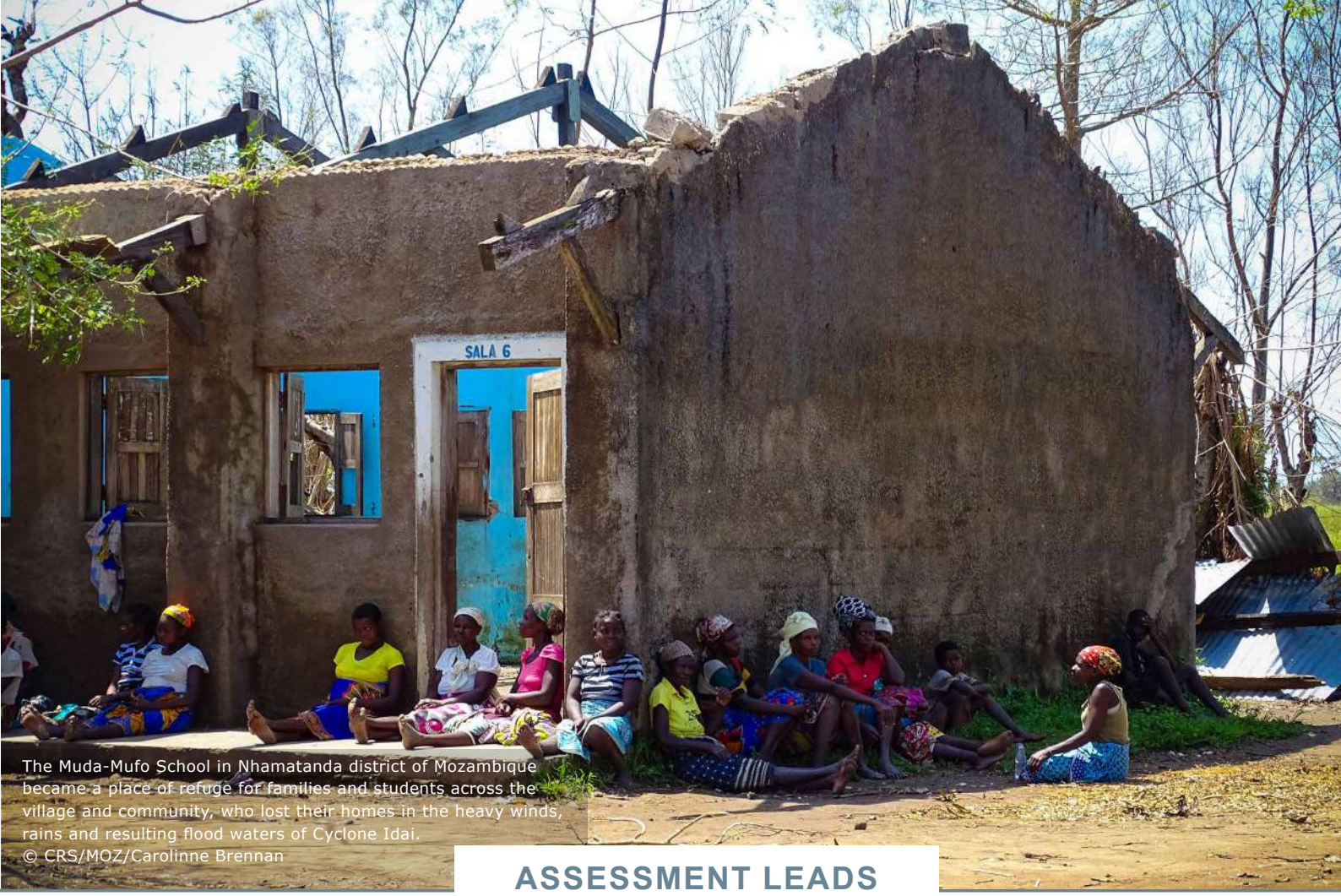
EMERGENCY MARKET ASSESSMENT

TIMBER, POLES AND BAMBOO

THE IDAI CYCLONE RESPONSE

Shelter Cluster Mozambique
ShelterCluster.org
Coordinating Humanitarian Shelter



The Muda-Mufo School in Nhamatanda district of Mozambique became a place of refuge for families and students across the village and community, who lost their homes in the heavy winds, rains and resulting flood waters of Cyclone Idai.
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ASSESSMENT LEADS AND CONTRIBUTORS

CHRISTOPHER M. REICHERT, MPH
CHRISTOPHER.REICHERT@CRS.ORG
CATHOLIC RELIEF SERVICES
ASSESSMENT COORDINATOR

LUCIO COCCONI
MOZ.TECH1@SHELTERCLUSTER.ORG
SHELTER CLUSTER TECHNICAL ADVISOR

Shelter Cluster Mozambique
ShelterCluster.org
Coordinating Humanitarian Shelter

Cover page
A man uses his bycyle to transport small amounts of bamboo from producers to the market in Dondo.
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An aerial view of the city of Beira, Mozambique and the extensive damage to homes, buildings and trees.
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ACKNOWLEDGMENTS

We are very grateful for the support of all agencies and individuals involved in this joint assessment, particularly:

- Caritas (Diocese of Sofala and Chimoio), for logistical support, field knowledge and guidance – Sr. Adelito (Padre), Lino Miguel (Project Coordinator); and Chicho Chichone Suliar (Emergency Coordinator).
- Catholic Relief Services (Mozambique Outreach Office and the Humanitarian Response Department, HRD), for the in-country support, budgetary support, technical advice, strategic guidance, and final document editing and polishing – Jennifer Weatherall (HRD Technical Advisor – Cash and Markets); Renata Mendez (HRD Consultant for Shelter); Jamie Richardson (HRD Global Senior Technical Advisor); Seki Hirano (HRD Global Senior Technical Advisor); William Martin (HRD Technical Advisor – Cash and Markets), Cristina García Escobar (HRD Technical Assistant – Shelter and Settlement) and Caroline Brennan (HRD Emergency Communications Director).
- Government of Mozambique for sharing detailed information, and their strategic priorities and vision – Carlito Nhama, GREPOC; Amina Zemanino (DPTADER, Chimoio); Costino Paz (DPTADER, Beira); Hermenegildo Barreto (DPTADER, Beira); Luis Almeida Bacacheza Constantino (DPTADER, Chimoio); Sr. Mamade (DPTADER, Beira); and Silvestre Dos Santos (DPTADER, Beira).
- International Organization for Migration (IOM) for operational support, information sharing and guidance – Jessica Mamo (NFI Program Manager), Luis Junior (Logistician) and Patricia Ocana (Shelter Program Manager).
- International Federation of Red Cross and Red Crescent Societies (IFRC) for operational support, assessment team volunteers, and fieldwork team leads – Aldair Coutinho Joao Rafael (Information Analyst); Eduardo Manuel Artur Gumancanze (Information Analyst); and Samson Oche (Head of Information Management).
- Shelter Cluster for guidance, background information, technical support and strategic advice – Eva da Costa (Information Manager); Francisco Monteiro (National Coordinator); Frédéric Riopel (Beira Coordinator); and Mikhail Broger (Beira Coordinator)
- Key players in the private sector, such as LevasFlor for their openness and linkages to the broader private sector – Claudia Esteves (Sales and Compliance Manager) and Nils von Sydow (CEO); and Abdul Majid (CEO) of IMM for sharing sector knowledge and the timber processing site visit.
- UNHCR for the authorized use of many of the professional images found in this report.

Twenty-six-year-old Internally displaced Mozambican, Amelia, was displaced with her husband, Almeida Juoa, 34, and their children Rosa, 8, Elias, 4 and Alsofina, 1, when their home was destroyed by Cyclone Idai in March 2019.
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Carpenters constructing pine trusses in the resettlement camp, Manica.
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Veronica, 62, a woman affected by Cyclone Idai in the remains of her home in Dondo. She lost the roofing of her house and all of her food stores to Cyclone Idai.
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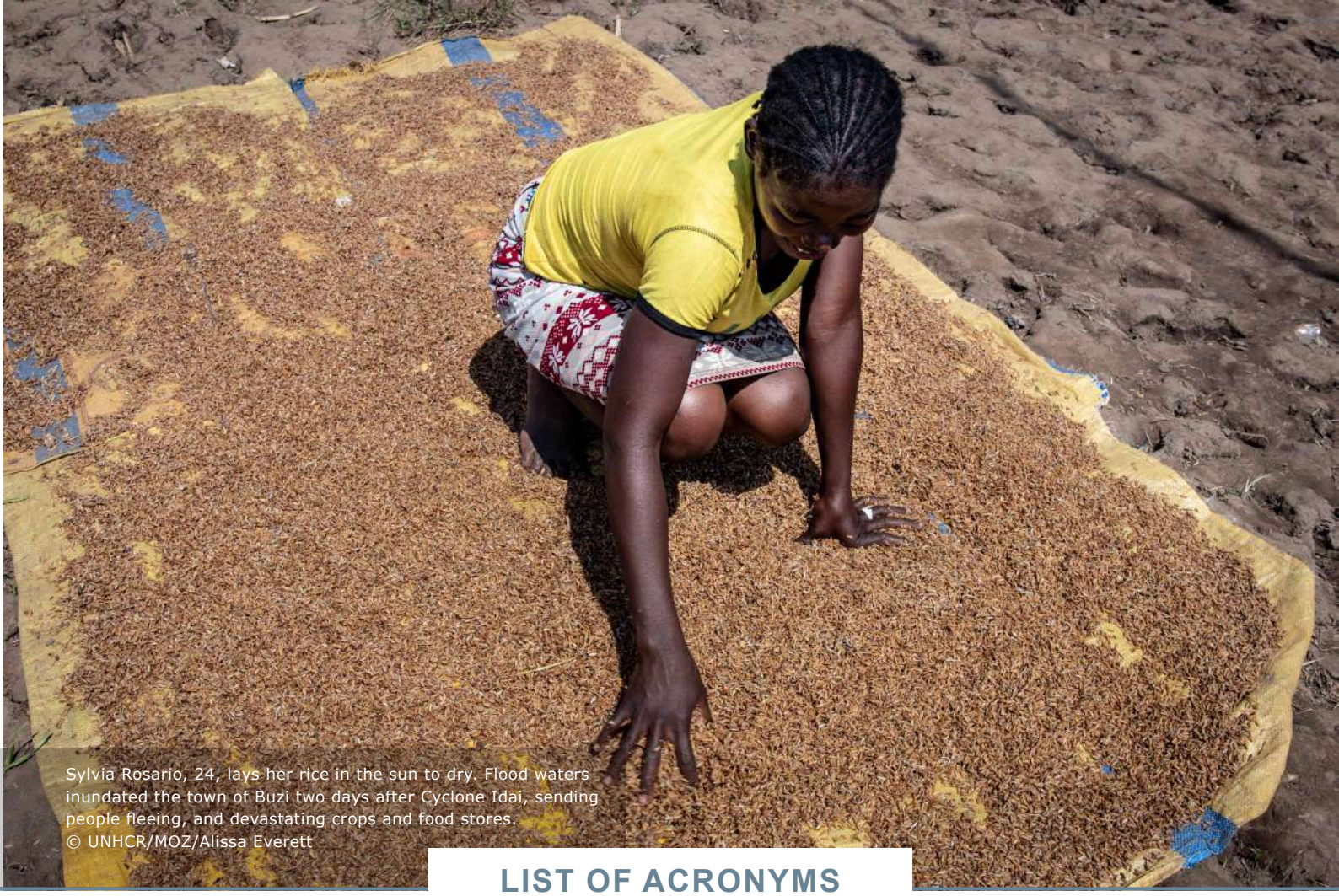

Sylvia Rosario, 24, lays her rice in the sun to dry. Flood waters inundated the town of Buzi two days after Cyclone Idai, sending people fleeing, and devastating crops and food stores.
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LIST OF ACRONYMS

BBS	Build Back Safer
CARE	Cooperative for Assistance and Relief Everywhere
CCA	Chromated Copper Arsenate (wood preservative)
CGI	Corrugated Galvanized Iron
CRS	Catholic Relief Services
DFID	Department for International Development
DPTADER	*Direcção Provincial de Terra, Ambiente e Desenvolvimiento Rural* (Provincial Directorate of Land, Environment and Rural Development)
EMMA	Emergency Market Mapping and Analysis
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GoM	Government of Mozambique
GPS	Global Positioning System
GREPOC	*Gabinete de Reconstrução Pós Ciclones* (Post Cyclone Reconstruction Office)
IBR	Inverted Boxed Rib (roof sheeting)
IFLOMA	*Indústrias Florestais de Manica*
IFRC	International Federation of Red Cross and Red Crescent Societies
IOM	International Organization for Migration
MT	Mozambican metical[1]
NGO	Non-Governmental Organization
OFDA	Office of Foreign Disaster Assistance
PALPOC	*Plano de Alojamiento Pós Ciclones* (Post Cyclone Housing Recovery Plan)
PDNA	Post Disaster Needs Assessment
SAVE	Save the Children
SOW	Scope of Work
TBD	To Be Determined
TOR	Terms of Reference
UN	United Nations
UN-Habitat	United Nations Habitat
UNICEF	United Nations Children's Fund
US	United States
VAT	Value-Added Tax (17%)
WFP	World Food Programme
WOS	Untreated cut wood
WOSP	Untreated planed wood
WVI	World Vision International

Kids affected by Idai standing next to a informal pole and bamboo shop (called „estaleiros“) in Beira along the Estrada Manga Aeroporto.
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Executive Summary

Background

In March 2019, over 1.5 million people were affected by Cyclone Idai across four provinces of Mozambique. By October 1 that year, half of those in shelters had returned home, while 61 resettlement areas remained open. An estimated 240,000 homes have been affected, half destroyed completely, and the rest partially destroyed. Through a rapid market assessment, the government of Mozambique and its partners sought to better understand markets to help communities rebuild their homes. By October 2019, the emergency response had reached 182,366 houses, though 49 partners in four provinces and 20 districts.[1] For shelter upgrades and recovery, cluster partners supported a broad set of activities, implementation methods, construction typologies and targeting criteria. Nearly $4.5 million[2] has been earmarked for recovery programming, targeting 47,000 families with support ranging from $50 to $3,500 per family.

Objectives and methods

Using mixed methods, this report assessed the capacity of markets to supply key inputs (timber, poles and bamboo) to the Idai-affected populations across two provinces and eight markets. (Beira, Chimoio, Dondo, Nhamatanda, Dombe, Mafabise, Tica and Mbuzi). The qualitative portion included 20 key informant interviews with 14 entities across five main segments: government, multilateral institutions, nongovernmental organizations (NGOs), vendors and communities. The quantitative portion used a mobile structured survey of nearly 100 vendors, with over 30 variables in key themes, such as vendor contact information, vendor and client profiles, vendor payment options and terms, stock levels and pricing data. Pricing data included current prices, wholesale pricing and pre-Idai pricing. The study was designed, implemented and written-up over the course of one month in September and October of 2019.

Findings

Target and needs. Since most partners were still planning the recovery and reconstruction solutions, partner-driven figures on total timber, poles and bamboo needed were not available. Therefore, the assessment used available data and material needed per shelter typology, and created a projection using a set of key assumptions to estimate targets

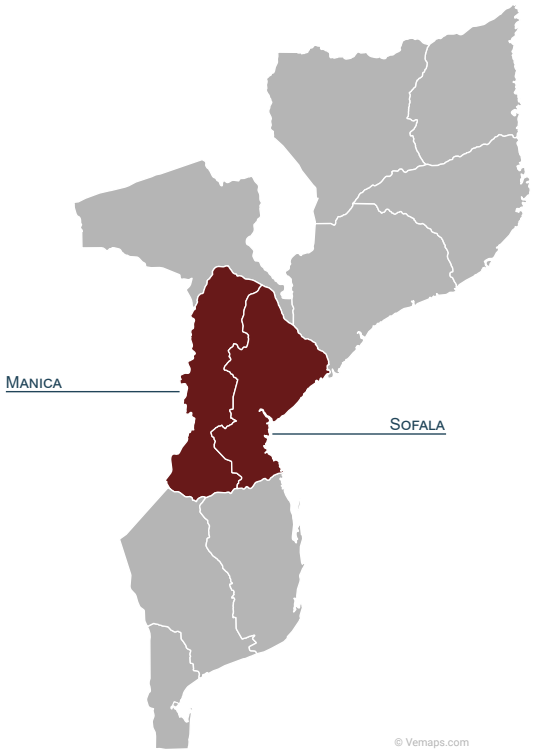

Figure 1. Geographical coverage of the study: provinces Manica and Sofala, Mozambique.

and input needs. The projection indicates support will be needed for 179,158 households (127,056 conventional block houses; 20,202 mixed; and 31,900 traditional adobe homes). Total estimated need for each input is: 57,255m^3 of timber, 1,355,742 poles and 2,232,987 bamboo sticks.

Vendor profile/pricing. The assessed vendor profile is dominated by informal merchants, cash business, low stock levels, poor storage practice, and vendor-centric terms (100% pre-payment). All items were found in the markets, but at varying quality levels. The more distant input markets from the main inter-provincial axis were characterized by insufficient quantity and inferior quality. Overall, assessed timber stocks yielded enough supply for about 500 houses, poles for 180 houses, and bamboo for 85 houses. Prices were commensurate with material size, quality and vendor type. Average 6m timber ranges from $6.85 to $17.82 (5cm to 15cm), poles from $1.19 to $2.98, and bamboo $0.31 to $0.40. Average input prices for informal vendors

[1] Mozambique Shelter Cluster
[2] Data was collected in Mozambican meticais, and converted to USD using the rounded up, average rate during the week data collection, or 62 meticais per USD (Oanda.com). For ease of reading, when useful, figures are rounded to the nearest dollar.

is significantly lower than the formal vendors (24% less). Idai-impact data indicate prices increased an average of 13% for the selected inputs.

Timber supply. For the most crucial material (timber), average prices on the open market are 168% higher than the main producer (IFLOMA in Manica) and range widely (between 141% and 235%). Although IFLOMA production potential is very high, production capacity was severely limited to 30m^3 per day, or the equivalent timber for 90 houses. For perspective, at this rate, the total timber needs would take 5.5 years to process. LevasFlor currently processes about 13m^3 per day, but currently has a greater capacity to scale up sawing production (250m^3/day). LevasFlor may be a very good option for certain partners, particularly those with a strategy focus on environment sustainability.

Key environmental issue. Although beyond the scope of the assessment, indicative data was collected on wood needed for burnt brick production. Data collected in Dombe indicate that between a quarter and a half-ton of large girth trees is needed as firewood to create blocks for one home. In Dombe alone, which lies adjacent to the national Chimanimani forest reserve, 2,300 tons of wood would be needed to fire the blocks for 4,600 resettlement houses.

Recommendations

From the findings, the top recommendations include:

1. Due to the severe shortfall of projected needs, negotiate with national and international suppliers for large pipeline timber procurements. IFLOMA may be able to leverage its relationship with its South African parent company to meet targeted needs, which may include treated timber.

2. Timber pricing models including transport to affected areas indicate that economies of scale hit a tipping point between 50 and 100 houses. Partners targeting more than 50 homes in one geographic area should consider bulk orders from IFLOMA.

3. Partners with a strategic environmental focus can consider suppliers that have alternatives to pine, such as LevasFlor. LevesFlor has a production capacity of 250m^3 per month (694 houses). Additional inquiry or pilot projects may be needed to understand how communities react to using *msasa*[3] as construction material.

4. Partners with smaller target numbers should consider pilots of small-scale market-based voucher programs for timber, exotic poles and bamboo.

5. Given the varying quality of timber and poles on the market, and poor storage facilities, implement strong quality control mechanisms. Examples may include detailed contractual specifications (in-kind or processed) and pre-delivery sampling at IFLOMA (in-kind). Support vendors to improve storage practices and facilities, such as basic education outreach, and conditions on projects to incentivize proper storage.

6. For owner-driven support (e.g. cash mechanisms), use conditionality to manage and monitor construction quality if households are responsible for their own rebuilding (e.g. ensuring minimum cyclone proofing, adequate foundations, etc., before issuing the next installment). Support communities during the material selection process via technical trainings.

7. Of the three value chains, cash-based market programming in the current market climate may be most suitable for bamboo, which is relatively less likely to have environmental implications (need to verify and monitor this assumption), and would inject cash into rural economies.

8. Research, lobby and support pilots and partners that promote burnt brick alternatives, especially in more concentrated areas, such as the resettlement sites.

[3] Medium-sized tree, Brachystegia spiciformis.

Rosa, 8, washes clothes. She was internally displaced with her mother Amelia, 26, father Almeida Juoa, 34, and siblings Elias, 4, and Alsofina, 1, when their home was destroyed along with 3,000 other displaced people.
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An aerial view of the city of Beira, Mozambique and the extensive damage to homes, buildings and trees.
© UNHCR/Alissa Everett

Objectives and Methods

The purpose of the study is to help the Shelter Cluster to support decision-making and advocate with the government and other stakeholders regarding appropriate modality options (in-kind, service provision, market support, voucher and cash) for shelter reconstruction. Annex 1 provides a synopsis of the scope of work. The assessment objective is to provide evidence on whether the markets and related services could supply sufficient products to disaster-affected populations in terms of quantity and quality. The Shelter Cluster will use the market assessment findings to provide evidence-based recommendations for intervention in response to Cyclone Idai; identify what actions stakeholders need to take during pre-crisis times to strengthen local markets so they are better able to adapt and respond to a markets-based humanitarian response; c) adapt organizations' contingency plans based on the findings. Given the implications on cost, preference of the local population for sawn timber, and the environment, the study focuses on timber, but includes information on poles and bamboo where relevant.

Key research questions included:

1. What is the market map baseline, before Cyclone Idai and now, after the disaster?

a. Identification of major local, regional and, if applicable, distant markets

b. Assessment of market size, sales volume and market integration/segmentation

c. Market actors' (consumers, sellers, traders, middlemen) behavior

d. Prices, procurement mechanisms and market requirements

e. Impact of Cyclone Idai on local markets and its dynamics, impact on price and availability.

f. Availability of sustainably-sourced and plantation timber

g. Support services and identifying the enabling environment

2. What is the current and projected input demand?

3. Can demand access supplies safely, now and during the recovery phase?

4. Can supply meet demand, now and during the recovery phase?

5. What constraining or enabling factors affect the local markets, now and during the recovery phase, including current environmental and other government regulations?

6. Identify environmental impact of the changes in the demand/supply including current environmental and other government regulations.

Assessment team

The assessment team was composed of ten people: one coordinator, two team leads and eight enumerators. Over the course of a day (September 5, 2019), the coordinator trained the team in the data collection approach and tools. The enumerators practiced using the mobile technology and familiarized themselves with the qualitative tools. The team was divided into two, one focusing on Dondo, Nhamatanda, Tica, Chimoio, Mafabise, and Dombe, and the other on Beira and Mbuzi. Data was collected over the course of seven days, September 6 through September 12, 2019.

Quantitative component

The quantitative portion used a structured survey through mobile technology (Kobo platform) with 99 vendors across two provinces and eight markets. The markets were Beira (51 vendors), Chimoio (8), Dondo (13), Nhamatanda (8), Dombe (4), Mafabise (6), Tica (5) and Mbuzi (4). The survey tool included at least 33 fields across five domains: introduction/ consent, vendor contact, vendor profile, input profile and input pricing. Table 1 provides a summary of the domains and content. Data for input profiles and pricing was repeated until all information was gathered. For example, if a vender sold poles and bamboo, two input profiles were created. Pricing data was collected for 273 items, including current prices, wholesale prices and pre-Idai pricing. In each market, Quantitative data was supplemented with semi-structured interviews with the vendors to better understand the context.

Qualitative component

The qualitative portion included 44 semi-structured key informant interviews with 11 entities across government, multilateral agencies, companies and NGOs. Key partner interviews were conducted with cluster contacts, DPTADER, GREPOC, Department of Forestry, IOM, FAO, WFP, UN-Habitat, IFRC, CRS, WVI, CARE, SAVE, Care for Life, Concern Worldwide, and the private sector (LevasFlor, IFLOMA and IMM). Annex 2 provides a list of contacts and detailed contact information.

Domain	Fields	Content	Notes:
Introduction/ consent	3	Enumerator, location, consent	If consent not provided, terminate the interview
Vendor contact/location	6	Vendor name, store name, phone numbers, GPS coordinate, picture	Some vendors (especially informal) declined to provide name and phone numbers
Vendor profile	10	Vendor type, years trading, licensing, banking, payment options, payment terms, credit and input available	
Input profile	9	By input type: client turnover, client spending, stock levels, species/type, treatment, supplier and input origin	Repeat for each input (timber, pole, bamboo)
Input pricing	5	By specific input item (e.g. timber 5x5cm): length, retail price, bulk price and pre-Idai price	Repeat for each specific item, and for all items of interest

Table 1. Quantitative survey tool content by domain and fields.

Figure 2. Map showing the assessment area and the number of quantitative interviews, by location.

Background

Tropical Cyclone Idai

Tropical Cyclone Idai made landfall on March 15, 2019, near Beira, Mozambique, bringing strong winds (180 to 220 kilometers per hour) and heavy rain (more than 200 mm in 24 hours) across the provinces of Sofala, Manica, Zambezia, Tete and Inhambane, causing rivers to overflow, with flood waters reportedly rising above 10 meters. Over 1.5 million have been affected across the five provinces, more than 600 people died and over 1,600 were injured. By the end of April 2019, 400,000 people had been displaced, of whom 160,927 were sheltering in 164 temporary accommodation centers. By October 1, half of those in shelters had returned home, but 61 resettlement areas remained open. An estimated 240,000 homes have been affected, half destroyed completely and half partially destroyed.

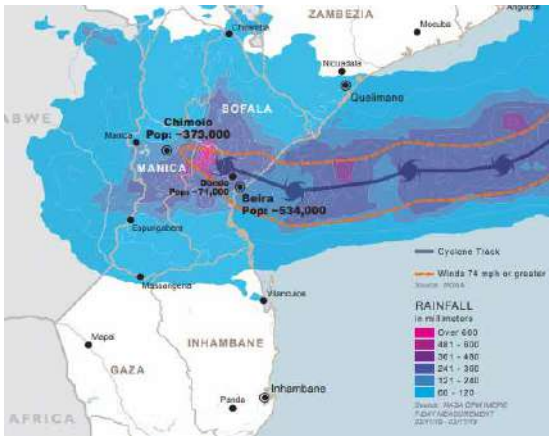

Figure 3. Idai cyclone map.

Current program summary

During the emergency phase, shelter needs focused on providing access to adequate shelter for survival and dignity. Various humanitarian actors provided emergency shelter kits for essential security and personal safety, protection from the weather, and enhanced resistance to disease and ill health. By October 1, 2019, the response had reached 182,366 houses, through 49 partners in four provinces and 20 districts.[4] The response has included 120,120 tarps; 65,556 kitchen sets; 58,286 toolkits; 42,414 mosquito nets; 38,341 jerrycans; 33,375 sleeping mats; 5,607 solar lights and 3,642 tents. Five of the 49 agencies (10%) have reached over half of the total households (56% of 183,000), including: WVI (27,641), Samaritan's Purse (24,334), CRS/Caritas (20,283), IFRC (16,457) and Tzu Chi (13,213).

By October 1, 2019, the response had reached 182,366 houses, through 49 partners in four provinces and 20 districts.[4]

In general, families have quickly initiated self-recovery. In many cases, families procured roofing and walling materials themselves locally, or foraged for poles and timber in the surrounding forest to construct makeshift shelters. In the resettlement areas, typically, emergency tents have been replaced by emergency larger-poled tarped shelters. Families have constructed the base models provided in order to add mud walls later or completely shift to block walls. Those that have recently received sheeting tend to store it for later use.

Summary of the shelter kit upgrade and recovery programming

Cluster partners support a broad set of activities, implementation methods, construction typologies and targeting criteria. From those agencies that submitted information for the assessment, $3.8 million has been earmarked for recovery programming, targeting 24,800 families with support costing between $50 and $3,500 per family. In addition, IOM is implementing a shelter upgrade program valued at about $1.8 million for 23,000 families. Partners are using or considering using a variety of implementation methods including in-kind distributions, vouchers, sub-contracting to construction companies, and in-kind community contributions. The models span the four typologies supported by the Shelter Cluster from traditional adobe to conventional block houses.[5] Targeting includes self-recovered families, along with the most vulnerable populations that are likely to need additional support. Table 2 provides a summary of available information on partners' responses, and known recovery plans.

[4] Mozambique Shelter Cluster
[5] Shelter cluster BOQ and price lists by the technical support lead.

Partner	Program funding (not total budget) and targets	Programming type/phase
IOM	$1.8 million, 23,000 families $528,000, 2,460 families Total: $2.4 million, 23,000 families	Emergency upgrades 23,000 families with shelter materials, procured 48,000 poles/147,000 bamboo for two package types: - Full, 7,400 families, $110. Families who have been relocated to resettlement sites, and families living in severely damaged houses in their communities of origin. - Partial, 14,800, $60. Families who live in partially damaged houses – 7,200 through CARE/WVI, etc.; about 2,000 through Medair, and 5,600 directly distributed by IOM. Recovery (2,460 families) 1,360 families, $180. Transitional kit focused on roofing/walling, likely to be timber/CGI. Location TBD. 200 families, $450. Targeting severely damaged housing with materials to enable recovery. Location flexible. 900 families, $230. Repair kits targeting partially damaged houses. Unknown content. Likely to target urban areas, with roofing materials.
IFRC	$1 million, 1,400 families	Recovery (under discussion) Housing w/improved pau-a-pique (“wattle-and-daub”) design, combination of retrofit and construction. 2,000 families (500 rural and 1,500 urban), likely to be in Dondo, Praia Nova and Beira. Divided into self-recovery and most vulnerable groups.
CRS / Caritas	$255,000, 600 families	Recovery • 500 families, $250. Self-recovery with construction package, including pine timber. Considering in-kind or voucher support with BBS (Xadea and Macumba). Recovery • 100 families, $1,300. Full build for most vulnerable in Tica and Muda Mufo, five pilots began in October 2019 (adobe, CGI and poles).
WVI	Slated to start in April 2020	Plans • Large quantity of supplies still to distribute. • Plan to continue through April 2020 and then transition to reconstruction. • No secure funding yet, thus focusing on capacity building for self-recovery.
Care for Life	$600,000, for 300 families Between $85,000 and $250,000 for 500-1,500 families	Permanent housing • 300 families, $1,500-$3,200 each in Dondo (290 HHs) and Beira (10 HHs) • Three model types: 1 bedroom, 2 bedroom and 3 bedroom; $1,500, $2,500 and $3,200 each respectively (very few 3 bedroom) Repair focus • After completion of permanent builds, will shift to repair • 500-1,500 families, $167, likely a shelter kit support option
Cruz Vermelha Espanha	Not available	300 households; 3-4 standard solutions adapted to each beneficiary (repair/reconstruction) in Matadouro (blocks)
CARE	$1.2 million, 18,540 families	Recovery • 18,000 families, $50. (Buzi, but may expand to Nhamatanda/Dondo). Considering voucher approach, but more likely pre-order approach, and likely to focus on roof sheets, nails and hammers. • 540 families, $300. Targeting most vulnerable, probably traditional building, such as roundhouse and thatch.

Table 2. Program funding, targets and phasing by partner.

Critical market system

Critical market systems in an emergency context are those that "played, play, or could play a major role in ensuring survival and/or protecting the livelihoods of the target population." To be selected, market systems had to meet the follow criteria: related to significant or urgent need; were affected by the emergency; fit the agency mandate well; met seasonal factors, with appropriate timing; were consistent with government or donor plans; and had response options that appeared to be feasible. Based on these criteria, sawn timber, poles for roofing and bamboo were selected, in descending order of focus. The assessment collected information on four timber sizes – 5cm x 5cm, 5cm x 7.5cm, 5cm x 10cm and 5cm x 15cm; three pole sizes (small, medium and large) and bamboo sticks, focused on those over three meters in length.

Seasonality

The seasonal calendar (table 3) below shows the seasonal variation of the critical market chains selected. There is no material difference between the value chains reported. Regarding the target population, the main driver is the rainy season, which dictates the planting and harvesting season. As people prioritize their crops, the available daily wage labor decreases and prices increase.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Price spikes				X	x	x						
Cyclone season			X	X								
Rainy season	X	X	x							X	X	X
Agricultural preparation										X	X	
Agricultural harvest				X	x	X	X					
Wage labor cost spike					x	X					x	
Cold/lean season					x	x	X	X	X	x	x	
Construction			x	x	x	X	X	x	x	X		

Table 3. Seasonality calendar by month.

Example of an informal hardware shop („ferragem") found in Dondo's central market.
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A family sits in a makeshift structure on top of what was their home destroyed by Cyclone Idai. Buzi was hit by 170mph winds ripping off roofs and downing trees, then two days later, was completely submerged in 2 meter high flood waters.
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Post-cyclone damage and gap analysis

In April 2019, nearly 240,000 homes were assessed with varying levels of damage. The assessment found that 112,745 were totally destroyed, 111,202 were partially destroyed, and 15,784 were flooded.[6] A post-disaster needs assessment provided an indication of scope by construction typology (conventional, mixed and traditional) within each damage level, fully destroyed, 20%, 30% and 50%, respectively, and partially destroyed, 45%, 15% and 40%, respectively. The Post Disaster Needs Assessment (PDNA) also indicated that most of the affected homes (60%) were conventional block homes within urban areas. Table 4 provides a synopsis of the data

In April 2019, nearly 240,000 homes were assessed with varying levels of damage. The assessment found that 112,745 were totally destroyed, 111,202 were partially destroyed, and 15,784 were flooded.[6]

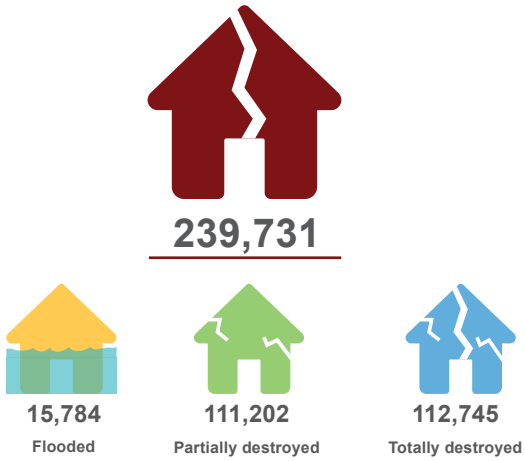

Figure 4. Quantity of houses affected.

Damage level	Conventional	Mixed	Traditional	Total
Fully	22,549	33,824	56,373	112,745
Partial	50,041	16,680	44,481	111,202
Flooded				15,784
Total	72,590	50,504	100,853	239,731

Table 4. Estimated number of affected houses by area, type and damage level.

Resettlement camps and point of origin

The affected families have been divided into two categories: those in resettlement camps and those that have remained at "point of origin." Currently, less is known about the profile of the point-of-origin families; thus, this section focuses on describing the resettlement camp data. As of October 1, 2019, 63 resettlement camps with 16,883 families and 84,084 individuals, were open across four provinces – Sofala (54%), Manica (27%), Zambezia (14%) and Tete (4%). A little more than one-third of the administrative posts (40%) accounted for nearly 80% of the resettlement case load. (Table 5)

In resettlement areas, such as Sussundenga, the government's plan is to convert the existing resettlement areas into future towns, which are located on land higher than where people lived previously.[7] In this approach, the government has demarcated areas for the towns, and started allocating plots of land (30x40 m^2) to families. Each family in the resettlement camp has received preliminary support through emergency blanket coverage. Moving forward, the community has been requested to produce their own fire blocks. Once the blocks are available, supplementary

[6] National Institute of Disaster Management House Damage Assessment, April 2019.
[7] KIIs indicated that this approach is modeled after the 2006 Zambezi flood.

material (timber, nails, etc) will be provided. In the resettlements visited, there seemed to be a disparity between the community and governmental/nongovernmental organizations with respect to block provision.[8] For example, local camp representatives requested support for water transport, block provision, firewood, and additional boreholes, stating that one 60-meter borehole[9] for household consumption was insufficient.

A public trading square has been demarcated, and families are investing into the construction of small trade shops. For example, one family had collected about 50 large poles for a small store. In about three days, one family constructed a clay oven, using about half a bag of flour to make 400 loaves of bread per day for the local market.

Example of structures found in resettlement camp included:

Structures in Resettlement Camp

- **Emergency tents** (very few left): Basic, some are still being used, but not many.
- **Emergency upgrade shelter:** Eucalyptus and/or forest poles and tarps, secured with rope. Some received CGI; however, most have stored the CGI for later use.
- **Most structures are built in stages: a)** start with large poles, with tarp to cover the main structure, **b)** more poles/weave with thin wood added, c) mud adobe added later. However, it was unclear when these were going to be improved, as there was an indication that residents were waiting for blocks. In addition, those consulted expressed a strong preference for sawn timber roofing materials.
- **Kitchens:** Some families are building traditional round kitchens before the rains. A typical kitchen is made of forest poles, thatch, adobe floor and wall covering. Msasa bark is used to tie it together.[10] Varying types of adobe, from light red to deep black.
- **Public areas:** A few homes have constructed open gathering structures.[11]
- **Economic recovery:** A pubic trading square has been demarcated, and families are investing into the construction of small trade shops. For example, one family had collected about 50 large poles for a small store. In about three days, one family constructed a clay oven, using about half a bag of flour to make 400 loaves of bread per day for the local market.
- **Church** (30m^3): Constructed using joined pine trusses (5x15cmx6m pieces) purchased in Chimoio by the local Church, and renting local transport. Priest brought the wood by renting transport.

Administrative Post	Province	Families	Individuals	Average individuals per family	% of total (family)	Cumulative %
Buzi	Sofala	5,170	27,443	5.3	31%	31%
Sussundenga	Manica	4,601	22,749	4.9	27%	58%
Chibabava	Sofala	1,807	9,206	5.1	11%	69%
Dondo	Sofala	1,357	5,997	4.4	8%	77%
Maganja Da Costa	Zambezia	1,280	5,571	4.4	8%	84%
Nhamatanda	Sofala	860	4,878	5.7	5%	89%
Nicoadala	Zambezia	660	3,292	5.0	4%	93%
Cidade De Tete	Tete	565	2,832	5.0	3%	97%
Namacurra	Zambezia	408	1,240	3.0	2%	99%
Mutarara	Tete	175	876	5.0	1%	100%
Grand total/average		16,883	84,084	5.0	100%	

Table 5. Number of families and individuals in resettlement camps by administrative post and province.

[8] Community members highlighted that the best material for blocks was from the termite mounts (called mumushé or majuro and, although very strong, the perception is it is harder to work with and thus some don't use it.
[9] The administrative post plans to drill 15 boreholes in 9 surrounding camps, and is opening that bidding process.
[10] Msasa is viewed as an insect-prone wood, and not used for construction, but rather firewood, charcoal, temporary structures and tie-downs (bark).
[11] Known locally as *Machesas*.

Residents of the resettlement camps have found ways to jump start economic activity, including bread ovens. Bread is sold to neighbors in the camp.
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Estimated gap, target number of households and materials

Since partners are still planning longer-term solutions, figures on total timber, poles and bamboo needed were not available. Therefore, the assessment used available data, projected material needed per typology, and used various assumptions starting with the 239,731 figures. The assumptions for the projection include:

- Current programming materials (see table 2 above) have been sourced, or will shortly be sourced, thus are not included in the calculations.
- Flooded homes do not require timber, poles and/or bamboo (less 15,784).
- Of the affected, 20% have already recovered materials, and will not need additional support for timber, poles and/or bamboo (less 44,789).
- Conventional homes will require conventional solutions.
- Half of mixed homes will require conventional solutions (shift 20,202 homes to conventional rebuild, the rest are rebuilt as mixed).
- Nearly all affected families that were displaced into resettlement camps lived in traditional homes that were totally destroyed, will be slated for full rebuilds, and thus will require conventional solutions (shift 16,883 homes from traditional to conventional).
- Half of former traditionally built homes will have conventional solutions (shift 31,900 from traditional to conventional).

The projection indicates that timber, poles and bamboo will be needed for 179,158 households, of which 127,056 homes will be conventional, 20,202 mixed and 31,900 traditional (Table 6). The total number of conventional block homes targeted for rebuilding (71%) is close to the PDNA figure of 60% of the total affected.

The projection indicates that timber, poles and bamboo will be needed for 179,158 households, of which 127,056 homes will be conventional, 20,202 mixed and 31,900 traditional

In order to calculate the amount of timber, poles and bamboo needed, the assessment summarized the four cluster typologies. Annex 3 provides a summary of the sample materials needed for each typology including estimates for fire block production, rafters, purlins, wall plates and covering. Traditional houses require 85 poles and 200 bamboo sticks, mixed homes require 0.57m^3 of timber, and conventional (one-pitched of burnt or cement block) require 0.36m^3 of timber. The mixed home typology requires more timber due to the hipped roof structure and reinforcements. The total estimated need for timber is 57,255m^3; 1,355,742 poles and 2,232,987 bamboo sticks.

Traditional houses require 85 poles and 200 bamboo sticks, mixed homes require 0.57m^3 of timber, and conventional (one-pitched of burnt or cement block) require 0.36m^3 of timber.

The total estimated need for timber is 57,255m3; 1,355,742 poles and 2,232,987 bamboo sticks.

Assumptions	Conventional	Mixed	Traditional	Total
Assessment totals	77,851	55,765	106,115	239,731
Projected needs				
Less flooded homes	(5,261)	(5,261)	(5,261)	(15,784)
Recovery rate, 20%	(14,518)	(10,101)	(20,171)	(44,789)
Half of mixed become conventional	20,202	(20,202)		-
Resettlements become conventional	16,883		(16,883)	-
Half of remaining traditional become conventional	31,900		(31,900)	-
Total estimated needs	127,056	20,202	31,900	179,158

Table 6. Total estimated needs and assumptions by construction typology.

Large-girth msasa used to create burnt bricks. The bricks are stacked in blocks, covered in mud, and heated.
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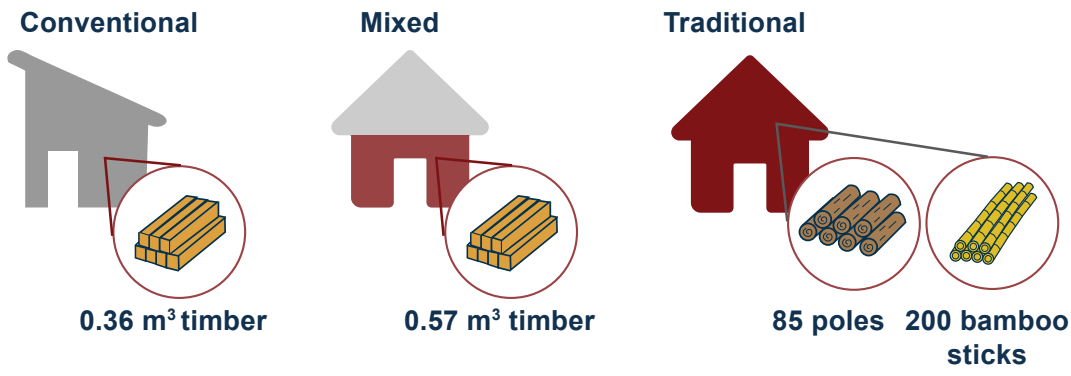


Figure 5. Quantity of material required by construction typology for one house.

Burnt brick
environmental implications

Although a detailed environmental analysis is beyond the assessment scope, data was collected to better understand possible wood needs for burnt brick production. The estimated cost of producing burnt bricks is significant, and a more detailed assessment should be done. Interviews in Dombe indicated that to produce 20,000 burnt bricks (~ 3 homes), two tons of firewood would be needed. For every 100 homes, 30 tons of large-girth msasa tree trunks would be needed. Additional information includes:

- Low, flat burnt blocks (12cm x 8cm x 25cm) are produced and sold for the local market for $0.02 each.
- Typically, a small "business" is funded by locals with access to small amounts of capital.
- The business rents a small truck for about $24 and pays firewood collectors for the wood. The total cost (two loads of firewood, $32, and transport, $24) is $56 to make about 5,000 blocks.
- An average of 6,000 blocks are needed per house (range given was 5,000 to 7,000 blocks for one 6x3m house), which would be covered with 10 CGI sheets.[12]

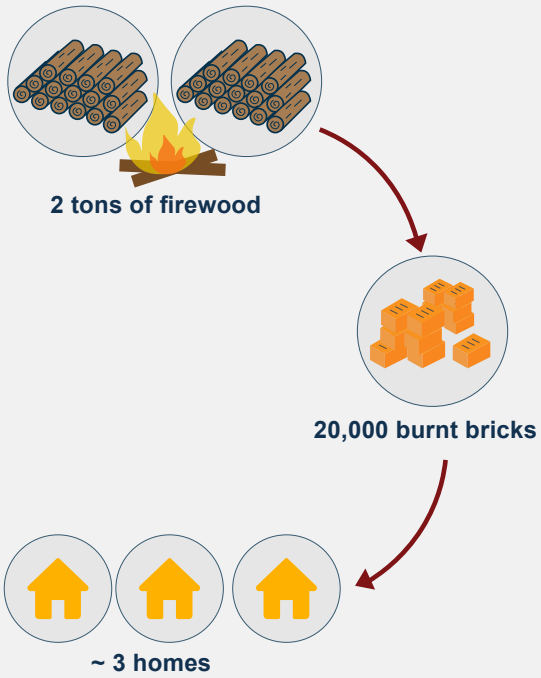
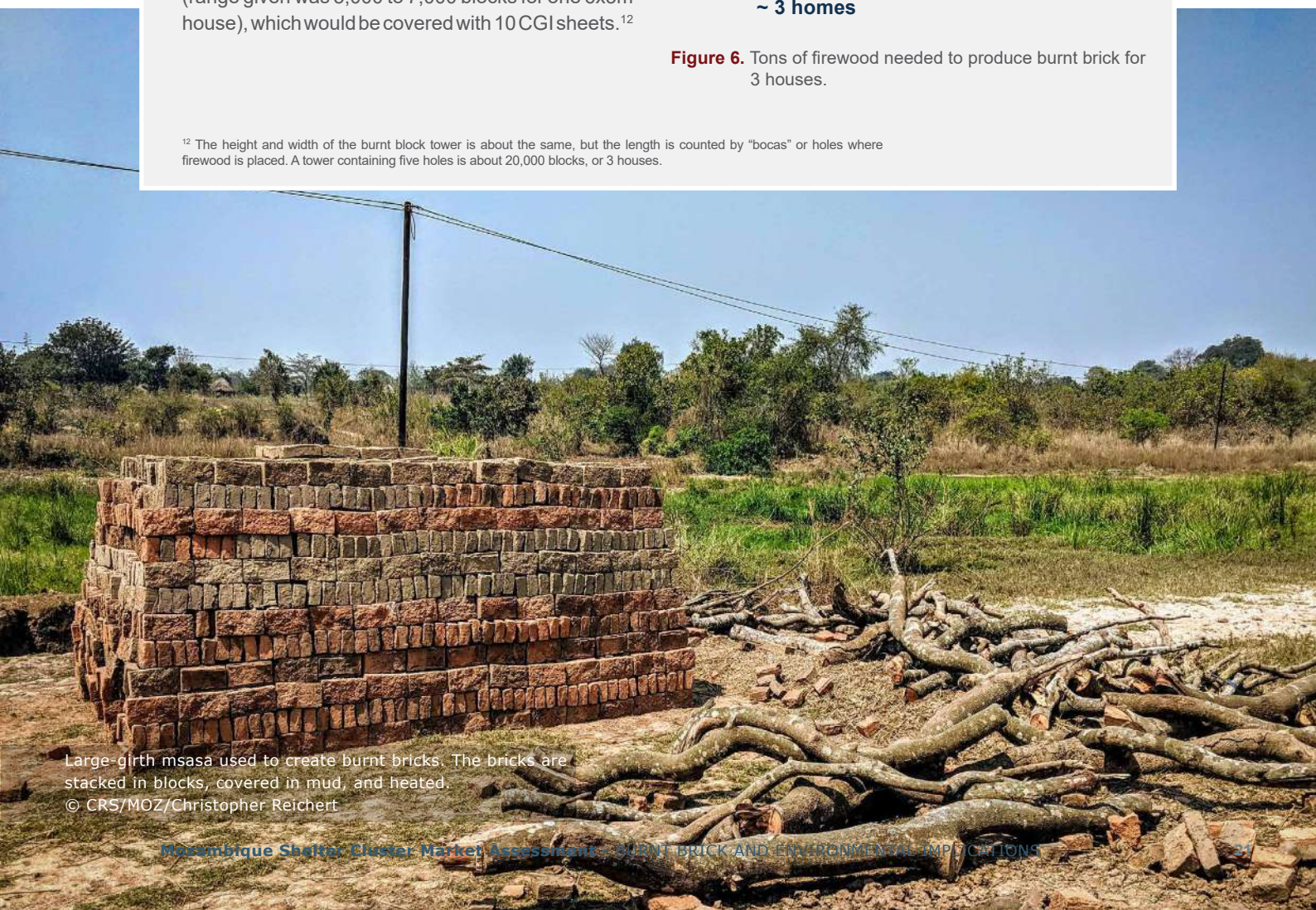


Figure 6. Tons of firewood needed to produce burnt brick for 3 houses.

[12] The height and width of the burnt block tower is about the same, but the length is counted by "bocas" or holes where firewood is placed. A tower containing five holes is about 20,000 blocks, or 3 houses.



Large-girth msasa used to create burnt bricks. The bricks are stacked in blocks, covered in mud, and heated.
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Members of the data collection team conducting the market survey with an informal vendor near Sussendunga, Manica.
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Market data

The Market summary. The quantitative portion of the survey included 99 vendors across two provinces and eight markets, which are summarized in table 7.

Market	Interviewed	Access/location	Road condition	Market type	Distance from Beira/Chimoio
Beira	51	Along main trade artery on coast	Good along main arteries, dirt in periphery	Coastal port, provincial capital with central business district and many peripheral markets	0km/217km
Chimoio	8	Along main trade artery bordering Zimbabwe	Very good condition, easy access	Provincial capital with central business district, thinner market than Beira	217km/0km
Dondo	13	Along main trade artery	Good along main arteries, dirt in periphery	District capital market	53km/169km
Nhamatanda	8	Along main trade artery	Good along main arteries, dirt in periphery	District capital market	107km/100/km
Dombe	4	Far from main artery	Good paved road, however large lorries cannot use main route due to curves	Administrative post sub-market	280km/131km
Mafabise	6	Along main trade artery	Good along main arteries, dirt in periphery	Administrative post sub-market	57km/152km
Tica	5	Along main trade artery	Good along main arteries, dirt in periphery	Administrative post sub-market	76km/127km
Mbuzi	4	Further from main artery	Poor access, paved/dirt	District capital market (sub-market)	152km/204k

Table 7. Market summary.

[10] Msasa is viewed as an insect-prone wood, and not used for construction, but rather firewood, charcoal, temporary structures and tie-downs (bark).
[11] Known locally as *Machesas*.

VENDOR PROFILE. The vendors were categorized into formal and informal, the former defined by the presence of a permanent structure, usually including solid walls, and the latter an open-air sales point, which may include a covering, but not solid nor permanent feature. Over two-thirds of the vendors found in the market were informal (68%), and were often characterized by very small roadside street-shops with small stocks, limited turnover, and no bank access (only one-third claimed to have a bank account). Formal shops were mainly run by larger chains such as Construa and Lucky Trading, which have branches across the two provinces. Over 80% of formal vendors had bank access. Construa stocks treated timber from South Africa, and Lucky Trading deals in local untreated timbers. It's salient to note that in Chimoio only Construa stocked timber, and the informal market dominated timber sales in this market. Very few formal shops stocked poles or bamboo. Overall, there were very few "opportunistic businesses," as only 14% of the vendors had started after Idai. That said, less than half (47%) had more than five years in business. The data indicate the aphorism rings true – "cash is king." Payment options are dominated by cash on order (45%), mobile payments (39%), and bank transfers/checks (32%). Terms are limited, as two-thirds (64%) required 100% pre-payment, and only 6% permitted payment upon delivery without an advance. During key informant interviews, even large chains were hesitant to consider purchase-order arrangements. However, notable exceptions include IFLOMA and Lucky Trading.

MATERIAL SUPPLY/TYPES. Of the vendors surveyed, over half sold timber (55%), nearly half offered poles (46%) and one-third sold bamboo (34%). The vast majority of the timber found in the markets was untreated pine from INFLOMA (approx. 80%), supplemented by imported pine (South Africa, Zimbabwe and Malawi). Smaller amounts of other types of timber were also found, such as coco lumber (from Inhambane sold in Dondo) and mangrove. Regarding poles, the two most common types found were locally sourced "forest poles," (likely msasa) and exotics, usually called "Eucalyptus," ranging from 2 to 6 meters. Bamboo ranged from 2cm to 4cm in width and 3 to 4 meters in length, usually sold in bundles of 10.

Over two-thirds of the vendors found in the market were informal (68%), and were often characterized by very small roadside street-shops[13] with small stocks, limited turnover, and no bank access (only one-third claimed to have a bank account).

STOCK (table 8). Vendors current total stock is estimated at nearly 50,000 items, half in timber (23,697), a quarter in poles (12,380), and a quarter in bamboo (12,720). Formal shops hold most of the timber (15,759), whereas informal shops hold most of the poles (11,630) and bamboo (12,420). Current timber stocks could yield enough for about 500 houses,[14] poles could yield enough for 180 houses,[15] and bamboo for 85 houses.[16] Stock-outs and delays are common, unless pre-payment for shipments is made. IFLOMA agents may be able to better supply areas as they are able to access a limited line of credit.

Vendor type	Stock			Average clients/week			Average cost/client		
	Bamboo	Poles	Timber	Bamboo	Poles	Timber	Bamboo	Poles	Timber
Formal	300	750	15,759	12	13	33	$3.23	$24.39	$57.93
Informal	12,420	11,630	7,938	41	29	25	$3.65	$4.55	$11.30
Total or average	12,720	12,380	23,697	40	28	29	$3.64	$5.93	$32.02

Table 8. Stock, client turnover and client spending by vendor type.

[13] Called *estaleiros*.
[14] Assumptions: 50% of the total timber is suitable for needed rafters and purlins (size, quality, type); a house requires 12 pieces of 6m timber; and surge demand could only take a maximum of 50% of remaining stock (due to other buyers. (23,697 * 50% / 12pieces * 50%) = 514 houses
[15] Assumptions: 90% of total pole stock is suitable for needed vertical/horizontals, each house requires 50 poles, and surge demand could take up to 80% of remaining stock (more elastic than timber). (12,380 * 90% / 50 pieces * 80% = 178 homes
[16] Assumptions: 100% of total pole stock is suitable for needed walling, each house requires 150 bamboo sticks, and surge demand could take up to 90% of remaining stock (more elastic than timber). (12,420 * 100% / 150 pieces * 10% = 82 houses

CLIENTS AND SPENDING (table 7). The average number of clients for timber and poles is about one-third lower than bamboo (30 vs 40 clients per week), but average spending per client is about five times higher ($32.02 vs $5.93). It appears that informal vendors cater more to piecemeal construction, whereas formal shops deal in larger bulk and values.

PRICING (table 9). Prices are commensurate with material size, quality and vendor type. Assessed timber ranged from $6.25 to $18.88 (5cm to 15cm), poles from $1.19 to $7.31, and bamboo $0.31 to $0.40. On average, informal vendor pricing was 76% of formal vendor pricing, which is likely a function of VAT (17%) and vender overhead.

Regarding retail, wholesale and Idai impact, the data indicate important market pricing differences showing increased average prices post-Idai (8% increase, but 13% for structural materials), and possible savings in wholesale (4%). Timber and prices increased an average of 14% and 12%, respectively, and bamboo prices were static. Tables 9 and 10 provide retail and bulk prices average (table 10) and by each item (table 11).

PRICES BY MARKET (table 12). Timber prices increase from the main origin source in Manica (IFLOMA) an average of 168%, but range from 141% to 235%. For the most common sizes (7.5 and 10 cm), the largest price premium was found in Dondo, which may reflect that most of the vendors were formal vendors.

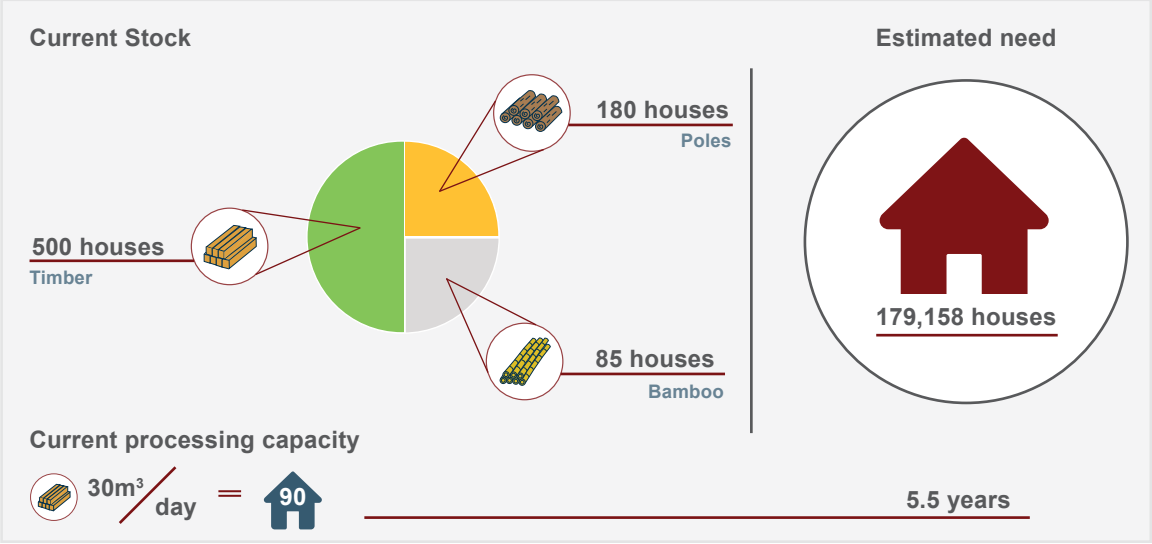

Figure 7. Current stock of material and estimated need.

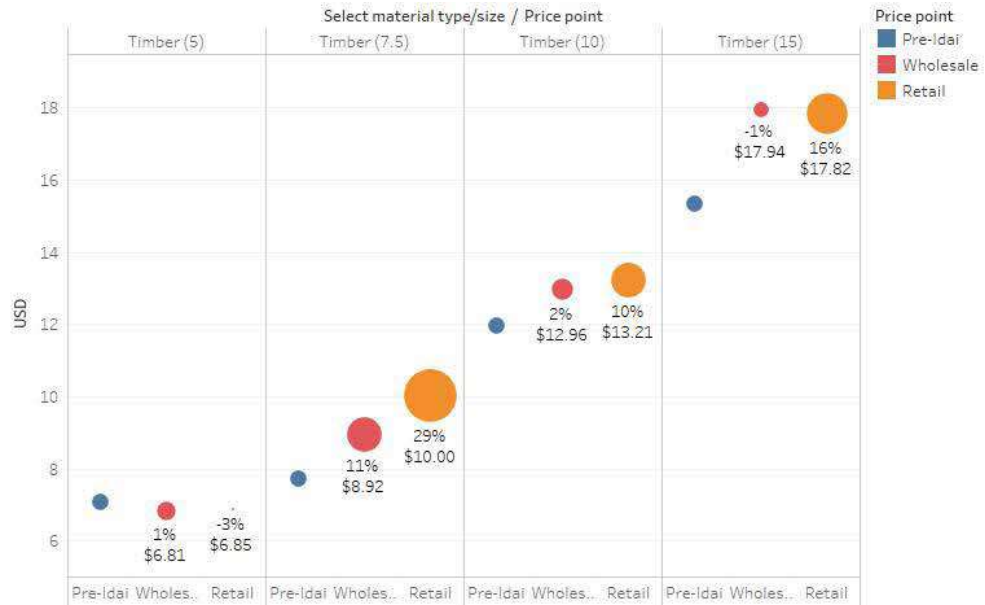

Figure 8. Average prices (pre-Idai, post Idai whole-sale and retail) and % increase from pre Idai prices (size of bubble) by material item.

Material (size in cm, or relative size)	Formal	Informal	Average	Informal/Formal %
Timber (15)	$18.88	$15.56	$17.82	82%
Timber (10)	$13.82	$12.27	$13.21	89%
Timber (7.5)	$11.25	$8.33	$10.00	74%
Timber (5)	$7.31	$6.25	$6.85	86%
Pole (lg)	$ -	$2.98	$2.98	NA
Pole (med)	$4.03	$1.84	$1.91	46%
Pole (sm)	$ -	$1.20	$1.20	NA
Bamboo	$0.40	$0.31	$0.31	77%
Average				76%

Table 9. Average retail prices by material type and vendor type

Figure 9. Average retail (pre-Idai and current) and wholesale prices by material item.

Select material type/size	Pre-Idai	Retail	Wholesale	% change	% wholesale savings
Bamboo	$0.32	$0.31	$0.29	0%	8%
Pole (sm)	$1.19	$1.20	$1.12	1%	6%
Pole (med)	$1.72	$1.91	$1.87	11%	2%
Pole (lg)	$1.98	$2.98	$2.89	50%	3%
Timber (5)	$7.08	$6.85	$6.81	-3%	1%
Timber (7.5)	$7.72	$10.00	$8.92	29%	11%
Timber (10)	$11.96	$13.21	$12.96	10%	2%
Timber (15)	$15.32	$17.82	$17.94	16%	-1%

Table 10. Average retail (pre-Idai and current) and wholesale prices by material item.

Pine wood including origin tag from IFLOMA plantation, Beira.
© CRS/MOZ/Christopher Reichert

Material	Pre-Idai	Retail	Wholesale	% change	% savings
Bamboo	$0.32	$0.31	$0.29	0%	8%
Poles	$1.55	$1.76	$1.79	14%	-2%
Timber	$10.62	$11.84	$11.23	12%	5%
Average	NA	NA	NA	8%	4%

Table 11. Average retail (pre- and post-Idai) and bulk prices by material type.

Location	Timber prices				% cost of IFLOMA				Total ave
	5cm	7.5cm	10cm	15cm	5cm	7.5cm	10cm	15cm	
IFLOMA	$4.19	$5.52	$8.27	$11.05	100%	100%	100%	100%	100%
Buzi	$8.87	$10.48	$11.69	$18.55	212%	190%	141%	168%	178%
Tica	$6.05	$9.68	$12.10	$14.11	144%	175%	146%	128%	148%
Beira	$7.12	$10.09	$12.56	$17.53	170%	183%	152%	159%	166%
Chimoio	$5.91	$10.71	$13.49	$20.57	141%	194%	163%	186%	171%
Nhamatanda	$5.91	$7.96	$14.11	$15.97	141%	144%	171%	145%	150%
Dondo	$7.96	$12.98	$15.37	$19.78	190%	235%	186%	179%	197%
Average	$6.97	$10.32	$13.22	$17.75	166%	187%	160%	161%	168%

Table 12. Average timber prices and % cost from IFLOMA base prices by market

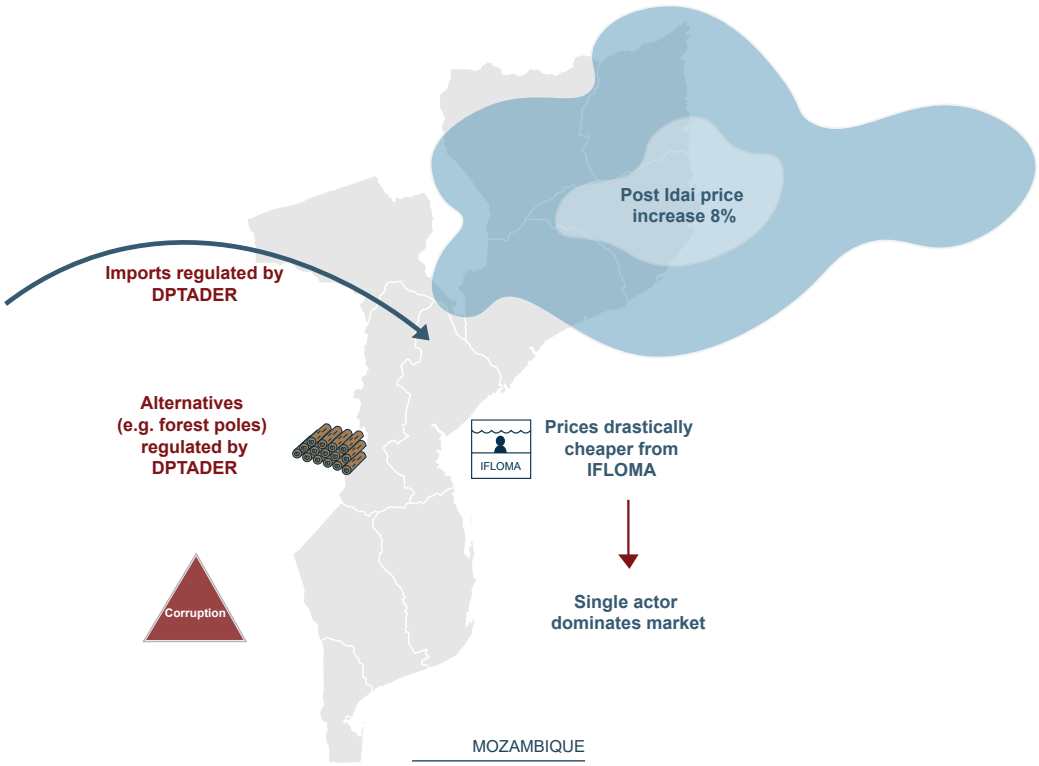

Figure 10. Timber market environment.

Typical informal vendor and storage conditions found alongside roads, Beira.
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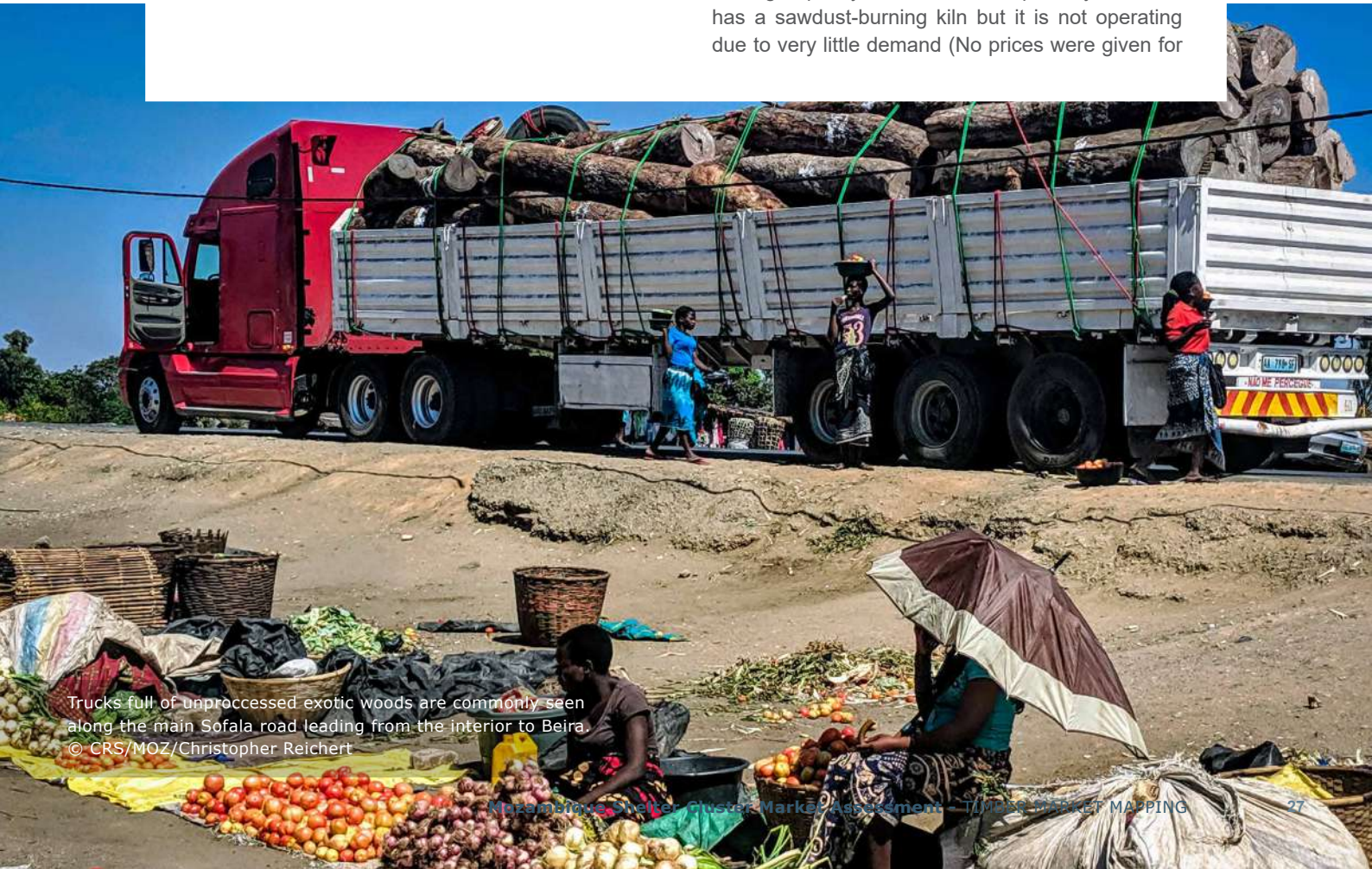
Timber market mapping

MAP. Annex 4 provides a summary market map of the timber market including the environment, market chain, and infrastructure, inputs and services. The market environment is regulated by the GoM. Interviewees highlighted that although a high level of corruption can be found in the precious woods market (e.g. ironwood, rosewood and mahogany), relatively little corruption is found in the exotic construction timber market (pine, eucalyptus, etc). Licensing and material movement in the domestic market is easier than the precious woods market. As mentioned in the section above, pricing is drastically cheaper directly from IFLOMA than other suppliers, as IFLOMA wood dominates the market. Regarding infrastructure, inputs and services, the domestic market is relatively undeveloped. In-country processing capacity is very low, along with stock levels. Both informal and formal vendors maintain low stock levels to limit exposure, but also to avoid loss (due to timber degradation in a low-turnover market). Only a few vendors maintain proper storage facilities (e.g. horizontal stacking, off-the-ground, dry, covered), such as Construa. Even the assessed IFLOMA agent did not maintain ideal storage of timber. Observations in the markets showed that warped, off-cut, and second-cut wood was common.

Market chain

IFLOMA is the main integrated pine timber player in the affected area, focusing on raw material production, value addition, exploration licensing, agent licensing and consumer retail. IFLOMA manages a large swathe of land covering 31,000 hectares, 50% pine and 50% eucalyptus. IFLOMA says it is able to bring in South African timber, and is considering supplementing its domestic production. IFLOMA views Zimbabwe pine producers as its main competitor in terms of quality, however, production has decreased during the economic crisis and costs are higher. Efforts to reach three Zimbabwe pine producers through telephone and email were not successful. Malawi pine is viewed as inferior and has varying output levels. Threats to IFLOMA production include fire and the cyclone season, for example, wind and flooding destroyed about 240 hectares in 2019.

IFLOMA maintains a sawmill, kiln and treatment facilities. Current processing facilities are limited to two mobile saws, which have a sawing capacity of 30m^3 per day, or slightly more than one, 30-ton truck. IFLOMA's main saw was not functioning during the assessment, but the plan is to quadruple sawing capacity to reach 120m^3 per day. IFLOMA has a sawdust-burning kiln but it is not operating due to very little demand (No prices were given for



Trucks full of unproccessed exotic woods are commonly seen along the main Sofala road leading from the interior to Beira.
© CRS/MOZ/Christopher Reichert

kiln-dried products). IFLOMA can treat 30m³/day with Chromated Copper Arsenate (CCA), and plans to obtain finger-joinery capacity.

Sales are divided into two main streams – exploration license/sales through agents and direct sales. First, IFOMA sells prepaid licenses to large buyers to explore a specific area, which is sold in cubic meters stipulated with a minimum purchase order of 200m³. The licensee cuts, transports and uses and/or sells the wood. IFLOMA currently has 15 exploration licenses, but plans to terminate these contracts, when the main saw is functioning. Currently, most of this timber under this contractual arrangement is sent to Tete, Maputo and Nampula. In addition to the exploration licenses (IFLOMA doesn't control quality, just quantity), IFLOMA holds consignment contracts with four agents in Chimoio, Nhamatanda, Vanduzi and Inchope. The agent line of credit is limited to just under $200, but IFLOMA plans to increase agents, especially in Beira.

Second, IFLOMA sells processed timber directly to consumers, middlemen and/or contractors. Of IFLOMA's ad hoc sales, 60% are through middlemen through prepaid purchases, 30% are direct retail to consumers, and the smallest portion (10%) is to large individual orders (resettlements due to mining exploration in Tete. Large-scale purchases can be arranged with terms, such as a two-week post payment plan.

Overall, IFLOMA sawed pine costs $242/m³. However, IFLOMA has a tripartite variable pricing structure driven by three main variables: length, value addition and quality. Annex 5 provides a comprehensive price guide. For first-cut, untreated key timber sizes (5x7.6cm, 5x11.4cm and 5x15.2cm), the prices are $141/m³, $192/m³, and $242/m³ depending on length, 90-270cm, 300-480cm and 510-660cm, respectively. Discounts are provided for second-quality timber (twisted plank, having knots and/or including edges with bark), 90-270cm is $108/m³ (24% discount), 300-480cm is $158/m³ (17% discount) and 510-660cm is $208/m³ (14% discount). IFLOMA says that the overwhelming demand is for 600cm lengths, even if the consumer ends up cutting it themselves.

Overall, IFLOMA sawed pine costs $242/m3. However, IFLOMA has a tripartite variable pricing structure driven by three main variables: length, value addition and quality.

Affected area	Total $ with VAT	Distance (kms)	$/km	$/ton[18]	$/cubic meter[19]	$/house[20] (18m²)	$/house[21] (27m²)
Beira	$566.13	271	$2.09	$18.87	$15.10	$5.47	$9.85
Nhamatanda	$518.95	168	$3.09	$17.30	$13.84	$5.02	$9.03
Dondo	$566.13	237	$2.39	$18.87	$15.10	$5.47	$9.85
Dombe	$754.84	279	$2.71	$25.16	$20.13	$7.30	$13.13
Buzi	$849.19	245	$3.47	$28.31	$22.65	$8.21	$14.78
Average	$651.05	240	$2.75	$21.70	$17.36	$6.29	$11.33

Table 13. Indicative transport (30-ton truck) pricing from IFLOMA to Idai-affected areas.

Material	m³	cost/m³	$/house	Transport	Total	%transp.
Rafters (12 pcs of 5x11.4, 3.3m	0.2257	$192.08	$43.36	$3.92	$47.27	9.0%
Purlins (6 pcs of 5x7.6, 6m)	0.1368	$241.94	$33.10	$2.37	$35.47	7.2%
Total	0.3625		$76.45	$6.29	$82.75	8.2%

Table 14. Calculations of base model house with IFLOMA pine and transport.

[17] Pietros also produces cement blocks. All blocks are 40 cm long and 20cm high, and cost ranges by width. (10cm, 22MT; 15cm, 25MT, and 20cm, 30MT).
[18] Total cost divided by 30 tons
[19] Assumes 1.25 cubic meters per ton (800kgs of pine per cubic meter)
[20] Assumes 0.3625 cubic meters of pine per house
[21] Assumes 0.6525 cubic meters of pine per house

Indicative transport costs from IFLOMA

Transport from IFLOMA (Manica) to the affected populations is important to consider. Thus, Pietros Transport,[17] one of the largest transporters in Manica province offering seventy 30-ton trucks, was interviewed to better understand cost implications. Pietros Transport is located near IFLOMA sawmills, has worked with IFLOMA before, and will consider purchase-order payment options. The total average cost to the affected areas is $651.05, ranging from $518.95 to $849.19 per 30-ton truck. Per kilometer costs average $2.75 and range from $2.09 to $3.47/km. The average cost of transporting timber for a single 18m2 or 27m2 house to the affected areas is $6.29 or $11.33 per house, respectively, assuming a full truck load). However, the rates range widely depending on destination, $5.02 to $8.21 per 18m2 house and $9.03 to $24.78 per 27m2 house. A key determinant of pricing includes the availability of back-haul, rather than distance. Table 13 provides a summary of the transport pricing to each target area, costs per km, per ton, per cubic meter and per house.

A base model home of 18m2 with one-pitched roof requires 0.3625m3 of timber, and costs $82.75 including transport to the average administrative post center. Transport costs average 8.2% of the total timber cost, or $6.29 per house. Table 14 provides a simplified projection of the total timber costs, based required rafters and purlins.

Additionally, a more detailed projection based on model variants is presented in Annex 6. The more detailed model variants may be useful for those agencies considering a range of timber solutions to understand how the selection will impact pricing and target number of households. The annex presents three variants (base model, base with bracing and base model with bracing, doors, and windows) for block and adobe models. The annex calculates the number of cubic meters of timber required, number of 30-ton trucks needed to transport the timber, and the estimated cost.

The assessment focused on collecting data related to construction timber and, in the interests of future sustainably, limited the main focus to widely available timbers, or pine. However, it is important to note that partners may have other options, depending on their strategic focus. For example, for those partners seeking alternative timber to pine, LevasFlor would be a very good option, especially if the partner strategy includes a strong environmental component.

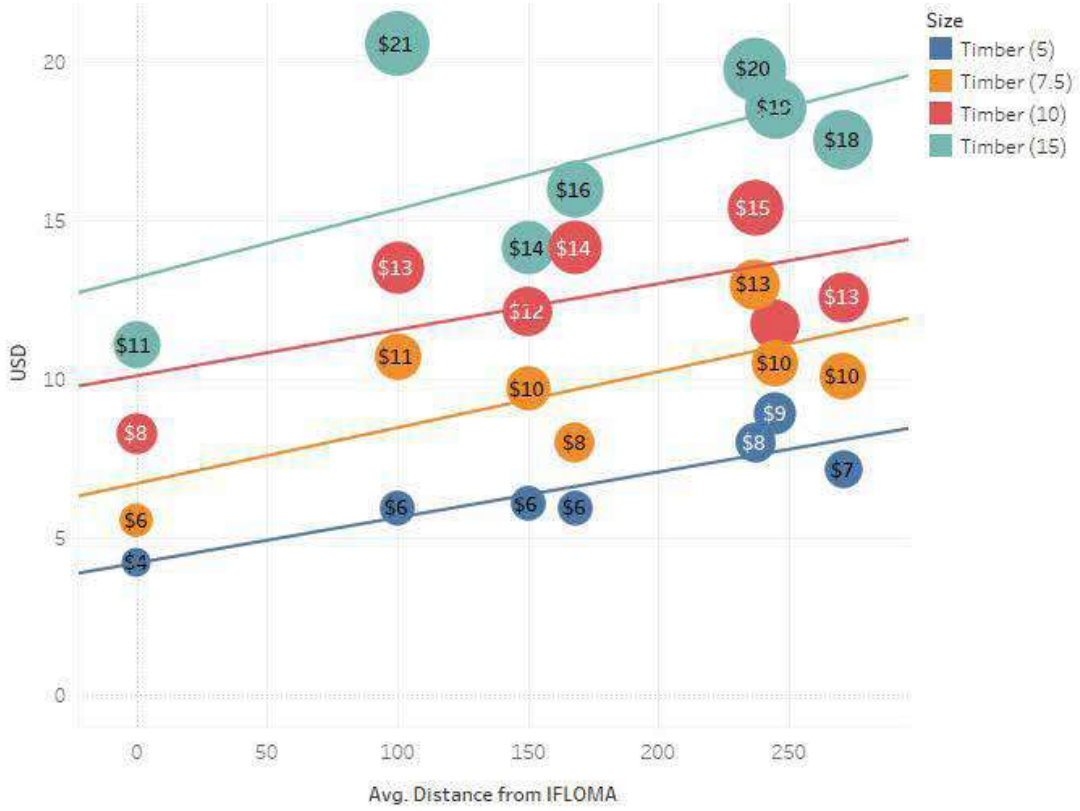


Figure 11. Price as distance from IFLOMA.

LevasFlor
(native forest concession)

LevasFlor has a large sustainable forest concession near Gorongoza National Park. LevasFlor manages 20 blocks in two districts, harvesting one block per year, and returning to that block 20 years later. The level of rigor appears high (for example, a GPS coordinate of each felled tree can be provided), as it is the only FSC-certified (since 2005) concession in Southern Africa. In 2018, commercial production was 8,000m3, of which about 70% is miombo. Logs are processed at one mill on-site, and timber is pressure treated. An on-site autoclave processes about 30m3 per hour, or the equivalent of 83 houses. Although LevasFlor does not own trucks, transport from their mill to Beira costs about $600 per 30-ton truck.

Advantages include: Only FSC-certified company in Southern Africa, specializes in sustainable harvest of native msasa timber products, and sells treated products.

Limitations may include: Cost ($645/m3 – nearly three times the cost of IFLOMA), production capacity, and community perception that miombo's use is for firewood, charcoal and bark ties, not construction timber.

Example of informal market storage conditions for timber, poles and bamboo, Dondo.
© CRS/MOZ/Christopher Reichert

Findings

Findings, organized by key research question:

1. What is the capacity of markets to supply material needs for the shelter upgrade to 100% of the target population?

Key finding: Although in-country availability of pine through IFLOMA is very high, output capacity is limited by the demand pipeline and current sawing capability. Supplemental findings include:

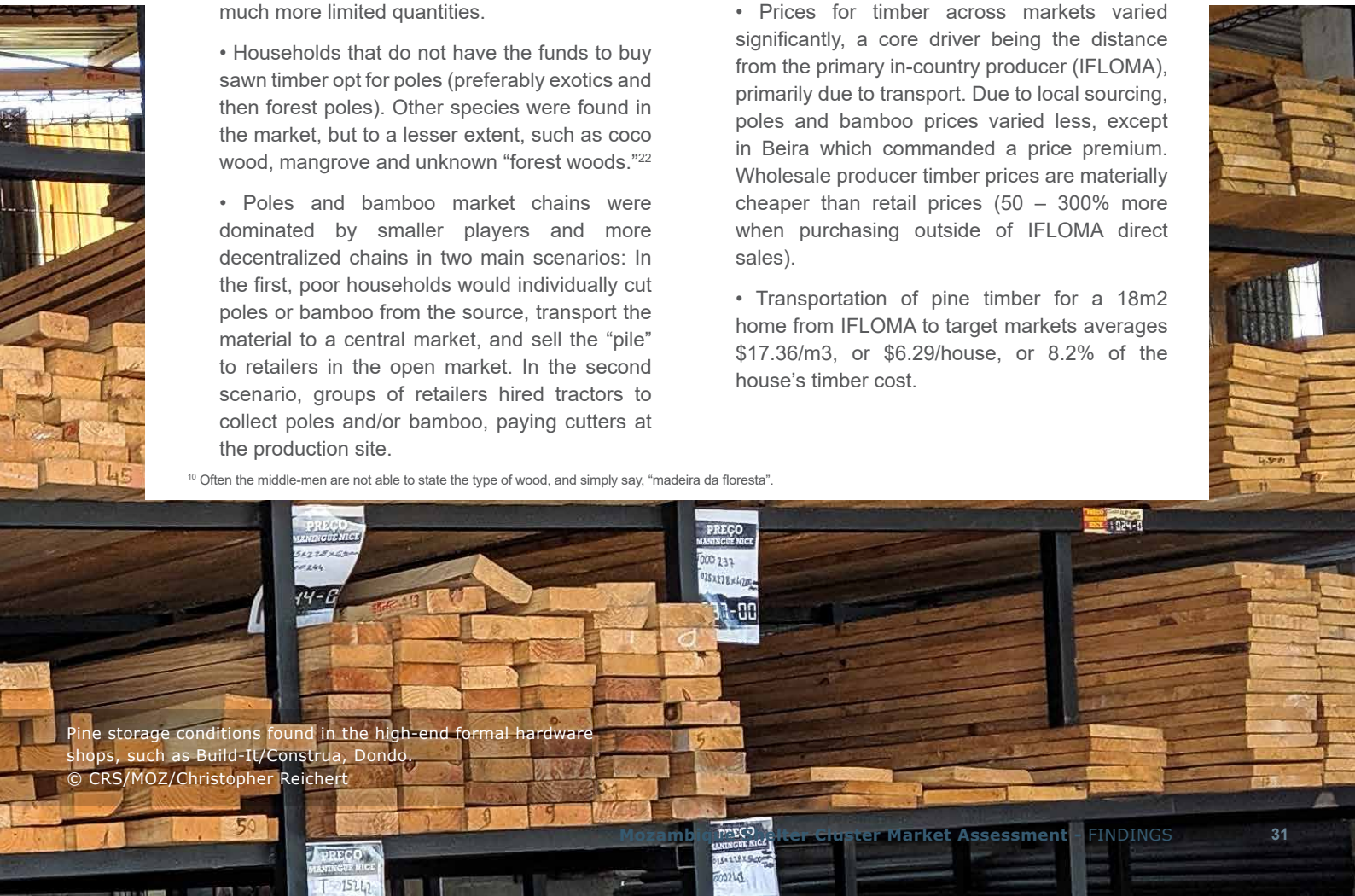
- Nearly all assessed items (timber, poles and bamboo) can be found in the markets to varying stock levels and quality. Distant markets off the value chain axis (Mbuzi and Dombe) have far less quantity and inferior quality. Current and projected stock will not meet the needs for timber, poles and bamboo.
- The timber market is dominated by untreated local pine from one producer (IFLOMA). IFLOMA operates across the value chain in four key links: production, sub-licensing, agents and direct sales. Treated higher-quality imported pine from South Africa and Zimbabwe can be found in the formal (South Africa) and informal (Zimbabwe) markets at higher prices and in much more limited quantities.
- Households that do not have the funds to buy sawn timber opt for poles (preferably exotics and then forest poles). Other species were found in the market, but to a lesser extent, such as coco wood, mangrove and unknown "forest woods."[22]
- Poles and bamboo market chains were dominated by smaller players and more decentralized chains in two main scenarios: In the first, poor households would individually cut poles or bamboo from the source, transport the material to a central market, and sell the "pile" to retailers in the open market. In the second scenario, groups of retailers hired tractors to collect poles and/or bamboo, paying cutters at the production site.

2. Is a market-based response appropriate for the shelter upgrade response?

Key finding: Market-based response should be an integral part of the response, but probably most appropriate for smaller projects with shorter timelines that include a strong component of quality control. Broad payment method options in Mozambique are limited, and few vendors expressed overt interest in vouchers. Supplementary findings:

- Nearly all vendors lack the capacity or the interest in post-payment systems. However, those that have expressed interest should be further canvassed for working modalities. Learning can be gleaned from current voucher programming.
- There is a strong preference among communities for construction timber rather than other roofing materials, such as forest or exotic poles. Local implementing partners and communities are not accustomed to using pine alternatives (e.g. treated msasa) for construction, and there were examples of active resistance to piloting alternatives.
- Prices for timber across markets varied significantly, a core driver being the distance from the primary in-country producer (IFLOMA), primarily due to transport. Due to local sourcing, poles and bamboo prices varied less, except in Beira which commanded a price premium. Wholesale producer timber prices are materially cheaper than retail prices (50 – 300% more when purchasing outside of IFLOMA direct sales).
- Transportation of pine timber for a 18m2 home from IFLOMA to target markets averages $17.36/m3, or $6.29/house, or 8.2% of the house's timber cost.

[10] Often the middle-men are not able to state the type of wood, and simply say, "madeira da floresta".



Pine storage conditions found in the high-end formal hardware shops, such as Build-It/Construa, Dondo.
© CRS/MOZ/Christopher Reichert

3. Are there risks associated with market-based response options for shelter upgrade? (deforestation, inflation, etc.)

Key finding: There are significant risks associated with market-based responses that may promote and/or accelerate burnt brick production. Price data from the study indicate a small risk of price inflation.

- Preliminary evidence suggests that burnt brick technology will have severe impacts on rebuilding efforts, as two tons of firewood (usually large truck of msasa) is used to create 20,000 bricks, or enough for three houses.
- For those organizations with a heavy emphasis on sustainable development, and broader fiscal leeway, strong consideration should be given to LevasFlor, the only FSC-approved vendor in Mozambique.
- There was little evidence of opportunistic trading, defined as those vendors setting up sales after the cyclones.
- Bamboo prices have been relatively unaffected by the cyclones, but construction materials have been affected. The massive pricing swings reported in other value chains (e.g. rosalite roof-sheeting) were not found in timber/poles.

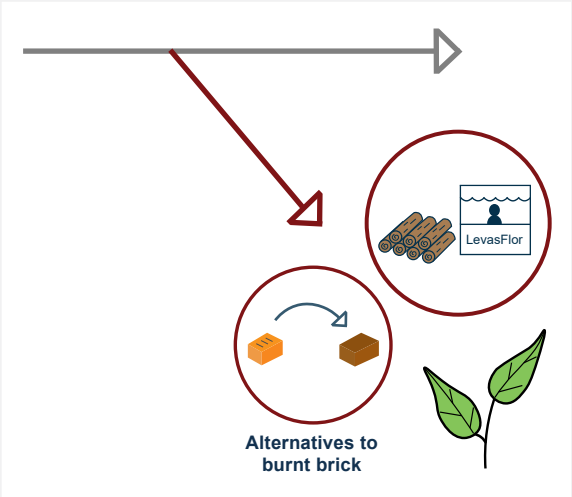


Figure 14. Alternatives to consider for a more sustainable approach.

Example of incremental building showing addition of kitchen to the main shelter in the resettlement camps, Manica.
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Example of a traditional kitchen found in the resettlement camps, Manica.
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Recommendations

The recommendation section includes a detailed list of options to consider, and also a set of variables to consider for each type of support—in-kind, voucher and cash—found in table 15.

1. Consider a mixed and phased approach for meeting the timber, pole and bamboo needs by layering in various mechanisms including conditional cash pilots, local in-kind purchases, regional in-kind purchases and international in-kind purchases.

2. Due to transport and logistical demands, bulk orders from IFLOMA make fiscal and logistical sense at a certain tipping point, which ranges from 50 to 100 houses, (depending on shelter size). Smaller pilots and project target number should consider local procurement, which the larger administrative posts should be able to support.

3. Larger-scale responses will need close collaboration with IFLOMA to ensure demand can be met and/or selecting multiple external suppliers. Relying on local market actors for large amounts of pine is not feasible.

4. Large-scale shelter response should opt for sawn pine timber or exotic poles, avoiding unsawn forest wood either for brick burning or roofing trusses and purlins due the environmental implications.

5. Smaller-scale staggered responses may consider using the current market players to meet the timber roofing needs; however, if in-kind distributions are not used, carefully monitor the procurement of materials to reduce the environmental impact. For example, consider conditional cash transfers (if permitted) to ensure exotics are prioritized over forest poles.

6. For smaller-scale responses, consider piloting a shelter kit voucher program with an established retail store, such as Lucky Trading or Construa, which has multiple branches. Start with those homes closest to the retailer, providing for transport (e.g. cash for transport – hand-carts, motorbikes, etc). Although some retailers have expressed interest, their concern is payment and liquidity.

7. Quality control of timber will be a crucial component of any intervention. The markets contain a variety of qualities, including second-tier pine sold by IFLOMA. If second-tier pine cuts are permissible for the home designs, this may be a way to reduce costs further.

8. Of the three market chains assessed, bamboo is the best candidate for a market-based response in those communities: a) that habitually use bamboo for walls/ceiling, b) live close enough to the bamboo source. The cash injection would feed disposable income to those in the local value chain and relieve support organizations from the logistical complications already incurred by bamboo procurements.

9. Consider supporting and/or lobbying for increased sawing capacity with IFLOMA, and supporting local vendors on storage capacity and methods.

10. During distributions, provide educational support to beneficiaries on choosing materials, particularly around quality (storage, off-cuts and end-user storage).

11. Considering a larger environmental impact study of burnt bricks approach for construction prior to designing programs with burnt brick technologies.

Variables	In-kind	Voucher	Cash
Number of households	Higher	Medium	Smaller
Cost-effectiveness versus market support	Cost-effective from supplier, bulk order	Cost-effective from supplier agent, individual orders	Logistically simpler once system in place
Distance	Far from major transport axis/ markets	Midway, for medium densities (few vendors to implement system)	Higher density areas with higher number of shops
Needs	Most vulnerable	Mix	Self-recovery
Phasing	For large early support to beneficiaries	Complement the in-kind contribution with voucher system early on, and scale up or down depending on ability to shift to cash	Start with smaller pilot projects and, as market's ability to supply increases, shift to cash.
Pros	Able to meet large demand needs at once; negotiate prices; monitor quality at few checkpoints	Provides level of control of material procured (number/quality), supports local market	Best matches materials with need (family chooses; possible quickest way to deploy resources, assuming a fiscal control mechanism)
Cons	Bypasses local market which would benefit from cash injection; may take more time to source materials; sawing ability of producer	Little interest from informal vendors; slight interest from formal vendors; may not match material with need	Less experience/interest; few models/examples in Mozambique; less useful in thin markets such as Dombe/Mbuzi

Table 15. Variables to consider by program support type.

Figure 15. Variables to consider by program support type.

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Residents of coastal region come to terms with devastating cyclone. A girl navigates the rubble of her house destroyed by Cyclone Idai. She and her family are staying in the house of a neighbor until they are able to rebuild.
© UNHCR/MOZ/Alissa Everett

Annex 1. Summary of TOR Shelter Cluster

Assessment Summary

Geographical coverage:	Sofala province: Beira, Buzy, Dondo and Nhamatanda districts. Manica province: Chimoio district (mainly acting in Posto adminitrativo Dombe)
Study Purpose	Provide market analysis that will inform assistance modality decisions; support contingency planning and contributetowards advocacy with government.
Primary Methodology	EMERGENCY MARKET MAPPING AND ANALYSIS (EMMA) based methods approach

1. Purpose, Objective and outcomes of the market assessment

Overall purpose – Shelter cluster will use the market assessment findings to support decision making and advocate to the government and other stakeholders regarding appropriate modality options (in-kind, service provision, market support, voucher and multi-purpose cash) for shelter reconstruction. The assessment objective is to provide evidence as to whether the timber and bamboo market and related services could supply sufficient products to disaster affected populations in terms of quantity and quality.

Key answers to reply:

• What is the capacity of markets to supply Timber and bamboo for the Shelter upgrade to 100% of the target population?

• Is a market-based response appropriate for the Shelter upgrade response?

• Are there risks associated with market-based response options for Shelter upgrade? (deforestation, inflation, etc)

• How can the market based response can merge with self-cutting of local available?

2. Shelter cluster will use the market assessment findings to:

• Provide evidence-based recommendations for intervention in response to Idai.

• Identify what actions stakeholders need to take during pre-crisis times to strengthen local markets so they are better able to adapt and respond to a markets based humanitarian response.

• Adapt organisations contingency plans based on the findings.

The outcome will be an analysis of the timber and bamboo market baseline and the impact of Cyclone Idai in the timber/ bamboo market in Sofala Province (Beira, Buzi, Dondo and Nhamatanda) and in Manica Province (Dombe). As well, aiming for a clear understanding whether the markets can respond or not to the existing and possible increase of the demand for reconstruction.

3. Proposed market assessment methodology

The reference approach recommended is Emergency Market Mapping and Analysis (EMMA) The methodology will entail comparative analysis of market places and prices and supply chain mapping before and after the disaster. Data should be sourced from secondary sources, key informant interviews, focus group discussions, trader surveys, household interviews and observation as appropriate.

3.1 Geographic scope: The assessment will be conducted in Beira, Dondo, Nhamatanda, Buzi and Sussundenga districts affected by Cyclone Idai.

3.2 Research questions – orientative:

• What is the market map baseline, before Cyclone Idai and now, after the disaster?

- o Identification of major local, regional and, if applicable, distant markets.
- o assessment of size of markets, volume of sales, market integration/segmentation.
- o market actors (consumers, sellers, traders, middle-men) behaviour.

- **o** prices, procurement mechanisms, market requirements (standards, conditions for delivery).
- **o** impact of Cyclone Idai on local markets and its dynamics, Impact on price and availability of using sustainably sourced and plantation timber.
- **o** support services and identifying the enable environment.

• What is the current and projected DEMAND for timber and bamboo?

• Can DEMAND access supplies safely, now and during all recovery phase?

• Can Supply meet DEMAND, now and during all recovery phase?

• What constraining or enabling factors affect the local markets, now and during all recovery phase, including current environmental and other government regulations?

• Identify environmental impact of the changes in the demand/ supply including current environmental and other government regulations.

4. Tasks

• Desk review of key situation analysis reports, and market assessments that have been carried out in the past three years for Mozambique, with a focus on documentation related to the selected districts in the country, legal and governmental regulations that will affect timber supply.

• Design of the assessment methodology and data collection tools in consultation with Shelter cluster.

• Onsite data collection/ supervision of information collection.

• Data cleaning and data analysis, to produce the reports and charts requested by the project.

• Consultations with sector experts, on individual basis to interpret the findings.

• Reporting, the report will be 40 pages maximum (excluding annexes).

5. Deliverables. Reporting: the report will be 40 pages maximum (excluding annexes) and will include:

• A complete value chain baseline map for timber and bamboo showing who are the chain actors, stakeholders, supporters and influencers, how many they are, values and volumes handled, including a detailed stakeholders analysis.

• Representation of the post Cyclone Idai map, analysis and narrative on how the cyclone Idai has impacted the dynamics of the timber market .

• Recommendations about potential alternative response modalities, such as, service provision, market support, voucher and multi-purpose cash to support the decision making for shelter recovery interventions.

• Identification of possible improvements that can lead to stronger and more integrated markets.

• Risk analysis and mitigation measures recommended.

Annex 2. Estimated timber, poles and bamboo for 18m² home

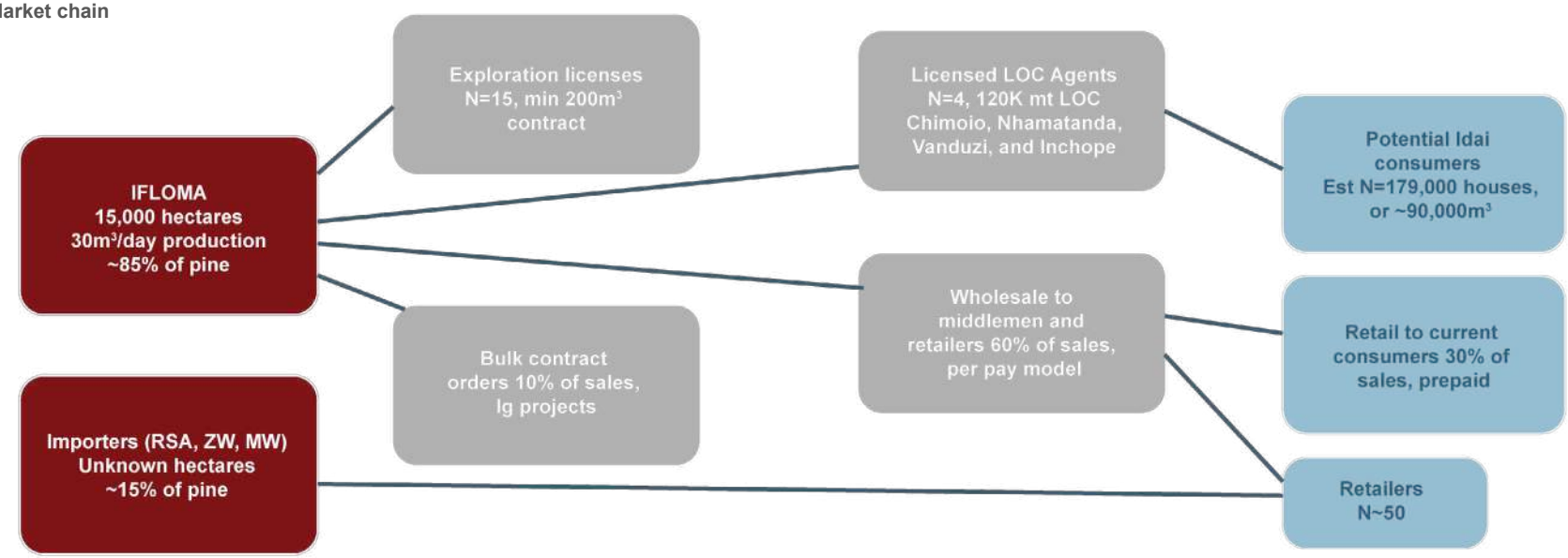
List of contacts (sorted by type and organization)

Description	Wattle and daub	Adobe block	Burnt brick	Compressed or cement block
	Pau-a-pique, exotic (e.g. eucalyptus) pole roofing, thatch; hipped roof	Fired block foundation/adobe block/hip roof; Fired blocks for foundation (3000), adobe blocks for walls, hipped roof CGI/ IBR	Burnt brick, one pitch roof of CGI/IBR	Compressed hydroform or cinder block, one pitch roof w/CGI/IBR
Approx cost	$200 - $300	$800 - $1000	$1,200 - $1,500	
Total wood for production (tons)	NA	1/4 ton firewood, ~ 30 large tree trunks	1/2 ton firewood, ~ 60 large tree trunks	NA
Total timber (m3)	NA	5x11.4mm - 2 pcs of 4.6m - 7 pcs of 3m - 13 pcs 3.3m	5x11.4mm - 12 pcs 3.3m 5x7.5mm - 6 pcs of 6m	5x11.4mm - 12 pcs 3.3m 5x7.5mm - 6 pcs of 6m
		5x7.5mm - 8 pcs of 6m Total m3 = .57	Total m3 = .36	Total m3 = .36
Total timber cost (mt)	NA			
Total poles	- 11 large 3m poles - 60, 3m med poles - 15, 3m small poles	NA	NA	NA
Total bamboo	200 pieces	NA	NA	NA

Annex 3. Construction timber market chain

Market environment

Market chain



Infrastructure, inputs, services

Annex 4. IFLOMA price list by treatment and size

IFLOMA price list by process and size

Length		50x152			50x114			50x76			38x228		
		WOS	WOSP	CCA	WOS	WOSP	CCA	WOS	WOSP	CCA	WOS	WOSP	CCA
0.9	90	$ 0.97	$ 1.19	$ 1.94	$ 0.73	$ 0.90	$ 1.45	$ 0.48	$ 0.60	$ 0.97	$ 1.11	$ 1.37	$ 2.21
1.2	120	$ 1.29	$ 1.45	$ 2.58	$ 0.97	$ 1.19	$ 1.94	$ 0.65	$ 0.81	$ 1.29	$ 1.47	$ 1.82	$ 2.95
1.5	150	$ 1.61	$ 2.00	$ 3.23	$ 1.21	$ 1.50	$ 2.42	$ 0.81	$ 1.00	$ 1.61	$ 1.84	$ 2.27	$ 3.68
1.8	180	$ 1.94	$ 2.40	$ 3.87	$ 1.45	$ 1.79	$ 2.90	$ 0.97	$ 1.19	$ 1.94	$ 2.21	$ 2.73	$ 4.42
2.1	210	$ 2.26	$ 2.79	$ 4.53	$ 1.69	$ 2.10	$ 3.39	$ 1.13	$ 1.40	$ 2.26	$ 2.58	$ 3.19	$ 5.16
2.4	240	$ 2.58	$ 3.19	$ 5.18	$ 1.94	$ 2.40	$ 3.87	$ 1.29	$ 1.60	$ 2.58	$ 2.95	$ 3.65	$ 5.90
2.7	270	$ 2.90	$ 3.60	$ 5.82	$ 2.18	$ 2.69	$ 4.37	$ 1.45	$ 1.79	$ 2.90	$ 3.32	$ 4.10	$ 6.63
3	300	$ 4.37	$ 5.13	$ 7.61	$ 3.27	$ 3.85	$ 5.71	$ 2.19	$ 2.56	$ 3.81	$ 4.98	$ 5.85	$ 8.68
3.3	330	$ 4.81	$ 5.65	$ 8.37	$ 3.61	$ 4.24	$ 6.27	$ 2.40	$ 2.82	$ 4.18	$ 5.48	$ 6.44	$ 9.53
3.6	360	$ 5.24	$ 6.16	$ 9.13	$ 3.94	$ 4.61	$ 6.84	$ 2.63	$ 3.08	$ 4.56	$ 5.98	$ 7.02	$ 10.40
3.9	390	$ 5.68	$ 6.68	$ 9.89	$ 4.26	$ 5.00	$ 7.42	$ 2.84	$ 3.34	$ 4.94	$ 6.48	$ 7.61	$ 11.27
4.2	420	$ 6.13	$ 7.19	$ 10.65	$ 4.60	$ 5.39	$ 7.98	$ 3.06	$ 3.60	$ 5.32	$ 6.98	$ 8.19	$ 12.15
4.5	450	$ 6.56	$ 7.69	$ 11.40	$ 4.92	$ 5.77	$ 8.55	$ 3.27	$ 3.85	$ 5.71	$ 7.48	$ 8.77	$ 13.00
4.8	480	$ 7.00	$ 8.21	$ 12.16	$ 5.24	$ 6.16	$ 9.13	$ 3.50	$ 4.11	$ 6.08	$ 7.98	$ 9.37	$ 13.87
5.1	510	$ 9.37	$ 9.05	$ 14.87	$ 7.03	$ 8.00	$ 11.15	$ 4.69	$ 5.34	$ 7.44	$ 10.69	$ 12.16	$ 0.02
5.4	540	$ 9.94	$ 11.29	$ 15.74	$ 7.45	$ 8.47	$ 11.81	$ 4.97	$ 5.65	$ 7.87	$ 11.32	$ 12.87	$ 17.95
5.7	570	$ 10.48	$ 11.92	$ 16.61	$ 7.85	$ 8.94	$ 12.47	$ 5.24	$ 5.97	$ 8.31	$ 11.95	$ 13.60	$ 18.94
6	600	$ 11.05	$ 12.55	$ 17.50	$ 8.27	$ 9.40	$ 13.11	$ 5.52	$ 6.27	$ 8.74	$ 12.58	$ 14.31	$ 19.94
6.3	630	$ 11.50	$ 13.18	$ 18.37	$ 8.69	$ 9.89	$ 13.77	$ 5.79	$ 6.58	$ 9.18	$ 13.21	$ 15.02	$ 20.94
6.6	660	$ 12.13	$ 13.81	$ 19.24	$ 9.10	$ 10.35	$ 14.44	$ 6.06	$ 6.90	$ 9.61	$ 13.84	$ 15.74	$ 21.94

Notes: WOS (cut), WOSP (planed), CCA (treated). 2nd cut wood discounts: .9m-2.7m is $108.40; 3-4.8m is $158.44; and 5.1 - 6m is $208.47.

Annex 4. IFLOMA price list by treatment and size

IFLOMA price list by process and size

Length		38x152			38x114			38x76			38x38		
		WOS	WOSP	CCA	WOS	WOSP	CCA	WOS	WOSP	CCA	WOS	WOSP	CCA
0.9	90	$ 0.74	$ 0.90	$ 1.47	$ 0.55	$ 0.68	$ 1.11	$ 0.37	$ 0.45	$ 0.74	$ 0.18	$ 0.23	$ 0.37
1.2	120	$ 0.98	$ 1.21	$ 1.97	$ 0.74	$ 0.90	$ 1.47	$ 0.48	$ 0.61	$ 0.98	$ 0.24	$ 0.31	$ 0.48
1.5	150	$ 1.23	$ 1.52	$ 2.45	$ 0.92	$ 1.15	$ 1.84	$ 0.61	$ 0.76	$ 1.23	$ 0.31	$ 0.39	$ 0.61
1.8	180	$ 1.47	$ 1.82	$ 2.95	$ 1.11	$ 1.37	$ 2.21	$ 0.74	$ 0.90	$ 1.47	$ 0.37	$ 0.45	$ 0.74
2.1	210	$ 1.73	$ 2.13	$ 3.44	$ 1.29	$ 1.60	$ 2.58	$ 0.85	$ 1.06	$ 1.73	$ 0.34	$ 0.53	$ 0.85
2.4	240	$ 1.97	$ 2.44	$ 3.94	$ 1.47	$ 1.82	$ 2.95	$ 0.98	$ 1.21	$ 1.97	$ 0.48	$ 0.61	$ 0.98
2.7	270	$ 2.21	$ 2.73	$ 4.42	$ 1.66	$ 2.05	$ 3.32	$ 1.11	$ 1.37	$ 2.21	$ 0.55	$ 0.68	$ 1.11
3	300	$ 3.32	$ 3.90	$ 5.77	$ 2.50	$ 2.92	$ 4.34	$ 1.66	$ 1.95	$ 2.89	$ 0.84	$ 0.97	$ 1.45
3.3	330	$ 3.66	$ 4.29	$ 6.35	$ 2.74	$ 3.23	$ 4.77	$ 1.82	$ 1.82	$ 3.18	$ 0.92	$ 1.08	$ 1.60
3.6	360	$ 3.98	$ 4.68	$ 6.94	$ 2.98	$ 3.52	$ 5.21	$ 2.00	$ 2.34	$ 3.47	$ 1.00	$ 1.18	$ 1.74
3.9	390	$ 4.32	$ 5.06	$ 7.52	$ 3.24	$ 3.81	$ 5.63	$ 2.16	$ 2.53	$ 3.76	$ 1.08	$ 1.27	$ 1.87
4.2	420	$ 4.65	$ 5.47	$ 8.10	$ 3.48	$ 4.10	$ 6.06	$ 2.32	$ 2.73	$ 4.05	$ 1.16	$ 1.37	$ 2.02
4.5	450	$ 4.98	$ 5.85	$ 8.68	$ 3.74	$ 4.39	$ 6.50	$ 2.50	$ 2.92	$ 4.34	$ 1.24	$ 1.47	$ 2.16
4.8	480	$ 5.32	$ 6.24	$ 9.24	$ 3.98	$ 4.68	$ 6.94	$ 2.66	$ 3.13	$ 4.63	$ 1.32	$ 1.56	$ 2.31
5.1	510	$ 7.13	$ 8.08	$ 11.31	$ 5.34	$ 6.08	$ 8.47	$ 3.56	$ 4.05	$ 5.65	$ 1.77	$ 2.03	$ 2.82
5.4	540	$ 7.55	$ 8.58	$ 11.97	$ 5.66	$ 6.44	$ 8.97	$ 3.77	$ 4.29	$ 5.98	$ 1.89	$ 2.15	$ 2.98
5.7	570	$ 7.97	$ 9.06	$ 12.63	$ 5.97	$ 6.79	$ 9.47	$ 3.98	$ 4.53	$ 6.31	$ 1.98	$ 2.26	$ 3.16
6	600	$ 8.39	$ 9.53	$ 13.29	$ 6.29	$ 7.15	$ 9.97	$ 4.19	$ 4.77	$ 6.65	$ 2.10	$ 2.39	$ 3.32
6.3	630	$ 8.81	$ 10.02	$ 13.95	$ 6.60	$ 7.52	$ 10.47	$ 4.40	$ 5.00	$ 6.98	$ 2.19	$ 2.50	$ 3.48
6.6	660	$ 9.23	$ 10.48	$ 14.63	$ 6.92	$ 7.87	$ 10.97	$ 4.61	$ 5.24	$ 7.31	$ 2.31	$ 2.63	$ 3.66

Notes: WOS (cut), WOSP (planed), CCA (treated). 2nd cut wood discounts: .9m-2.7m is $108.40; 3-4.8m is $158.44; and 5.1 - 6m is $208.47.

Annex 5. Projected timber (m3), transport and cost
by typology, variant, size and scale

# house	m3 of timber											
	2 rooms, 18m2						3 rooms, 27m2					
	Cement				Adobe		Cement				Adobe	
	1.1	1.2	1.3	2.1	2.2	2.3	1.1	1.2	1.3	2.1	2.2	2.3
5	2	2	3	3	3	4	3	3	4	4	5	6
50	18	21	29	27	30	38	26	32	44	41	46	58
100	36	42	57	55	61	76	53	63	87	81	92	116
500	180	211	287	273	304	380	264	316	436	407	459	580
1,000	360	423	575	545	608	760	527	631	873	814	918	1,159
5,000	1,800	2,113	2,873	2,725	3,038	3,798	2,635	3,157	4,363	4,068	4,590	5,796
10,000	3,600	4,226	5,746	5,450	6,077	7,596	5,270	6,314	8,726	8,136	9,180	11,592

18m2	27m2	18m2	27m2	Types	Content
m3	m3	mt/house	mt/house		
0.360	0.527	5,787	8,473	Type 1.1	rafter/purlin (cement)
0.423	0.631	6,794	10,151	Type 1.2	rafter/purlin/horizontal (cement)
0.575	0.873	9,237	14,029	Type 1.3	add door/window frames
0.545	0.814	8,762	13,079	type 2.1	rafter/purlin/wall plate+lintel (adobe)
0.608	0.918	9,769	14,758	type 2.2	rafter/purline/horizontal/wall plate + lintel (adobe)
0.760	1.159	12,211	18,635	type 2.3	add door/window frames

Variations on cement block and adobe block construction

Annex 5. Projected timber (m3), transport and cost
by typology, variant, size and scale

# house	number of 30-ton trucks required											
	2 rooms, 18m2						3 rooms, 27m2					
	Cement				Adobe		Cement				Adobe	
	1.1	1.2	1.3	2.1	2.2	2.3	1.1	1.2	1.3	2.1	2.2	2.3
5	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
50	0.5	0.6	0.8	0.7	0.8	1.0	0.7	0.8	1.2	1.1	1.2	1.5
100	1.0	1.1	1.5	1.5	1.6	2.0	1.4	1.7	2.3	2.2	2.4	3.1
500	4.8	5.6	7.7	7.3	8.1	10.1	7.0	8.4	11.6	10.8	12.2	15.5
1,000	9.6	11.3	15.3	14.5	16.2	20.3	14.1	16.8	23.3	21.7	24.5	30.9
5,000	48.0	56.4	76.6	72.7	81.0	101.3	70.3	84.2	116.4	108.5	122.4	154.6
10,000	96.0	112.7	153.2	145.3	162.0	202.6	140.5	168.4	232.7	217.0	244.8	309.1

# house	costs in meticais											
	2 rooms, 18m2						3 rooms, 27m2					
	Cement				Adobe		Cement				Adobe	
	1.1	1.2	1.3	2.1	2.2	2.3	1.1	1.2	1.3	2.1	2.2	2.3
Cost/ HH	5,787	6,794	9,237	8,762	9,769	12,211	8,473	10,151	14,029	13,079	14,758	18,635
5	28,937	33,972	46,183	43,810	48,845	61,057	42,363	50,755	70,143	65,397	73,789	93,176
50	289,368	339,718	461,831	438,103	488,453	610,566	423,635	507,551	701,428	653,972	737,888	931,765
100	578,736	679,436	923,663	876,206	976,906	1,221,133	847,270	1,015,103	1,402,856	1,307,943	1,475,777	1,863,530
500	2,893,680	3,397,180	4,618,313	4,381,032	4,884,532	6,105,665	4,236,348	5,075,515	7,014,280	6,539,717	7,378,884	9,317,650
1,000	5,787,360	6,794,361	9,236,627	8,762,063	9,769,064	12,211,330	8,472,695	10,151,029	14,028,561	13,079,434	14,757,768	18,635,299
5,000	28,936,800	33,971,803	46,183,133	43,810,315	48,845,318	61,056,648	42,363,475	50,755,147	70,142,803	65,397,168	73,788,840	93,176,496
10,000	57,873,600	67,943,606	92,366,266	87,620,630	97,690,637	122,113,296	84,726,950	101,510,294	140,285,606	130,794,336	147,577,680	186,352,992