CASE STUDY

BANGLADESH 2018–2021 / ROHINGYA CRISIS

KEYWORDS: Bamboo treatment, Coordination and partnerships, Environmental sustainability

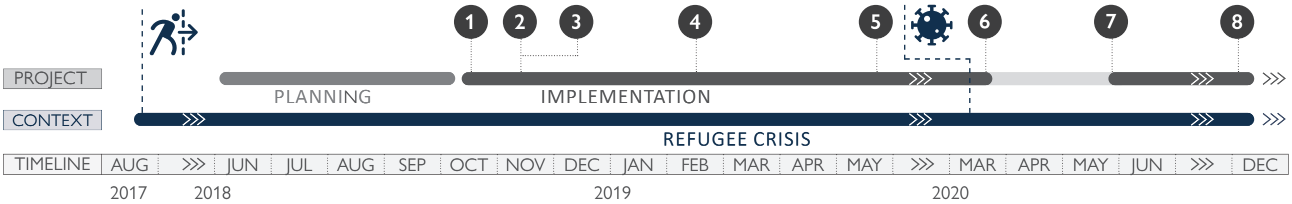
CRISIS	**Rohingya Refugee Crisis, Cox's Bazar, 25 August 2017 onwards**
PEOPLE WITH SHELTER NEEDS	**289,660 HHs** (884,042 individuals)*
PROJECT LOCATION	Cox's Bazar District, Bangladesh
PEOPLE SUPPORTED BY THE PROJECT	**92,492 HHs** (385,411 individuals) received treated bamboo as part of shelter assistance. Treated bamboo has also been used to build community facilities. Livelihood opportunities created: **254** host community members per day (on average) work in the treatment facility.
PROJECT OUTPUTS	**665,220+ treated bamboo poles:** **583,020** large bamboo poles (Borak) **82,200** smaller support poles (Muli)
DIRECT COST	**USD 4.01** untreated bamboo pole per piece **USD 1.69** labor cost per pole treated **USD 0.20** chemical cost per pole **USD 5.90** total cost per treated pole
PROJECT COST	USD **657,600** Facility set-up cost (including construction, labor, tools and equipment)

*Source Joint Government of Bangladesh - UNHCR Population factsheet as of March 2021

PROJECT SUMMARY

This project was implemented to support existing shelter and infrastructure programming in order to strengthen and extend the lifespan of structures in the camps, by reducing the costs of repairs but above all, making structures safer and more resistant to hazards. Working within established sector guidelines, treating bamboo increased its durability and decreased supply chain pressure and environmental impacts on the bamboo forests of Bangladesh.

The program works as a common pipeline for sector partners, supplying partners with treated bamboo.



25 Aug 2017: Beginning of violence in Rakhine State which drove an estimated 655,500 Rohingya across the border into Cox's Bazar, Bangladesh.

1 **Oct 2018:** Pilot treatment facility construction began.

2 **Nov 2018:** Pilot facility completed, and treatment of bamboo began.

3 **Nov 2018:** Main facility design began.

4 **Feb 2019:** Main facility construction began.

5 **May 2019:** Main facility began operations.

11 Mar 2020: WHO declared the novel COVID-19 outbreak a global pandemic.

6 **Apr 2020**: Production halted due to COVID-19 restrictions.

7 **Jun 2020:** Production resumed to support COVID-19 programming and continued response activities.

8 **Dec 2020:** 500,000 large bamboo poles treated to date.

The facility has a daily production capacity of treating 2,500 bamboo poles.

CONTEXT

For more background information on the Rohingya Crisis see the response overview in Shelter Projects 2017-18.

On 25th August 2017, a mass exodus of Rohingya refugees travelled from northern Rakhine State, Myanmar, to Cox's Bazar, Bangladesh. Over 712,000 individuals arrived during the first few months of the crisis, joining the 200,000 plus individuals who had arrived in previous influxes since 1978 – bringing the total population living in camps to more than 930,000 by August 2017.

SHELTER SITUATION

Following the 2017 influx, newly arrived refugees were accommodated in self-built, makeshift shelters made of bamboo, sticks, and low-grade plastic sheeting. These have been progressively upgraded with Shelter & NFI assistance, but conditions remain very challenging. Due to the rapid formation of the camps, they suffer from lack of site planning, low quality infrastructure and risks from landslides, flooding and fires. Families often reside in a single room shelter, with a covered area of 2 to 2.5m^2/person on average, including cooking space. Such over-crowdedness exacerbates security, health, and protection risks.

With the distribution of upgrade shelter kits and tie-down kits, plus training and technical assistance, the immediate need to improve the robustness of the shelters to better withstand the climatic conditions expected during the monsoon/cyclone season, was partially addressed. The space per person however remained below the minimum desired of 3.5m^2 per person, and the extent to which DRR features, such as bracing, tie down, strong connections etc., were incorporated varied from household to household. The lifespan of the materials, and therefore of the shelters, was measured in months rather than years, compromising the sustainability of the shelter response on a mid-term perspective. The structural resistance of the shelter is of critical importance to reduce risk.

PROJECT APPROACH

Due to the ongoing displacement, shelter durability within the camps is an ongoing major concern. The initial rapid response used both poor quality bamboo and unsustainable building methods due to the spontaneous nature of the initial settlement process. These practices promoted both rot and infestation of boring beetles, leading to the fast and widespread degradation of structures within camps in a short time frame. As a policy of non-permanent structures is maintained in the camps by the Government of Bangladesh (GoB) – meaning that the use of building materials such as CGI, concrete, steel, brick, and mud are restricted – the Shelter Sector in 2018 assessed the strength of bamboo and its long-term structural integrity. The conclusion of the study recommended the treatment of bamboo to increase its lifespan and to reduce frequency of replacement while increasing the structural resistance of the shelters to the impacts of the monsoon.

The primary goals of the program are to increase the lifespan and structural integrity of shelters within camps, reduce long-term shelter costs by decreasing the frequency of bamboo replacement, and lessen the impact of sustained bamboo usage on the bamboo forests and groves of Bangladesh by the treatment of bamboo in an environmentally friendly manner.

As the GoB maintains a policy of non-permanent structures within camps, the project was designed to support and integrate with the ongoing upgrading and maintenance of the camps. The size of the project reflected the overall scale of the response and the ability to treat and distribute bamboo as quickly as possible.

Bamboo is the primary building material in the camps. A GoB policy for non-permanent structures in the camps means that the use of materials such as concrete, brick and steel is restricted.

PROJECT IMPLEMENTATION

PHASE I: UNDERSTANDING, PLANNING AND PILOTING

Within the first six months it became evident that a solution was needed to increase the longevity of the bamboo being used. Clarity was provided through studies commissioned by the Cox's Bazar Shelter Sector to understand perceived bottlenecks in bamboo supply and to address the visible damage seen within camp structures. Existing studies by the Bangladesh Forest Research Institute indicated deficits in supply before the response began. The response's heavy use of bamboo exacerbated the existing problem. Compounding this issue would be the need to replace the bamboo yearly to maintain structural integrity of shelters.

By June of 2018 planning began for the development of a bamboo treatment facility. This planning period revolved around finding a suitable location, designing a pilot treatment facility, studying boron treatment methods, and identifying chemical suppliers. In October 2018 construction began on the pilot facility in Teknaf, Cox's Bazar. This facility began operations in November with the first treated batch of bamboo ready in December. The pilot treatment facility allowed the program to understand and develop a working understanding of the process, establish testing procedures, hone production techniques, and begin the planning for the main facility.

Construction of the bamboo treatment facility began in February 2019 with operations commencing in June. The planning and design of the main facility considered the production needs of the organization, direct implementing partners, and pipeline capacity for bamboo treatment for shelter partners.

The facility has a daily production capacity of 2,500 poles. The common pipeline is open to all operational agencies with a formal agreement. The pipeline provides a reliable steady stream of quality controlled treated bamboo. Partner agencies purchase and deliver untreated bamboo of a certain quality standard and receive treated bamboo in exchange.

COMMUNITY ENGAGEMENT

As the facility is constructed outside of the camps, Bangladesh labor laws dictate the strict use of non-refugee labor. The treatment facility's labor force is comprised wholly of the host community, and in compliance with national labor guidelines. The program in full production employs 440 laborers daily to complete the production cycle and added almost USD 995,000 in wages to the host community in its first year. The program strives to be an inclusive environment and currently twenty percent of the workforce is female. This targeted goal was implemented incrementally to address cultural sensitivities to women working alongside men in labor intensive roles.

MATERIALS AND SUPPLY

The large bamboo used for structural construction is supplied predominantly from Rangpur, the northern most state of Bangladesh. As it starts with growers and harvesters the supply proceeds to local markets where brokers purchase in bulk selling on to individual vendors who then transport to response purchasers. The supply chain can respond quickly when a direct purchase order is made with brokers. Generally, from signed purchase order to first delivery takes one month.

The initial response had significant impact on the bamboo supplies of Bangladesh. As the program has continued, efforts have been made to purchase bamboo in the appropriate season. The treatment of bamboo will extend the lifespan thus further decreasing the impact of the response on the bamboo forests and groves of Bangladesh.

Bamboo for construction is mostly supplied from Rangpur in the north of Bangladesh.

When in full production the treatment facility employs 440 laborers, all from the host community.

TECHNICAL SOLUTIONS

The technology of treating bamboo with orthoboric solutions at scale was introduced to Bangladesh during the Rohingya refugee crisis. This option was introduced through consultancies and multiple actors with experience in treatment of bamboo. It was chosen for its simplicity of treatment and because it is a nontoxic environmentally sustainable solution.

The orthoboric solution is a mixture of forty five percent boric acid and fifty five percent borax, which is maintained in a seven percent solution. Soaking the poles for eight days in the solution allows for complete penetration of the vascular tissue of the bamboo walls. The treated poles become insect resistant as plant sugars are replaced with orthoboric solution. As the poles dry out the orthoborates remain in the poles working as an insecticide against boring beetles and termites. The treatment also provides mild fungus resistance.

The solution is maintained in a circular loop. All solution is preserved after each treatment and additional water and orthoboric chemicals are topped up as needed. Periodically the solution is filtered through an established gravel, sand, charcoal filtration system to remove dissolved organic carbons. The charcoal used for the filtration is produced in custom kilns designed to use the bamboo wastage to both produce charcoal and fire the kilns.

Additionally, sound shelter elements such as metal footings were added to shelter designs to protect the bamboo from ground contact, rain, and ultraviolet sunlight preventing damage and decreasing the quantity of structural bamboo need in the camps over time.

In designing a facility with capacity of producing 60,000 poles per month (which is enough poles for 7,500 transitional shelters per month) all program and pipeline partner implementation requirements were covered allowing distribution timelines to be met.

DISASTER RISK REDUCTION

The improved lifespan of the bamboo increases its long-term durability as a building material allowing it to resist inclement weather for longer periods. The treatment process can increase the bamboo's use by three to five years and if fully protected from the elements and ground contact can last ten plus years. The lifespan increase, combined with the structural shelter components, in which household members are trained, allows a general decrease of risk due to structural failure and collapse during the monsoon. Repairs and maintenance to non-structural elements will continue to be needed but households will be safer and better protected from natural hazards. This also represents a cost saving that can be directed toward improving other areas of risk in camps such as slope stabilization, drainage and access, all factors contributing to a decrease of the risk of disasters.

The complete treatment process from intake to distribution is completed in **two weeks:**

- Quality control intake - **1 day**
- Cutting, cleaning, and drilling nodes for solution penetration - **1 day**
- Soaking tank loading (2,000 poles) - **1 day**
- Soaking in orthoboric solution to penetrate ninety eight percent of vascular tissue - **8 days**
- Soaking tank unloading (2,000 poles) - **1 day**
- Vertical drying - **1 day**
- Stacking horizontal distribution racks - **1 day**

Treated bamboo is ready for distribution to camps.

The orthoboric solution used for the treatment of bamboo was selected for its ease in processing and its non-toxic nature.

ENVIRONMENTAL SUSTAINABILITY

Due to the nature of the Rohingya refugee camps being inside Government of Bangladesh forestry land there is a mandate to construct in a manner which will allow the land to return to forestry use in the future. From inception, the aim of the program is to reduce the impact of camp shelters and structures on the forestry land while continuing to strengthen and develop long-term structural solutions. This is done in tandem with environmentally sound solutions to protect households from disasters and the continual disruption of rebuilding structures yearly.

The program's major contribution to environmental sustainability is the increased lifespan of the bamboo and therefore the decreased need for maintenance and replacement. By decreasing the need to replace bamboo annually the production pressure on the bamboo forests and private groves decreases, allowing the groves to develop to full maturity.

Additional ways environmental sustainability is integrated into the program include:

- A quality control team ensures mature bamboo of three to five years of age is purchased. The team works with vendors to assure only mature bamboo is purchased ensuring immature bamboo is not harvested prematurely.
- The program works to buy bamboo in season which protects the bamboo groves during the monsoon season, allowing them to regenerate new growth and assuring future crops.
- The program works with the Bangladesh Forestry Research Institute to develop better harvesting practices: training agencies, growers, and vendors in methods to assure future crops of bamboo are available for all uses in Bangladesh.
- The program has secured environmental and fire licenses for operation of the facilities with the Bangladesh Department of Environment in order to be within best practices guidelines.

LONG TERM COST SAVINGS

Before treatment was initiated bamboo had to be replaced cyclically every 6-12 months in order to maintain minimal structural integrity. By providing treatment, the decreasing need for cyclical replacement of bamboo reduces the amount of bamboo needed for distribution for the structural maintenance of shelters.

The long-term savings is determined by comparing the cost to replace the bamboo each year or one cycle which would cost USD 2,727,416 for full replacement of all structural bamboo poles. As the treated bamboo is expected to have a life span of three to five years plus, the cost savings of not distributing each cycle is seen as the overall savings:

- If the treated bamboo is degraded at the earliest estimate of three years and is replaced the program will have a cost savings of USD 8.2 million.
- If replacement is needed after five years, the cost savings will be USD 13.6 million.
- As research shows that the treated bamboo life cycle can be ten plus years if protected from the elements the savings could end up being over USD 27.3 million.

MAIN CHALLENGES

The top challenge for the program has been **fostering a healthy supply chain which understands the quality control protocols of the program.** These quality control measures are now in place to assure mature structural grades of bamboo are delivered for production into treated poles and to allow younger poles to reach maturity decreasing the impact on bamboo forest and private groves of Bangladesh. The issue was addressed through workshops with partners and education of vendors. Additionally, a strong quality control team was built to interface with deliveries and reject substandard materials. Through these efforts the program has lessened the impact and works to assure future crops of bamboo are available in addition to strengthening and increasing the lifespan of shelters in camps.

OUTCOMES AND WIDER IMPACTS

The program highlights the ability to **overcome a specific material constraint,** while **considering environmental sustainability throughout the process**. By developing the bamboo treatment facility, the program was able to add value by **increasing the lifespan and durability** of a strong but short-lived building material leading to **increased resilience of camp structures and considerable long-term cost savings.**

The program can both **scale up and scale down** based on material needs of programming. It can facilitate all programming and pipeline partners treated bamboo needs. **The program has so far produced 665,220 treated bamboo poles which have been used in transitional shelter, mid-term shelter, community shelter upgrades, site development projects, protection safe spaces, and COVID-19 isolation and treatment centers.**

Additionally, the program provides **regular income for host community members.**

The program has been designed to integrate a range of environmental sustainability considerations, including a strong focus on the sustainability of the bamboo supply chain in Bangladesh.

STRENGTHS, WEAKNESSES AND LESSONS LEARNED

STRENGTHS

√ **Reduced shelter maintenance costs.** The treatment of bamboo has increased the structural lifespan of bamboo from three to five years. If the bamboo is kept dry it has the potential to maintain strength up to ten plus years.

√ **Environmental impact reduction.** By increasing the lifespan of the bamboo poles, the need for continual distribution of structural bamboo has been reduced. This will have a direct impact on allowing the bamboo forests and groves of Bangladesh to recover from the impact of the continued response needs for bamboo.

√ **Quality standardization of bamboo.** Through the implementation of a quality control program, the program has standardized high-quality bamboo for the organization's shelter programming and bamboo supplied to the pipeline partners. The program has further become a catalyst for research on the potential of treated bamboo for other uses than shelter.

√ **Host community livelihoods and skills development opportunities**. The need of a regular workforce for the treatment process has created a new livelihood for members of the local community. The program has provided training and reliable employment in a rural area.

√ **Scale of the program and pipeline creation.** The creation of a pipeline allowed partners to focus on implementation of projects rather than many organizations having to divert focus to build a treatment process.

WEAKNESSES

× **Shelter programs were directly affected by slow initial construction and operational delays.** Early delays led to an initial phase of low production which effected both direct and pipeline partner implementation in camps until the facility became fully operational. Many of the delays can be traced to contractor delays and facility design changes which would increase long term productivity but brought initial delays to shelter material distributions.

× **The treatment's long-term effectiveness is dependent upon multiple factors.** The treated bamboo must be protected from fungal rot, rain, and UV light as all will work to break down the material. As such, the bamboo must be used with a steel or concrete footing and covered to assure extended lifespans. As the materials are distributed to households for shelter construction some chose to sell DRR items such as metal footings and place the bamboo poles into direct contact with the ground leading to water penetration and fungal rot during monsoon season.

× **Assurance of best harvesting practices by bamboo producers is extremely difficult.** Due to the nature of programming, bamboo is purchased throughout different irregular funding cycles and is not purchased as a regular and predictable commodity. Furthermore, as bamboo should only be harvested outside of monsoon season it needs to be stockpiled but creating a large stockpile seasonally is a continued challenge due to many factors in the market and the nature of funding mechanisms.

LESSONS LEARNED

- **Development of a core team to focus exclusively on the project was essential** to its success and increased the implementation timeline.
- **The programming learning curve was steep due to the introduction of new techniques and processes.** Through continued small improvements and redesign the program increased efficiencies allowing the program to scale up and down as needed. During COVID-19 this resilient capacity was quite evident and addressed with shifts and rotational staff cycles.
- **Timely inputs from outside experts were vital** to the overall long-term success of the program. As the program began from an idea and grew into a full program many ideas were not fully conceived from the beginning and there were multiple practical challenges. More technical consulting in the start-up phase could have reduced the steep learning curve of the process.