Global Shelter Cluster
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Coordinating Humanitarian Shelter

"Greening the Response" Shelter Materials Market and Environmental Assessment – SUMMARY REPORT

Chikwawa and Nsanje Districts, Southern Malawi

Malawi Shelter Cluster

May 2023

Acknowledgments

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Cover photo by CRS/staff.

Contents

Acronyms

BOQ	Bill of Quantity
CGI	corrugated iron sheeting
CO_2	carbon dioxide
CRS	Catholic Relief Services
CVA	Cash and Voucher Assistance
DoDMA	Department of Disaster Management Affairs
DRR	Disaster Risk Reduction
ECHO	European Civil Protection and Humanitarian Aid Operations
GoM	Government of Malawi
REDD+	Reducing Emissions from Deforestation and Degradation
SHCG	Safer House Construction Guidelines
SMAC	Shelter Methodology for the Assessment of Carbon
SSB	soil-stabilized brick
t CO_2e	tons CO_2 equivalent
UNHCR	United Nations High Commissioner for Refugees

Background and Purpose

The southern districts of Malawi are frequently affected by extreme weather events that have been exacerbated by the effects of climate change, population growth, urbanization and environmental degradation. Cyclone Freddy is the most recent in a series of tropical cyclones that have led to widespread displacement and destruction of homes across southern Malawi. Chikwawa and Nsanje were among the districts most affected by the recent, highly destructive Cyclones Ana[1] and Freddy.[2]

Funded by European Civil Protection and Humanitarian Aid Operations (ECHO) through the United Nations High Commissioner for Refugees (UNHCR), the Global Shelter Cluster has undertaken this market and environmental assessment as a collective effort led by Catholic Relief Services (CRS) in its "cash champions" role.[3] The purpose of this assessment is twofold:

1) To identify the environmental and market implications of various assistance modalities (cash, vouchers, in-kind and additional market support) in achieving localized, environmentally sound shelter response and recovery strategies, using Chikwawa and Nsanje as case examples; and
2) To furnish data and analysis to provide generalized recommendations to Shelter Cluster and related shelter implementers for environmentally sound shelter assistance that considers the capacities, norms and practices of the market supply chain and other related factors.

Methodology

This study is a combination of market assessment and environmental assessment. The study explored the market systems of four key shelter materials: **corrugated iron sheeting (CGI)**, **timber (for roofing, window frames and doorframes**), **burnt brick** and **cement**. The study also considered the environmental and market implications of transporting each material.

The team chose Chikwawa and Nsanje districts for the study due to the recent effects of multiple cyclones and the regular flooding of these districts. In each district, the team selected communities that had received both cash and in-kind assistance from Shelter Cluster actors. The team surveyed a combination of medium-sized supply markets and small retail markets most frequented by the selected communities, as well as vendors from Blantyre, a key source market.

The team focused on the following elements:

- **Market capacity and modality appropriateness**, including supply, sources and market integration, competition, vendor capacity, quality, price, and participant preferences. In consideration of the Shelter Cluster's secondary objectives to support replicability, this report also references elements of a recent CRS study on affordability.
- **Environmental considerations**, including carbon dioxide (CO_2) emissions (from raw materials extraction, production and processing, transportation and distribution of materials, and disposal), based on kg CO_2 equivalent emissions, environmental degradation related to the extractive nature of specific materials included in the shelter design, and waste generated from any component of the shelter design.

[1] Department of Disaster Management Affairs (DoDMA), Government of Malawi (2022). *Tropical Storm Ana Consolidated Assessment Report.*
[2] Office of the President and Cabinet, DoDMA (March 2023) *Tropical Cyclone Freddy Emergency Response Plan.*
[3] CRS has had a role as a "cash champion," providing assistance to the Global Shelter Cluster in cash- and markets-related considerations.

The team used mixed-method research to conduct 72 interviews across the two districts in December 2022 and January 2023. Using purposive sampling, the team identified a small number of households to be interviewed in depth. These households included people who had either received cash in the past for shelter construction or received in-kind assistance to compare differences in sourcing, materials or other issues. In addition, the team spent four days conducting market and field interviews in Chikwawa and Nsanje, three days recording and analyzing data, and five additional days conducting remote key informant interviews. See Table 1.

Table 1: Interviews.

Interviewee type	Chikwawa	Nsanje	Blantyre (central market)	TOTAL
Households: in-kind recipients	7	9		16
Households: cash recipients	8	4		12
Community leaders	2	2		4
Community-level vendors and key informants: brick	2	7		9
Community-level vendors and key informants: timber	0	1		1
District or local market vendors: CGI	3	4		7
District or local market vendors: timber	6	4		10
District or local market actors: transportation	5	6		11
Central market vendors and key informants			2	2
TOTALS	**33**	**37**	**2**	**72**

Secondary research was a key part of this study, including a desk review with significant references from publicly available market data and recent and ongoing market materials research by CRS in the same geography. In addition to collecting limited primary data on environmental sustainability, the team conducted the secondary data component of the environmental assessment in March and April 2023.

For the emissions component, CRS Disaster Risk Reduction (DRR) and Shelter and Settlements specialists designed an approach to consider the emissions generated by the transitional shelter design currently being applied in disaster-affected regions throughout southern Malawi. The analysis focuses on identifying the amount of CO_2 associated with materials (including production and raw materials), transportation (both international from importing as well as within Malawi from distribution), packaging and disposal. The Shelter Methodology for the Assessment of Carbon (SMAC) tool provides a "cradle-to-grave" analysis of the materials; that is, it captures the relative carbon for which the materials are responsible during their life cycle, from extraction to after end-of-use. In line with InterAction's research framework,[4] CO_2 equivalent emissions are a "proxy for environmental footprint" and thus can be used for decision-making by non-experts.

Context

The study zone in southern Malawi is characterized by high levels of poverty compared to the rest of the country, as well as a high incidence of flooding and higher levels of food insecurity. Malawi's population is largely rural and agricultural, and incomes depend on harvests that take place between May and October. However, it is estimated that by 2030, 30% of Malawi's population will

[4] Twigg and Babister (2021). Roadmap for Research: A Collaborative Research Framework for Humanitarian Shelter and Settlements Assistance, USAID/InterAction. Chapter 9, "Measuring the Environmental Footprint of Shelter Options," as referenced in SMAC Step-by-Step User Guide.

be living in urban areas.[5] This urbanization trend will continue to be a consideration for the Malawi Shelter Cluster and its strategy, as common types of homes and the sources of construction materials will change.

A significant gap exists between need and general supply of housing nationally in Malawi. Habitat for Humanity has estimated an annual housing demand of 21,000 units nationally, noting that likely only 10% of that demand is filled.[6] The vast majority of registered construction companies in Malawi are small (95%); however, formal sector construction is still quite expensive relative to the incomes of most people in the country.[6] Considering the low incomes of populations that Shelter Cluster actors generally serve, many project participants are unlikely to engage the formal sector directly, as it is usually outside of their ability to pay, and they may not have direct connections.

Recent macroeconomic challenges have pressured local businesses as well as household purchasing power, as is currently the case in many countries. Inflation rates have been high, especially since April–May 2022, and are remaining high, at over 25% as of May 2023.[7] In June 2022, the government devalued the Kwacha, and fluctuations in exchange rates and the currency's value continue to perturb businesses and buyers. While prices have started to decrease, they still remain well above early 2022 levels.[8]

Shelter Cluster actors practice some components of market-based programming. Many undertake market assessments of some kind during programming. Actors undertake activities ranging from cash-based shelter provision, often combined with some in-kind materials or labor provision, to full direct builds. Overall, most organizations offer a combination of in-kind assistance for some materials and cash or vouchers for others. Few actors promote other types of market support. Increasingly, Cluster actors are incorporating environmental considerations into their work. The updated Safer and Healthier Homes Construction Training Manual, recently adopted by the national Cluster, incorporates many of these considerations, which are also reflected in this report.

Findings

CGI

While thatch is still a common roofing material for poorer communities, both the Malawi Shelter Cluster and the Malawian government promote CGI as a critical component of shelters. In 2021, Malawi imported over 40,000 MT of iron sheeting, the majority from China.[9]

The analysis showed that, from a market perspective, there is a strong CGI market with robust abilities to procure 32-gauge CGI and the potential for higher-quality CGI. Cash or local procurement of CGI is appropriate for Chikwawa and Nsanje. Emissions from transportation are high, but the local contribution is negligible because emissions from the long supply chain (from China) are large; thus, differences in emissions between local transportation modalities are negligible. Because 32-gauge CGI is more readily available and affordable locally, it is likely to be purchased by cash recipients or Shelter Cluster actors; thus, teams should consider waste

[5] CRS Malawi (2022). "Systemic Scaling Strategy for improving access to affordable housing solutions for durable, flood and rain resistant housing for poor households in Southern Malawi." [draft].
[6] Ibid.
[7] Malawi inflation rate, tradingeconomics.com, accessed 24 May 2023.
[8] Trading Economics; accessed 24 May 2023.
[9] CRS estimates based on UN COMTRADE data

disposal or end-of-life actions. Teams could also consider inducing demand for local vendors to supply higher quality (28-gauge) CGI.

Several enterprises import flat sheets and corrugate them for sale. Larger importers and traders are based in larger cities like Blantyre or Lilongwe, but they serve as sources for community-level CGI vendors. At the district level, vendors mostly sell CGI in hardware stores that sell a variety of construction materials.

Table 2: General market characteristics of the CGI market systems in Chikwawa and Nsanje.

Market	Largest vendors	General capacity of vendors	Product sources	Current stocks of products[10]	Quality	Prices
Chikwawa district markets	More than 3 medium-sized vendors in Nchalo (up to 10, including small sizes)	High (avg. 1,000–2,400 sheets per week during high season)	Blantyre (Macsteel, Mkango Malata, Safintra, Top Malata)	Medium to high (1,000–4,000 sheets; one provider reported having 10,000 sheets)	Sufficient (mostly 32-gauge; some 28-gauge, sometimes on order)	K1,000–1,200 ($0.87–1.04) per foot
Nsanje district markets	About 4 medium-sized vendors in each of Nsanje and Bangula	Medium (avg. 250–1,500 sheets per week during high season)	Blantyre (Safintra, Macsteel, Mkango plus, Universal Trading/GT)	Medium (3,000–4,000 sheets)	Sufficient (mostly 32-gauge; some 28-gauge)	K990–1,090 ($0.86–0.94) per foot

Notably, vendor capacity and storage appeared quite high in all four district markets. Agora is an established company that has outlet shops in district markets, including Nchalo; its prices are usually lower because it doesn't have to charge for transport from Blantyre. Agora uses large trucks for transport and thus has lower transportation costs, as larger trucks can transport more supplies. Macsteel, a steel manufacturer and supplier, also has a branch in Nchalo.

All interviewed vendors offered 32-gauge sheeting. Only some offered 28-gauge,[11] although vendors noted that this can be ordered. All vendors noted that 28-gauge is significantly less preferred by consumers, as it is more expensive. While it is likely that only 32-gauge and lower quality CGI is available in their small local market, respondents gave no indication that they'd seek higher quality CGI from district markets. Lower-quality CGI was also readily available locally. While the Safer House Construction Guidelines (SHCG) recommend that CGI should be no lower quality than 28- or 30-gauge, about half of in-kind recipients (9 of 16) and all 12 cash recipients reported that they were provided with 32-gauge CGI as direct in-kind assistance. Malawi Shelter Cluster actors have noted that they often offer 32-gauge CGI, as 28-gauge is significantly more expensive and 30-gauge is limited in supply.[12]

[10] These estimates (i.e., "medium") are relative to anticipated demand as defined by CRS.
[11] Lower gauge (28 or 30) is thicker than higher gauge (32, 33, 34, and so on). Thus, higher gauge CGI is thinner and of lower quality. It will not last as long as lower gauge CGI, as it deteriorates and can leak under extreme heat.
[12] Personal communication, CRS Malawi, 7 May 2023.

According to the SMAC tool, galvanized steel and aluminum sheeting have relatively high levels of CO_2 equivalent emissions from the production process, significantly higher than local thatch.[13] The main suppliers are about 100 kilometers away, and the CGI is transported on trucks or lorries to district markets. More locally, potential emissions from local transportation are almost negligible, as more than half of cash recipient households reported transporting CGI via oxcart; others hired transportation, which included small trucks. However, on a more macro scale, emissions from transportation are significant, as raw materials are imported from China or South Africa, among other locations.

Households reported using old CGI for animal shelters and reported that very little goes to waste. Some respondents, however, reported that people dispose of CGI in "pits" in the communities, indicating that there can be some waste disposal issues. Less expensive, thinner CGI grades degrade much more quickly than thicker, more robust qualities; thus, 28-gauge CGI will last longer than 32-gauge and will not contribute to community waste as readily.

Timber

The Shelter Cluster recommends that hardwoods be used for building superstructures, doorframes, window frames and lintels, noting some restrictions on the procurement of certain hardwoods. The most common hardwood in the target area for doorframes and window frames is red mahogany.[14] For roofing, pine planks or blue gum poles are the most common timber types found in local markets and at the community and household levels. Pine and blue gum are durable softwoods in the target area.[15] Cash recipients most frequently cited pine and neem as roofing timber in Chikwawa.

Specialized vendors sell timber for roofing, housing frames, window frames, doorframes and doors. Some timber sellers sell treatments separately from the planks or poles, noting that the treatment makes the timber more expensive and thus unaffordable for community members.[16] In spite of regulations regarding the extraction of timber from preserved forest locations, black market timber trade is very common.

Table 3. General market characteristics of the timber market system in Chikwawa and Nsanje.

Market	Largest vendors	General capacity of vendors	Product sources	Current stocks of products	Quality	Prices
Roof timber (blue gum, pine, neem)						
Chikwawa district market (Dyeratu, Nchalo)	2–3 small-sized in each market; no commercial timber sellers	Low–medium (65–80 planks per week during high season; indicated ability to	Pine is sourced from Chikangawa in Mzuzu, around 800 km away, or Zomba. Locally, pine or blue gum	Varies	Sufficient	Planks: 6x2, K8,500–9,000 ($7.37–7.80); 4x2, K6,000–7,500 ($5.20–6.50); 2x2, K3,000–4,000 ($2.60–3.47)

[13] As thatch has sequestered carbon over its lifetime, it has a negative CO_2 emissions equivalent.
[14] Shelter Cluster actor inputs.
[15] While technically classified as a hardwood by SHCG, blue gum is considered less firm (softwood) in Malawi because its cultivation mainly takes place on private estates and it is often harvested before it reaches full maturity.
[16] CRS Malawi (2022). "Systemic Scaling Strategy for improving access to affordable housing solutions for durable, flood and rain resistant housing for poor households in Southern Malawi." [draft].

Market	Largest vendors	General capacity of vendors	Product sources	Current stocks of products	Quality	Prices
		expand to 500–1,000 planks)	is sourced from Mtamba and Thelele, around Chikwawa			Poles: K6,500–7,000 ($5.63–6.07) N.B. Direct sourcing from suppliers: K8,000 ($6.93) for a 6-foot blue gum pole
Chikwawa local markets	Few to none[17]	N/A	N/A	N/A	N/A	Planks: 9–10-foot planks, K1,300–2,300 ($1.13–1.99)
Chikwawa communities	Only micro and small sellers; no or few communit y woodlots	Not collected	Local	Varies	Sufficient	Not collected
Window frames, door frames, doors (hardwoods)						
Chikwawa district markets	About 10 micro- to small sellers per market	Medium (medium vendors sell 50 frames and doors per week during high season; smaller vendors sell 10)	Mozambiqu, 200 km away; Locally (Chapananga , East bank and Kakoma)	Varies	Varies (mostly "local" or not standard, but some capacity for higher quality products)	Standard door frame: K9,500–12,500 ($8.23–10.83); Window frames: K7,500–25,000 ($6.50–21.66), depending on quality[18] Standard door: K30,000–38,000 ($26.00–32.93) Local door: K15,000 ($13.00)
Chikwawa local market (Livuzu)	About 5–10 micro-	Low (10–40 doors and frames per	Locally (Mitondo, a	*Unclear*	Varies	Window frames:

[17] Households mentioned one seller in the local market, although surveyors were unable to locate him or her. The size of this vendor is unclear.
[18] 2-glass: K,7500 ($6.50); K2,500 ($2.17) for lower quality
3-glass: K7,500–8,500 ($6.50–7.37)
6-glass: K9,000–10,500 ($7.80–9.10)
9-glass: K12,500 ($10.83)
12-glass: K25,000 ($21.66)

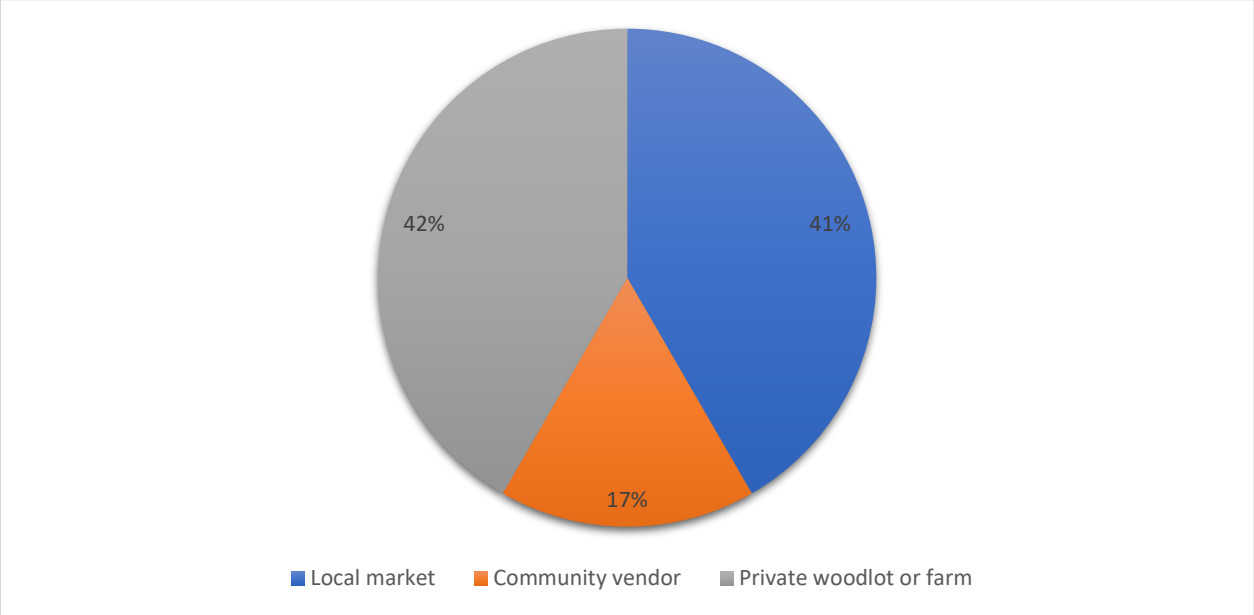
Market	Largest vendors	General capacity of vendors	Product sources	Current stocks of products	Quality	Prices
	to small vendors	week during high season)	small local market)			K2,000–9,000 ($1.73–7.80), depending on size Door: 6x2, K13,000–15,000 ($11.27–13.00)
Nsanje local markets (Malemia[19])	About 10 micro- to small vendors	Low (2–10 doors and frames per week during high season)	Locally (Chididi, also from "within the communities")	*Unclear*	Varies (mostly "local" or not standard, but some capacity for higher quality)	Doorframe: K7,000–15,000 ($6.07–13.00) Windows: K6,000–21,000 ($5.20–18.20), depending on size and quality Standard door: K45,000–65,000 ($38.99–56.33

Through their shelter work, Malawi's Shelter Cluster actors tend to 1) provide timber as part of an in-kind package; 2) expect timber to be part of a "community contribution" alongside in-kind distributions of CGI, cement and fittings; or 3) expect the homeowner to furnish timber with a mixed modality cash grant that is provided alongside in-kind materials. Actors that tend to provide timber as an in-kind contribution during shelter programs purchase their timber from commercial timber sellers, who are usually intermediaries that, in turn, purchase from national suppliers. To serve clients beyond a small scale, commercial vendors of roofing timber have to source from as far as Chikangawa in Mzuzu, around 800 kilometers away, which contributes to emissions outputs from the long supply chain as compared to community-supplied timber. There were no commercial timber sellers in any of the surveyed district markets, but there were several medium-sized timber vendors in Chikwawa district markets. These vendors had limited current stocks but some capacity for expansion of their supplies that could meet the needs of a small shelter program.

Within the communities, there were no private woodlots in either district; however, 7 of 12 cash recipients reported sourcing timber from within the community, including purchasing from private landowners or friends who have trees on their fields, cutting trees from their own land, or sourcing from a local intermediary. These landowners may or may not possess appropriate permits for the sale of timber. The team interviewed one community member who acted as an intermediary or community source for timber that he purchased from a neighboring community market.

[19] Malemia is a local market in an area near where CRS works. It was considered a small market at the level of Beleu (the next step below Njelatu, but not quite as small as Mitondo).

Figure 1: Cash recipients' sources of roofing timber.



There are two types of sellers of doors, doorframes and window frames: 1) sellers of doors, doorframes and window frames that sell solely to communities and do not adhere to size or quality standards; and 2) furniture sellers that sell standard-sized doors, doorframes and window frames that meet accepted quality standards but are often aimed at middle-class consumers. It is unlikely that a cash recipient would buy "standard" quality window frames or doors locally due to price differences. Vendors of window frames and doorframes, particularly those that sell non-standard sizes and qualities, source more locally or from Mozambique. Some local vendors would be able to meet the supply needs of a small shelter program.

Households regularly mentioned that they were aware of the detriments of deforestation, with some recognizing the link between fewer trees and an increase in flooding. However, they also noted that timber is a source of livelihood for sellers and charcoal producers, and there is a consistent perception that these livelihood needs outweigh the community's ability to protect trees.

The loss of carbon sinks from unmanaged deforestation is significant. Deforestation estimates for Malawi vary widely, from about 9,000 hectares per year, as reported in Malawi's 2019 REDD+ document,[20] to about 39,000 hectares per year, as reported in more recent 2021 research.[21] Malawi's Reducing Emissions from Deforestation and Degradation (REDD+) calculations in 2019 indicated 4,500,682 tons CO_2 equivalent (t CO_2e) of greenhouse gas emissions annually[22] due to deforestation and forest degradation, accounting for some level of improvements from mitigation activities on some plantations. In addition to this huge effect from deforestation, emissions from transportation can be significant, as many commercial enterprises source from 800 kilometers away. Malawi's National Forestry Policy (2016) recognizes the importance of livelihoods in ensuring conservation—that is, for people to be able to make a living through sustainable practices. The policy also recognizes the importance of community-managed forest conservation.

[20] Brown et. al. (March 2019). Malawi REDD+ National Forest Reference Level.
[21] Skole et. al. (2021). "Direct Measurement of Forest Degradation Rates in Malawi: Toward a National Forest Monitoring System to Support REDD+." *Forests*. 12,426.
[22] Brown et. al. (Estimated 2017). Malawi REDD+ National Forest Reference Level.

The National Forestry Policy acknowledges that private and publicly owned plantations are poorly managed, as managers allow timber to be cut more quickly than it is replanted; the policy notes a "10% land covenant" that is often not met as trees continue to be harvested in spite of conservation policy.

Timber is a versatile material and can be reused, burned for fuel or recycled into a variety of new products. However, treated timber is very limited in its recycling and reuse options.

The local timber market would benefit from market support to help it "professionalize" and provide verifiably sustainably sourced timber.

Burnt brick

Burnt brick is prohibited by the Government of Malawi (GoM) due to its contribution to deforestation. However, this report includes burnt brick because it is a preferred product. While people living in poverty in the study zone consistently use adobe (mud) brick, the "dynamic poor" and people in higher income brackets consistently seek burnt brick. There is a perception that burnt brick is of higher quality, and its use has social status significance, as burnt brick is significantly more expensive than adobe brick. While adobe brick can be quite durable when used with proper construction practices—and it has a significantly lower negative effect on the environment, as it requires no fuelwood—this type of brick can also be associated with poverty.

Quality varies for adobe and burnt brick, depending on the type of soil, the ratio of mud to water and the appropriate curing process (out of direct sunlight, as exposure to sunlight can cause cracking and thus less compressive strength). There are generally two sizes of brick: a "standard" size and a smaller size. Shelter Cluster actors have started to investigate the addition of binders or other additives to improve the quality of adobe brick and to encourage adobe as a replacement for burnt brick.

Brickmaking requires significant fuel supplies to maintain kilns for a full day. Most community-level brickmakers the team interviewed reported sourcing fuelwood from within the communities, often illegally. Adherence to local fuelwood extraction regulations[23] was varied; most respondents indicated that they sourced within communities and thus either didn't need or didn't bother to follow any regulations. Several were careful to state that they "make sure (they) don't break regulations," and one indicated he thought that forestry regulations didn't extend to community land.

Through interviews, suppliers noted that alternative fuel methods are cow dung, petrol, coal (malasha), charcoal,[24] sawdust and rice husks. Some noted that these alternatives take longer or don't produce the same quality bricks; another noted that most brickmakers are not familiar with these alternative techniques.

[23] National Forestry Policy.

[24] Malawi's National Charcoal Strategy 2017-2027 promotes increased law enforcement around fuelwood harvesting and charcoal production, and seeks legal, sustainable livelihoods as alternatives. It recommends alternative cooking fuels such as briquettes and biogas.

Table 4. General market characteristics of the brick market systems in Chikwawa and Nsanje.

Market	Largest vendors	General capacity of vendors	Fuelwood sources	Current stocks of products	Quality	Prices
Chikwawa communities	Numerous micro- and small-scale vendors	Medium for burnt and adobe	Within the communities, unregulated	N/A	Sufficient, but varies	K30–35 ($0.026–0.031)
Nsanje communities	Numerous micro- and small-scale vendors	Medium for burnt and adobe	Within the communities, unregulated; Mozambique	N/A	Sufficient, but varies	K25–40 ($0.022–0.035)

Many brickmakers also offer artisan services to build homes for families and supply households with information on the quality of bricks. Some people choose to burn the brick themselves using locally sourced fuelwood. While there is a competitive market with multiple brickmakers in each community, community-level brickmakers can only produce a limited number of mud and burnt bricks; CRS has reported challenges sourcing enough adobe brick for a medium- to large-scale shelter program due to limited labor availability.[25]

Cement

Malawi Shelter Cluster actors promote the use of cement for the foundation, floor (instead of mud smear) and mortar, although fly ash could be considered as an alternative for mortar. Cement is also used for soil-stabilized brick (SSB) production, and GoM promotes concrete block as a resilient material for walls.

A few large cement firms in Malawi import gypsum to manufacture cement locally through the addition of locally sourced raw materials.[26] Three of the largest of these companies are Shayona Cement Corporation, Cement Products Limited and Lafarge Cement (Malawi) Limited (now Portland Cement).[27] Shayona Cement Corporation and Cement Products Limited both use locally mined limestone and iron ore; all three use locally extracted kaolinitic clays. Cement companies in Malawi have complained that their profit margins are currently small due to the scarcity of foreign exchange, which has made it harder to source materials, packaging and spare parts for production. Imported cement can be sold at more competitive prices within Malawi, thus furthering challenges for companies sourcing local raw materials.

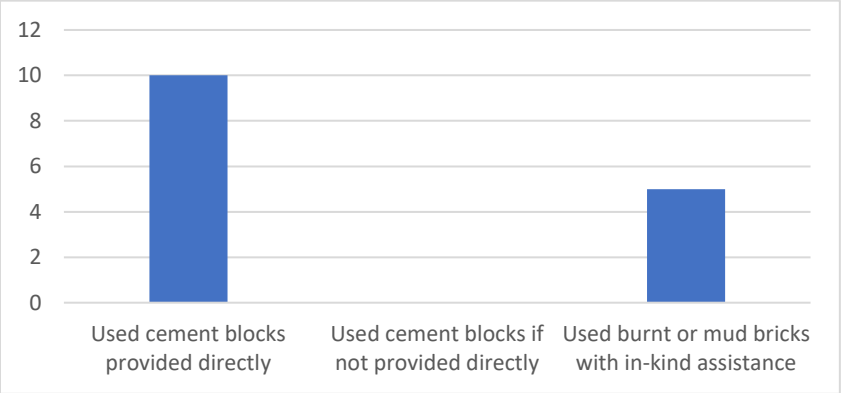
Cement is widely available in general-use hardware stores throughout Malawi. In small local markets in surveyed areas, however, cement is often sold in small quantities and at higher prices than when sold in bags in larger markets. Shelter assistance recipients reported using cement in the foundations of their homes. Some cash recipients reported receiving between two and four bags of cement from a Cluster actor; others did not receive cement but still reported using it in

[25] In many countries, brickmaking is among the greatest concerns in terms of child labor or forced labor. This concern was not addressed in this study, but it merits discussion.
[26] Mining and Trade News (October 2022). "Malawi's cement production to increase." https://miningtradenews.net/malawis-cement-production-to-increase/
[27] Lafarge Malawi was bought in December 2021 by Huaxin Cement, a Chinese company that is one of the 10 largest in the world. Subsequently, Lafarge Malawi was renamed Portland Cement Malawi. (Global Cement. Feb. 2022. "Lafarge Cement Rebrands as Portland Cement Malawi." https://www.globalcement.com/news/item/13647-lafarge-cement-malawi-rebrands-as-portland-cement-malawi)

their foundations. Most (13 of 15) in-kind recipients also reported using cement in the foundation, although one who was not provided it directly did not use any cement in her home construction. While the study did not survey cement in depth through primary data, no respondents reported any challenges in sourcing cement locally for home construction.

Project participants did not source concrete block on their own. Of shelter recipients surveyed, 10 of 15 in-kind recipients used concrete block only when it was directly provided to them. The remaining five in-kind recipients reported using burnt brick or mud brick, as brick was not included in the in-kind package. See Figure 9 below.

Figure 2. Use of cement, burnt or mud brick by in-kind recipients (n=15).



Cement production has a significant carbon footprint; globally, cement production accounts for about 8% of the world's carbon emissions.[28] The calcification process accounts for about half of the total carbon emissions from cement production, while the burning of fossil fuels for the kiln accounts for an estimated 40% of the total, and the use of fuels to mine and transport raw materials accounts for the final 10%.[29]

A 2019 report noted that Malawi has sufficient clinker, lime and cement to meet demand but that raw materials are still often imported because of inefficiencies of local distribution channels—in short, it can be cheaper to import them.[30] Clinker plants are being developed in the country, however. In theory, these plants will help the environment, as they will not have dust and smoke emissions from production. They may also help to reduce wanton cutting of trees in areas that usually burn bricks, because cement may be more abundantly available. Local plants also may reduce the cost of cement production, thus making cement affordable to more Malawians. However, local production of clinker will necessitate scaling up the extraction of other materials associated with the cement industry, such as limestone, gypsum and coal. While local production could reduce emissions and packaging linked with the transportation of imported raw materials, it would bring environmental consequences linked with extractives and mining.

Concrete alternatives exist but are not common in Malawi. Fly ash, for example, can reduce the amount of cement that is used in concrete. CRS is testing fly ash with husks for mechanical stabilization, with a report due at the end of 2023.

[28] Lehne, J. et.al. (2018). *Chatham House.* "Making Concrete Change: Innovation in Low-carbon Cement and Concrete."
[29] CarbonBrief. (2018). "Q&A: Why cement emissions matter for climate change."
[30] (2019). The Manufacture of Cement, Lime and Plaster in Malawi 2019

Affordability And Preferences

Affordability. For people not receiving the support of Shelter Cluster actors, affordability is a critical issue, and it is included in this study because the replicability of Cluster-supported homes is a consideration for the Malawi Shelter Cluster. While the cost of a home built by the formal construction sector could cost up to 10 million Kwacha (K)($8,665.51), those people earning the lowest incomes in the study area spent only K25,000–50,000 ($21.66–43.33) for a full home construction and might earn less than K300,000 ($259.97) annually. Most households put a priority on roofing, which was the largest home expenditure across income groups, with walls the second-largest expenditure. However, households struggle to invest significantly in their housing, underlining the importance of supporting local markets to provide affordable, quality materials.

Materials preferences. According to a 2021 CRS study, people in the study zone generally prefer homes that are "improved traditional" (with burnt brick and CGI roofing) or "modern" (with cement block and CGI roofing), associating adobe brick and thatch with poverty.[31] The study highlighted the critical role of perceptions as a barrier to replication. For example, while Shelter Cluster actors contend that adobe and SSB can provide sturdy, resilient homes if proper techniques are used, people in the study area perceive that the materials themselves are more important to the durability of a home, rather than the techniques used to build the homes. People in these flood-prone areas also have the expectation that their homes will only last a few years, considering the inevitable flood, which influences their investments and choice of materials. These factors all contribute to people's preferences in terms of materials.

Modality preferences. Participant preferences of modalities can vary by community or department, as they vary from household to household. Results from the surveyed area are represented in Figures 3 and 4.

Figure 3. Modality preferences of cash recipients.

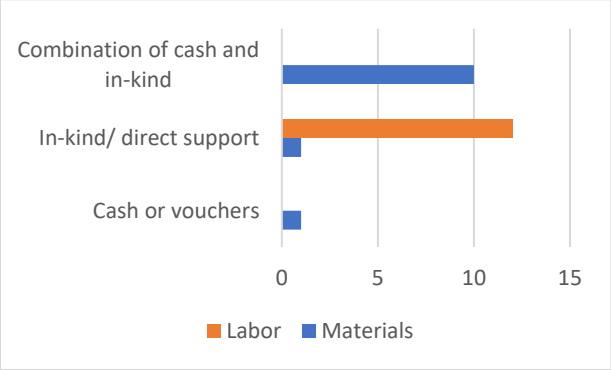
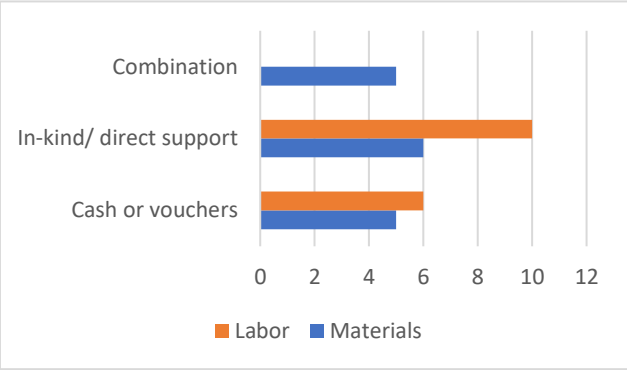


Figure 42. Modality preferences of in-kind support.



In the small sample size for the target zone, these figures illustrate a general preference for a combination of modalities for materials (some cash and some in-kind provision), although preferences vary from household to household. There is a general preference for shelter actors to provide direct labor, but even this preference varies among in-kind recipients. There were no notable differences across genders.

[31] CRS Malawi. (2021). H&C Market Assessment.

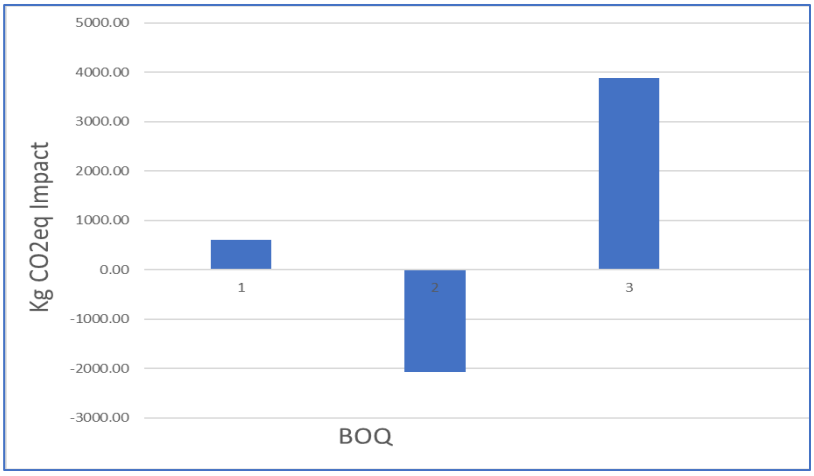
Emissions Analysis

Emissions by Bill of Quantity (BOQ). A comparison of CO_2 emissions across BOQs for three common shelter designs indicated that **transportation and end-of-life factors are the two biggest contributors to carbon emissions** across the main surveyed materials. Cement block is a key contributor to emissions due to emissions during transportation, with its long supply chain consisting of raw materials from China or South Africa, as well as high emissions from the cement production process. Of locally available materials, timber and burnt brick have high negative effects on the environment. While the timber and fuelwood themselves are not high emitters—in fact, they sequester carbon and thus are negative emitters—the loss of carbon sinks from their deforestation has a huge potential negative effect on the environment.

In the below figure, the BOQs analyzed included the following (BOQs in annex):

1) A commonly used BOQ from the Malawi Shelter Cluster, featuring adobe brick and CGI
2) A BOQ for a traditionally built home constructed of adobe brick and thatch
3) A BOQ for a home promoted by the GoM, including cement block and CGI.

Figure 5: CO_2 equivalent by BOQ.



1 Malawi Shelter Cluster BOQ
2 "Traditional" home
3 GoM BOQ

The figure clearly shows that the traditional home (BOQ 2 above) has the lowest CO_2 emissions; this is not surprising, considering that these materials are largely locally sourced and natural materials. However, it should be noted that the traditional home is not resistant to flood and storm hazards due to a lack of solid foundation and flooring. The GoM-supported BOQ (BOQ 3 above), which includes high quantities of cement block, has the highest CO_2 emissions. By contrast, the commonly used BOQ from the Malawi Shelter Cluster (BOQ 1 above) does incorporate a hazard-resistant design and ranks much lower in CO_2 emissions than the GoM-supported BOQ.

Through the SMAC analysis, the team also looked at the relative contributions of production, packaging, transportation and end-of-life usage (defined primarily as recyclability) to emissions outputs to identify where some emissions savings might be possible. The below tables compare two of the BOQs, the Shelter Cluster and the GoM, in this regard, showing the higher relative contributions of transportation and end-of-life to CO_2 emissions.

Table 5: SMAC results for two BOQs.

Factor	Kg CO_2 equivalent	
	Shelter Cluster BOQ	GoM BOQ

Component materials	-7,476.71	-5,641.79
Packaging	0.00	0.00
Transport (Per component – Multiple source locations)	1,873.67	3,309.85
Transport (Whole unit – Single source location)	0.00	0.00
End of life	6,199.96	6,221.76
TOTAL	**596.92**	**3,889.81**

Emissions by modality. It was difficult to account for emissions differences across procurement modalities. The most notable observations across modalities were:

1) Central (in-kind) or local sourcing (in-kind or cash and voucher assistance [CVA]) has negligible emissions differences. Transportation emissions are notable, but whether a truck transports CGI in bulk to a local market or smaller vendors transport it separately to their markets is negligible compared to the distance already traveled from China or South Africa.
2) The environmental sourcing of a material sourced via cash is harder to regulate. For example, it is likely that locally sourced timber does not follow state sustainability requirements, such as tree planting for reforestation, but this is not accounted for in the SMAC tool.

For these reasons, ultimately, the SMAC analysis shows that there is a greater difference in environmental sustainability between similar or alternative materials (such as concrete block compared with adobe brick) than across procurement modalities.

Alternative and Local Materials

While not included in primary data collection for this study, several important alternative materials that Malawi Shelter Cluster members are starting to explore should be considered.

***Soil-Stabilized Brick*.** SSB is an alternative brick option that uses mud compressed with a stabilizer like cement or lime. While it still requires mud extraction, its production is significantly more environmentally friendly than burnt brick because it doesn't require fuelwood and firing, thus avoiding deforestation.[32] The chemical or structural stabilization of the adobe makes the soil water-resistant by reducing swelling and increasing its compressive strength. The 2022 report by CRS notes that "use of compression and longer drying/curing periods can significantly boost the water-resistant properties of the bricks, which is a critical aspect of building resilient homes." Importantly, SSB looks similar to burnt brick, which may increase its desirability. SSB has been studied and promoted through some channels, but it is not widely adopted in Malawi.

Bamboo. Bamboo is increasingly being promoted within Malawi as an alternative cooking fuel.[33] In some circles, it is also being explored as an alternative building material. Bamboo has a reduced effect on the environment and good building performance. It will be essential for Cluster actors to identify proper treatments that can increase the durability and strength of the bamboo and to understand the environmental impacts of bamboo and treatment procedures.

[32] Malunga, E.P.; Wambua, B.N. (2014). Infrastructural Development using Stabilized Soil Blocks as a Tool for Climate Change Mitigation and Sustainable Development in Malawi. *Asian Journal of Engineering and Technology, Volume 2* (Issue 4), https://www.ajouronline.com/index.php/AJET/article/view/1382/842.

[33] Mbendera M. (June 2022). Bamboo: Malawi's untapped potential for clean energy innovation and climate change solution. https://www.undp.org/malawi/stories/bamboo-malawis-untapped-potential-clean-energy-innovation-and-climate-change-solution.

Thatch. Thatch is a common material for roofing for traditional housing models in the surveyed zone. According to SHCG, "Thatch roofs represent a valid alternative to corrugated metal sheet roofs"; however, WHO recognizes that thatch can be a resting place for disease vectors, and Cluster actors should consider this health risk. Thatch also must be replaced regularly and may face supply limitations, as supply is seasonal and thatch may only be available in some locations.

Recommendations and Conclusion

Modality analysis and recommendations

The study team examined response options to identify the most appropriate assistance modality that would contribute best to positive market impacts and environmental sustainability. The program objective, market factors, social factors, operational feasibility and cost are standard criteria in response analysis. Environmental factors are not yet standard components of response analysis across the humanitarian markets community, but they have been considered here. Similarly, affordability has also been considered here. Altogether, for this assessment, criteria included:

- Program objective: to identify the environmental and market implications of various assistance modalities in achieving localized, environmentally sound shelter response and recovery strategies
- Market factors: supply (including current vendor capacity and availability or potential availability of quality products), competition, prices and market integration (including vendor capacity to restock)
- Environmental factors (emissions, extractive considerations, waste and end-of-life)
- Social and demand-side factors (modality preferences and affordability for replication)
- Feasibility (operational feasibility)
- Cost (including cost-effectiveness).

Through this response analysis process, **a mixed modality of cash or local procurement plus in-kind procurement and distribution is recommended, both for market impacts and for acceptable environmental impacts**. Notably, alongside modality choices that support environmental sustainability should be **market support to encourage environmentally sustainable business practices** among interested vendors in surveyed markets. To this end, the team recommends strategies to support more environmentally sustainable materials market systems.

CGI

As CGI markets in Chikwawa and Nsanje are fairly strong, Cluster actors can consider cash-based assistance or local procurement for some or all materials. Procurement strategies can include conditions or environmental requirements. Vouchers can be used to support the supply and use of higher-grade CGI. Additional suggestions to promote environmentally sustainable CGI markets include the following:

- Accompany cash with information or market support. Quality is critical both for roof resilience and reducing end-of-life waste so that teams can conduct social promotion of 32-gauge CGI or better. Cost is a major determinant in consumer choice of materials, and 28-gauge is not available locally, so information and awareness-raising should be part of a cash program where CGI will be purchased. Market support—to stimulate demand for 28-gauge CGI and support vendors to supply it—could also be considered.
- If in-kind is preferred or more appropriate, use local procurements to inject cash into the local economies where quantities are sufficient.

- Implement safer waste disposal practices and recycle CGI.

Timber

The two suggested possibilities for timber modality in Chikwawa and Nsanje are:

1) Provide cash to a small subset of project participants who are located near larger markets, and couple this with market support activities for those timber vendors to promote environmentally friendly sourcing; or
2) Provide in-kind distribution of timber, again verifying sustainable sourcing.

In each case, the teams should consider some of the **market support** recommendations below to promote sustainable timber markets. All programs, regardless of modality, should provide information on the importance of tree cover, on government policies governing sustainable sourcing and extraction, and on suggested and sustainable suppliers. Additional recommendations to support environmentally sustainable timber markets include:

- Explore bamboo as an alternative to timber. Malawi Shelter Cluster actors noted that there is great potential for bamboo as a building material—it is structurally appropriate, strong, fast-growing and sustainable—but preparation and building techniques must be taught to local artisans, and any negative perceptions of bamboo by the community must be addressed.
- Explore creating a "Verified Sustainable" program.
- Support market vendors in becoming more environmentally friendly and provide incentives, such as making them preferred vendors in a given project.
- Use sustainable sourcing criteria for the selection of suppliers.
- In the longer term, couple tree planting or provision of seedlings with shelter programs.

Brick

Burnt brick should be actively discouraged. **Program participants can source adobe brick locally** through cash or via the team's local procurement for a smaller set of participants, coupled with direct distribution from other markets if a large quantity is needed. At the same time, **the team should explore small-scale SSB production locally**, coupled with a voucher scheme to stimulate demand and other demand-creation and behavior change activities. Strategies to support sustainable brick markets include:

- Use alternatives to burnt bricks, like SSB. These can be created as livelihood options within communities.
- Promote alternatives to fuelwood for burnt bricks, learning from previous efforts.
- Conduct behavior change campaigns promoting adobe brick using proper techniques.

Cement

While cement was not included in the primary data collection, general recommendations for cement include:

- Seek and research cement options that use less cement.
- Create a social media campaign for households on investment decisions that can help promote mixed types of bricks.
- Engage in advocacy around cement emissions and cement brick affordability to help promote alternatives.

General Conclusions

Malawi Shelter Cluster actors are part of the shelter materials market systems. As actors that create demand for certain products, they have influence and the ability to improve environmental sustainability through the choices they make in procurement and sourcing modality, in the vendors they work with, and in the materials themselves. The humanitarian shelter sector can influence sustainability by:

1) Choosing modalities and suppliers that positively influence environmental sustainability and quality of materials;
2) Carefully choosing materials and continually researching and piloting alternative materials; and
3) Making investments to support sustainable market systems for future impact.

Given these possibilities, the study notes the following conclusions related to supporting environmentally sustainable shelter materials market systems.

1) **Modality is important but should be considered alongside other design choices**. While "traditional" response analysis processes aim to determine the most appropriate modality for a set of selected shelter materials, teams should consider revising the process. The modality decision process should be expanded to regularly include environmental factors. Additionally, the shelter design process should include criteria such as environmental sustainability, market impact, affordability, and potential for market development in the choice of shelter materials and designs. The SMAC analysis showed the relative importance of materials rather than modality as a driver of emissions and environmental sustainability. Thus, shelter design choices should be guided by this type of environmental analysis, looking at various technical, environmental, and market criteria to choose materials — and modalities — that meet the needs of disaster-affected people in a way that optimizes environmental sustainability and promotes positive market impact.
2) For in-kind or voucher components, teams should also **select vendors that meet environmental sustainability standards**. If none exist, teams should work with vendors to support their ability to meet these standards.
3) As Chikwawa and Nsanje are at continual risk of flooding and thus will continue to require emergency shelter materials and services, teams should place an emphasis on working toward a stronger local market system that is capable of supplying sustainably sourced shelter goods and services for the next emergency, for consumption by both local populations and Cluster actors. Emergency shelter programs should strive to **include market-strengthening components**, with an aim to eventually increase the supply of quality, affordable, environmentally sustainable materials in the districts. To this end, teams should consider market support activities in any forthcoming preparedness or emergency shelter response.

The Malawi Shelter Cluster should consider information on market, environmental impact, affordability, preference and quality, in addition to other technical considerations, when determining materials to use in disaster preparedness, response and recovery. Future market assessments in Malawi should include these elements and not look at modality selection in isolation. The team also notes that further study, particularly into the timber trade and potential alternative materials like bamboo and SSB, is warranted.