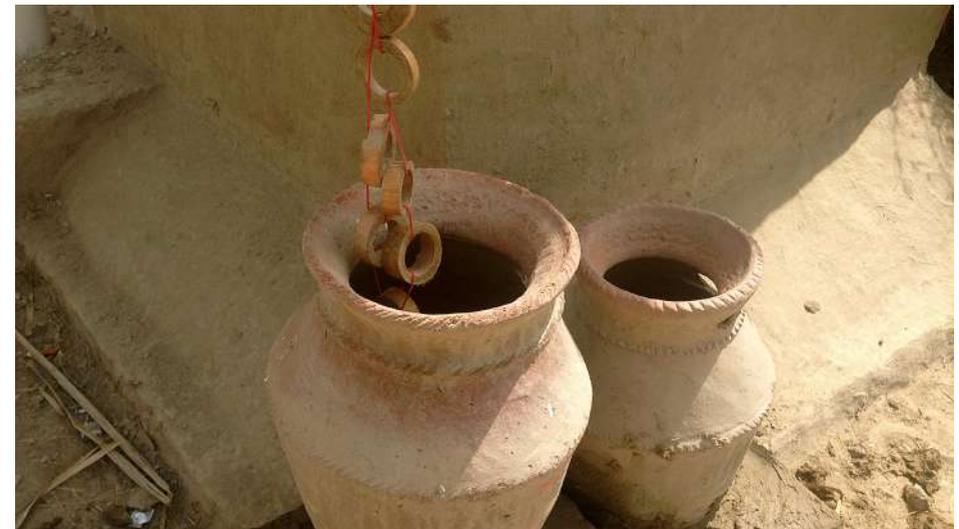
However, it is perfectly suitable for other household chores and for plantation and can help to save a large amount of drinking water.



Installation of Bamboo Rings.



Installation of Bamboo Gutter on KaravanRoof.



Rain water catchment pots.

11.3 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.1

METHOD OF CONSTRUCTION: PHASE 1



STEP 1
INSTALLING BAMBOO
GUTTER



Use a half split 4" dia bamboo for gutters. Remove inside sections of bamboo for smooth water flow. Install gutter at the sloping end of roof.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.2

METHOD OF CONSTRUCTION: PHASE 1

STEP 2
MAKING BAMBOO RINGS



Make 1"-1 1/2" wide rings cut out of a 3" dia bamboo and bind them together using jute rope. The rings will bring the water down to the pots.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.3

METHOD OF CONSTRUCTION: PHASE 1



STEP 3
INSTALLING POTS



Make 3 stands for pots of 9"x 9"x 3", 9"x 9"x 6" and 9"x 9"x 9". Then place pots on each stand with over flow bamboo spouts installed.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.4

METHOD OF CONSTRUCTION: PHASE 2



STEP 1
MARKING LAYOUT



STEP 2
EXCAVATION



Mark the layout, 6' dia for outer extents and 2' dia for inner extents. Remove top soil and excavate 6'-0" below ground. Compact the earth.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.5

METHOD OF CONSTRUCTION: PHASE 2



STEP 3
LAYING PLC



STEP 4
LAYING HARDCORE



Pour PLC 1:2:4 lime: sand: gravel and then put a 5"-6" thick layer of hardcore. Compact after laying hardcore.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.6

METHOD OF CONSTRUCTION: PHASE 2

STEP 5
MUD PLASTER



STEP 7
LIME SAND PLASTER



STEP 6
CHIKEN WIRE MESH



Put 2" thick mud plaster mixed with dung with chicken wire covering the entire surface of the well, treated with 2" thick sand lime plaster.

12.1 Why organic fertilizer?

Chemical fertilizer containing mineral salts can be absorbed quickly by plant roots. But these mineral salts do not contain any plant food and by acidifying soils, earthworms etc. are prevented from regenerating soils.

Thus, due to continuous use of chemicals, all organic matter and living organisms are lost. Over time the water holding capacity of the soil reduces which requires increasing amounts of chemicals to get the desired growth in plants.

Therefore organic fertilizers are vastly better for the health of soils and will not create the crisis conditions that chemical fertilizers do.

Organic fertilizers encourage microorganisms and earthworms to survive thus helping in regeneration of soil and creation of healthier plant growth. Soils that are treated with organic fertilizers retain their loose structure and remain



Training of Organic Fertilizer at Moak Sharif, Tando Allahyar.

airy, thus holding moisture and nutrients. They help in healthier plant root development.

Since organic fertilizers also prevent use of energy in production, these are also better for the environment to avoid pollution.

The *Lari Principles of Disaster Risk Reduction* promote methodologies that reduce carbon emissions, and as such it

is important to promote the production and use of organic fertilizers.

This method is also part of HF's Green Skills repertoire which promotes collection of animal waste leading to hygienic conditions as well as income generation through recycling of waste agricultural material.

The production of compost from waste generates income for rural communities.



Master Trainer explaining the benefits of Organic Fertilizer.

12.2 What are the ingredients of organic fertilizer?

The formulation is provided by Mr. Sohail Mirza (Code: HERAF-BSOF-1-13). It should be understood that it will take 3 years for soil to adapt. No loss is expected in spite of lower yield in first and second year. Overall costs are lower, thus benefits the farmer. Patience on the part of the farmer will be needed.

NO.	MATERIAL	LOCAL NAME	QUANTITY	PURPOSE	NATURE
1	Cow Dung	Gobar	10 kg	Macro/ Micro Nutrients	Fresh wet
2	Cow Urine		10 L	Macro/ Micro Nutrients	Fresh
3	Lentil Flour	Daal	1 Kg	For bacteria	Grounded
4	Juggery	Gur	750 gm-1 Kg	For bacteria	Worst Remains
5	Wet Mud from soil	Mitti	500 gm-1 Kg		Fresh Taken
6	Water	Paani	200 L	H ₂ O	Solvent
7	Plastic Drum		(200 L) w/ Lid	For mixing	

12.3 What is the procedure for making organic fertilizer?

The following should be mixed in a drum:

- Mix ingredients 1 and 2.
- Add ingredients 3, 4 and 5.
- Thoroughly mix contents.
- If necessary, add a little bit of water to make a slurry
- Cover the drum with a loose cover and let it rest for 15 days. Avoid direct sun at all cost.
- After 15 days add about 150-200 litre of water.



Village women learning how to make organic fertilizer, Tando Allahyar.

The liquid fertilizer is now ready for dispensing.

12.4 How is organic fertilizer dispensed?

12.4.1 Dispensing Schedule

- One day after ploughing. Sowing to be 2-4 days thereafter.
- Use 21 days after sowing and 21 days thereafter.
- Continue 21 day cycle depending upon crop and cultivation.

12.4.2 Dispensing Method

- Sprinkle with a small container, e.g. large mug, large glasses etc.
- Add to a water channel using a container (controlled dosage).
- Wet balls with earth to be spread evenly in the field.

Use spraying machine after removing the nozzle. Spray on soil and after the crop has grown tall.

12.5 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 1.1

BENEFITS OF ORGANIC FERTILIZER

قدرتی کھاد کے فائدے



Organic fertilizer is made from animal waste that have more nutrients and minerals which improve the soil and its fertility.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.1

PREPARATION STEP 1: INGREDIENTS REQUIRED

ضروری اجزاء



Quantity = 1/2kg

DAAL (Lentils)



Quantity = 5 kg

COW DUNG



Quantity = 1/2kg

KALA GHURR



Quantity = 5 litre

COW URINE

Ingredients: channa or other cheap daal; kala ghurr; cow dung; cow urine. Any poor quality daal is acceptable.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.2

PREPARATION

STEP 2 & 3: MIXING DUNG WITH URINE & GRINDING INGREDIENTS

فضلہ اور پشاب ملا کر اور اجزاء کو پیسنا



STEP 2: Mixing Cow Dung & Cow Urine

STEP 3: Grinding Daal & Ghurr

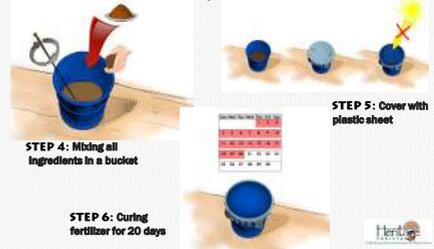
Prepare a container for mixing. Size: 100 litre. Mix dung and urine with a stick. Grind daal and gurr to form powder.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.3

PREPARATION

STEP 4, 5 & 6: MIXING CONTENTS, COVER AND CURE

اجزاء کو ملانا، ڈھانپنا اور محفوظ کرنا



STEP 4: Mixing all ingredients in a bucket

STEP 5: Cover with plastic sheet

STEP 6: Curing fertilizer for 20 days

Mix all in container with a stick. Cover with a lid away from direct sunlight for 20 days. Mix with stick every few days.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.4

USAGE

STEP 7: USING FERTILIZER IN LIQUID FORM

کھاد کو پانی کے ساتھ استعمال کرنا



STEP 7: Using fertilizer in liquid form

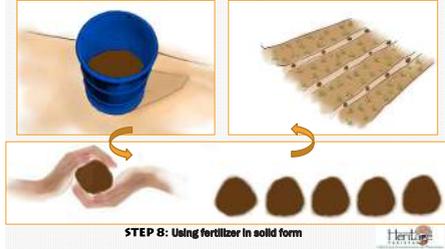
Liquid use: add 50 liters of water and place the drum near water source of fields. Open drum's tap to add the fertilizer in water.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS 2.5

USAGE

STEP 8: USING FERTILIZER IN SOLID FORM

کھاد کو ٹھوس حالت میں استعمال کرنا



STEP 8: Using fertilizer in solid form

Place balls of fertilizer at regular 3'-0" intervals in the water channels in the fields. Once water is turned on, balls will dissolve slowly.

13.1 Why should organic soap be used?

Reetha or Soapnut soap has been traditionally used in the subcontinent. Before soap had become widely available, the natural Soapnut product was utilized for washing, bathing and washing hair.

Today, when there is emphasis on the use of natural and organic products, Reetha soap is highly valued and fetches high prices.

However, for the poverty ridden communities, it can serve as a boon, since the prices of commercially produced soap are very high and unaffordable. Since washing hands is one of the key elements to prevent many diseases, a healthier community requires that regular hand washing is encouraged.

Clearly, unless low cost cleansing agent is available, low income communities find it difficult to carry out the regimen of personal hygiene. Even in the most deprived areas, it is important to instil



Training for making organic fertilizer.



Making organic soap with soap nut berries.

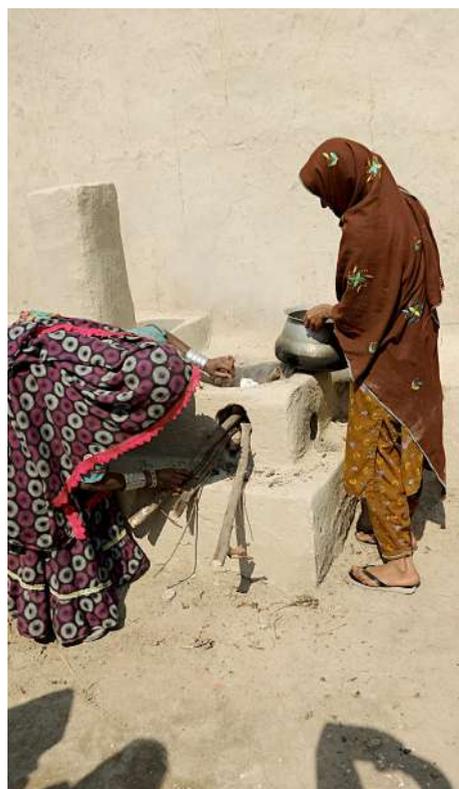
the need for hygiene and grooming. Accordingly, in all trainings, the importance of bathing, brushing teeth, hand and face washing, keeping feet clean, cleaning ears and wiping and blowing noses is emphasized. It goes without saying that grooming can only be achieved if deprived communities have access to a cheap source of detergent. Thus, organic soap becomes the basis for a healthier community.



Explaining the correct method to wash hands.

The use of organic soap has many advantages:

- a. It can be easily made at home.
- b. It is extremely low cost, eco-friendly and reusable.
- c. It has 100% natural ingredients. No preservatives are used, so it does not harm human skin.
- d. It leaves the skin smooth and results in shining hair as well as for fighting against skin and scalp infections.
- e. It is beneficial for those with sensitive skin. It is specially beneficial for those suffering from fungal infection in hair and scalp.
- f. It can prevent many skin diseases as it is naturally anti-bacterial and antifungal.
- g. It is 100% bio-degradable, compostable and non-polluting. It is safe for gray water systems.



Making organic soap during training.

13.2 What is organic soap?

Organic soap is made by crushing soap nut. These are fruits of the soapnut tree and contain 'Saponin', a 100% natural product. When immersed in water it creates mild suds, which is similar to industrially produced soap.

Soapnuts are gentle and if used for washing clothes will leave the laundry fresh. Thus, it is 100% substitute to normal cleansing materials.

Soapnuts are allergy-free and are particularly good for skin and especially for sensitive skins, e.g. those of babies.

Organic soap can be used for all cleaning purposes, from bathing, as shampoo, to washing clothes and other household utensils.

It is usually made as a liquid, which can be stored in bottles. Since it is a natural product, it is best used within a week of its production or stored in a refrigerator. HF's Barefoot Village Entrepreneurs (BVE) for organic soap are promoting the use of hand-washing as part of their marketing strategy, thus encouraging women and children to regularly wash hands.



Children washing their hands with organic soap on Global Handwashing Day, 2014, Kot Diji.

13.3 What are the ingredients for organic soap?

The ingredients are Soapnut and water.

The Soapnut needs to be crushed and brought to a boil in clean water and left overnight.

Once it is strained, it can be stored in bottles and left in a cool place. Water is required to be potable clean water.



Reetha is the main ingredient in making organic soap.



Children after washing their hands with organic soap on Global Handwashing Day, 2014.

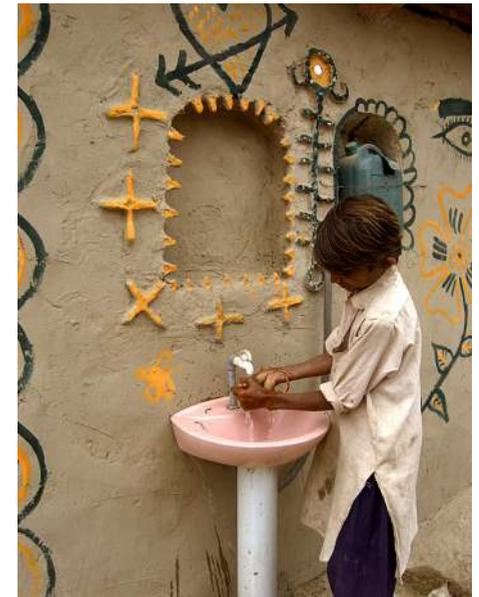
13.4 What is the procedure for making organic soap?

The following procedure should be followed:

- Select good quality Soapnut berries. These should be brown in preference to green berries which will not produce enough soap.
- The soapnuts should be cracked open with hands, hammer or mortar and pestle. The black seed from inside should be removed as these are hard and cannot be broken easily.
- Crushed shell should be soaked in water for 12 hours or more before the mixture is boiled and simmered for 10-15 minutes. This will result in a thick consistency and needs to be strained through a strainer.
- The strained liquid should be allowed to cool before it is stored in bottles. Any spilt soap should be cleaned. The waste should be collected in a cloth bag and reserved for washing clothes.
- If the liquid soap is to be sold, the bottles should be labelled and set aside for sale. The label should also inform the time during which the soap should be used. The Sabun Adhi (Soap Sister) should encourage the use of organic soap in her own village and also when marketing in surrounding villages.



Women observe the process of making organic soap.



Washing hands with organic soap.

13.5 Training Modules

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

1.0

HEALTH AND HYGIENE

صحت اور صفائی



Importance of hygiene is often over looked in a rural setting. It is important to emphasize on the consequences of lack of hygiene.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

1.1

THE BENEFITS OF ORGANIC SOAP

قدرتی صابن کے فائدے



Organic soap made with Reetha is sustainable, affordable, beneficial for skin, odourless, compostable and has countless uses.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.1

PREPARATION

STEP 1 & 2: INGREDIENTS & CRACKING SOAP NUT

صابن بنانے کی اجزاء اور تیاری



STEP 1: Collect Ingredients:
Water & Reetha

STEP 2: Preparation
Cracking Reetha (Soapnut)



Use brown Soap Nut berries and clean water. Crack open nut with your hands/hammer or by using a mortar and pestle. Separate the skins.

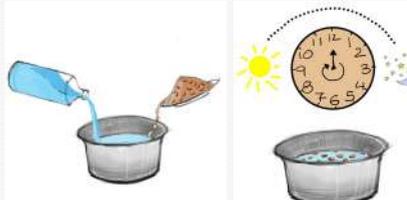
DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.2

PREPARATION

STEP 3: SOAKING

چھلکوں کو بھگونانا



STEP 3: Soaking Soap Nut In
Water for 24 hours



Soak the Soap Nut in water in the ratio 1: 3 (Soap Nut: water). Soak the mixture for 12 hours or more.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.3

PREPARATION

STEP 4 & 5: COOKING AND STRAINING

صابن کو پکانا اور صفائی پادور بنانا



STEP 4: Cooking soap nut in
water

STEP 5: Straining the
liquid; Collect waste in bag
as washing powder



Cook the mixture over a stove. Bring to a boil and simmer. Cool down and strain. Add essential oils for perfume if desired.

DISASTER PREPAREDNESS AND SUSTAINABLE CONSTRUCTION SKILLS

2.4

PREPARATION

STEP 6 & 7: POURING INTO BOTTLES & HAND WASHING

پوس میں ڈالنا اور ہاتھ دھونا



STEP 6: Pouring liquid soap in
bottles

STEP 7: Washing hands



A small quantity of soap should be used for washing. Organic soap can be used for washing hands, face, hair, body, clothing and dishes.

Amphitheatre at Sayani DRR Park, Kot Diji.



*UN Recognition Award for Promotion of Culture and Peace, 2002
Islamic Development Bank Laureate 2013 for Women's Development
Emirates Airline Greener Tomorrow Award 2013-14
Finalist World Habitat Awards 2014-2015*



© HERITAGE FOUNDATION OF PAKISTAN
E-6, 4th Gizri Street, DHA 4, Karachi
www.heritagefoundationpak.org info@heritagefoundationpak.org