

Shelter after Disaster

An overview of shelter responses in Pakistan 2011- 2014
and
how to build low-cost houses with lime that can withstand future floods



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In areas like these flooded by intense rains in September 2012



Kashmore, September 2012 – almost 400,000 families lost their homes during this flood alone. That's almost three million people in these kind of conditions.

Significant flood damage still evident
six months later



Often destruction starts from the roof-down

Because roofs are built badly and heavy beams bear down upon mud walls that have no stability.



Both katcha (mud) and pukka (brick) houses collapsed



Water supply is also seriously damaged or interrupted after major floods. The needs are diverse, including health care, education, re-starting livelihoods.





Badin district, November 2011

Despite disasters, the poorest and hardest hit are always the most positive, friendly and resilient!







A picture of vulnerability

when poor people lose everything, have no insurance nor advice on how to rebuild to cope with future floods.

Basic shelter – for almost 2 years: Little protection from the elements. Up to 50 degrees C. by May

Women and children exposed and at risk.

Animal faeces and disease all around



First priority: emergency shelter
But how much does this cost?

Large tent: \$200- \$350 range. Limited adaptability
– can't be used to reconstruct the home.

And expensive!



\$25 / Unit

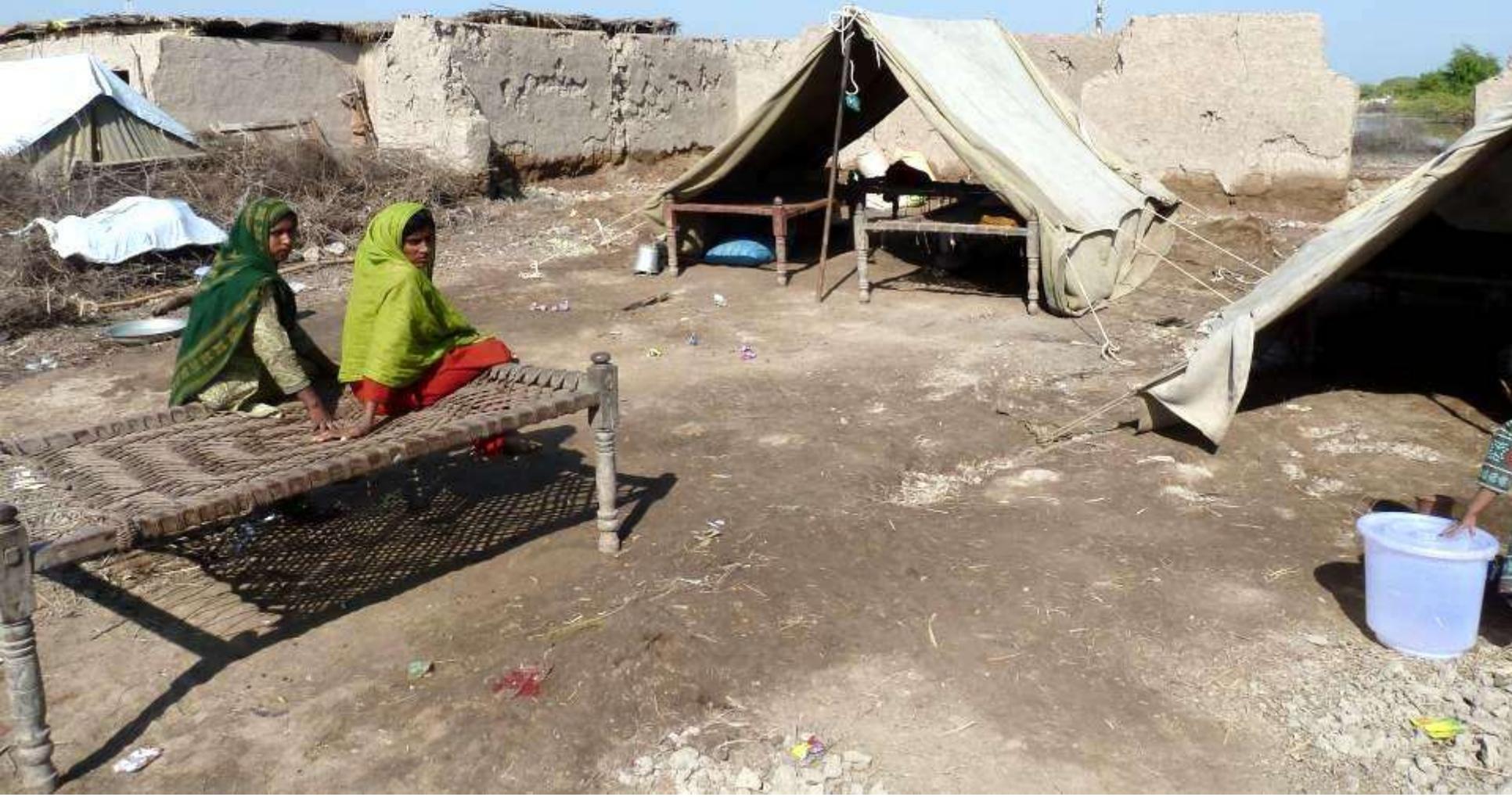
Cheap but almost worthless:

- Limited space
- No closing at the ends
- Limited privacy and dignity
- Low cost is not always best!

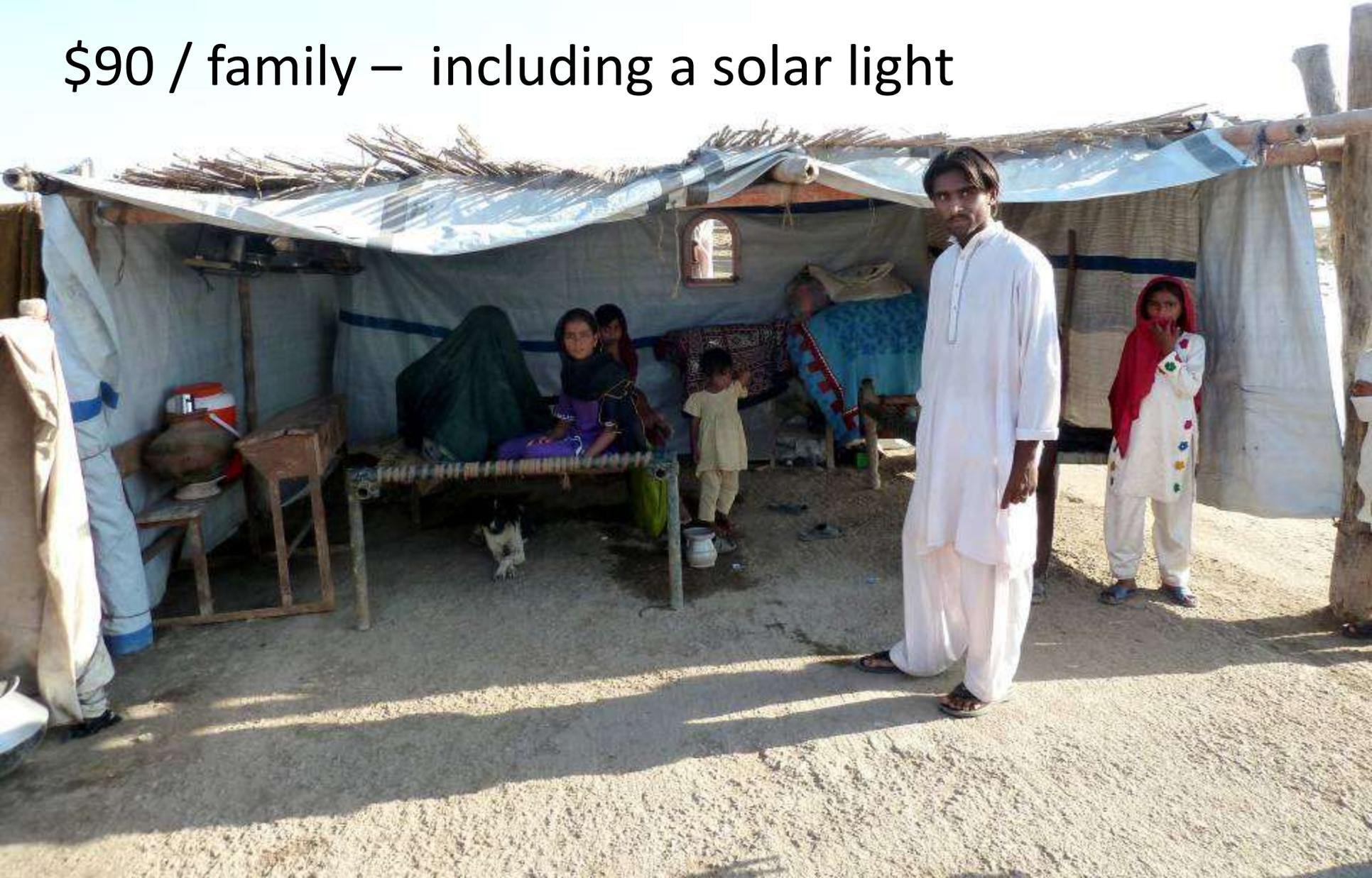


Cheaper tent (\$150)

But still not enough space for a whole family.



In contrast – a DFID / IOM designed family shelter
\$90 / family – including a solar light



Whole families: better protection, enhanced dignity



The “Roofing Kit” idea (by HANDS, a local NGO)

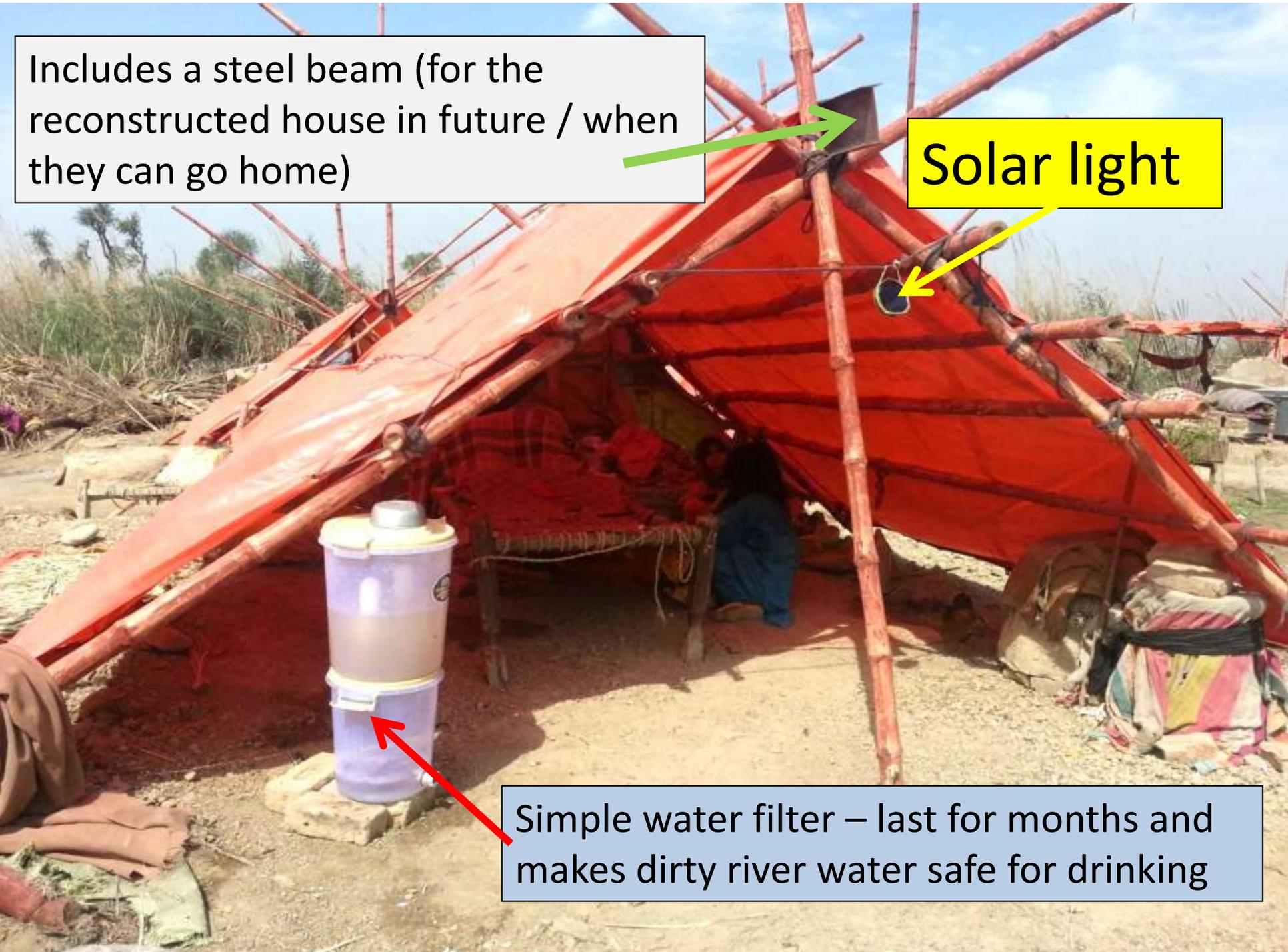
- \$100 per family
- Used as temporary shelter
- Later to build a roof
- Double the value of a tent
- And half the price



Includes a steel beam (for the reconstructed house in future / when they can go home)

Solar light

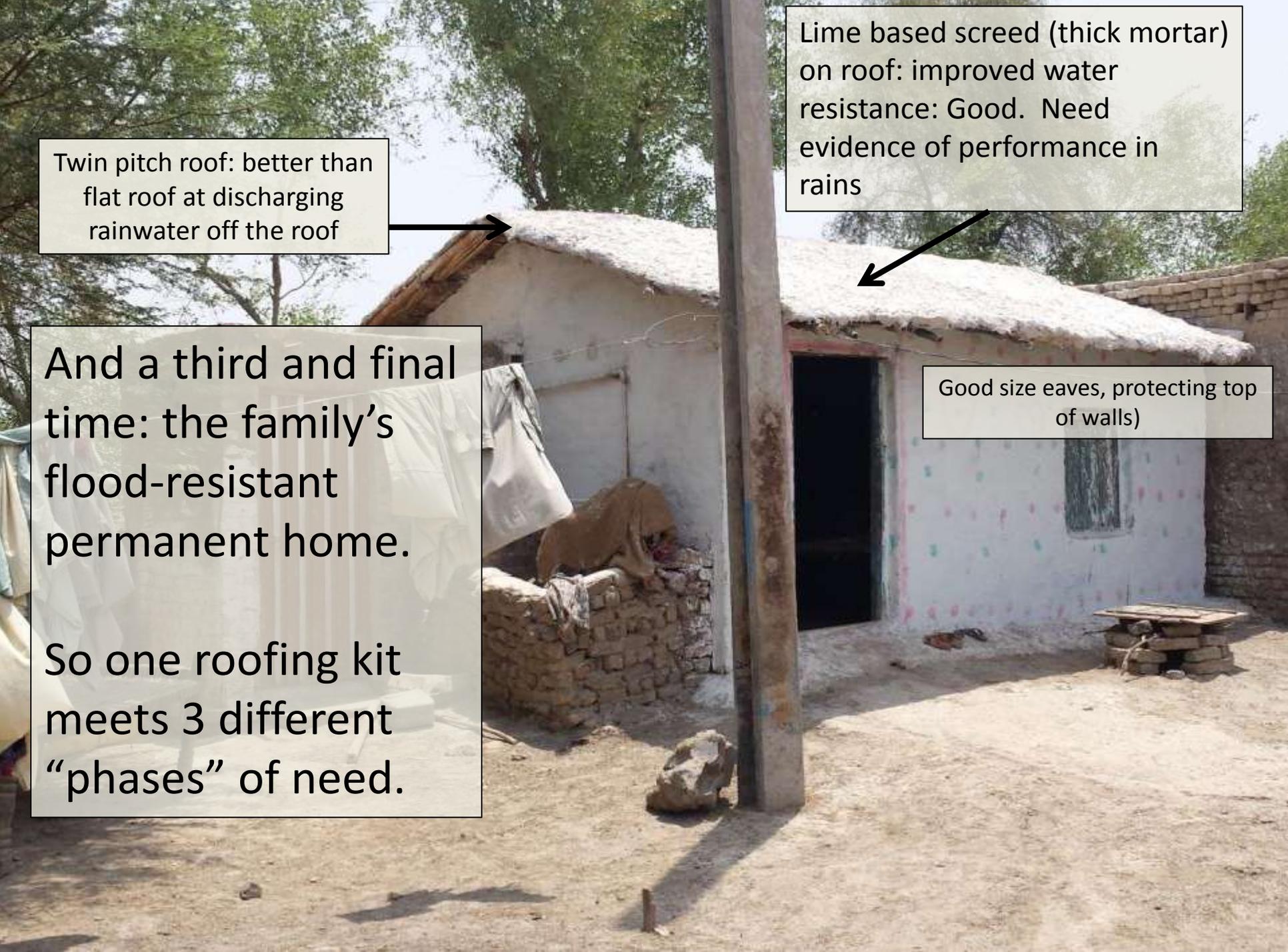
Simple water filter – last for months and makes dirty river water safe for drinking





Upon return, most families have used this roofing kit a “second time” to cover temporary shelters (that are NOT flood resistant). Now these same materials will be used a third time to cover a durable flood-resistant home.

Twin pitch roof: better than flat roof at discharging rainwater off the roof



And a third and final time: the family's flood-resistant permanent home.

So one roofing kit meets 3 different "phases" of need.

Lime based screed (thick mortar) on roof: improved water resistance: Good. Need evidence of performance in rains

Good size eaves, protecting top of walls)

Cost:

Emergency: £60 / family

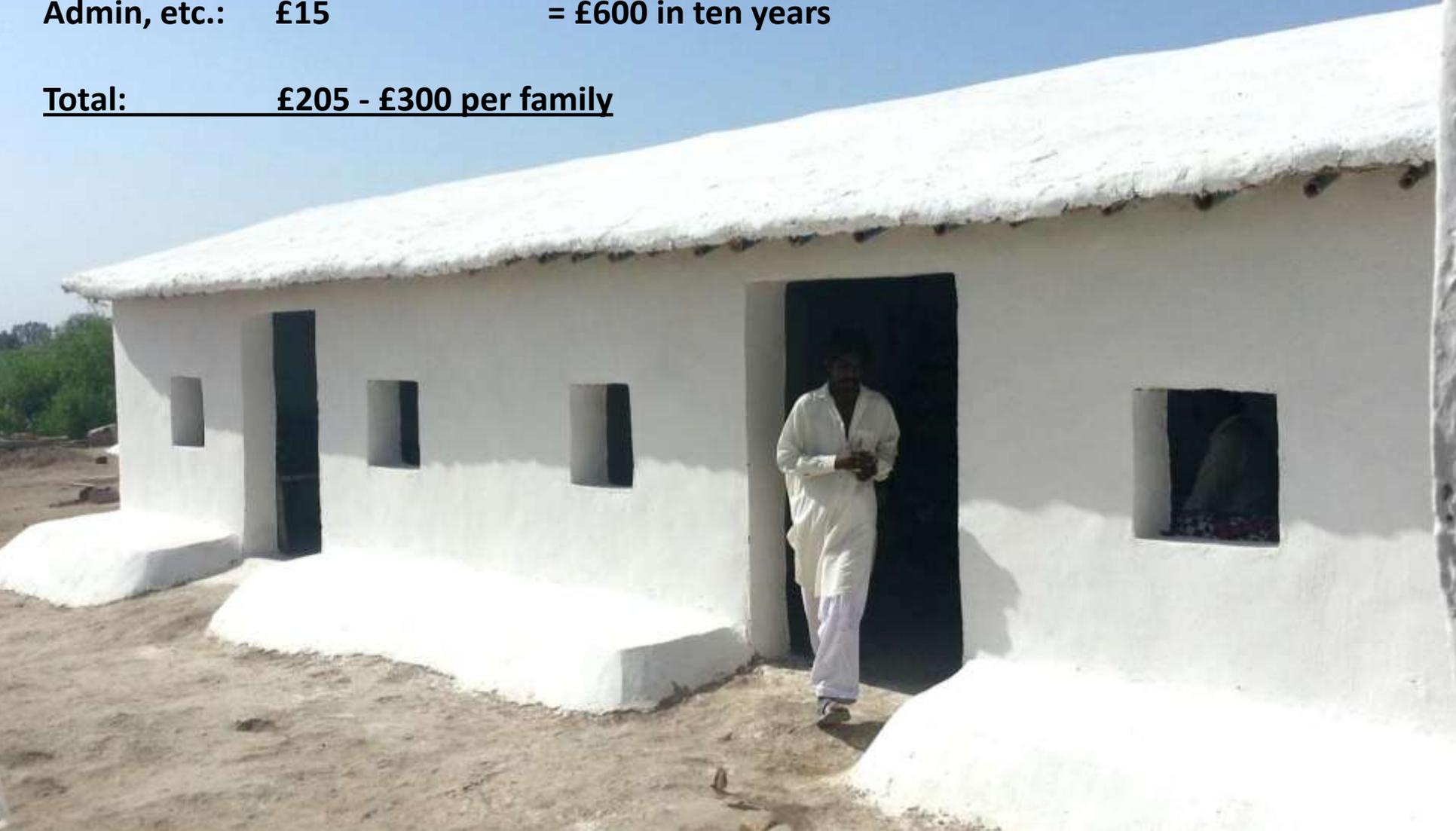
Robust shelter: £130

Admin, etc.: £15

Total: £205 - £300 per family

The alternative:

**Emergency only: £60 / family – every year assuming
= £600 in ten years**



This makes a real difference!

Kiela, mother and house builder

Used the roofing kit to build a family home

Now they have a safe roof



**Keila outside her window.
Note depth of wall, good
thermal mass and natural
cooling!**



The Ring Beam

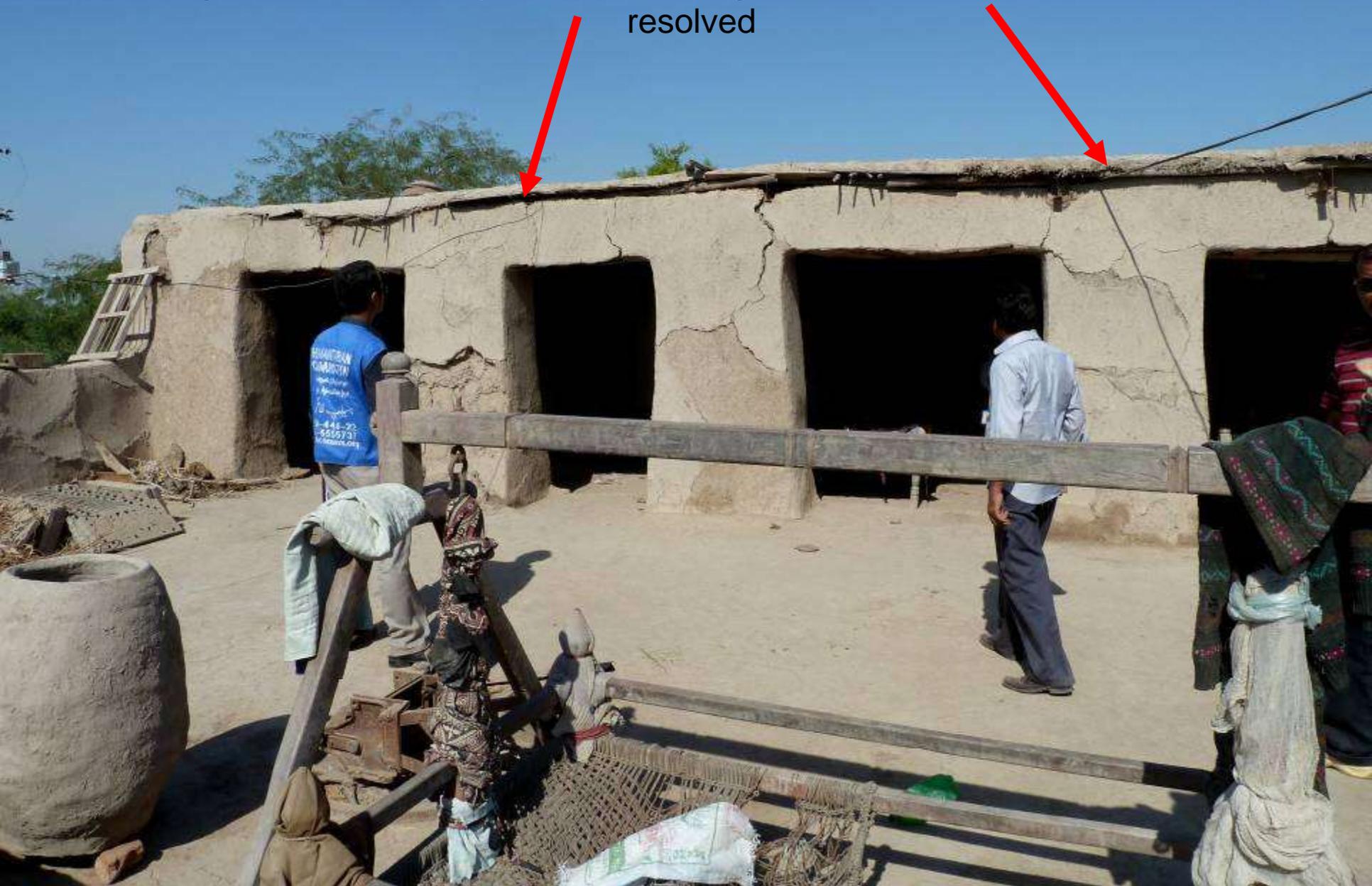


Heritage 
IOM-HF SHELTER PROJECT
CONSTRUCTION OF MODEL UNITS
بہتر روایتی طریقے سان
مضبوط گھر بنائیو
ماڈل یونٹ جی تعمیر
گرین کاروان چت جیٹا یونڈ کان بجایی
بہتر روایتی طریقے
سے مضبوط گھر بنائیں
ماڈل یونٹ کی تعمیر
سیلاب سے بچاے گرین کاروان چت
(0221) 3414214
www.heritage-education.org
info@heritage-education.org

Local people learning to make a ring beam of bamboo and lime-concrete.



A typical house in lower Sindh. The top of the wall is not protected by the roof – making it vulnerable to monsoon rain getting in, weakening and eventually causing the walls to collapse. By extending the eaves further out this would be resolved



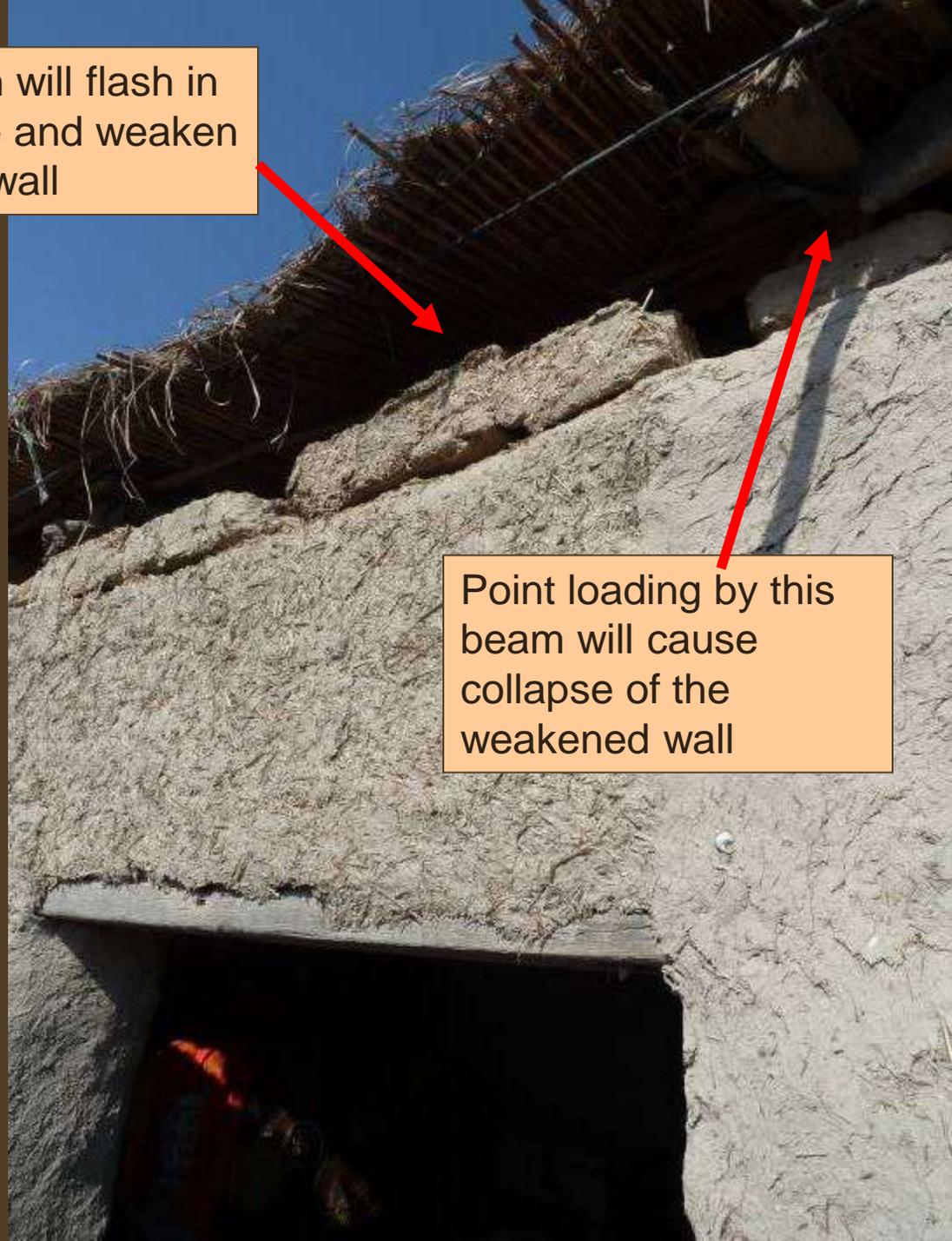
This house has already been rebuilt – without technical advice so the building is once again vulnerable to collapse in heavy rains.

For this reason, technical training is one of the best ways to build resilience to future floods / heavy rains.

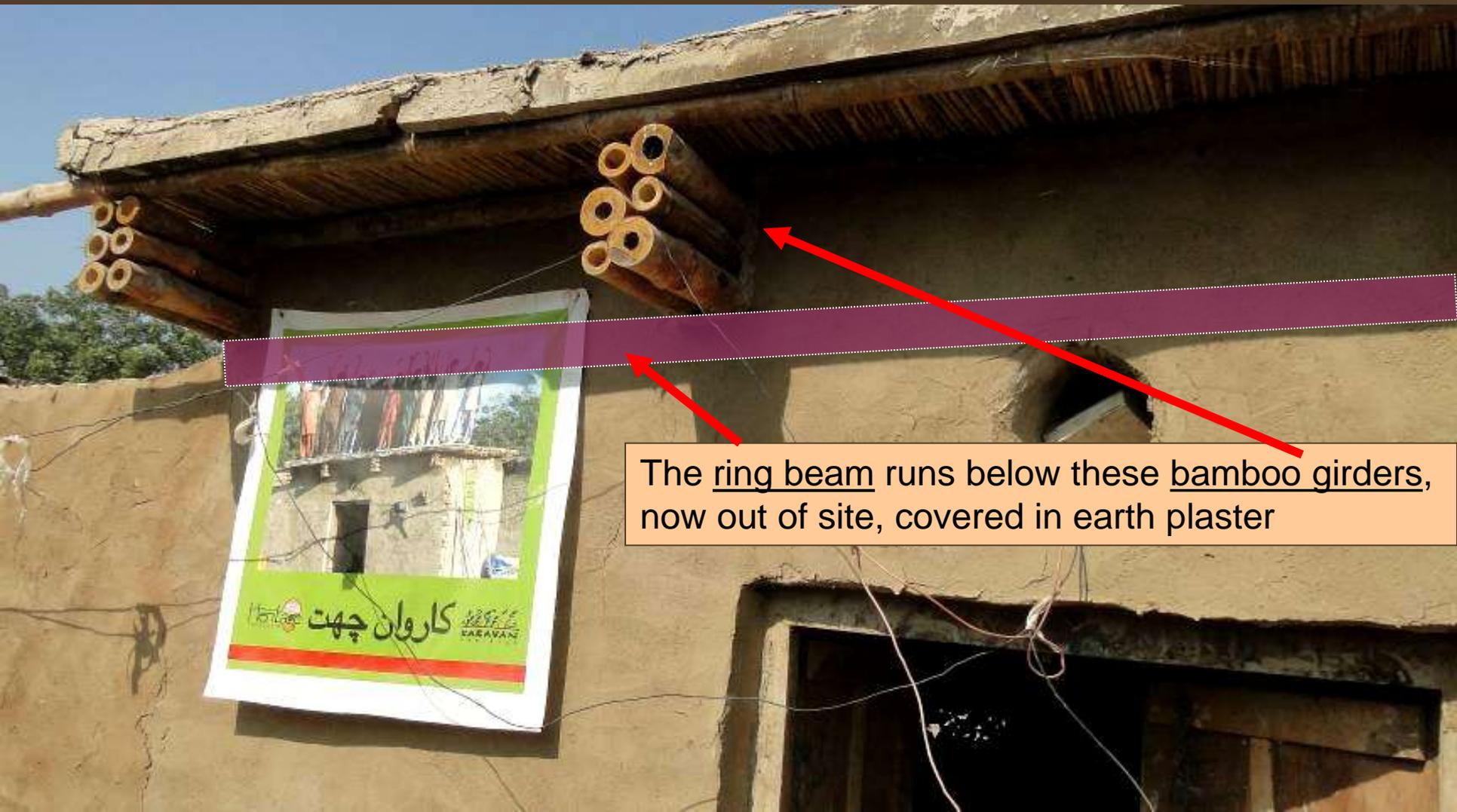
Training should take place in as many communities as possible, using “hands-on” learning, re-building at least one house properly – as reference for the rest of the community.

Rain will flash in here and weaken the wall

Point loading by this beam will cause collapse of the weakened wall



An extended eave, built by local people during Heritage Foundation training. This will prevent rain flooding into the top of the wall.



The ring beam runs below these bamboo girders, now out of site, covered in earth plaster

Without a ring beam the heavy girders “point load” onto specific points on the wall causing it to crack, buckle then collapse



These roofs are far stronger than typical roofs made from steel girders and bamboo poles (partially because of the shorter distances between each girder & rafter).

So they can be used as “refuge platforms” in case of future flooding (or to grow food, store stuff, etc.).

This is a good example of innovation, building resilience and value for money!



Lime: the key to low-cost flood resistant houses

- Lime makes ordinary soil completely flood resistant
- These blocks were submerged for 3 months
- Seeing is believing



Lime Kiln in Southern Pakistan

Local Lime Production

Vast lime deposits in most countries

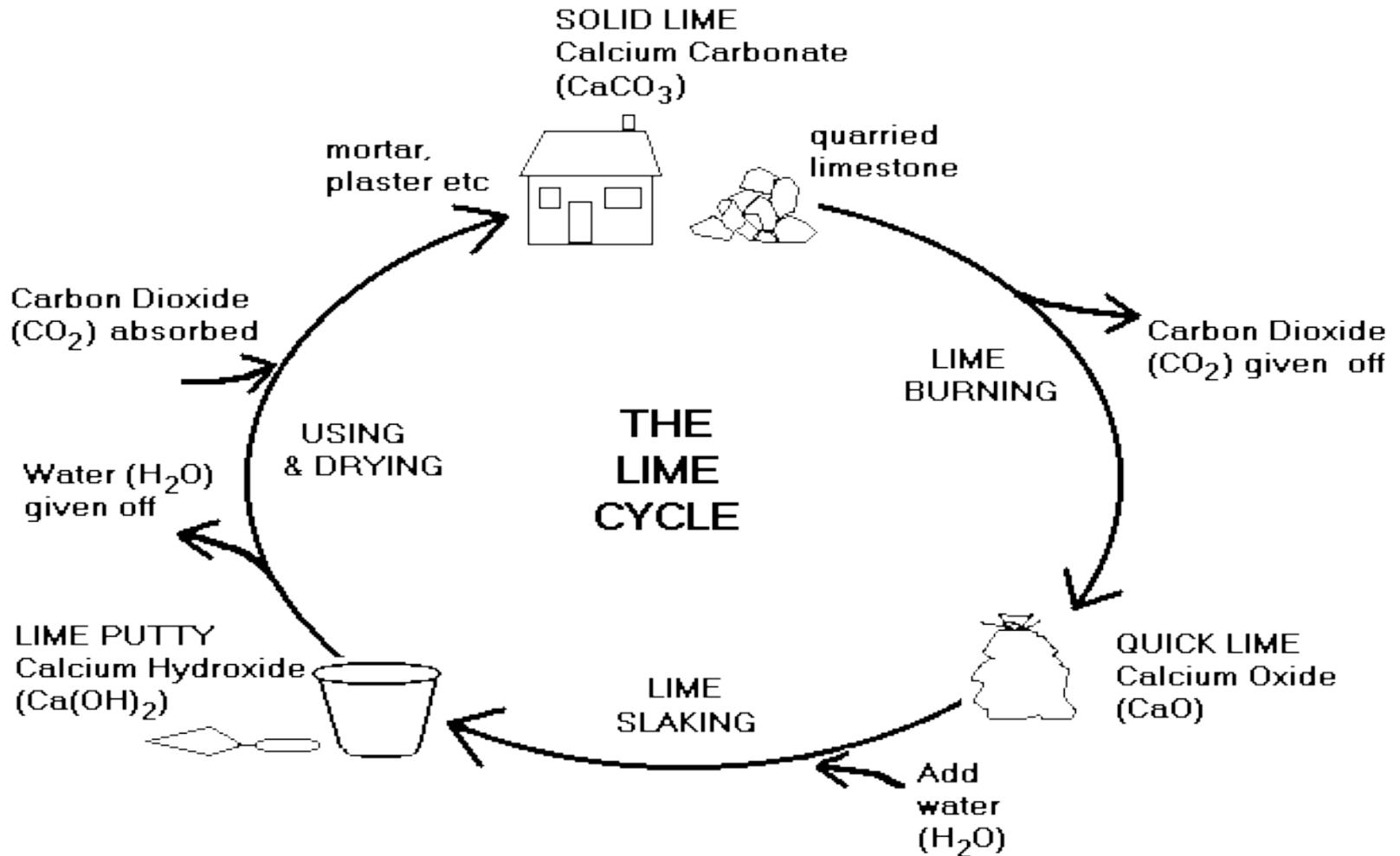
There is a large demand from steel, sugar and food industries

Local bushes are cut for fuel and the fire burns for 3 days and 3 nights. The bushes regrow after they're cut.

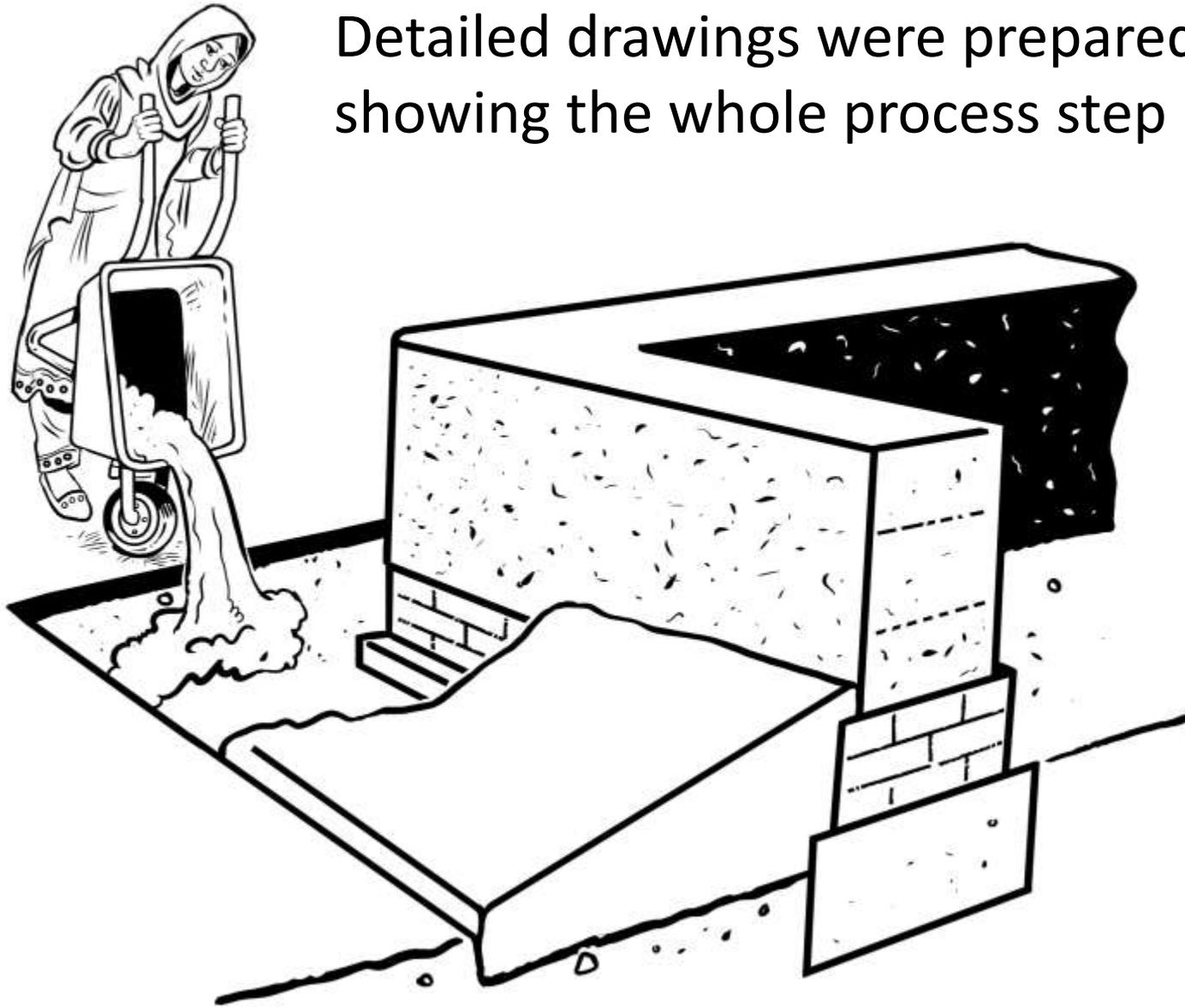
Offers ZERO CARBON lime products (unlike in Europe where fossil fuels are used)

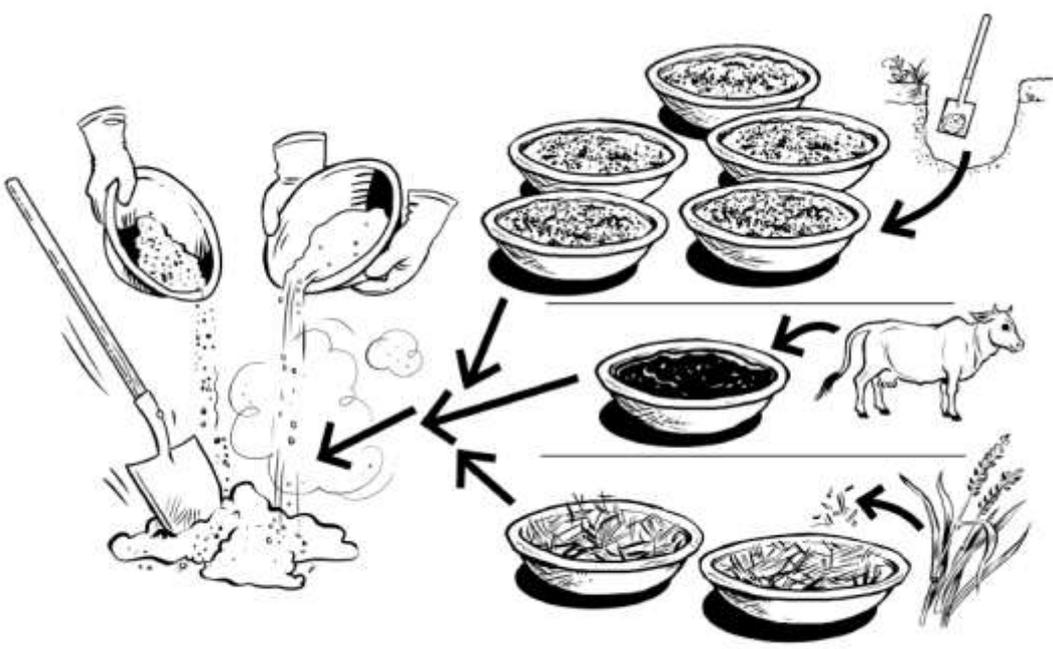


The lime cycle

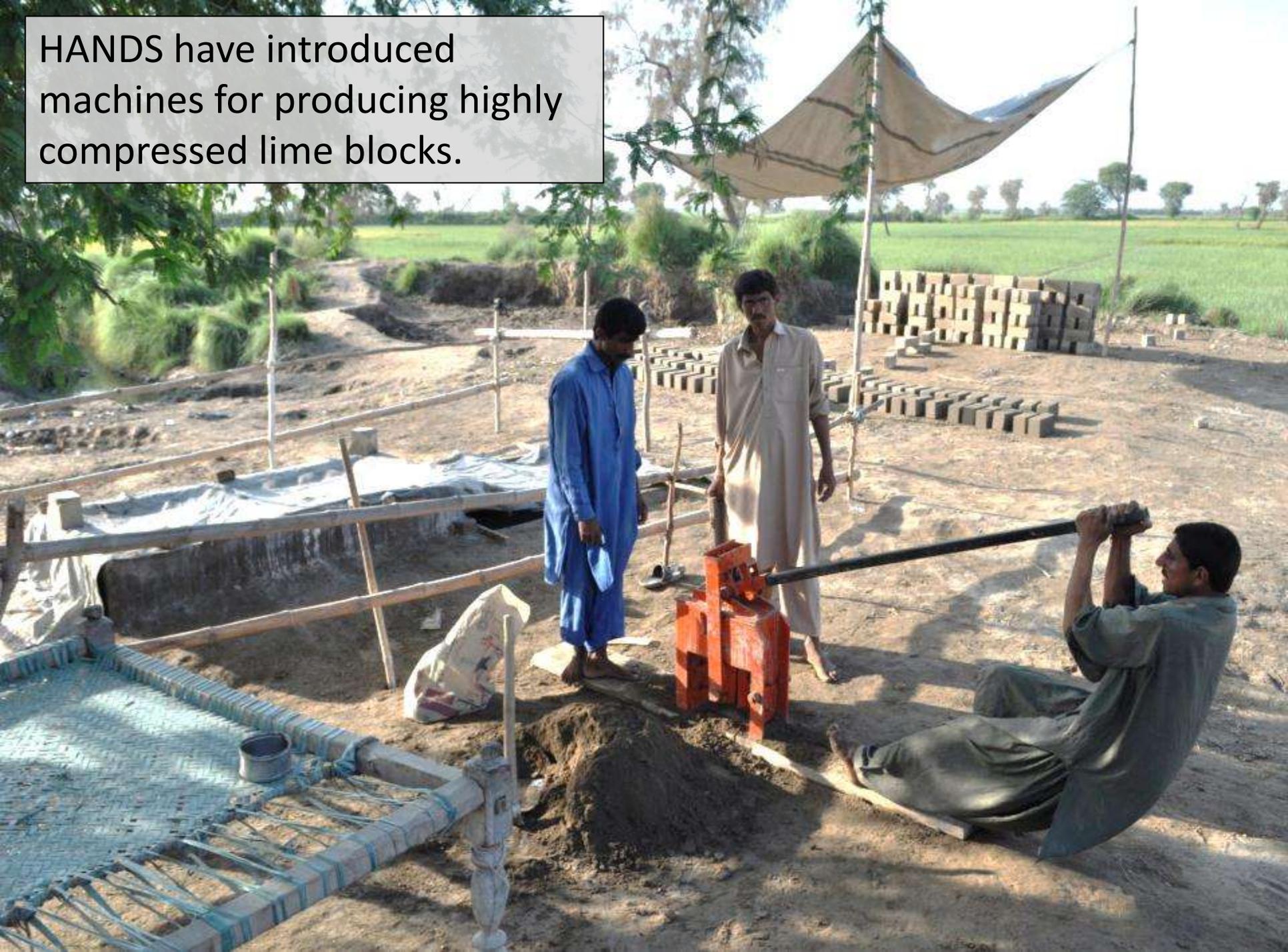


Detailed drawings were prepared –
showing the whole process step by step





HANDS have introduced machines for producing highly compressed lime blocks.





Examples of better shading:
Use existing structures where possible (see left)

HANDS, Gotki district

Temporary wood and thatch structure erected for block stacking in shade.

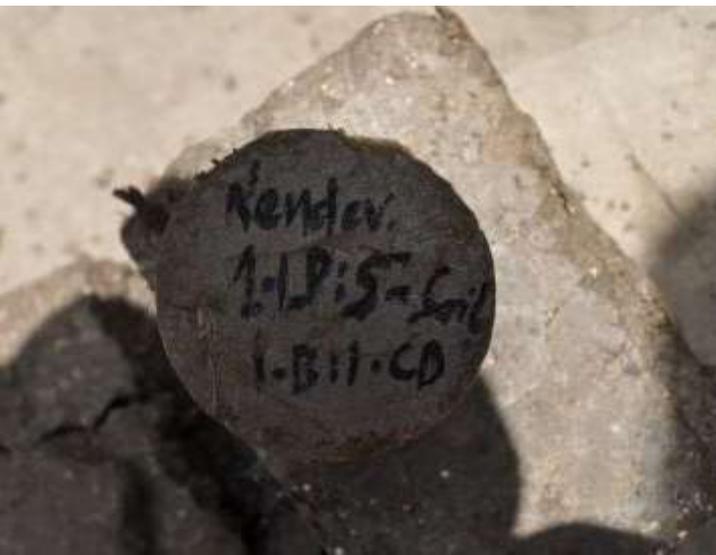
Much less likelihood of exposure to sun

Lime – earth blocks like these need 30 days to “cure” before being ready for building



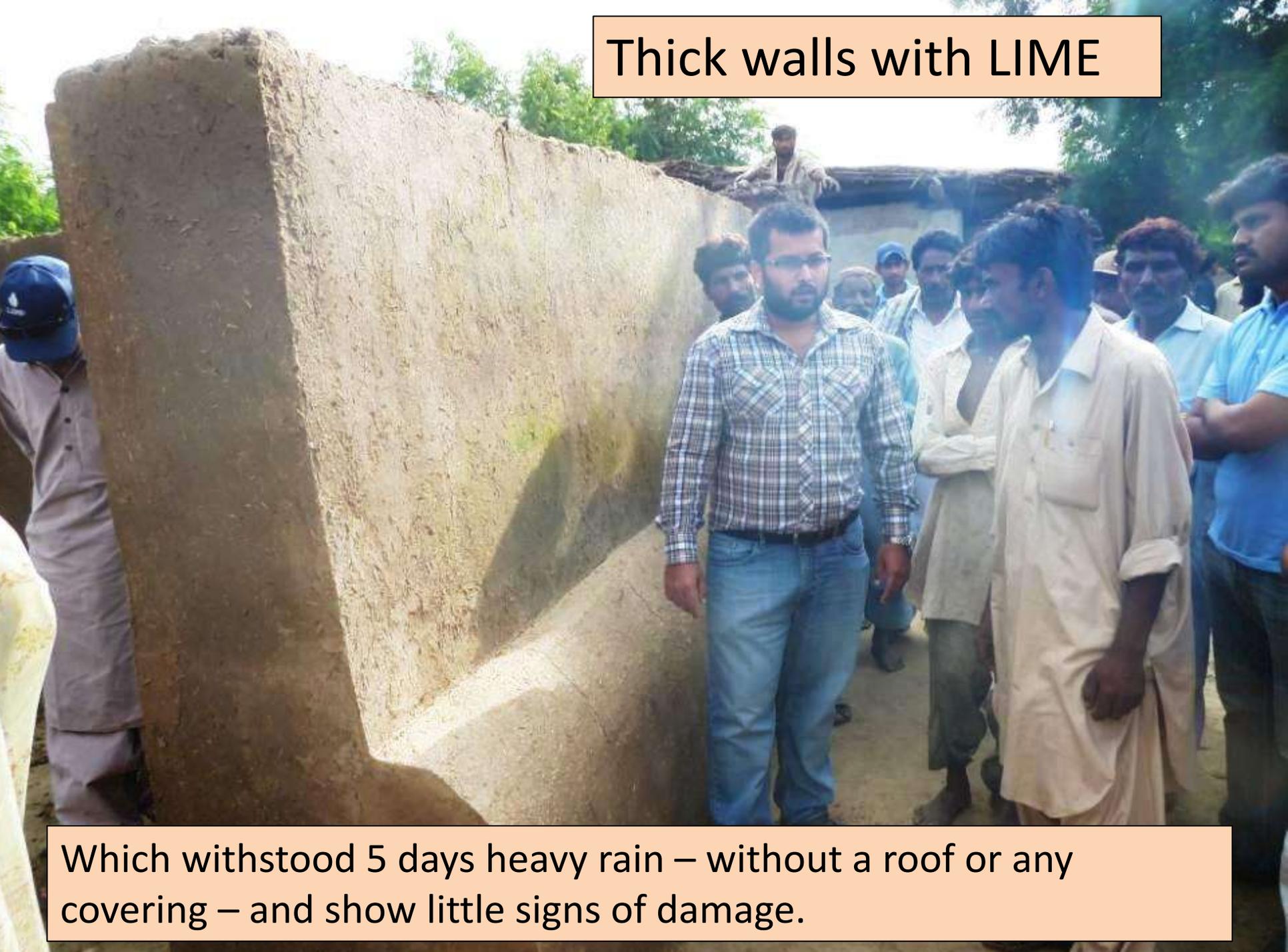
Every project using lime should start to institute these soak tests – in villages where the materials will be used.

Only by seeing and experiencing will beneficiaries understand the relative merits of proper lime use, of testing different mixes and then choosing the best solution for themselves.



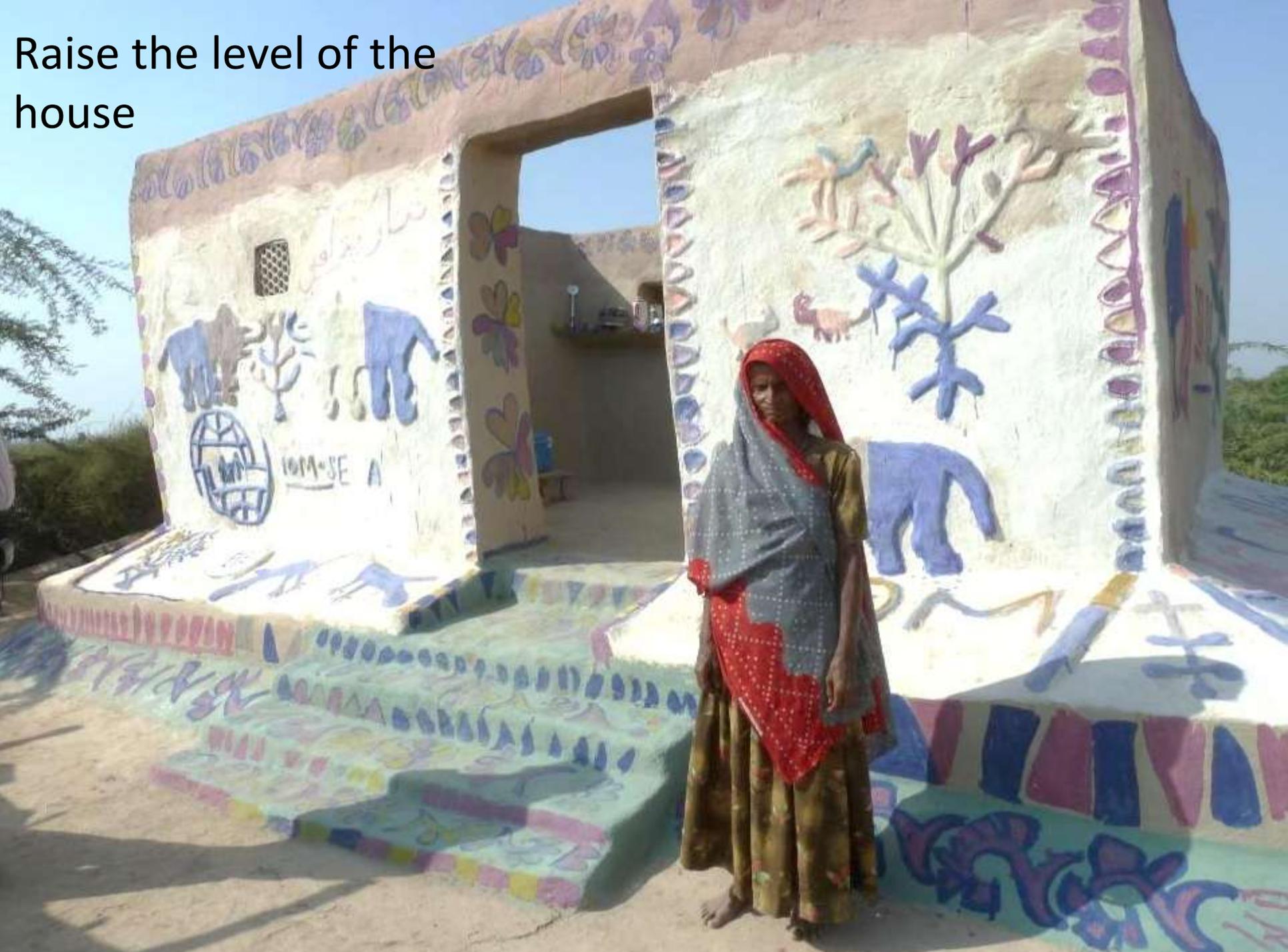
- Straw-build UK now working with all partners to enhance knowledge and capacity in lime technology.
- Qazafi Memon, pictured, now Straw-build's local advisor and trainer supporting partners at community level.

Thick walls with LIME



Which withstood 5 days heavy rain – without a roof or any covering – and show little signs of damage.

Raise the level of the house





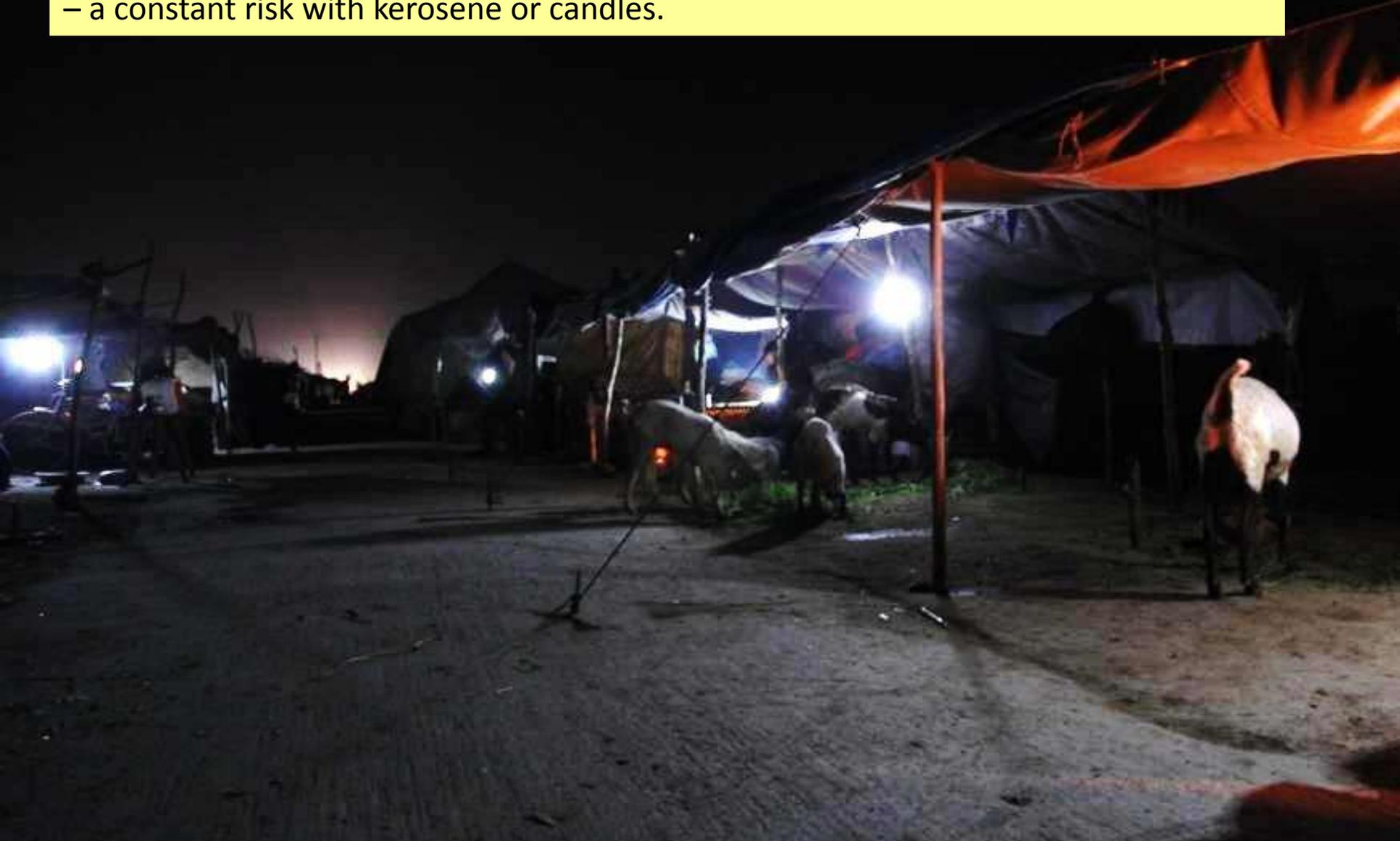
SEWNA



S S



Solar light – these cost about 600 PKR (£5) and save people between 300 and 600 PKR per month. Light is critical for protection, to see snakes (who are also displaced in floods and come into settlements), for education, etc. They also don't cause fires – a constant risk with kerosene or candles.



Solar lights, distributed in late 2012 by HANDS and IOM, still appear to be working well

One family experimented with one light to create a charger for mobile phones!

The switches appear to break first. This family made repairs at a local workshop. Sorted.



VFM:

1 light saves <400 per month

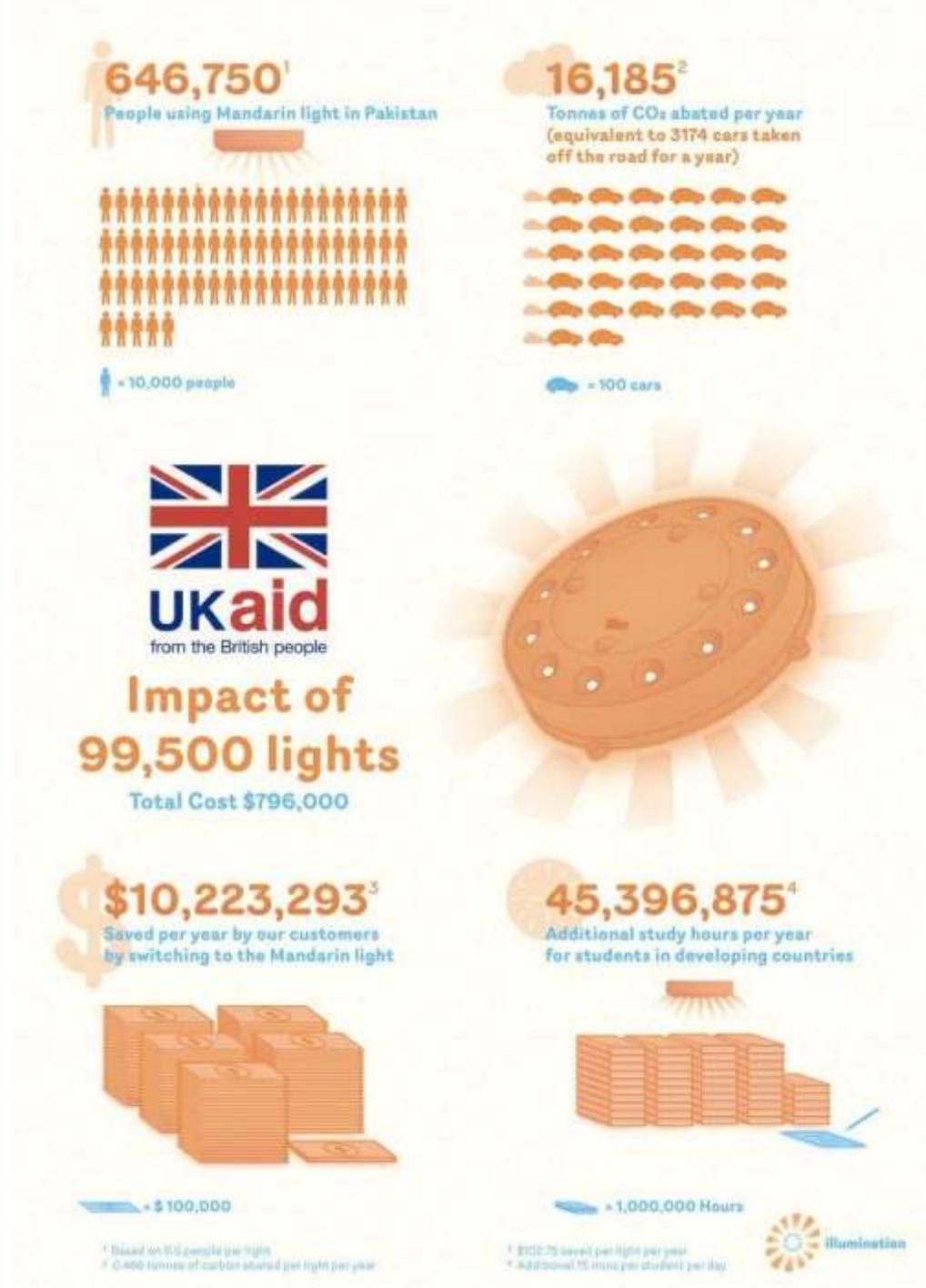
Investment is 800 per light

Impact: payback in two months – saving 4,800 over 24 months

£1 invested generates £5.8

Solar Lights – the story so far and important outcomes

- Better protection and safety for women and children
- Saving money < 15% of income
- Less indoor pollution and fire risk



Local roundhouses (chora) are prevalent in many parts of Southern Sindh.

These show how local reeds are used to build the walls, then mud and lime plaster added later.



IOM and HANDS select elected focal points in the communities who will receive money in their bank accounts on behalf of all the beneficiaries. Money is advanced in three phases, each requiring the previous phase to have been completed so the funds are conditional on progress by the whole community. This way the community manage their own reconstruction.



An example of bamboo structure for a twin-pitch roof. This avoids the use of local **trees** – a non-renewable source of building material, causing serious environmental damage



A cross-section of a safe foundation made from earth and lime, with a projected “toe” to give further durability in case of flooding

A traditional Sindhi round-house, built on a raised platform by Heritage Foundation as a model. Lime mud render for water-resistance.



Birani, in front of her temporary home for the last two years, and in the background the new HANDS / DFID-funded shelter she can now move into.

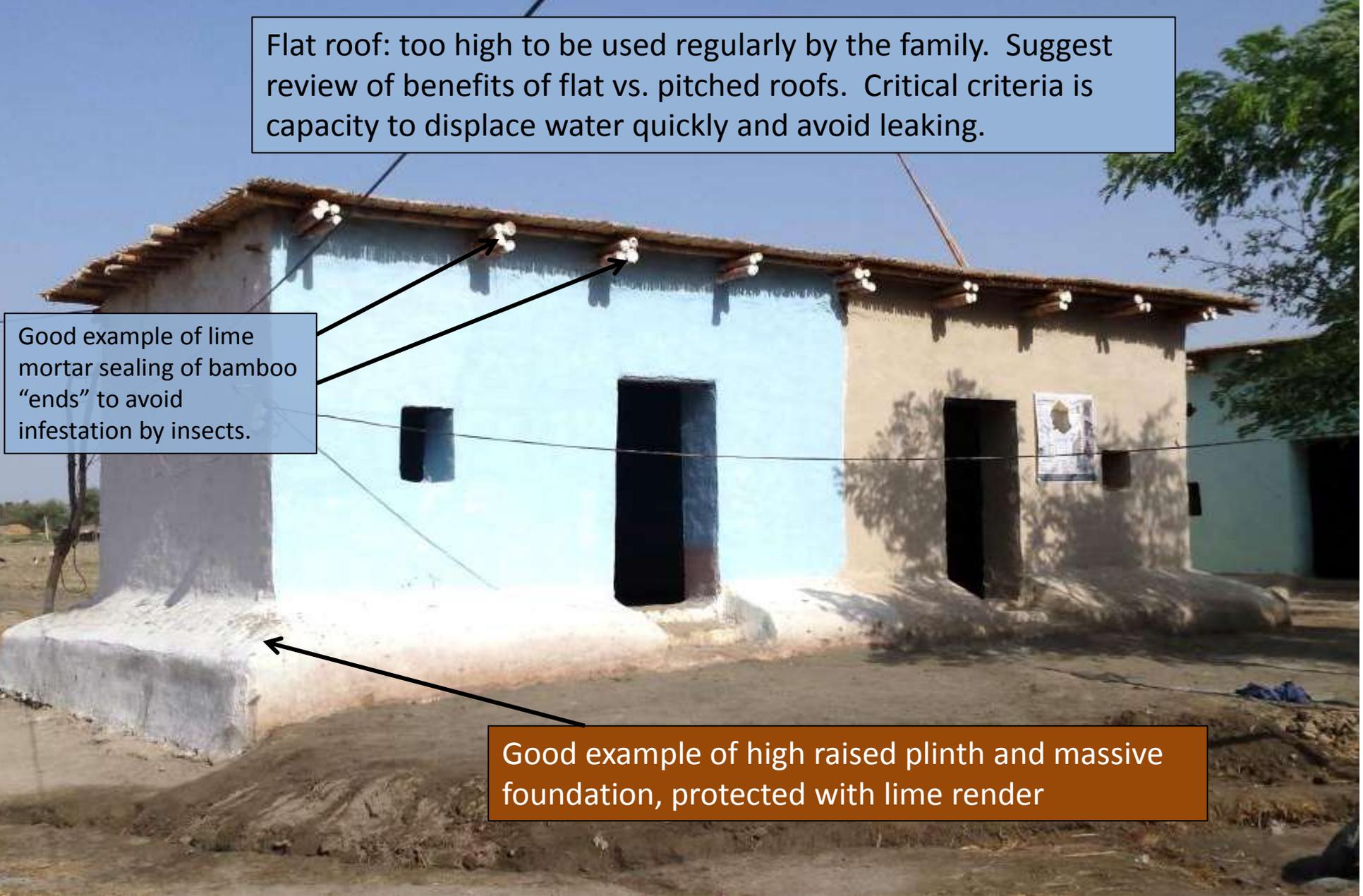


Case studies like these are really important to tell the story of our work. Suggest all partners try to draw out more human stories like these.

Flat roof: too high to be used regularly by the family. Suggest review of benefits of flat vs. pitched roofs. Critical criteria is capacity to displace water quickly and avoid leaking.

Good example of lime mortar sealing of bamboo "ends" to avoid infestation by insects.

Good example of high raised plinth and massive foundation, protected with lime render



Completed IOM Shelter, UC Jagan, District Shikarpur.

Another HANDS shelter / house. As the walls were built with lime-stabilised blocks (following the bucket “soak” test) they are proven to withstand extended immersion in water. Cost per shelter: £180 (29,000 Rs) . As wall elements are well stabilised, no need for extended “toes” – this is a technical challenge to all. Discuss.





DFID LAMP-10M

HERITAGE FOUNDATION'S QRR-COMPLIANT SUSTAINABLE CONSTRUCTION LIME INSTRUCTIONS

1. **1. LIME KILN**
The lime kiln should be built on a level, well-drained area. The kiln should be built with a thick, well-compacted base. The kiln should be built with a thick, well-compacted base. The kiln should be built with a thick, well-compacted base.

2. **2. PERSONAL PROTECTIVE EQUIPMENT (PPE)**
All workers should wear appropriate PPE, including hard hats, safety glasses, and work clothes. PPE should be worn at all times when working on the construction site.

3. **3. TRANSPORTATION**
Materials should be transported using appropriate methods, such as wheelbarrows or carts. Materials should be transported in a safe and secure manner. Materials should be transported in a safe and secure manner.

4. **4. FOUNDATION**
The foundation should be built on a level, well-drained area. The foundation should be built on a level, well-drained area. The foundation should be built on a level, well-drained area.

UKaid USAID USAID



The impact of a good shelter programme: on left – how people live without a shelter programme after a disaster. Behind, the house that should stand for generations



Consistent quality across the IOM shelters: good attention to detail, built by the whole family themselves.



Sun-dried bricks form the core of the walls in the IOM shelters. Ideally, these should now become lime-stabilised bricks, for increased flood-resistance.





Heritage Foundation, 2010 response, Khaipur district. This 3 room building being used as a school. These are raised high above the ground in case of flooding. They could be used to protect people's physical assets and elderly or disabled people who may not be able to reach temporary settlements in times of emergency. This cost around \$5,000

CO₂ emissions reductions from our low-carbon approach to building

Building material	Tonnes of CO2 emissions - conventional building	Tonnes of CO2 emissions - DFID shelters	# Houses (flood resistant)
Bricks	323,675	22,657	107,000
Cement	60,990		107,000
Steel	11,267	6,760	107,000
Lime		1,252	107,000
Total	395,932	30,669	

Source for calculations: University of Bath, Embodied energy and carbon in Construction materials (2008). Available at: <https://www.circularecology.com/nuqjdajdklasah.html>

- Result: Over 365,000 Tonnes of CO₂ emissions avoided
 = 170,000 flights London – Tokyo, return
 Or... 3 days emissions for the city of London
 Or... annual CO₂ emissions of 24,000 Brits

Arawan, Baluchistan earthquake (2013) response – still ongoing



- 4,500 homes under reconstruction with HANDS trainers
- Earthquake compliant and low cost
- Design collaboration with Huzdar University, Balochistan

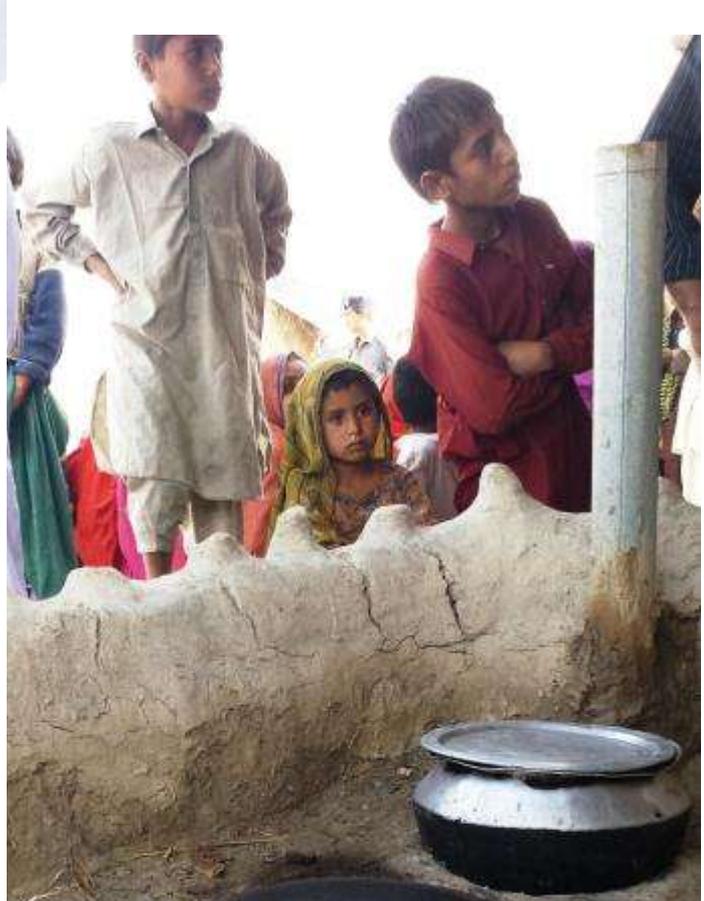
Cash grants for affected families

But...

- Supporting productive livelihoods
- Rather than free hand-outs

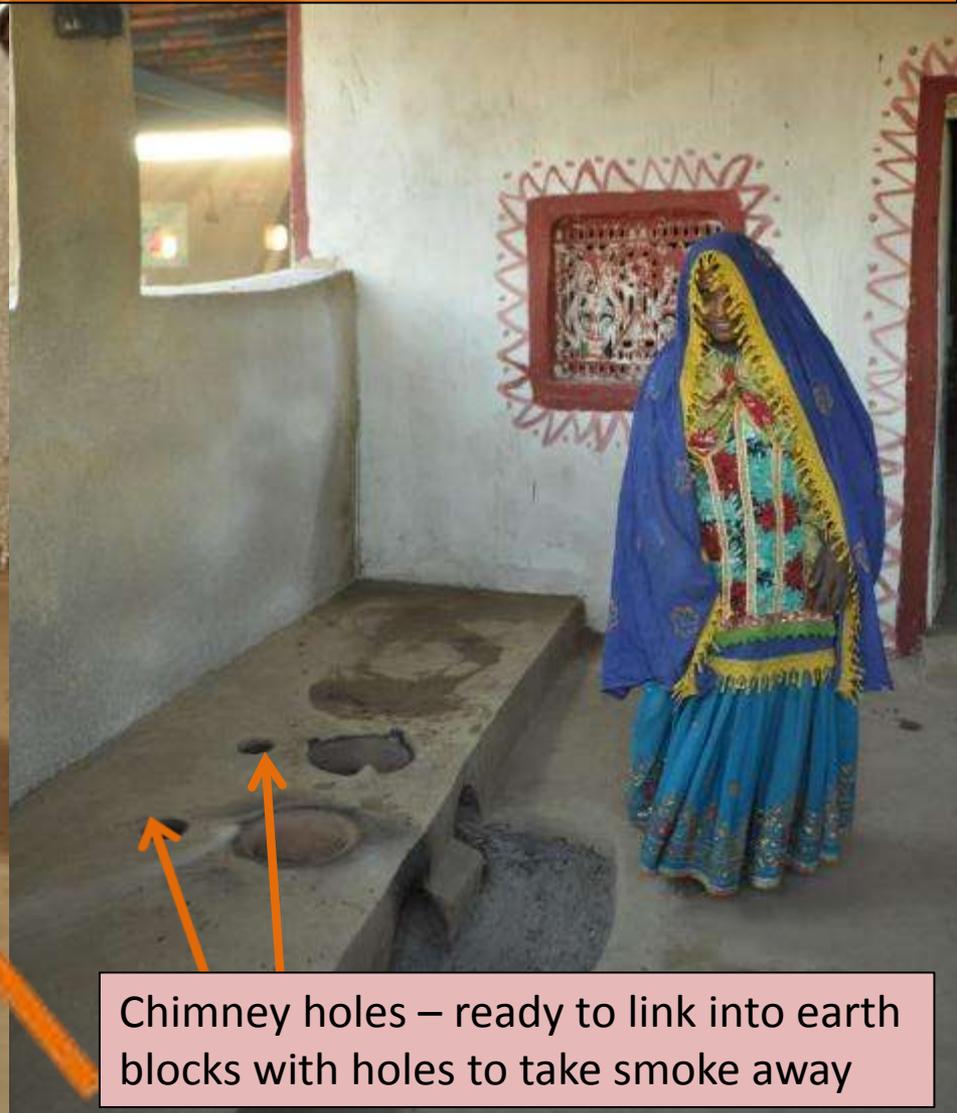
Here women and elderly selected to make building materials for shelters





- Cook-stoves – models build in every shelter village.
- Very good feedback so far from women and girls:)

Mira, shown seated on the left, designed this stove herself, based on some discussion with HANDS colleagues. She says it works much better: two pots can cook from the same fire (twice the efficiency). She has now trained several other women in the community how to replicate this, such as the lady on the right. The “Mira-Stove” begins.

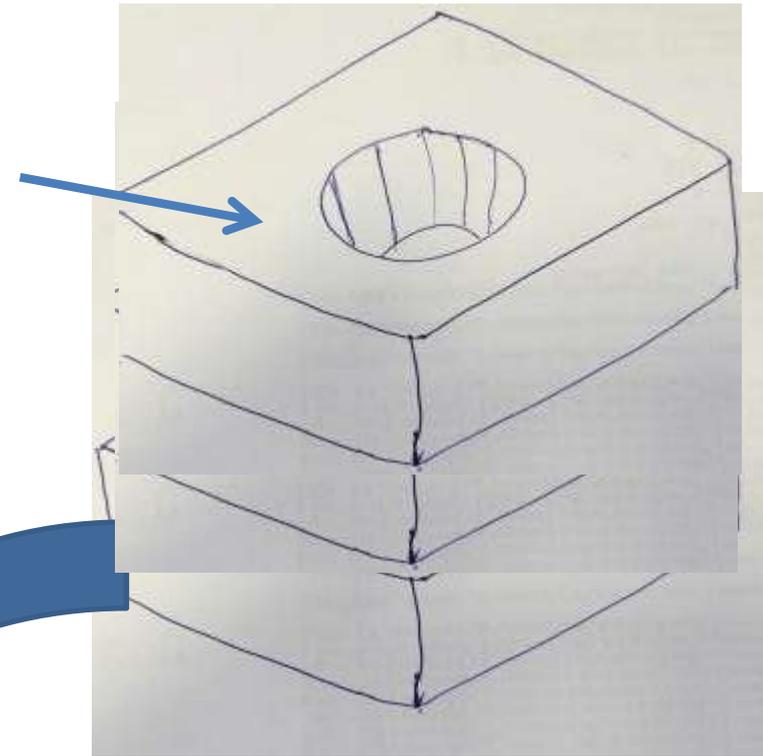


Chimney holes – ready to link into earth blocks with holes to take smoke away

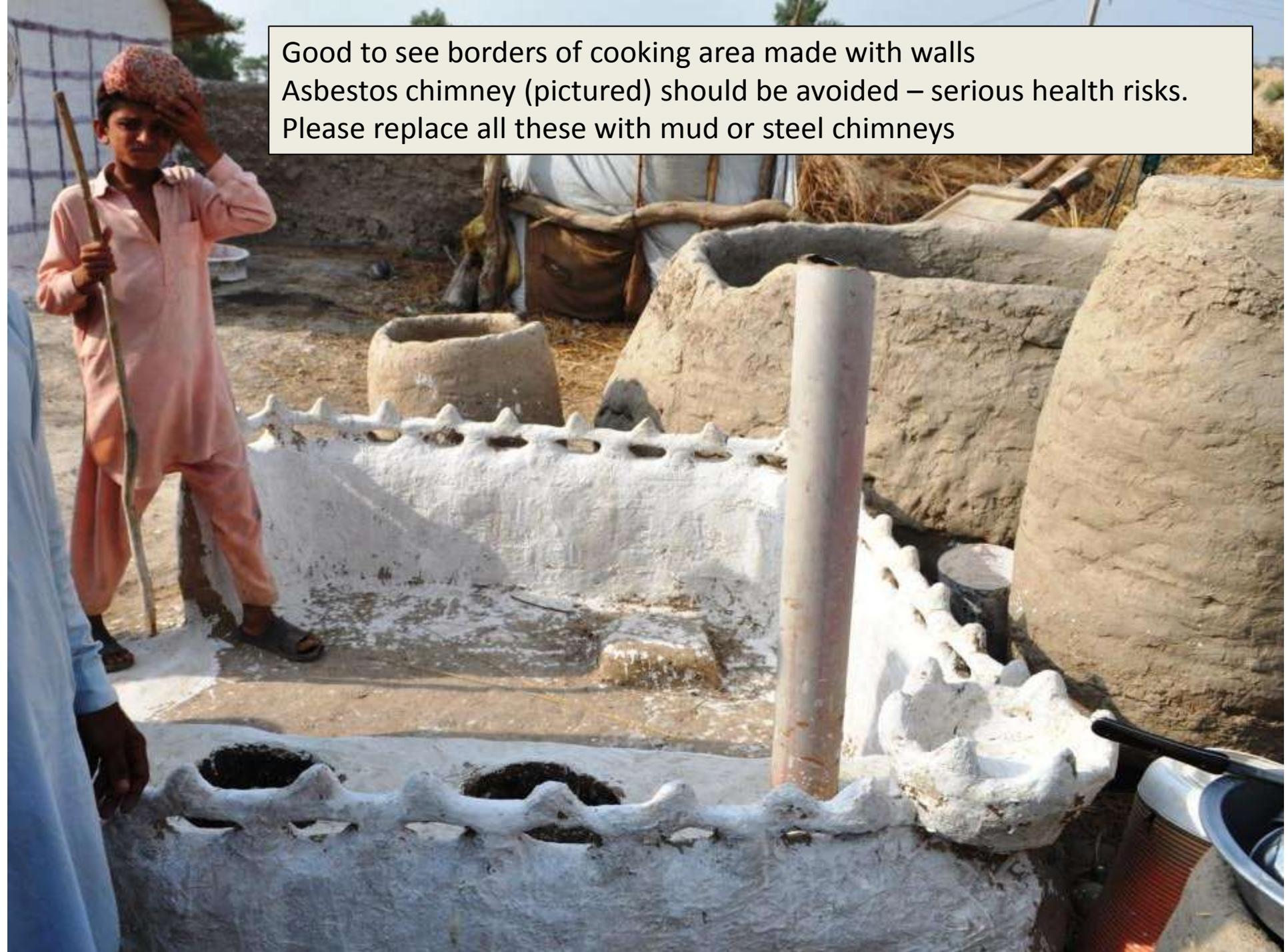
I suggest that an earth-lime chimney block is made – to produce blocks with a chimney hole in the middle. Stacked one on top of each other they create a chimney.

This would avoid the need to purchase any chimney piece from the market,

Reducing the price of the stove to zero



Good to see borders of cooking area made with walls
Asbestos chimney (pictured) should be avoided – serious health risks.
Please replace all these with mud or steel chimneys

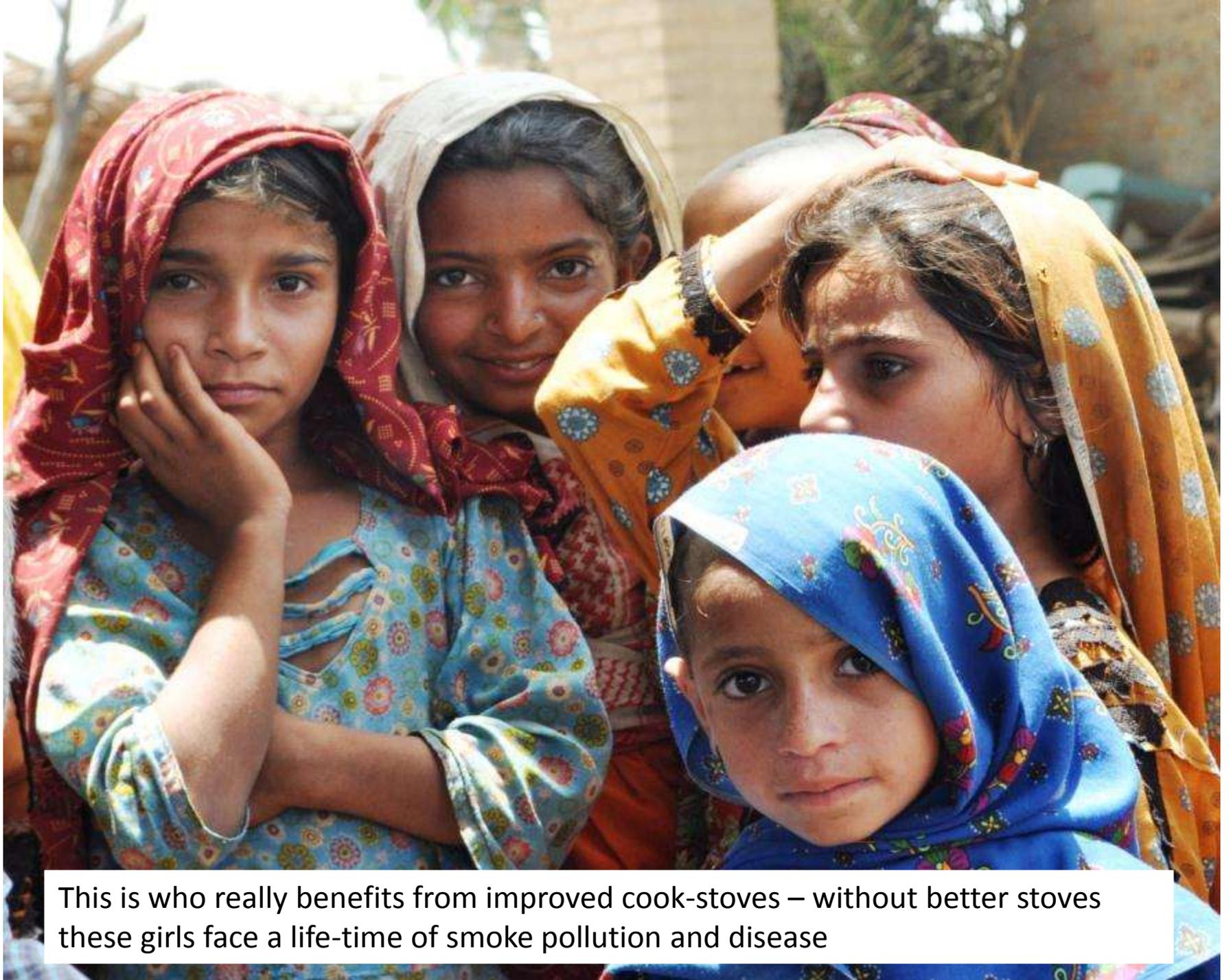


Heritage Foundation model – based on a raised platform, for more hygienic cooking and eating.

What is Karavan SwissoPak Chulah? DRR- Compliant Earthen Smokeless Double Stove



The 'no-cost' Karavan SwissoPak chulah is part of HF's disaster preparedness strategy being implemented in 10 Core Villages.



This is who really benefits from improved cook-stoves – without better stoves these girls face a life-time of smoke pollution and disease

Summary feedback on stoves

- Women and girls tell us they have less eye disease and fewer coughs; can we measure these health improvements? (disease reduction).
- Are there any financial savings from reduced medical expenses or fuel costs they can recall?
- Multiple designs underway: suggest we develop a technical evaluation towards end of 2014 to compare quality, impact, efficiency, etc.
- The WHO estimate that 4.3 million people each year die of indoor air pollution from cooking smoke, which is the second highest cause of mortality for women in the developing world, after maternal mortality.
- Can we build the evidence base in Pakistan?

Economic impact of integrated design

project component	Pak Rupee savings / month	Savings / year	savings in \$ / year	Notes
Clean water & sanitation	1,500	18,000	175	Based on verbal feedback from men and women in villages where toilets were being used and hand-washing practiced regularly.
Stoves	TBD	TBS	TBD	Too early for evidence of cost-savings. More research needed
Kitchen garden	1,500	18,000	175	As communicated by owners of each garden. More thorough research needed.
Solar lights	400	4,800	47	Average savings reported by people who have off-set purchase of kerosene, candles or torches.
Total	3,400	40,800	396	

- Per family savings of up to 3,300 per month
- More research needed to get more accurate data on savings, over the year

Kitchen gardens

Some good examples across Sindh

- From livelihoods projects (photo right)
- And from WASH / grey water from hand-pump
- Need to capture financial savings on vegetable spend per family, per month
- Try to find out how many families one garden reaches
- Is it being replicated or are there only one per village?
- How can it be replicated across all houses?



Before
(Oct 2013)



After
(May 2014)



Cost to project: \$0 (Zero)

Impact:

- < 2,500 Rs. / month savings
- & nutrition gains
- & public health hazard reduced

Village:

UC Dasti

District Jacobabad

Kitchen gardens summary

- Can shelter partners promote these in the “shelter only” villages?
- What additional resources necessary to promote more gardens?
- Can we measure nutritional gains / changes from garden produce?

UNICEF model

- Pakistan Approach for Total Sanitation - PATS
- Up to 10% of community receive small subsidy to build a clean toilet slab
- To promote a model for people to replicate
- Cost per unit: 5,500 (£35)
- Walls and septic tank built by community
- But how to target the 10% without causing division in the community?





Basic walls built by some families

Shelter partners could show people how to build basic walls and septic tanks using lime blocks

The slab needs to be set into a smooth concrete apron (surround) so that the floor can be kept clean. As shown in picture.

This will save lives, reduce diarrhoea and save money

- Hand-washing WORKS! (UNICEF, WHO, et al)

LOW to ZERO cost innovation with MASSIVE impact potential

Making hand-washing easy

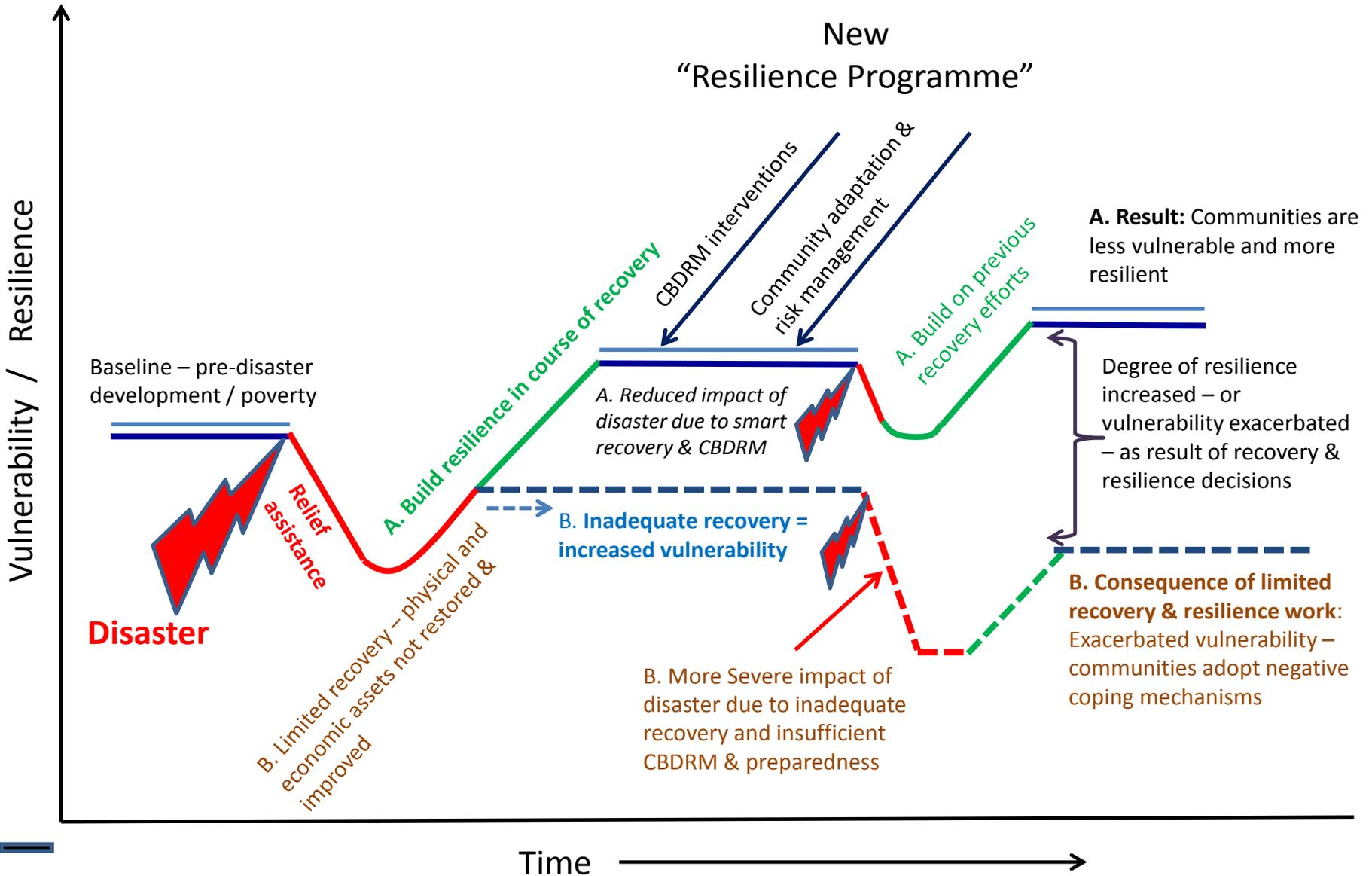


UNICEF / NRSP provided 5,500 towards the cost of this latrine.

Note: INNOVATION for hand-washing

Disaster – recovery – resilience continuum

An overview of our strategy in DFID-Pakistan



Post Emergency – Flood Resistant Shelters

Criteria:

- Low cost – replicable
- Respect local vernacular
- Must be flood resistant

Design improvement # 1:

- Extended roof eaves



This series of pictures portrays normal village life in many villages in Pakistan and how, with community mobilisation and low-cost, appropriate design, the transformation that could be achieved. This need cost no more than conventional WASH and early recovery projects.

Residual water from hand-pump lying stagnant

With lack of fodder, goats roam free and eat emerging trees and plants

Overflow from septic tanks creating disease

Slide 1: A normal village in Sindh: little shade in the extreme heat, no kitchen gardens, high malnutrition, poor health and hygiene, deforestation, denuded environment, etc.



Slide 3: Goats enclosed and controlled. Sunken beds below hand-pumps planted. Kitchen gardens have started; constructed wetland for septic tank operational; specific native trees planted around the compound, including mango / other fruits, neem and moringa species for multiple nutritional and health benefits.



3 to 5 years on, Moringa trees providing fodder for animals, increasing milk production by up to 50% and weight gain < 35% While providing multiple nutritional and health benefits for people

Kitchen gardens saving 30 – 50% people's income on food while improving nutrition

Increased shade, wind and flood protection, better hygiene, sanitation and nutrition, household income boosted. Overall resilience enhanced.

Constructed wetland system provides complete treatment for sewage waste while providing habitat for bamboo and other useful species

Concept: DFID
Illustration and artwork: UNHABITAT

