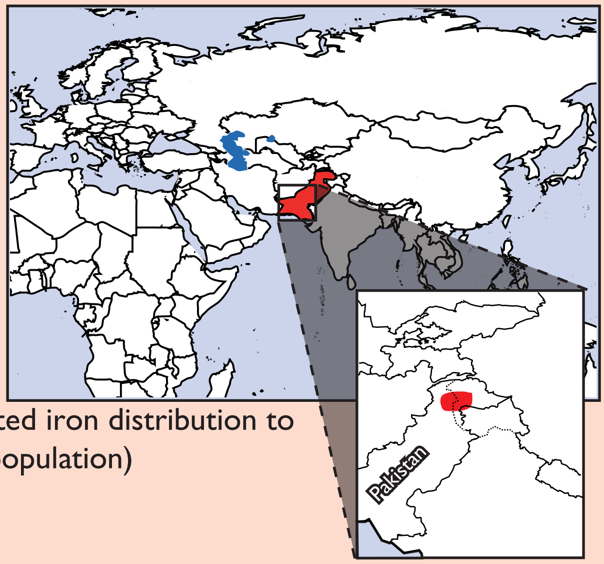
B.10 Pakistan - 2005 - Earthquake

Case Study: Transitional shelter construction



Project type:
Transitional shelters
Tools
Self-build, cash for work
Technical support

Disaster:
South Asia earthquake, 2005

No. of houses damaged:
600,000 (over 90% in rural locations)

Project target population:
Shelter for 1,125 families, with additional corrugated iron distribution to 657 families (approximately 0.2% of the affected population)

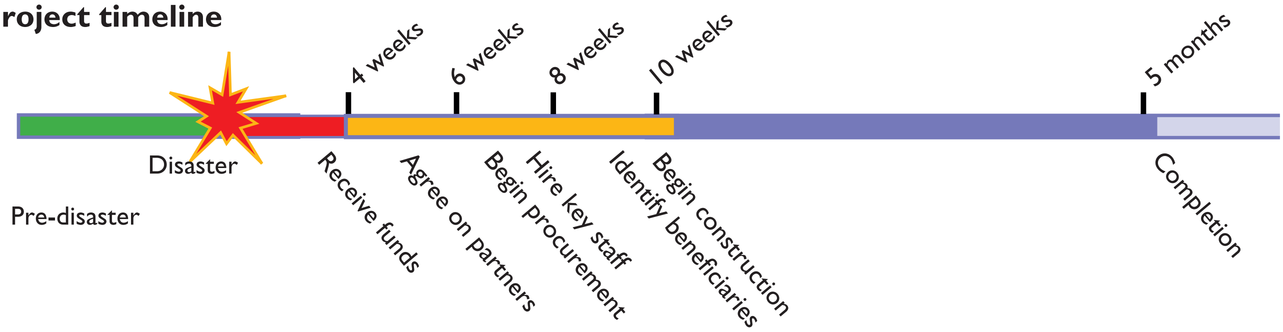
Occupancy rate on handover:
Over 95% occupancy for the first three months
Over 50 % for over two years
Nearly one-third of shelters still occupied after 2½ years

Shelter size
6.5m^2 - 10.5m^2 for people; 2m^2 - 3m^2 for livestock

Summary

A project to build transitional shelters according to the same basic design. The shelters used reclaimed materials as well as distributed materials and toolkits. Cash for work, carpenters and technical support were also provided. The project was a combination of direct implementation and working through partner organisations.

Project timeline



Strengths and weaknesses

✓ To ensure completion of shelters, carpenters were trained and corrugated iron sheets were withheld until the frame was complete.

✓ The technical assistance that accompanied the shelter distribution was well received.

- For the same amount of inputs, more families would have received corrugated galvanised iron under a materials distribution programme. However, fewer recipients would have used the material to construct shelters and the quality of construction would have been less sure.

- The use of village committees and local staff increased participation in the beneficiary selection and implementation processes. This offered greater equity but led to corruption and nepotism.

✗ The shelter design used sandbags for walls, but this did not gain cultural acceptance.

✗ The project had a high cost in terms of management and staffing time.

✗ Because they were builit on the same plots, many shelters had to be later demolished to build permanent houses.

Materials distribution

A shelter two years after it was built

Targeting

The highest villages were targeted first as they had the worst of the winter weather. Within these villages, pre-existing conservation committees were asked to identify a limited number of vulnerable families. Once shelter had been provided to these families, an expanded list was then drawn up in consultation with the community.

As the project grew in complexity and the local staff became strained by the demands of their own situation and needs, outside staff were brought in to help manage the programme.

Technical solutions

A design was developed based on materials salvaged from traditional kacha houses. Additional materials were selected, taking into account weight considerations to reduce logistics challenges and risks due to earthquakes. Consideration was also given to how the materials could be later reused.

As the project areas were difficult to access, a prototype was built in Islamabad, the capital city, so that the shelter design could be shared with other organisations.

The shelter design had low walls and a sloping corrugated iron roof. It provided covered space for people and for their livestock (at one end). Its base was made of soil. On this base, walls were built out of polypropylene sacks filled with soil. The higher parts of the wall were made from sacks filled with lighter materials, such as crop wastes, straw or pine needles. The roof was made from corrugated iron fixed to a reclaimed timber frame. Additional sandbags were provided with the intention that they would be filled with lightweight material and placed against the corrugated iron as insulation.

In practice, only one quarter of the shelters were built using sandbags as walls or insulation. This was due to cultural acceptance, snow storms in January that made it difficult to fill the bags and the fact that the carpenters involved in the programme found timber walling quicker to build.

Roofing insulation was not commonly installed. This was because it was the last thing to build and was not seen as a priority by the people living in the shelters.

In an evaluation of the shelters, the most commonly mentioned disadvantage was that the shelters were too short and too small. However, the majority of occupants agreed that the shelters provided protection from the wind, rain and snow.

Implementation

Once individual Village Conservation Committees had provided their list of vulnerable families, a date was set for families to collect the first delivery of materials.

A shelter (background) on the same plot of land as the permanent house under construction (foreground)

Villagers collected their shelter kits at the park office. The amount of materials included in each kit depended upon the family size. There was a toolkit for every five families.

After some initial issues with shelters not being completed, the roofing materials, including the most valuable part of the kit, the corrugated iron, were distributed only upon completion of the frame.

Most of the shelters were constructed by a team of two to four workers in less than one week. The project provided an allocation of five 'person days' of payment for the construction of each shelter. In practice, the technical assistance teams ended up constructing many of the shelters. Progress was periodically halted by deteriorating weather conditions, particularly in early January.

The major constraints in the implementation of the project were related to the procurement and transportation of materials and the weather conditions. The corrugated iron sheeting, which was used as the roofing for shelters, was difficult to procure in the required quantity. A tender for sheeting was placed in November but suppliers were not able to deliver. Eventually it was imported from India, which required high-level negotiations to relax the import restrictions into Pakistan for Indian materials.

Logistics and materials

For much of the duration of the project period, road access to the project sites was blocked by landslides. As a result, materials had to be driven to Muzaffarabad and then airlifted to the site. The final stage of transportation was by donkey and by foot.

There was a warehouse for each project area. Materials were then transported to the villages; from there it was the responsibility of villagers to carry them to construction sites.

The shelters after two years

After two years, nearly half of the shelters were still standing in their original position. Of those that had been removed, one was reassembled in the summer pastures. Shelters were commonly removed to make space for the 'permanent' house or to reuse the materials. The corrugated iron and the timber were the most commonly reused materials.

Materials	Quantity
Polypropylene sand bags	350
Wire 14g/PP strips 20 x 6mm	¼ roll
Polypropylene string	6 rolls
Corrugated iron sheets 2.74m x 0.99m	16
Iron ridge sheets	6.7m
Nails	5kg

Salvaged timber was also used for the roofing frame.

Toolkits were shared between five families and contained: an adze (woodworking axe) with handle, a cold chisel, a 1.3 m crowbar, a hacksaw with 20 blades, a 2kg hammer, a claw hammer, 10m of transparent hose, three needles, a pick with handle, pliers, a 400mm handsaw, a shovel, a 10m tape measure and an adjustable wrench.

Photo Albert Reichart

Inside one of the transitional shelters

Photos: Albert Reichart

Building one of the transitional shelters

B.11 Pakistan - 2005 - Earthquake

Case Study: Shelter materials distribution

Project type:
Transitional shelters
Distribution of household non-food items, corrugated iron and toolkits

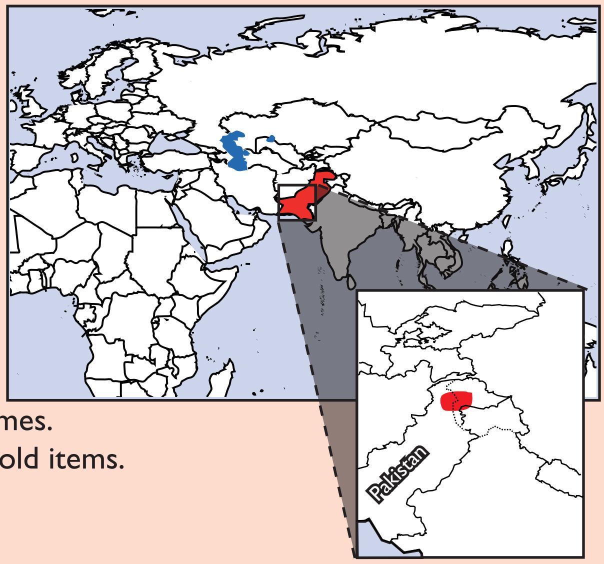
Disaster:
South Asia earthquake, 2005

No. of houses damaged:
600,000 (over 90% in rural locations)

Project target population:
15,900 families were provided with corrugated iron sheets and basic tools to build transitional homes.
Around 11,000 families received quilts and household items.

Occupancy rate on handover:
Unknown

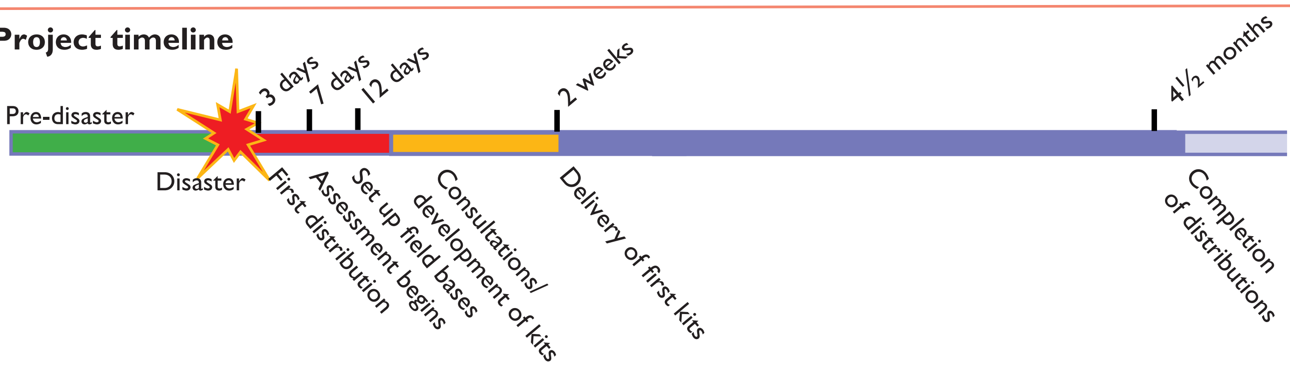
Shelter size
6m x 4m of plastic sheeting and $22m^2$ of corrugated iron
Approximately $18m^2$ covered space per family



Summary

An international NGO ran a distribution programme to over 15,000 families in areas with difficult access. Field teams validated each beneficiary family. Once supply lines were established, a large-scale programme was set up to deliver blankets, plastic sheeting, corrugated iron, toolkits (including fixings), as well as some stoves and buckets. As a result of the rapid set-up of the programme, the scale of procurement and staffing challenges, consultations on the material items were limited. This led to varying levels of satisfaction between project areas.

Project timeline



Strengths and weaknesses

✓ An international organisation was able to set up a distribution programme that helped to support over 15,000 families.

✓ Beneficiaries were selected on a house by house basis.

✓ Materials delivered (including tools and fixings) were selected so that they could only serve to make buildings stronger.

✗ Due to challenges in finding staff, there was no seismic-resistant construction training component to the programme and the programme was run exclusively as a logistics exercise.

✗ Due to the scale of procurement and time constraints, toolkits were developed through a limited consultation process that did not take into account different individual, local and regional needs.

✗ There were many issues with the quality of the materials procured, leading to the question of whether one good quality hammer for five families was better that five bad quality hammers.

✗ Access was limited, and families were responsible for transporting materials home from distribution points without assistance.

✗ A 'one size fits all' approach was taken. This did not take into account differences in needs between individuals or regions.

Selection of beneficiaries

Within one week of the earthquake, major field offices were set up in Bagh and Muzaffarabad, the two operational hubs for relief operations in Pakistani-controlled Kashmir. The programmes were in rural areas, selected on the basis of the level of damage and coverage by other organisations.

The initial lists of people who should qualify for support were provided by community leaders. A member of the field team then visited each house, often climbing a long way to reach it. People were checked against a number of criteria, including the level of damage to their house. Each qualifying homeowner then received a distribution card, which could be exchanged for items at an agreed distribution point at an agreed time.

The only location where there was significant dissatisfaction with the assessment process was where the distribution took place through a local partner NGO, where prominent local individuals may have biased the selection.

Technical solutions

Given the logistics and staffing constraints and the scale of the need, a programme was developed that was based exclusively on distribution directly to affected families. Tents and blankets were distributed in the first weeks. However, a revised plan to distribute blankets, roofing materials and toolkits was rapidly agreed upon. People were expected to salvage their own timber to construct a frame and a roof.

Corrugated iron and plastic sheeting were distributed for use as roofing materials. The advantage of corrugated iron and plastic is that they are relatively lightweight. Even a poorly built shelter is unlikely to kill people in the event of further aftershocks and building collapse.

Toolkits containing basic carpentry and earthmoving tools, as well as nails and metal strapping for use as fixings, were developed through a limited but rapid community consultation. The time pressure was such that orders for large numbers of kits could be rapidly placed, leading to cost and logistics savings. The idea of delivering materials in standardised kits was to reduce difficulties and tensions at the distribution points, but it led to distributions being less targeted to individual needs.

The shelter programme distributed directly to affected families

At a later stage, cooksets, stoves and coal were procured and distributed, but not in the same quantities as the toolkits and the roofing materials.

An evaluation indicated that many people did not find the toolkits very useful. In Muzaffarabad, where the toolkits were initially specified through a rapid consultation process, satisfaction was higher than in Bagh, where consultation had been very limited. It is not known whether the distribution of large quantities of fixings and metal strapping served to make buildings more seismically resistant.

Reasons for dissatisfaction with the toolkits

These included:

- limited consultation in the design of the toolkits due to time pressures;
- the varying skills and capacities of affected populations to use the tools;
- the variable security surrounding Bagh;
- lack of support to help people use their tools to rebuild; and
- the inconsistent quality of tools.

Implementation

Although distribution points were selected with the consent of community representatives and communities were notified well in advance, the terrain and earthquake damage to roads meant that many people incurred costs in getting to the distribution points and transporting materials home. This was by far the largest cause of dissatisfaction with the distribution process.

Corrugated iron became a much sought-after commodity in distributions. A combination of the cost of the iron and the very low incomes of many affected families meant that a distribution of corrugated iron was equivalent to months' or even years' worth of disposable income to families. The value was such that many people did not use it to meet immediate shelter needs as intended. Instead they stored it for use in reconstruction or sold it for cash.

The non-availability of land was due to areas being prone to landslides and the remaining land being owned or used for farming. Due to the scale of the programme and challenges in identifying staff, it was not possible to provide support in negotiating access to land or to support construction.

It was noted that affected people tended to act more as individuals and families than as 'communities' following the earthquake. Individual families limited their responsibilities to building their own shelters, rather than creating and supporting initiatives. The challenges of the earthquake, the environment and the weather made people prioritise to ensure that their own needs were met.

Material	No.
Corrugated iron sheets 8'x3'	10
Quilts	4
Blankets	2
Toolkit: spade, hammer, wood saw, iron saw, 20m rope, pliers, hoe, 8kg nails (including roofing nails)	1
Plastic sheet 6m x 4m	1
Stove with exhaust pipes	1
Jerry can 20l	1
Jackets – 1 large, 1 medium, 1 small	1
Plastic shoes – 1 large, 1 medium, 1 small	1
Cookset: 3 pots, 6 large plates, 6 small plates, 6 spoons, 1 knife, 2 mugs	1

B.12 Sri Lanka - 2007 - Conflict returns

Case study: Core shelter

Project type:
Transitional shelter construction

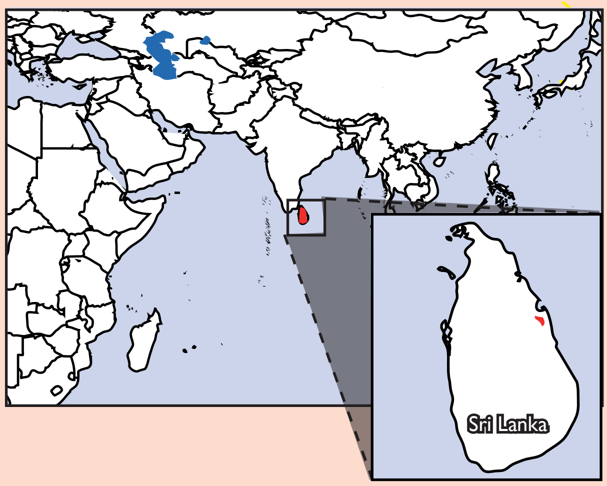
Disaster:
Civil conflict in Sri Lanka

No. of houses damaged/ people displaced:
520,000 families displaced by the end of 2006;
238 houses in Karukamunai, the community where the NGO was working

Project target population:
Over 300,000 people displaced in 2006;
213 of these families targeted

Occupancy rate on handover:
100%, with 83.5% of families making adaptations to their shelter after moving in

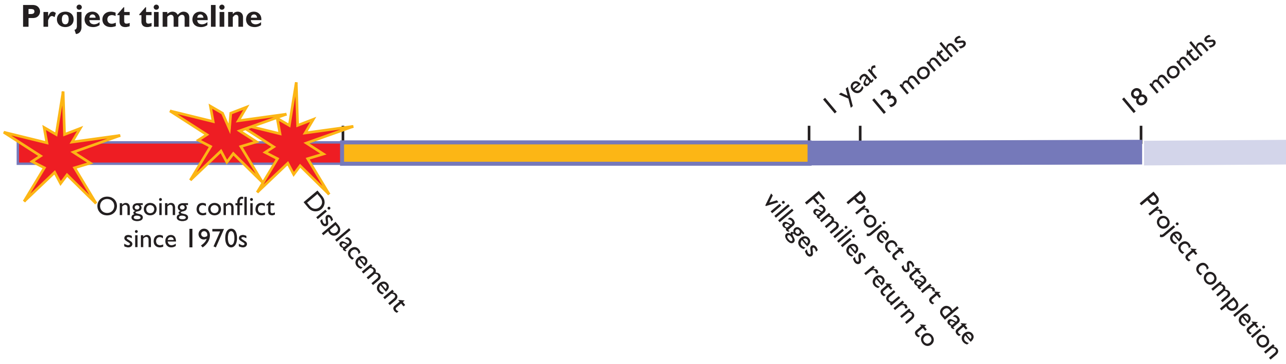
Shelter size
18.6 m^2



Summary

This project built core shelters for families returning to their villages after being displaced by conflict. The construction was owner driven, allowing families to later expand the shelter as their circumstances allowed and for the same initial costs as less durable 'semi-permanent' shelters. Expansion and adaptation of the shelters happened very early on among the majority of beneficiary households.

Project timeline



Strengths and weaknesses

✓ Families were able to quickly adapt the core shelters to their own needs. Much emphasis was placed on beneficiaries' own capacities.

✓ 'Sweat equity' provided income for some community members. Income from this was used to buy materials for shelter improvements.

✓ Use of community networks reduced the challenges involved in monitoring and supporting the project from a distance.

- Smaller-sized core shelters can be appropriate for some communities.
- Clearly-defined written 'contracts' between the NGO and each beneficiary household reduced the potential for mismanagement of expectations.

Core shelter under construction

Completed core shelter

Before the project

The district of Karukamunai, in north-east Sri Lanka, had been on the front line of the fighting between the Sri Lankan government and the Liberation Tigers of Tamil Elam rebels for many years. Families from the area had been displaced to camps near the large port town of Batticaloa during the heightening of hostilities in 2006.

In July 2007 many displaced families returned to their villages to find many of their homes destroyed or in disrepair. The majority of the previous housing stock had been constructed from mud-brick and palm-thatch roofs, and had often fallen apart due to the weather, lack of maintenance or encroachment by elephants.

Previous to this project, the government had insisted upon a 500 ft^2 foundation. In many cases the beneficiaries did not have the personal resources to complete the larger shelter immediately, or had expected other NGOs or the government to provide them with the shelter extension.

The district was very isolated, which made direct monitoring of the project difficult. It also forced the NGO to adopt a relatively hands-off approach, and greater responsibility for construction quality and completion was allocated to the beneficiaries themselves. At the same time, the NGO was under pressure to show results in a short period of time. This was partly expressed as the wish of the local government, but also in recognition of the short time before the next rainy season.

The community had a large capacity for self-build work and a knowledge of carpentry and masonry, and was also eager to finish the work quickly.

Selection of beneficiaries

Effective coordination among the shelter actors resulted in the allocation of the nine different Grama Niladarai administrative areas to different specific agencies. Within the one administrative area assigned to the NGO, the local authorities supplied a list of names of 238 eligible households. Of these, 213 were able to give the NGO staff the necessary confirmation of loss of housing and tenure of the land.

Land rights / ownership

Each beneficiary household had to show the location and remains of their destroyed house as proof of tenure. This was then confirmed by the local authorities, although time constraints did not permit the NGO to make further investigation. Confirmation was hindered by the large number of families who had lost documents during the displacement.

Technical solutions

Analysis showed that there would be little difference in costs between a semi-permanent shelter of the style used during earlier tsunami responses, and a core shelter made with permanent materials. After research and discussions in the communities, the NGO also came to the conclusion that a smaller (18.6m^2) core shelter would be acceptable to the communities, as long as there were obvious demonstrations of the design's adaptability and expandability. In group meetings with the communities the core shelter version was chosen.

The core shelter has a fully enclosed space, as well as a veranda area that can also be enclosed. Technical drawings were provided to demonstrate basic possible variations to expand it in different directions (front, side). Specific features were incorporated to give the walls greater durability (stabilisation and curing of the building blocks) and greater resistance to cyclones and heavy rains (steel bar reinforcement of wall pillars, roof trusses, binding of trusses to walls, use of J-hooks for the roofing sheets, overhang of roof to protect walls from rain, adequate foundations, raised flooring). Where possible, the raised floors were built using recovered materials from the destroyed houses.

The beneficiaries used a variety of materials when building extensions, ranging from building blocks to plastic sheeting and palm thatch. It was estimated that the construction of each shelter would take about three weeks, including the one week needed for curing the building blocks.

'It's nearly the same size as our previous house, but with a good door and window'.

Implementation

A local school was designated as a central storage area for all the materials being brought in by the NGO, and a storekeeper was employed from the local community. Each family was required to sign a contract with the NGO, which clearly stated the responsibilities of the NGO and those of the beneficiaries.

The NGOs delivered the materials (apart from the locally sourced river sand) and gave small grants, provided at different stages of completion, to cover labour costs. The beneficiaries were responsible for taking the materials from the central distribution site, for

More than 80% of the families used personal resources or their own time and effort to upgrade their core shelters.

organising the construction and for quality assurance, both of the shelters and of any subsequent additions. The NGO also distributed instructions on proper methods of block-making and technical drawings of model designs for the shelters.

The NGO loaned work tools for each community to share, with the intention that each family would take their turn with them and then pass them on, or would sign them out and give them to hired masons. In practice the method of sharing the tools devised by the community members was more informal, but did not produce complaints.

During initial community discussions, the NGO explained that they would consider giving extra support to those members of the communities who fell into categories of vulnerability, but that this extra help might be limited to providing materials for the floor filling and extra funding for the work of floor compaction (all other construction needs were already taken care of through the provision of the materials and the grants for labour). In the end, few members of the community came forward with such requests.

As a complementary programme, the NGO provided repairs of pre-existing toilets and also identified a partner for the provision of new toilets where needed.

Logistics and materials

Because of the isolation of the location, the ongoing conflict, and the lack of local suppliers, the NGO provided all materials, apart from locally sourced sand. All other materials were procured in Trincomalee, the nearest large port. The majority of the timber was coconut timber taken from sustainably managed sources. The beneficiaries were given small grants to pay for the transportation of materials from the central distribution site.

After the project

More than 80% of the families used personal resources or sweat equity to start the process of improving their shelters. Some members of the community were also able to gain livelihood opportunities by doing masonry or construction work for other members of the community. The isolation of the location and the damage to the economy caused by the conflict meant that there was little other competition for employment among members of the community.

Material	Quantity
Cement 50 kg bag	26
River sand (tractor load)	4
20mm aggregate (metal)	0.3m^3
Gravel (existing debris could be used)	1.3m^3
10mm diameter steel reinforcement	2
6mm diameter mild steel reinforcement	3.7m
Binding wire	0.2kg
Wall plate 50mm x 100mm	15m
Ridge plate 50mm x 100mm	7.5m
Tie beam 75mm x 125mm	3.7m
Prop 75mm x 125mm	1m
Rafter 50mm x 100mm	44m
Reaper 25mm x 50mm	60m
Soligram	10 litres
28-gauge corrugated iron sheet, 2.4m long	20 sheets
Tar sheet 0.9m wide	3.4m
Ridge tiles	20
L-hook with nut & washer, 75mm	6kg.
Nails 100mm	2kg
Nails 50mm	2kg
10 mm diameter bolt and nut, 150mm	2
10 mm diameter bolt and nut, 100mm long	6
Door 0.9m x 1.8m with frame, including ironmongery and fixing	1
Window 0.9m x 1m with frame, including ironmongery and fixing	1

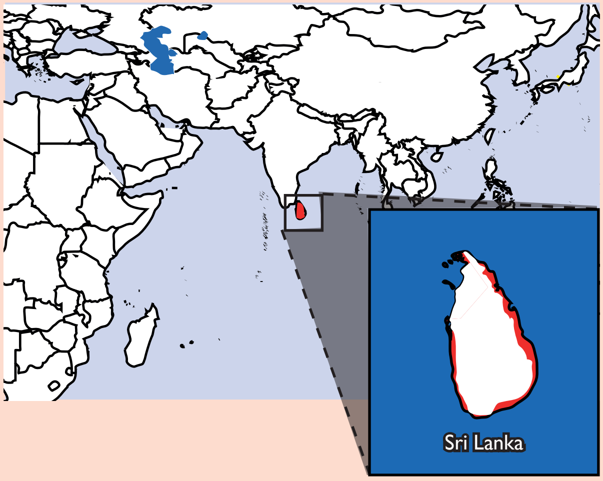
A durable upgrade of a core shelter

B.13 Sri Lanka - 2004 - Tsunami

Overview of the tsunami response

The tsunami of 26 December 2004 hit Sri Lanka two hours after the initial earthquake and killed over 35,000 people along the eastern and southern coasts. It destroyed approximately 100,000 houses and damaged or destroyed much of the infrastructure and public buildings in the affected areas.

The shelter strategy developed for much of Sri Lanka focused on the construction of transitional shelters to bridge the gap until permanent shelters could be built. This case study is of one such transitional shelter project, where an international organisation provided metal-framed shelters that people could erect on their own plots of land.



Shelter Strategy

In the areas of Sri Lanka controlled by the national government, a national transitional shelter strategy was adopted.

The general principles of the shelter strategy were founded on Sphere standards, but were expanded to describe a transitional process looking beyond emergency needs, and taking into account the need to support livelihoods.

The international scale of the disaster and the intense media attention it received meant that there were large amounts of funding available and a great number of organisations wishing to become involved. This was recognised when the strategy was formed.

The technical design aspects of the strategy gave a per shelter budget and a series of spatial guidelines (minimum indoor space, minimum height, etc.). Within those guidelines, humanitarian organisations and communities were free to make their own specific shelter designs. In most cases, the shelters were single-family huts, built with varying levels of input from beneficiary groups, using a mixture of wood, metal frame, roofing sheet and concrete-block materials.

Coastal buffer zone

The national government insisted upon having a coastal buffer zone. Construction was excluded from within 100m of the high-tide mark in the south and west and within 200m in other areas. This created major challenges in finding land to rebuild on, leading many families to live far from their livelihoods and forcing the creation of many camps.

Coordination

Coordination within the shelter sector was generally good, with full participation from the government at both the national and local level. However, in many areas up to 60% of the shelter support was provided by small organisations. Many of these had little previous disaster experience and were often involved for only short periods of time.


Photo: Joseph Ashmore

One of many transitional shelter designs adapted by its occupants

Different levels of support

Different levels of support were given to those who had been affected by the tsunami and those who had been affected by the armed conflict in the north and the east. This led to tensions and difficulties for many ongoing development projects.

Emergency shelter needs

Immediately following the tsunami many families found temporary shelter in public buildings, such as temples, or with host families. In the weeks that followed, many were able to make some basic repairs to their houses, while others lived in tents until the transitional shelters were constructed.

After the first year

Government numbers showed that all affected families had been provided with transitional shelter by mid-2005. However, permanent housing would take significantly longer.

Many humanitarian organisations were only funded for the initial six- to nine-month emergency and transitional periods, and there were often gaps in the handover to other organisations that could support permanent reconstruction.

Despite the incentives of government grants, many families rebuilt houses that were not resistant to the common hazards of cyclones and floods. Remittances from relatives living abroad and grants from smaller charities made it more difficult to ensure construction quality.

Due to the length of time required to build permanent shelters, the UN and other organisations advocated for the upgrading and maintenance of a large number of the transitional shelters. They were aware that some families would be living in them for some years to come.

There was no construction allowed within 200m of the high-tide mark in some areas and within 100m in other areas.

In some cases, small groups of transitional shelters were built on small plots of land that were negotiated on a temporary basis.

New settlements or camps had to be built for many of the displaced. Many of the allocated sites were prone to flooding and away from livelihoods.

Photos: Jo Da Silva and others.

The shelter strategy allowed for many different shelter designs. Over 70,000 transitional shelters were built.

B.14 Sri Lanka - 2004 - Tsunami

Case study: Transitional shelter construction

Project type:
Transitional shelter construction

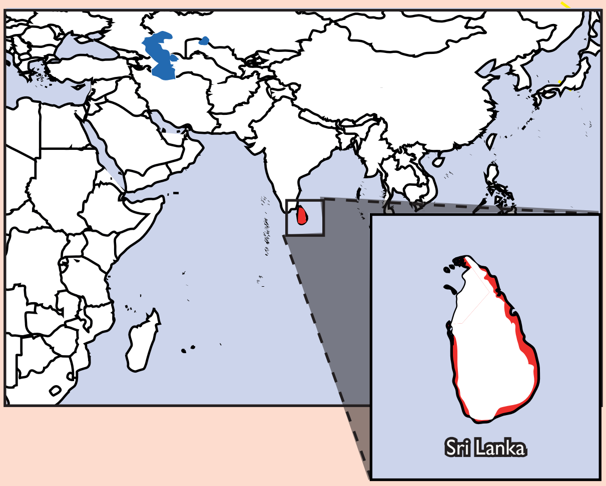
Disaster:
Indian Ocean tsunami, 26 December 2004

No. of houses damaged:
100,000 nationally; 5,500 in the area where the NGO was working

Project target population:
1,500 families (January 2005), then reduced to 1,000 families (March 2005)
Final total of approximately 850 families

Occupancy rate on handover:
Estimated at 90%

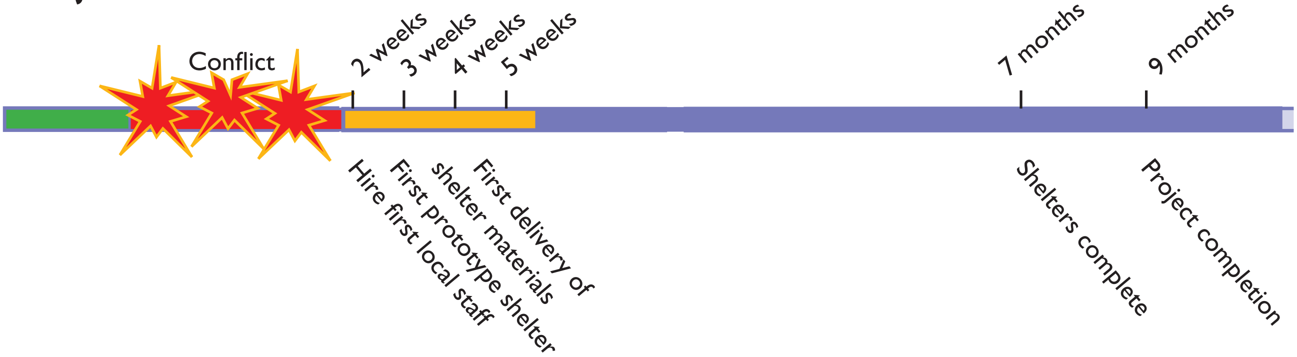
Shelter size
18.6m^2 (200 ft^2), later upgraded to approximately 20.5m^2 with enclosable veranda space



Summary

Using easy-to-construct and easy-to-carry metal frame shelters adapted from previous Sri Lanka programmes, the NGO was able to support affected families in 27 different villages along the coastline. The project avoided the creation of large camps, focusing instead on helping people to build on customary plots of land that belonged to them or were negotiated from land owners.

Project timeline



Strengths and weaknesses

✓ A high level of choice was given to beneficiaries in terms of location, adaptability of design, transferability and potential for reuse.

✓ Apprenticeship training in basic carpentry and electrician skills was provided for local tsunami-affected youth.

✓ Support was given to families to build on customary plots of land and not to build new camps.

✓ The project was augmented by rainwater harvesters and community-based micro-irrigation projects.

- Beneficiary labour was used, with trained support for vulnerable beneficiaries.

× The project perpetuated unplanned coastal settlements, preventing upgrading of sanitation or better environmental husbandry.

× There was no clear link to permanent reconstruction.

Before the tsunami

Many families had built houses on customary plots in ribbon settlements along the coast road. This was a response to the economic development of the region over the previous decade and was spurred on by government-backed housing programmes. However, consideration was not given to the consequences of cyclone and flooding risks to individual houses or to the consequences of drying out coastal marshes and naturally flooding areas. The haphazard layout of the housing also limited the possibility of community-wide or municipal sanitation and drainage solutions in many cases.

In-country experiences

This project was implemented by an NGO that had previously worked on transitional shelter programmes for those displaced by the conflict in the north of Sri Lanka. Much of the shelter design and the methods for interacting with the communities and the local government were adapted from this previous programme.

Minor changes were made in the design of the shelter from the previous project, giving the shelters greater height.

In the previous programme in the north, many of the beneficiaries were living in IDP camps and had limited access to livelihoods. This meant that they could spend more time on shelter construction, and were more inclined to work on each other's shelters. In contrast, the tsunami-affected populations in the south had a culture of working independently, with more diverse livelihoods. This led to the project running more slowly than anticipated.

Selection of beneficiaries

The NGO approached local village officers and coordinated with them to receive a full list of those in need of shelter. This was then cross-checked by door-to-door visits conducted by NGO staff. The cross-checking process was also used to identify vulnerable households eligible for support from NGO technical teams in the construction of their shelter. All the beneficiaries from a community were asked to nominate a small committee to store the shelter materials and help with their distribution.

Shelters were arranged in small groups on plots of land, often negotiated with the help of the NGO.

Land rights / ownership

Many of the families living beyond the 100m coastal buffer zone had lived on traditional plots, although many did not have clear ownership titles. Almost all of these families chose to remain on their traditional plots of land.

For those who had lived within the buffer zone, the NGO worked with the communities to find host families on whose plots shelters could be built. In three cases, small planned settlements of 15-30 families were constructed, as close to sea-based livelihoods as possible.

Local government officials were usually willing to allow families to construct shelters on their previous spots. This deferred ownership issues until the time when permanent reconstruction would start.

Technical solutions

Shelters needed to be easy to construct so that beneficiary participation could be maximised. They also needed to be movable, to help people as they moved out from living with host families or were disassembled to make way for permanent reconstruction.

The basic shelters were made from box-bar metal frames, which could be rapidly assembled into the basic skeleton of the shelter so that even those with little physical strength or prior construction knowledge could assemble them.

The metal frames also meant that the shelters could be relocated and reused if necessary, unlike shelters made from wood. The roofs were made from galvanised metal (a material specifically insisted upon by the beneficiaries to reflect their perceived social status), with open eaves under the roofs to provide for ventilation.

The beneficiaries were asked to provide the rubble for the raised foundation and the sand for the cement mix. A half-wall of concrete blocks was built along the edge of the foundation. Each household was given a small grant to do the masonry or to find local craftsmen. The sides of the shelters were then initially covered with plastic sheeting, which was reinforced by plywood. The work was done by 'shelter crews' of local tsunami-affected youth from the communities involved.

A detached veranda was later added as an upgrade. This could be positioned on any side of the basic shelter and could be used either as additional living space or as a kitchen area. Later, guttering and rainwater harvesters, as well as roofing insulation and basic electrical wiring, were added.

As part of a parallel programme, families without latrines were provided with materials and technical advice for latrine construction.

Implementation

Shelter materials were delivered upon completion of each stage of the building. The frame and roofing were delivered first, then the concrete blocks for the half-wall, followed by the siding materials. However, the timing of the delivery of second- and third-stage materials was complicated by families building at different speeds.

The frames and roofing sheets were prepared in the NGO's warehouse, while the plastic sheeting was cut to measure in a small workshop set up by tsunami-affected families in one community.

Site with poor drainage. Not all available shelter sites were ideal.


Photo: Colin Heinz-Loya

Shelters built with tanks for rainwater harvesting

In each community, the first one or two shelters were constructed by NGO staff for the most vulnerable people, as a way of demonstrating the assembly method to the rest of the community.

The longer times taken by many families to complete their shelters meant that the amount of time needed for support and supervision by the NGO staff also increased. This in turn meant that the NGO was not able to extend its support into more communities and caused the initial forecasts for completed units to be reduced twice across the programme.

Logistics and materials

There was an effort to ensure that the procurement process would support the national economy, while trying to avoid creating scarcity or putting inflationary pressures on the materials needed for permanent reconstruction. Most materials were supplied from the south and west of Sri Lanka, with the exception of the roofing sheets and the plastic sheeting, which both came from abroad.

There were concerns that the concrete blocks would conflict with demand due to permanent reconstruction. Many of the concrete blocks supplied for the transitional shelters were not of sufficient quality for hazard-proof permanent housing.

The supply of sand (for mortar and for constructing the foundations) also posed difficulties. Initially the NGO had encouraged the communities to take sand from the beaches, but this was counter to government bans and also had a potentially negative impact on the environment. In some cases, communities were given small grants to buy sand from local suppliers.

Materials list

Material	Quantity
Steel column - 40mm x 40mm x 1.85m	8
Steel bracing - 20 mm x 20 mm x 2.13m box bar	4
Steel purlin - 20mm x 20mm x 5.7m box bar	4
Steel trusses - 25mm x 25mm box bar	4
Steel rear side bar - 20 mm x 20mm x 3.48m box bar	3
Steel side bar - 20mm x 20mm x 5.18m box bar	2
Steel front side bar - 20mm x 20mm x 230mm	1
Pop rivet - 3mm x 16mm	
G.I. bolt & nut - 75mm x 6mm and 64mm x 6mm	32
Door (fully completed)	1
Door stopper - 25mm x 25mm x 45mm	1
Hinges -100mm x 75mm	2
Cement (50Kg)	1
Roofing Sheet - 190mm	8
Ridge sheet - 470mm x 45mm	1
Hook bolt nut	32
Concrete block - 380mm x 180mm x 100mm	210
Concrete feet for columns	8
Sand (provided by beneficiaries)	

After June 2005, an upgrade veranda extension was made using the following materials:

Material	Quantity
Pillar plate - 100mm x 50mm x 250mm	4
Rafters - 50mm x 50mm x 200mm	6
Tie bars - 50mm x 50mm x 125mm	8
Wire nails 50mm & 75mm	1.5kg
Roof sheet	4
Umbrella nails	0.2kg
G.I. ridge sheet - 0.9m x 2.4m	1

In July and August 2005, basic electrical wiring (one plug socket and one light socket) and roofing insulation were added.


Photos: Jim Kennedy

The construction of the shelters was not a difficult process.

Section C
Latin America and Caribbean

C.1 Honduras - 1998 - Hurricane Mitch

Case study: Transitional shelter

Project type:
Transitional shelter construction

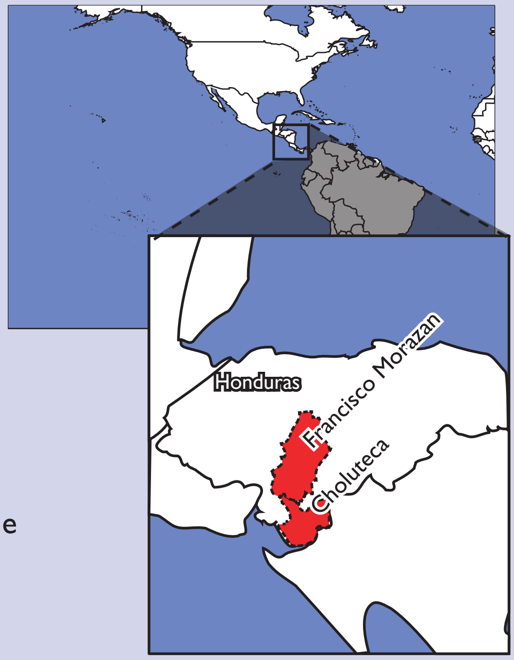
Disaster:
Hurricane Mitch, 1998

No. of houses damaged:
33,000 houses destroyed and 55,000 damaged across Honduras

Project target population:
3,000 families (15,000 beneficiaries)

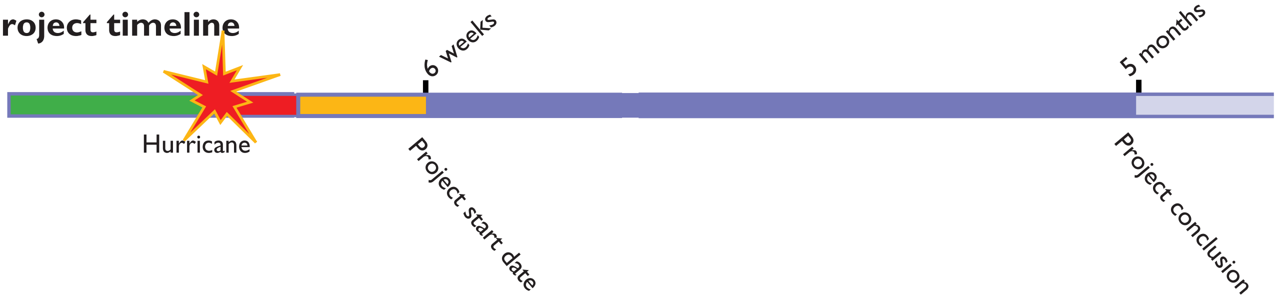
Occupancy rate on handover:
Very high

Shelter size
11.1m^2
The shelter was targeted to a family of four to five people (two adults and up to three children).
Larger families were offered more than one shelter.



Summary
The programme provided materials and technical assistance for construction of a 3.05m x 3.65m wood-framed shelter in central and southern Honduras for victims of Hurricane Mitch. The roof was made of galvanized roof sheets that were reused when the families rebuilt their houses with more durable materials. The sides were made of reinforced good quality woven plastic sheeting. The shelter included a door and two windows with nets to provide both privacy and ventilation.

Project timeline



Strengths and weaknesses

✓ The project involved quick implementation, immediate community involvement, low costs, use of local material and labour, and was replicable.
- The shelter was rapidly accepted as a model by local authorities and beneficiaries.
- Logistics were sometimes tough in highly concentrated areas.
- There was confusion with the beneficiary lists given by local authorities.
✗ The provision of basic services such as water and electricity were slow and somehow chaotic.
✗ In highly concentrated areas sanitation was sometimes an issue if it was not addressed holistically.

Computer model of the timber frame of the shelter

The disaster

From 29 October to 3 November 1998, Hurricane Mitch dropped historic amounts of rainfall on Honduras, with unofficial reports of up to 1900mm of rain. Deaths due to catastrophic flooding made it the second-deadliest Atlantic hurricane in history: nearly 11,000 people were killed and over 8,000 were missing by the end of 1998.

The flooding caused extreme damage, estimated at over US$ 5 billion in 1998 (equivalent to US$ 6.5 billion in 2008 terms). Honduras was the worst-affected country, although Nicaragua, Guatemala and El Salvador were also severely effected.

Before the disaster

Before the hurricane, the organisation had a programme to assist the region's population to prepare for and mitigate disastrous events. This working relationship with communities in the area was very useful in helping the organisation work with the authorities to ensure that the beneficiary selection process was rapid, accurate and transparent.

Beneficiary selection

The transitional shelter programme first targeted the most vulnerable families in communities under the Departments of Francisco Morazan and Choluteca. Disabled and elderly

Computer model of the shelter with a corrugated iron roof and plastic sheeting walls

beneficiaries without resources were assisted first, followed by those without the financial resources to provide adequate shelter for themselves (the poor).

While 'the poor' are often difficult to define, the following types of families were prioritised: families that remained without adequate shelter two weeks after the disaster, and/or families identified by the municipality leadership as a poor family. This category was confirmed by a local social organisation or other reliable source.

Selected communities were asked to provide lists of the vulnerable families, according to standard local criteria for vulnerability.

Database

During the project, the organisation maintained an electronic database of approved beneficiaries, details of house/shelter location, family members, levels of vulnerability (age and disabilities), and status of shelter construction and beneficiary participation. This database was linked to systems for tracking the delivery of materials and shelter construction progress.

Land and ownership

For those families who chose to stay near their destroyed home and had an area that was safe, flat and dry, the organisation helped them to erect a transitional shelter on their own land. Families were required to clear a spot in the ruins of their former home.

In some other cases where safe land was not available near the original site, the organisation coordinated with local authorities to define temporary relocation sites.

Technical solutions

The shelter model adopted was a timber-framed structure.

Implementation

Materials for one shelter were delivered to each beneficiary family. Many families, especially the most vulnerable, lacked the skills to build sound frames for the shelter without direction, although they could often provide construction labour.

For the families who needed it, instruction and supervision on construction was provided. In cases where the family had limited capacity to assist with construction labour, the programme provided supplemental construction labour. This support ensured that the shelter was erected quickly and correctly.

For the most elderly and disabled, all or most of the construction labour for the shelter was provided. Where possible, timber from the destroyed house was reused in the temporary shelter.

'Though it is not a big space, it feels like home for me, my husband and children'. - Beneficiary in Las Brisas, Tegucigalpa

Marking out the site for a shelter

Photo: Milton Funes

Prefabricating walls

Shelter assembly using prefabricated walls

Completing the frame

Logistics

Beneficiaries signed for the material when it was delivered and were responsible for the material's security from that point onward. This requirement was made clear to each family at the onset of their involvement in the programme.

A senior staff member based in the country office was responsible for the procurement and transport of the materials required for the programme. Ensuring that all materials were procured and delivered according to schedule was challenging.

Covering the frame

Materials list

In addition to the materials listed below, approximately $36m^2$ of woven ribbon of international specification plastic sheet was provided by the donor organisation.

Materials	Quantity
Timber 50mm x 100mm x 3m	8
Timber 50mm x 100mm x 3.6m	4
Timber 50mm x 100mm x 4.3m	3
Timber 50mm x 100mm x 1.8m	1
Timber 50mm x 50mm x 2.4m	6
Timber 50mm x 50mm x 4.3m	5
Timber 25mm x 74mm x 2.4m	
Galvanized roof sheet 28 SWG - 0.8m x 2.7m	6
Galvanized roof sheet. 28 SWG – 0.8m x 1.8m	6
Nails 100mm	1.5kg
Nails 75mm	1.5kg
Nails 50mm	1.5kg
Roofing Nails 50mm	288
Staples 12mm	300
Diesel (to protect wood from termites)	2l
Cement (42.5 kg bag)	2.5 bags
Gravel	$0.18m^3$
Sand	$0.15m^3$
Plywood door / standard size	1
Plywood sheet (5mm x 1.2m x 2.2m) for corner reinforcements	1

List of tools needed to build 50 - 75 transitional shelters:

Materials	Quantity
Hole digger	10
Manual saw	10
Hammer	20
Tin snips (tin scissors)	10
Plumb	10
Tape measure	10
Level	10
Staple gun	10
Table saw	1
Portable saw	5
Diamond saw blades	5

Photo: Milton Funes

Covering the roof with corrugated iron

'Through this simple and quickly installed structure we have been able to provide an intimate family space for the victims of the hurricane'.
- Jose Aleman, carpenter working on the project

Photo: Milton Funes

Photo: Milton Funes

Although the preferred option was to build shelters on people's own land, in some cases it was necessary to build shelters on a temporary relocation site.

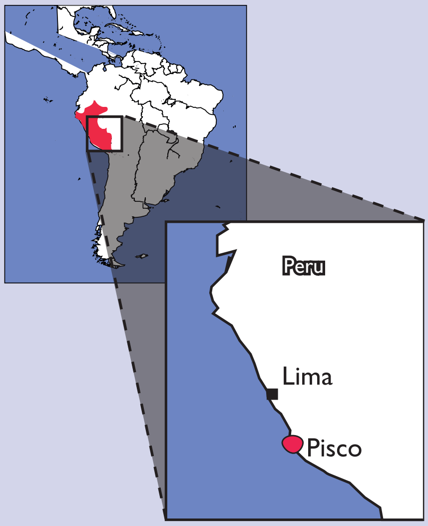
C.2 Peru - 2007- Earthquake

Overview of the response

Summary

On 15 August 2007 there were two major earthquakes separated by nearly one minute. This was followed by a three-metre tsunami that caused some damage along the coastline. The earthquake killed nearly 600 people and injured more than 1,800. Some 48,000 houses were destroyed and a further 45,000 were rendered uninhabitable. In total, 140,000 households were affected. The majority of the affected population lived in towns.

The three case studies included here are responses by non-governmental organisations. One rapidly distributed construction materials using existing community structures, one built shelters providing some cash for work on the shelters and one used contractors to build shelters with the shelter owners. All of these projects worked with those who already had land.



Earthquake location

The area that was most affected is situated in a desert area with high temperature variations and little or no rainfall. In the more mountainous areas that were affected, cold is a severe problem.

Access was significantly easier in the towns in the coastal area, and responses were correspondingly swifter and larger. Much of the response in the first weeks was from people within the country itself.

Response

The major focus of most responses was to support people to build on their own land. This left gaps for the landless who did not qualify for many assistance programmes. Some programmes provided shelter materials for those without land that could be later transported as land became available.

The shelter responses included:

- distribution of blankets, plastic sheeting, cooksets and other shelter items;
- distribution of tents (one organisation purchased over 13,000 tents);
- support for the construction of standard shelters through cash for work, training and carpenters; and
- support with rubble clearance, in coordination with the local authorities.

Government response

The government of Peru based their response on a plan developed by the Colombian government. Actions were divided into four stages (emergency, transition, reconstruction, termination), each with its own set-up and responsibilities. After eight months, the transition stage gave way to the reconstruction stage.

Fifteen days after the earthquake, the Central Peruvian Government created a reconstruction agency called FORSUR, which had a mandate to rebuild houses and infrastructure.

Five months after the earthquake, the Peruvian Ministry of Housing began distributing bonds for approximately US$ 2,000 to affected families who had land titles to their properties. These bonds were to help people purchase materials to rebuild homes. Families without land titles did not have access to this state programme.

Rubble

By January 2008, only one quarter of the rubble (nearly 2.1 million cubic metres of the total 7.8 million cubic metres) had been removed. Rubble removal did not advance as quickly in rural regions further inland.

Some programmes supported people to build lightweight shelters so that landless people could benefit from assistance programmes.

Some people with no other options found short-term shelter immediately after the earthquake in tents and camps.

C.3 Peru - 2007 - Earthquake

Case study: Community mobilisation

Project type:

Community mobilisation
Flexible package of shelter construction materials
Self-build
Training manual distributed

Disaster:

Peru earthquake, 15 August 2007

No. of houses damaged:

Over 48,000 houses destroyed; 45,000 uninhabitable

Project target population:

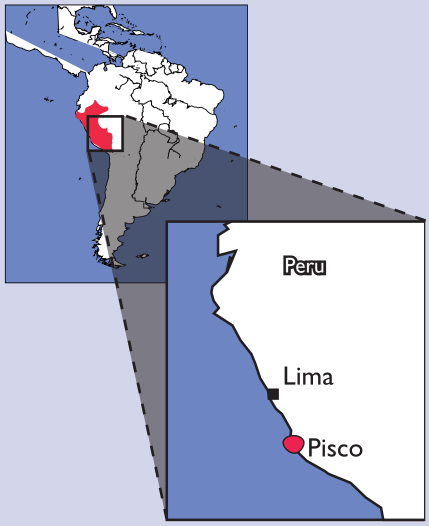
726 families
Just under 1% of the earthquake-affected population

Occupancy rate on handover:

Very high

Shelter size

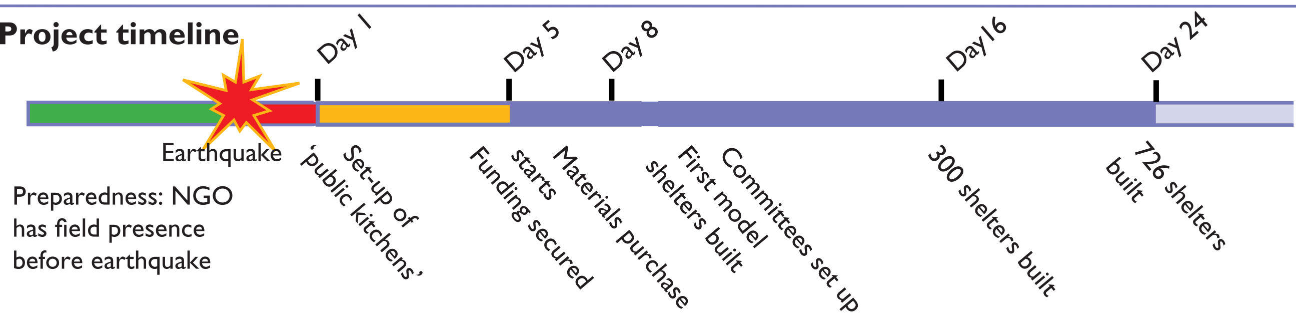
Materials distributed to create 9m² of covered space per family (to be supplemented by reclaimed materials)



Summary

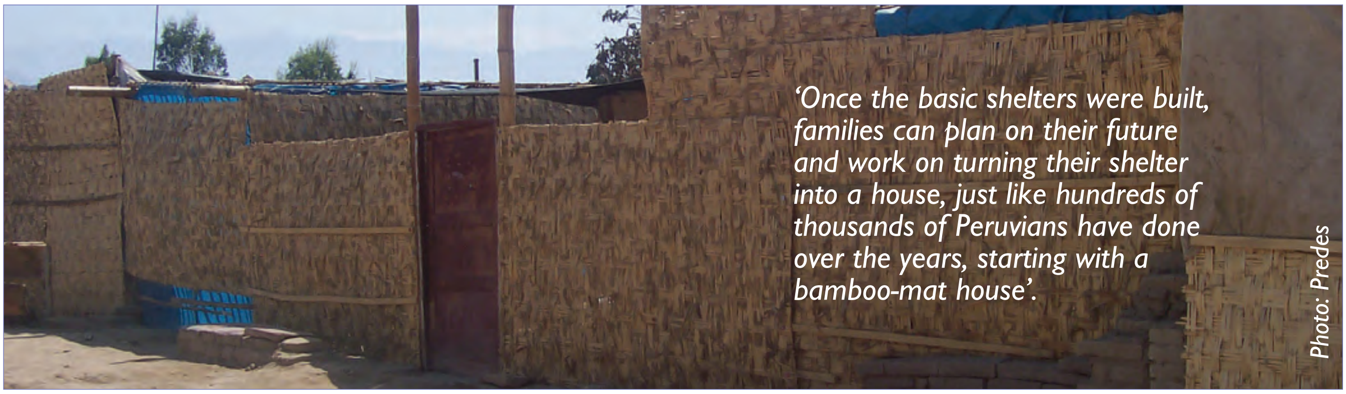
Following the earthquake of 15 August 2007 near Pisco (Peru) a local NGO set up 40 neighbourhood 'public kitchens'. These became a means to mobilise communities to distribute reusable construction materials for those most in need. Materials were selected that would have a longer lifetime than just the emergency phase. Technical support was provided in the form of a manual that had been written before the earthquake, and a carpenter who provided technical support where it was most needed. The speed of the response was possible due to the presence of the implementing NGO on the ground prior to the emergency.

Project timeline



Strengths and weaknesses

✓ Very quick response appropriate to the context allowed people to soon return to income-generating activities.
✓ By creating more solid shelters, there was greater safety against burglars than would have been provided by lighter-weight shelters.
✓ The project sucessfully used materials that kept funds in the local economy.
✓ Using community structures that were not initially designed to manage a shelter project can lead to a fast and effective response (Note: Collective feeding centres may not be advisable in all circumstances.)
× Bulk local purchase of materials can lead to them becoming scare and cause price rises. The project stopped when mats became scarce in the market.
× Technical support provided to families was limited.



Selection of beneficiaries

A public kitchen was the basis of the project management. In the first stage it had 40 groups, each with a designated responsible person. Most of the groups were led by women. They became the centre of all project activities and organised frequent assemblies to discuss all aspects of the project and take decisions. The whole project was conducted in close coordination with the municipality.

Within days of the earthquake, the NGO was able to present the project ideas to the communities via the 'kitchen group'. Most opted into the project, while some decided to wait for better offers. Some of those who opted out were still waiting for support eight months later.

The beneficiaries were chosen based on a list of criteria, including: loss of shelter, family situation, vulnerability, poverty, residency in the area, and willingness to build the structure.

Every selection was to be approved by the assembly of the kitchen group, which was something like a 'block committee'.

Technical solutions

In the coastal regions of Peru there is a long tradition of constructing semi-permanent shelters using bamboo. In the past, immigrants to Lima and other cities have established themselves with simple structures, leading to the step-by-step construction of a formal house.

While the bamboo mats are not considered a formal construction material, the climate allows people to live in such structures. Many of the disaster-affected people had lived in structures made from bamboo at some time in their lives.

The project was based on community soup kitchens as a starting point for social mobilisation.

Materials distributed

Materials	Quantity
Bamboo mats 6 walls, 3 ceiling, 1 door	10 mats
Round poles (for columns) 3" diameter, 3m long	12 poles
Round poles for beams and roof joists 2.5" diameter, 3m long	11 poles
Timber for fixing the mats	7 beams
Reinforced plastic sheet	3m x 15m
Nails 2", 3" and 4"	2.2 kg
Wire	1 kg
Hinges	3 units
Lock	1 units

Implementation

Every family was responsible for the construction of their shelter. This allowed them to make adaptations dependent on available space, using materials that they had rescued.

The preselected beneficiaries were visited by the coordinators of the community kitchens together with somebody from the NGO or the municipality to check whether they complied with the following criteria:

- People had to be occupiers of a house on a plot of a land before the earthquake.
- Their plot had to be cleared of debris in order to place the shelter on it.
- One family member had received instructions on how to build and had participated in the construction of a model structure.

Beneficiaries were first given wooden poles and received the mats only when the structure was properly assembled. Materials were distributed by the block coordinators. Most families ended up digging a new latrine on their property.

Transporting the mats for a shelter to site

Logistics and materials

The wooden poles and woven bamboo mats were purchased from local production in the informal market. Plastic sheeting and hardware elements (nails, hinges, etc.) were centrally purchased.

The materials were shipped to San José, where the municipality provided the football stadium and another building as storage areas.

The trucks were unloaded by the potential beneficiaries. The implementing NGO organized and was responsible for the warehouse management.

The materials were given to the beneficiaries when they presented vouchers issued by the coordinators.

Building with these materials costs about 25% of what some other local organisations spent on their provisional shelters made of timber or low-grade galvanized sheeting. However, the local market had a limited capacity to deliver bamboo mats - an issue which, in the end, led to the ending of the project.

Family shelter built during the project

Making a basic shelter

C.4 Peru - 2007 - Earthquake

Case study: Self-build transitional shelters

Project type:
Transitional shelter construction
Self-build
Rubble removal

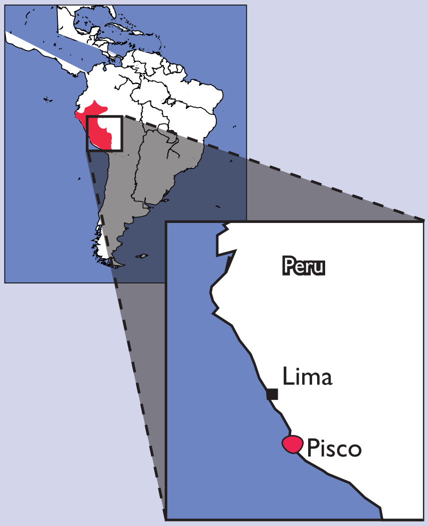
Disaster:
Peru earthquake, 15 August 2007

No. of houses damaged:
Over 48,000 houses destroyed; 45,000 uninhabitable

Project target population:
706 families (3500 people)
Just under 1% of the earthquake-affected population

Occupancy rate on handover:
Very high

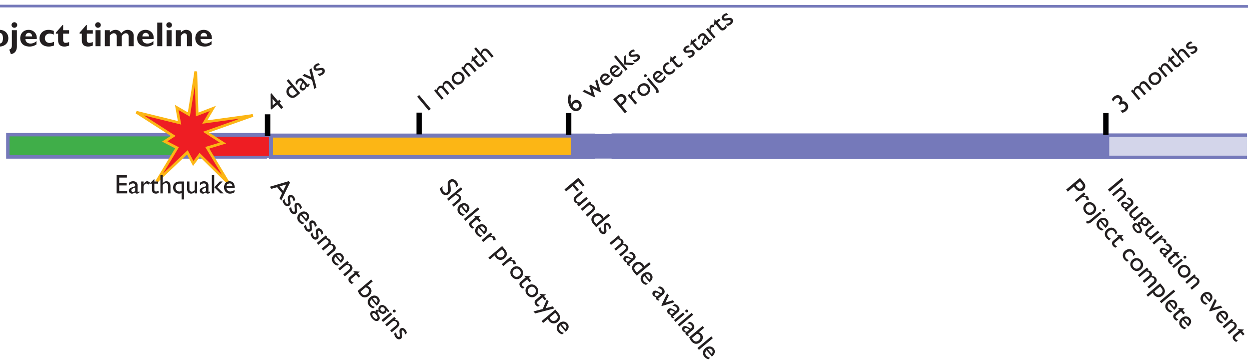
Shelter size
18m^2 covered space per family



Summary

An international NGO with no pre-disaster presence in the area implemented a programme to build emergency shelters made from reed mats, plastic sheeting, cement and wooden poles. The project was part of a larger programme that put particular emphasis on livelihoods for the affected population. In addition, it integrated water and sanitation interventions into the shelter programme.

Project timeline



Strengths and weaknesses

✓ The project paid special attention to the potential of shelter-related cash-for-work activities to speed up livelihoods recovery.
✓ Materials were procured through local suppliers, ensuring that cash remainied in the regional economy.
✓ Families were able to preserve materials for reconstruction and were given materials that they would be able to reuse.
✓ The project was integrated with sanitation and water supply projects.
\- By directly implementing the project, significant amounts of time were required to manage the project and its logisitcs.
✘ It was difficult to procure the materials (woven mats and timber poles) locally. They had to be imported by suppliers from other parts of the country. The competition in the market from the demand and from organisations aiming to assist led to local price rises that affected the disaster-affected communities.

Rubble clearance

Fabricating doors

Selection of beneficiaries

Community leaders were initially requested to identify beneficiaries. These beneficiary lists were validated by the field assessment team, including interviews to validate the selection of each family. Lastly, a community meeting was held to establish who was to be included in the programme.

Most families had no formal land title, so shelters had to be easy to dismantle and remove if required.

Technical solutions

The shelter provided had an area of 18 m^2, enough to host a family of five. The shelter area was chosen based on Sphere indicators. The shelter itself consisted of a timber pole-framed structure with a soil-cement mix as flooring. Plastic sheeting covered the timber structure and woven reed mats were placed on top of the plastic sheeting to increase insulation and durability. Some shelters incorporated reclaimed materials, particularly mud blocks and doors. However, higher-value reclaimed materials, such as timber beams, were often stored by families to be used in the future construction of permanent housing.

The basic shelter design was arrived at by asking three carpenters in an affected community to build a sample shelter. Members of the community vetted the shelter design and a pilot project was then implemented. The shelter design was modified during the pilot to improve labour productivity and efficiency in the use of construction materials. It was expected that the shelter materials would be later reused in the construction of adobe houses (e.g. plastic sheeting used as a water barrier in the clay roof) or that the shelter as a whole would be reused as a kitchen.

Implementation

This shelter project was part of a programme that included shelter, cash for work, sanitation (where destroyed), small grants for businesses and transitional classrooms for schools. The cash-for-work project included debris removal (employing 100 women for two months) and payment for families who could not build for themselves. The sanitation project included the repair of destroyed latrines.

The project was implemented by a team consisting of one project manager and a team of ten final-year engineering student volunteers, each responsible for the shelters of around 65 families.

The project was conducted in close consultation with the local authorities. Before distribution of materials could take place, each family had to clear the debris from their damaged house into the street.

Making the concrete floor slab

The mayor had the responsibility of removing the debris from the streets in trucks. The programmes supported the authorities through cash for work for debris clearance.

Logistics and materials

As the project continued, the supply of timber poles and mats increasingly became a problem, as a result of large-scale purchasing by organisations and local purchasing by affected communities. This led to local price increases. All purchasing took place through local suppliers, who brought timber in from elsewhere in the country.

Timber poles proved easier to procure than sawn timber and the local population was accustomed to building with them.

Distributing cement

Round poles, not sawn timber, were used

The materials were delivered to a central location; homeowners were responsible for transporting the materials for the shorter distances to their plots. The community was responsible for providing support to those members of the community unable to transport their materials.

Materials for one shelter

Material	Quantity
Wooden round poles 10cm x 2.5m	7
Wooden round poles 4cm x 6m	15
Plastic sheeting (m^2)	60
Woven reed mats 3m x 2m	9
Portland I cement 42.5kg bag	2
Construction wire	5kg
Hinges 1.5”	3
Nails 1.5”	0.5kg
Skilled labour (hours)	2.6
Unskilled labour (hours)	4

Shelters under construction

C.5 Peru - 2007 - Earthquake

Case study: Prefabricated transitional shelters

Project type:
Transitional shelter construction
Shelter components prefabricated by contractors
Shelters assembled by homeowners

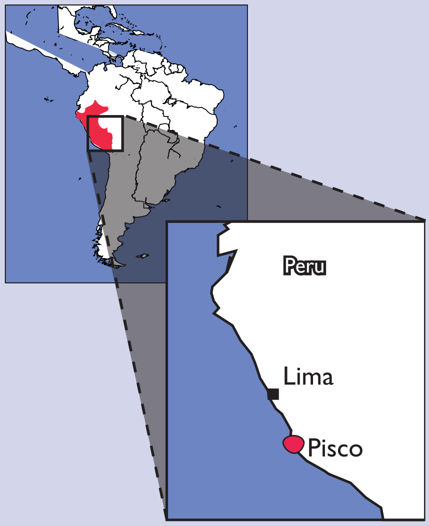
Disaster:
Peru earthquake, 15 August 2007

No. of houses damaged:
Over 48,000 houses destroyed; 45,000 uninhabitable

Project target population:
1,900 families in five selected communities
On project completion, an additional 120 shelters were requested by the government to help house those left landless by the earthquake.

Occupancy rate on handover:
Very high

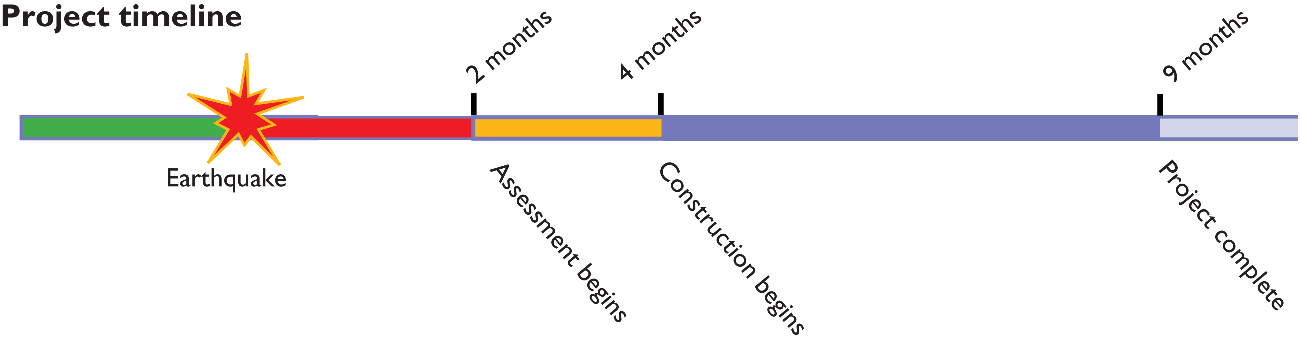
Shelter size
Materials distributed to create 18m^2 covered space per family.



Summary

As part of a larger post-earthquake programme, an international organisation hired a contractor to provide materials, equipment, tools and skilled tradesmen for the prefabrication of 1900 shelters. The contractor was also responsible for training all volunteer labour as needed, but was not responsible for providing land. By prefabricating wall panels and window frames and cutting timber on site, the supplier was able to cut costs. Homeowners themselves assembled the shelters.

Project timeline



Strengths and weaknesses

✓ This project successfully used a contractor to build semi-permanent shelters for families, thereby passing on the challenges of procurement and logistics, as well as many of the risks of a construction project.

✓ Setting up local 'factories' to prefabricate components, reduced logistics and supply challenges, and the ensuing costs.

✓ The project was able to adapt to suggestions made for structural improvements to the shelter design, following an evaluation early on in the project.

- The construction approach required significant capacity on behalf of the contractor and constant monitoring by the humanitarian organisation. An ongoing dialogue between the humanitarian organisation and the contractor was essential.

- The project initially prepared all materials for a village before construction could begin. This was later adapted so that materials were prepared for only 20 houses at a time before construction began. This was more efficient and kept the community more motivated.

✗ This project took four months to begin.

Completed shelter built on the roof of a damaged house

Selection of beneficiaries

Communities were selected by analysing the gaps and noting that no other organisations were working in the areas. Families within communities were prioritised based on need and individual vulnerability.

Beneficiaries needed to prove ownership of land before qualifying for the project. The criteria were later relaxed so that those awaiting ownership certificates as the result of wills of deceased family members could qualify for the project without holding the formal land ownership certificates.

Families who were at risk and relocated from the 'no return zone' had to wait in temporary shelter on squatted allocated land for over nine months before they could be allocated land and qualify for a shelter.

Technical solutions

The shelter design was a rectangular, single-storey, 18m^2 (3m x 6m), wood-framed, shed-roofed building. The side covering was vertical, tongue-and-groove wood. Each panel was approximately 1cm thick and approximately 10cm wide. The shelter had one door and a large window on one long wall (at the front). The roof was a shed style made with lightweight, corrugated cement panels approximately 1m wide and about ½cm thick. The roof panels were long enough to run the full width of the roof. The flooring used pre-existing concrete slabs.

Each house took approximately eight hours to construct once the prefabricated materials were transported to the site. The idea was that all materials could be later reused.

All tools needed by the homeowner to build his/her shelter were supplied by the contractor and were left with the homeowner at the conclusion of the programme as a home maintenance tool kit.

Implementation

The initial contract was for 500 shelters. Costs rose 25% for subsequent shelters, due to local cost escalations.

The contractor set up a materials manufacturing 'factory' in each project area. At this site, the contractor's employees (using some local labour) cut, planed and finished the wall frame units. Only the contractor's employees used power tools.

Families were responsible for rubble removal, site cleaning and marking out the shelter location.

The raw materials were prepared in workshops set up in the communities where shelters were to be built.

Completed shelter built on the roof of a damaged house

If the old floor slab could not be reused, or there was no existing slab, the homeowner was required to pour one. In some cases homeowners made their floors after construction. Employees of the contractor and trained community members provided guidance and oversight for the mixing and pouring of concrete.

Homeowners transported the materials from the 'factory' to their home. They then installed the tongue-and-groove wall sheeting onto the six wall-framing panels. Company employees and trained community members then assembled the sided frames (two for the side walls and four for the front and back walls) with assistance from company advisors. Families nailed the structures together and added the doors and windows.

Quality Control

Supervision and quality control were done by the contractor's staff. The contractor had one engineer and one project manager (who supervised), and five skilled workers who cut the timber. The homeowners transported the prefabricated shelter materials and assembled them on site. The only carpentry skill that homeowners required was the ability to hammer a nail and follow connection directions.

Monitoring took place through a team of approximately 30 volunteers, of whom 15 were active in the field on a daily basis. Of these, five or six worked with the contractor on a daily basis and mobilised community volunteers. The rest worked in the community, helping with registration, land rights and other emerging issues.

Safety and Liability

The contractor maintained control of the cutting and assembly yard and its employees, and controlled access to hazardous places. Since the contractor owned, controlled and supervised the operation they were the main liable entity.

Each community established a safety committee that controlled access to the cutting and framing site, as well as the assembly sites. In general, community activities were provided for youth and children to keep them entertained while their families were building their shelters.

Logistics

By delivering basic raw materials (rough timber, tongue-and-groove wall sheeting and corrugated iron, cement panels, nails, etc.) to the building site, logistics requirements were reduced. Warehousing was also reduced, since non-value-added raw materials took up less space than fabricated material components. Component costs were reduced by directly employing people on site to fabricate them. These people did this work as only a part of their salary. Everything was fabricated as needed on site and according to specification. This approach also provided a 'just-in-time' inventory system, but required the hiring of additional skilled staff by the contractor.

Bill of quantities

Item	Quantity
Wood (tongue and groove) 2.48m	68
Wood (tongue and groove) 2.3m	43
Wood (tongue and groove) 42cm	10
Wood (tongue and groove) 32cm	16
Wood (tongue and groove) 1.01m	16
Wood (tongue and groove) 2.48m to 2.30m	70
Nails	1kg
Wood strips 3cm x 6cm x 3m	2
Wall plates 6cm x 6cm x 2.5m	3
Hinge, steel 2.5"	7
Corrugated roofing 3m x 1m	6 sheets
Instructional manual	1
Plastic tape 1cm x 15cm	8
Screws	3

One toolkit was distributed per group of workers.

One of the project's shelters (background) and a shelter walled with reed mats (foreground)