BAMBOO TREATMENT PROGRAMME:

BANGLADESH ROHINGYA REFUGEE CRISIS RESPONSE

IOM
UN MIGRATION

PROGRAMME CONTEXT

On 25 August 2017, a mass exodus of Rohingya refugees traveled 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 hundreds of thousands of individuals who had fled previously - bringing the total Rohingya population to more than 930,000 and the total population in need in Cox's Bazar to 1.2 million.

Over two years later, the majority of Rohingya remain in a state of protracted displacement, and are almost entirely dependent on aid from the international community and support from the Government of Bangladesh. Despite progress made, the Rohingya remain in an extremely precarious situation - the root causes of their plight in Myanmar have not been properly addressed and their future is uncertain.

The crisis created a historic humanitarian need for shelter, as a city was rapidly formed where there had been little before. Beyond its impact on immediate survival, adequate shelter is necessary to provide security and personal safety, protect vulnerable individuals from the shocks of natural hazards and enhance resistance to ill health and disease. Through innovative shelter and non-food item programming, IOM seeks to address beneficiary needs and enhance resilience with sustainable solutions.

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ACRONYMS

BFRI	Bangladesh Forest Research Institute
BTF	Bamboo Treatment Facility
CSU	Community Shelter Upgrade
IOM	International Organization for Migration
MTS	Mid-term Shelter
PPE	Personal Protective Equipment
SMSD	Site Management Site Development
TSA	Transitional Shelter Assistance

DEFINITIONS

Borak	A type of bamboo species often used as load-bearing support in shelter design.
Borax	Borax is also called Sodium Tetra-borate, a water-soluble chemical used often to kill insects and fight mold and mildew.
Boric Acid	Boric Acid and its sodium borate salts are natural pesticides common in many products to control a wide variety of pests.
Cellulose	The primary substance found in plant cell walls to help it maintain its firmness and strength.
Hydrometer	An instrument used to measure the specific gravity or relative density of liquids, i.e. the ratio of the density of the liquid to the density of water.
Muli	A type of bamboo species used for making wall panels and roof rafters in shelter design.

OVERVIEW OF NEED

Due to the prolonged nature of displacement, shelter durability within the camps is a major concern among refugees and international aid organizations. Of key concern is the strength of the organizations' primary building material - bamboo. With current climate and camp conditions, the estimated average lifespan of untreated bamboo used for shelter is 0 to 20 months, with maintenance and repairs necessary to prepare for monsoon and cyclone seasons. This limited lifespan is especially concerning, as the crisis is now in its 25th month.

Over 24 million sticks of bamboo have been used by humanitarian agencies during the Rohingya Response in Cox's Bazar. The demands of an urgent humanitarian crisis at the peak of response and monsoon preparedness initiatives led to poor usage of bamboo with low quality and durability. Exacerbating this, structures have been constructed using untreated bamboo and poles in direct contact with the ground, creating perfect conditions for pests and rot. Extensive pest damage can already be seen throughout the camps, particularly in poles harvested while still immature or during the monsoon season (which are particularly attractive to pests).

While the total national supply of bamboo can be managed over time, demand constantly remains high and solutions to both decrease bamboo deforestation and improve shelter conditions for Rohingya individuals are paramount to the sustainability of the interventions and total response.

IOM is well positioned to lead efforts in improving the resilience of shelter material throughout Cox's Bazar due to its critical role in the humanitarian response and its coordination mechanisms. While political solutions are sought to end the crisis, it is the responsibility of IOM and the greater humanitarian community to continue searching for innovative solutions to replace those previously devised in an effort to increase durability and sustainability of shelter conditions for refugees.

PROGRAMME SUMMARY

PROJECT OBJECTIVE - To increase the lifespan and structural integrity of refugee shelters by chemically treating the primary building material, bamboo, in an environmentally friendly and innovative manner for use by both IOM and partner agencies.

TREATMENT BEGINS

In November 2018, IOM began running a pilot bamboo treatment facility in support of the greater humanitarian response. Beginning with only 4 treatment tanks, the pilot facility offered the opportunity to test production methods and begin training staff on the proper preparation and treatment of bamboo poles. From November 2018 until June 2019, the pilot facility produced 22,620 treated poles that would go on to benefit almost 16,000 households through several of IOM's projects. Construction of the main facility was completed in June 2019 with a capacity of 60,000 poles per month between 12 treatment tanks. This peak monthly capacity could be considerably higher as funding, operations and the material supply are optimized.

BENEFITS OF TREATING BAMBOO

Treating bamboo can increase material service life radically, to the extent that there is no distinguishable life limit when bamboo is well treated and used in a well-protected manner. Recent observations completed by the Humanitarian Benchmark Consulting (HBC) Group confirm that the treatment process serves as an effective and affordable option for increasing durability of shelters within the camps in a responsible and innovative way. During the treatment process, material is soaked in a mixture of borax and boric acid that are dissolved in water. Borates are extremely fine, dissolving easily and dissipating throughout the cellular structure of the poles. The chemical solution, which is toxic to common bamboo pests but is relatively harmless to humans, is then filtered and reused to ensure an efficient and environmentally friendly process.

The programme described in this report is one of the largest bamboo projects in history, and it is undoubtedly the largest ever conducted for humanitarian purposes. The response clearly demonstrates the concern of implementing agencies to assist vulnerable individuals in a responsible and innovative way that addresses and reduces vulnerabilities in migration.

OVERVIEW OF THE FACILITY

The Bamboo Treatment Facility (BTF) is located in Nhila, Teknaf – strategically positioned to facilitate distributions to camp complexes in the surrounding area (map on page 12). The facility itself is designed to maximize the efficiency of material movement with limited space. The BTF's layout includes a pre-treatment storage area, a prefabricated office for training and staff working space, five containers for storage, covered areas for cleaning, cutting and drilling, treatment tanks and drying racks designed to simplify the loading process for distribution.

A large portion of this land also works as a rotation of bamboo inventory. As poles arrive, they are organized in sequential piles, raised off the ground by concrete blocks and covered with plastic tarp as needed to protect raw poles from UV and rain exposure. According to capacity and demands, bamboo is rotated out from the earliest delivered materials to begin the treatment process.

The BTF relies on several key partners in order to ensure that its operational efficiency is maintained. Local staff primarily consist of cash-for-work subcontractors, but workplace diversity ranges from skilled national staff to labour from the host community. While this document showcases the IOM Shelter/NFI unit's bamboo treatment programme and its effect on the overall humanitarian response, it should be noted that the success of the facility is directly linked to the collective efforts of IOM Shelter, Procurement, Supply Chain and Logistics.

Daily production of treated Borak bamboo is approximately 2,000 poles/day, with the intention of ramping up operations in order to reach a peak capacity of 2,500 poles/day in the near future. By the end of 2019, the BTF produced over 265.000 treated poles to be used in the overall humanitarian response, and expects to maintain and potentially increase total production in 2020.

BAMBOO TREATMENT CYCLE

1. Bamboo reception and preliminary inspection
2. Individual quality control
3. Cutting station
4. Cleaning station
5. Drilling station
6. Treatment tanks
7. Vertical drying racks
8. Horizontal drying racks
9. Loading for dissemination to distribution points

Hasan Ali, a 58-year-old host community member from Nhila helps support his family household of 9 by working as a site cleaner at the BTF. Due to the labour-intensive nature of his previous work, he would have to take 2 or 3 days off to physically recover after each day worked. At the BTF he can perform daily work and is taking every opportunity to learn more about sustainable practices at the BTF.

RECEPTION & QUALITY CONTROL

The bamboo treatment process begins at the front gates of the facility, as untreated poles arrive by the truckload from IOM and partner suppliers every day. A visual preliminary inspection of the bamboo is undertaken by trained staff to ensure that large amounts of low quality or incorrect species material is stopped before a more thorough examination inside the facility.

During this preliminary inspection, staff ensure that the package conforms to currently accepted standards – including bamboo species, size, age and general condition. Those conducting the visual preliminary inspection of each truck can thus advise to reject or accept deliveries if it is clear that very little amount of the bamboo is compliant with the specifications required. Once paperwork is accepted and the preliminary inspection is completed, guards will guide supply trucks into the proper unloading slot.

Upon arrival in the unloading slots, the delivery from each truck is lowered onto the ground for the individual inspection of each pole. A more in-depth visual inspection is then conducted by the Quality Control Lead, as sticks are lifted, examined and measured. The quality control measures in place exist to ensure that bamboo is only treated if it can be effectively utilized from the beginning of the treatment process through its performance in IOM's Shelter projects.

With guidance from the Bangladesh Forest Research Institute (BFRI), IOM ensures that suppliers only collect mature bamboo ready for use – reducing deforestation in the area. Poles that are approved at this stage are then stacked neatly in the scheduled short-term storage area before moving to the next stage of the treatment process. Much of the material that does not meet Shelter's specifications during in-depth QC inspections is allocated to Site Management and Site Development (SMSD) which can use a greater range of material (e.g. curved bamboo) for non-shelter related purposes such as fencing, slope stabilization and drainage reinforcement in the camps.

While the facility is designed to reduce the movement of poles, careful attention to necessary relocation is crucial to the integrity of the treatment process. Workers carry single poles balanced over their shoulder, and one-way travel paths for materials and people have been established to ensure that the situational awareness of workers can effectively reduce incidents of injury. Carts are also often used to reduce worker fatigue and increased worker safety – having the capacity to carry up to fifty poles at a time.

CUTTING

Subsequent to the preliminary and secondary Quality Control checks, each pole of bamboo is taken through a three-stage process to prepare material for chemical soaking to maximize the impact of the overall treatment process. This three-stage process includes the cutting, cleaning, and drilling of each pole.

Approved poles are first transported to the cutting station, where labour teams measure and reduce each stick to a size compatible with chemical treatment tanks used later in the process. Cutting also provides an opportunity to reshape the angular cuts that commonly occur during the bamboo harvesting process, exposing fresh vascular tissue and increasing the absorptive capacity of each pole when exposed to chemicals during soaking. Off-cuts are collected and burned on-site in a purpose-built incinerator to produce charcoal that is used during the filtration process (see page 26).

The cutting station is the final opportunity for inspection, so QC oversight is present to keep close attention on the materials and assure conformity to current treatment standards. Rejected poles at this time are separated and may be allocated to SMSD.

CLEANING

When poles have been properly cut, they are transferred to the cleaning station nearby. Cleaners remove the outer portion of the nodes and branches using a sharp machete with the blade flat against the bamboo, away from the body, while gently turning the pole until a complete node is clean. Proper PPE is provided and worn by all cleaners in order to mitigate safety risks and boost efficiency.

The primary goal of this stage is to remove the excess material of the nodes and expose the inner wall tissue. By cleaning the poles, a more rapid absorption of the solution is achieved during soaking. For staff, maintaining tool sharpness is crucial to both the cutting and cleaning phases of the process. To have access to proper tools is to keep the work flow efficient, minimizing worker fatigue and ensuring consistent quality cuts on the bamboo.

DRILLING

After cutting poles to size and cleaning each one to expose its vascular tissue, poles are moved to the final stage prior to soaking – the drilling station. Bamboo is transferred from the cleaning station onto drilling workstations in bunches of 15-25 bound together by rope. Labour, using drills fitted with custom drill bits made of an 11' section of rebar with a knife cutting edge forged on the tip, then applies steady pressure to drill a hole through the full length of the pole. Workers are typically stationed with a small team at each end of the pole, working from opposite sides. After holes have been drilled, the bamboo is then moved either to a staging area or directly into the next empty tank for soaking.

TREATMENT TANK LOADING

WASHING AND LOADING

The chemical treatment process begins with the washing and loading of poles into several tanks, each one 17 meters long, 1.5 meters deep and 6 meters wide. The size of each tank allows for approximately 2,000 Borak bamboo poles to fit inside. Labour teams are divided into two groups, those transporting the bamboo to the tank and those inside of the tank to receive and align the poles properly. Each pole is lowered into the hands of the team inside of the tank and stacked in an orderly and safe manner for eventual collection.

Emptying tanks of solution prior to loading (and utilizing proper PPE), the labour team never comes in direct contact with chemicals. Placing the poles as flat as possible to maximize capacity, the desired height is reached when bamboo is approximately 30 centimeters from the top of the tanks.

BALLAST PLACEMENT

When the desired height is met, ballasts should be placed to weigh down bamboo for the duration of soaking. As bamboo is a very buoyant material and floats when water is added, the lack of ballasts would disrupt a uniform distribution of chemicals during this portion of the treatment.

Metal frames and load distribution sheets are placed evenly on top of the material, which is then weighed down with either 8 water tanks or a number of concrete ballasts. Ballasts are placed on top of the metal sheets, each approximately 1 meter from the edge of the tank with the length perpendicular to the bamboo.

PUMPING SOLUTION

With bamboo loaded and properly weighed down, solution is pumped into the tanks with additional weight added as necessary to keep the material fully submerged. Using a portable pump to transfer the fluid between tanks is a straightforward technique that also serves to agitate the solution to keep chemicals in suspension. Daily inspections of the pump are conducted to ensure that oil and fuel levels are normal, and that screws and fittings are tight after the previous use. Proper safety equipment is provided to all staff and its use is compulsory during all activities involving the solution.

SOAKING PROCESS

TESTING THE SOLUTION

Proper treatment of the bamboo requires the solution to be at the correct percentage of concentration, in order to maximize the effectiveness of soaking during the time-frame established. As poles sit in the fluid, they absorb a portion of the borax and boric acid into their vascular tissue through diffusion in the water. When bamboo is eventually removed from the tank, small portions of the solution will be taken by the material itself – so it is crucial to test and replace that portion of the fluid accurately.

Solution testing undergoes a three-step process at the facility:

1. Samples of the solution are taken by on-site staff.
2. Solutions is tested to measure PH, temperature, hydrometer readings, tank fluid depth and any other relevant observations.
3. Data is recorded and entered into a spreadsheet to be managed and referenced to assist in future programming.

MIXING THE SOLUTION

Because the solution is absorbed by the material treated and thus is carried out of the tank with each pole, the addition of new borates is often needed after testing. The IOM team accomplishes this through a process called agitated mixing, where pumps are used to move fluid through a closed tank while slowly adding Borax and Boric acid powders to the solution with the core objective of creating a uniform mix of solution maintained within the desired parameters.

The soaking cycle for each batch of Borak bamboo takes approximately 7 days, and around 2,000 poles are treated in each tank. On average, a tank of Borak bamboo completes the soaking process each day and is then moved to the next stage. The solution is then filtered using active carbon to remove dissolved organic carbons that inhibit proper absorption and ensure that the fluid is fresh, effective and reusable, minimizing environmental impact. Each quarter, bamboo samples are sent to BFRI to confirm that the chemical solution is properly penetrating each batch. According to recent laboratory-based tests (December 2019), BFRI confirmed that solution penetration was “very good”, and IOM’s Bamboo Expert recommended no changes to the treatment process at this time.

SOLUTION FILTRATION

During the soaking process, dissolved organic carbons (DOCs) that hinder treatment efficiency naturally build up in the solution as the boron salts enter the bamboo and sap is removed. In order to remove the DOCs, IOM employs a filtration system that uses charcoal to trap and isolate fine particles. The filtration system allows IOM to recycle and reuse its borate solution indefinitely without sacrificing its efficacy, thus minimizing environmental impact. Charcoal is produced on site from untreated bamboo waste and is recycled and recharged periodically as its carrying capacity and effectiveness diminish over time.

EMPTYING POOLS OF BAMBOO

With the soaking process complete and the tanks drained of solution, bamboo is safely and carefully removed from the tank in order to assure maximum drainage of pole solution. During removal, bamboo is held vertically to assure that remaining fluid is drained. The poles are then carried or loaded upon the carts mentioned previously for bulk movement to the drying racks. It is important to note that draining each pole properly is of vital importance to both the preservation of the material and for environmental care. Tanks are cleaned to remove excess material and prepared for new batches periodically. While extensive research shows that the solution utilized during soaking is neither harmful to humans or to the environment (including soil, plants and animals), staff take increased caution during the drying phase to eliminate any solution spilling.

VERTICAL DRYING

Vertical drying racks are utilized to optimize the amount of space available and to drain bulk fluid from the bamboo so that the humidity of the poles is reduced. Each vertical drying bay has the capacity to hold two rows of poles on each side of an aisle. Bottom rows are placed carefully, crossing the tops of the poles in an alternating pattern. The second row of poles are held slightly further back at the top in order to reduce the gap between each pole. Ensuring that drying bays are stacked in an orderly, successive fashion allows staff to easily rotate material through the storage area without causing clutter or confusion. Bamboo is then given between 12-24 hours in this vertical position before being moved to the next drying rack or directly to delivery trucks for the various programmes.

HORIZONTAL DRYING

Prior to the final shipping of material to various distribution sites, poles are removed from the vertical drying racks and stacked horizontally in an orderly fashion. The covered horizontal storage racks provide shade and rain protection to assist in the continued drying of treated bamboo poles before leaving the facility. Each horizontal drying bay is filled evenly in order to optimize loading space for delivery trucks. In effect, multiple trucks can be loaded at once – allowing staff to differentiate and easily split up specific deliveries with unique material or poles that are going to a unique destination.

DISTRIBUTION

Upon completion of the treatment process, material is safely and efficiently loaded onto delivery trucks to be taken to project sites and distribution points for use by both IOM and partners. Trucks are cleared by Log Base staff for entry into the loading area, labour teams load poles into trucks one at a time creating a secure load and QC staff record the final quantity of poles loaded before signing release paperwork and releasing the truck from the Log base. Poles are then sent to three of IOM's permanent distribution points and several temporary ones based on current need from the Transitional Shelter Assistance (TSA), Midterm Shelter (MTS), Community Shelter Upgrade (CSU) and Emergency Response Programmes. Because different projects and units require their own unique material specifications, the BTF has the capacity to provide tailored material - improving the overall efficiency of the programme.

IMPACT

IOM SHELTER PROGRAMMING

Material treated at the BTF goes on to support a number of IOM programmes that assist with the Rohingya Response in Cox's Bazar. The BTF's continued success is a signal that the humanitarian aid community intends to develop its own response capacity to the protracted crisis, replacing old solutions with more sustainable and environmentally friendly options.

TRANSITIONAL SHELTER ASSISTANCE (TSA)

IOM and partners support Rohingya families to carry out shelter improvements and regular maintenance activities by providing 1) distribution of durable shelter materials, 2) shelter maintenance training, 3) technical assistance and 4) vouchers for shelter and non-food items. Through the TSA Programme, IOM aims to support over 60,000 households with approximately 360,000 pieces of treated bamboo from the BTF.

MIDTERM SHELTER PROGRAMME (MTS)

Through this programme, the construction of 539 midterm shelters were approved for families that needed to be relocated from the congested camps due to infrastructure development (ie road and pathway construction), flood risk and landslide risk among other reasons. Each midterm shelter is built with 26 poles of treated bamboo from the BTF, concrete footings and metal rod connections.

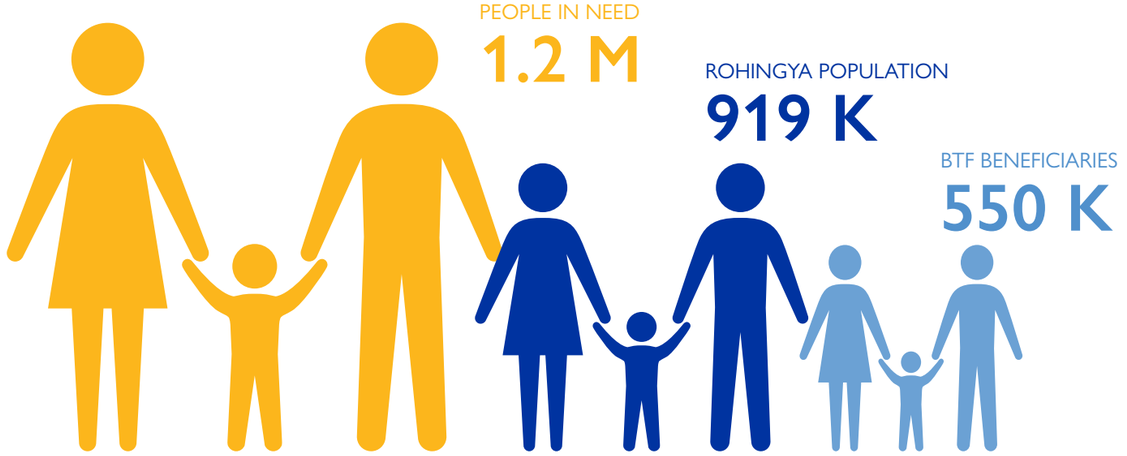
COMMUNITY SHELTER UPGRADES (CSU)

The Community Shelter Upgrade (CSU) Programme aims to upgrade community structures such as mosques, madrasas, women friendly spaces and child friendly spaces to be used to serve as temporary refuge locations for emergencies such as monsoons and storms. Under this programme, 223 community facilities have been upgraded as of December 2019. The durability of each shelter is improved using, among other things, treated mature bamboo columns from the BTF.

Pompi Rani Das is a 24-year-old host community member from a local fishing village in Teknaf. Living with her husband and 4-month old daughter, she is at high risk of harsh natural hazards due to the poor condition of her home.

Through IOM's host community intervention programme, Rani and her husband were provided with key shelter materials needed to upgrade their home and trained on shelter maintenance and disaster risk reduction techniques.

BTF FACTS AND FIGURES

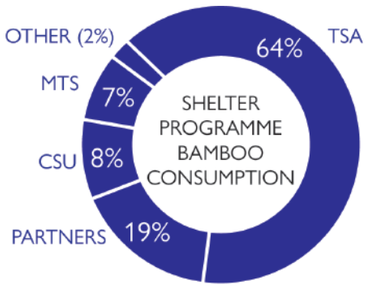


60,000

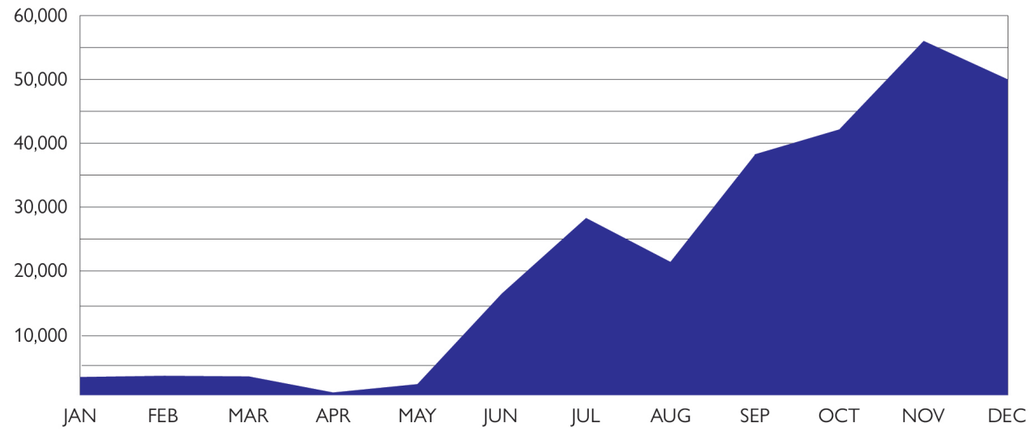
THE BTF'S CURRENT PEAK TREATMENT CAPACITY PER MONTH TO SUPPLY IOM AND PARTNER INTERVENTIONS

995 K

INCOME ADDED TO THE HOST COMMUNITY EACH YEAR OF OPERATION THROUGH A CASH FOR WORK SYSTEM (USD) ($2,000 / HH)



2019 MONTHLY BAMBOO PRODUCTION



HOST COMMUNITY IMPACT

THE BTF employs around 500 workers daily, and the intervention itself contributes to the economic development of host communities in the area. At the BTF's current level of operation, nearly one million USD will be added to the community through a cash for work system at the facility every year of operation, which can then lead to the improved livelihood of employees.

When the crisis is resolved and bamboo is no longer needed for the greater humanitarian response, the BTF could be handed over to the host community to contribute towards continued development and improved livelihoods for local individuals. Its proven success is an example for the rest of the country – by demonstrating its effectiveness in crisis, IOM helps to raise awareness for similar interventions and opportunities in other areas in the future. All knowledge and experience is shared with the Government of Bangladesh through the BFRI, shelter partners and private sector organizations interested in entering the industry. As a sustainability measure, IOM is also exploring a potential handover of the facility to BFRI as a center for research, study and innovation in the region at the eventual conclusion of the crisis.

ENVIRONMENTAL CONSIDERATIONS

IOM has strict measures in place to limit the environmental impact of mass-producing and chemically treating bamboo, as part of a greater global effort to ensure that material demand does not lead to the degradation of environmental resources.

Beyond this, IOM has partnered with the Bangladesh Forest Research Institute (BFRI) and Bangladesh Ministry of Environment, Forest and Climate Change to aim for zero sum accumulation of chemicals through several sustainable practices such as water recycling, filtration and the use of an incinerator to remove any small buildup of Borax or Boric Acid during the treatment process. Having already secured an environmental license from the Government of Bangladesh, our close cooperation with BFRI allows IOM to set a higher standard and identify/utilize suppliers who are proven to employ environmentally friendly practices. IOM continues to work with sector partners to discuss how other bamboo species (such as Muli) may be used in the response, in order to diversify the portfolio of potential solutions and distribute the load of harvested material. The primary objective of the Bamboo Treatment Facility's strategic approach to environmental sustainability is to improve resource efficiency, reduce waste and mainstream sustainable practices.

OPPORTUNITIES TO IMPROVE

Challenges to implementation will occur throughout the lifespan of the project, providing IOM with several opportunities to reassess mitigation measures that are currently in place in order to improve the overall effectiveness of the programme. Thus, the project team seeks to identify challenges, take corresponding action and measure results. Examples of this include the following:

CHALLENGES:	A) Fostering a more educated supply chain around specific species and the quality of bamboo.	B) Integrating tools and processes not frequently used in this region.	C) Promoting a greater understanding of safety precautions and Personal Protective Equipment (PPE) among staff.
ACTIONS:	A) IOM's shelter unit conducted a series of Quality Control workshops with staff and sector partners.	B) The project team conducted tools training for staff at every level of the innovation process.	C) IOM's shelter unit provided all PPE along with safety and gear training for all staff at the BTF.
RESULTS:	A) IOM has seen increased knowledge among vendors and additional effort among them to source material correctly and increase proper supply.	B) The project team has seen notable improved efficiency and further unexpected innovation from labour teams at the BTF.	C) Subsequent to actions taken, IOM has seen a marked decrease in safety incidents and a more cohesive team environment overall.

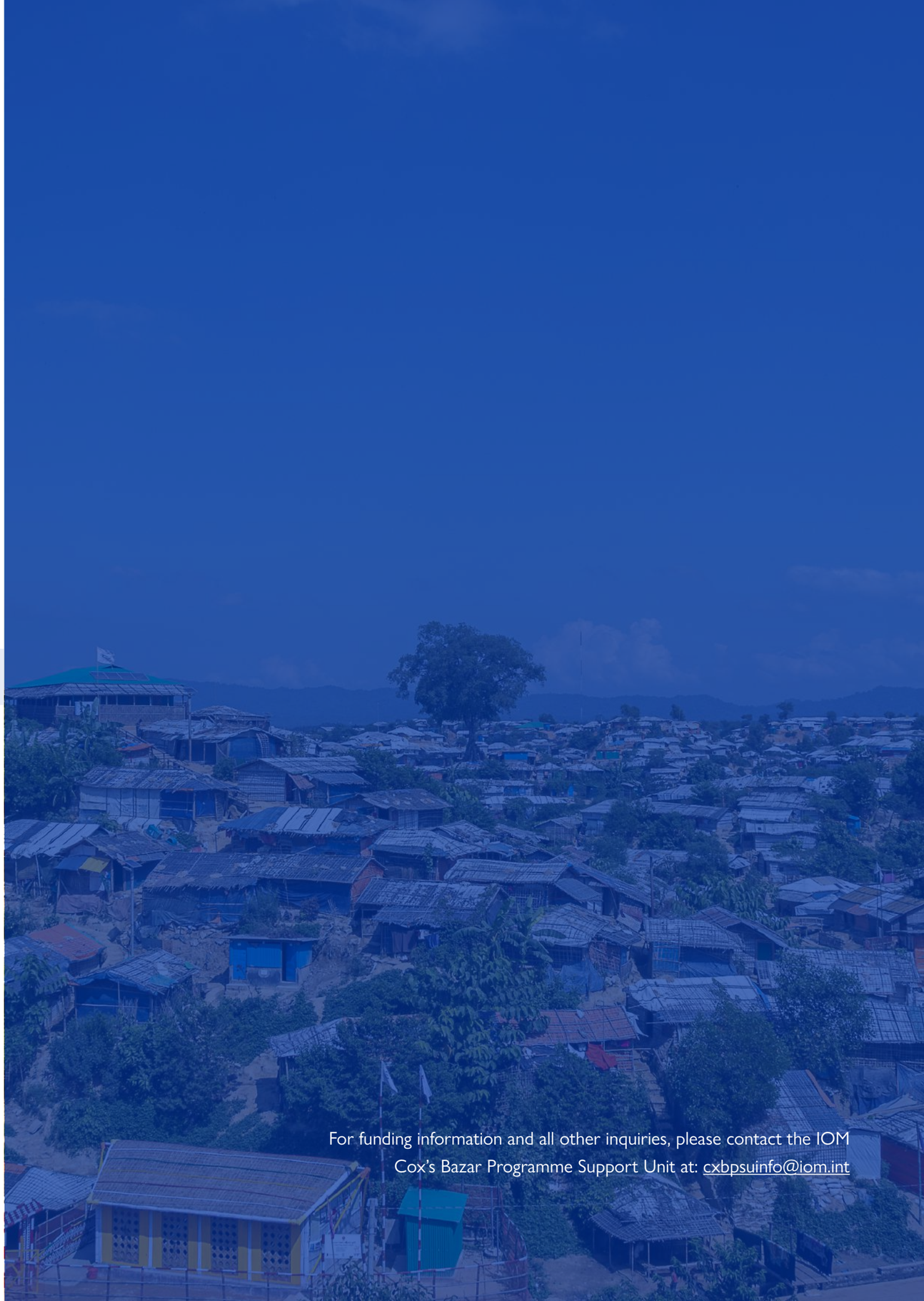
Syed Alam is a 22 year old beneficiary of the BTF, using the allocation of treated bamboo to upgrade his shelter in Alikhali Teknaf (Camp 25).

Syed is the sole income earner of his family, and supports his mother and younger siblings by supporting the upgrade of shelters in his community through an IOM cash for work arrangement.

CONCLUSION

The Bamboo Treatment Facility's contribution to the Rohingya Refugee Crisis Humanitarian Response is an immense and remarkable example of innovation under strict political and socioeconomic limitations. Recognizing that the humanitarian community's bamboo supply is limited, strengthening and increasing the lifespan of material use in project activities itself contributes to the minimization of overall bamboo usage. Over 268,620 poles have been treated as of December 2019, directly contributing to over half a million individuals through IOM's Shelter programming and work with partners. The increased lifespan of each pole from 0-20 months untreated to 3-5 years treated translates directly to reduced shelter maintenance costs, minimized environmental degradation/deforestation and the overall improvement of the livelihoods of beneficiaries.

The importance of the Bamboo Treatment Facility's contribution to the overall humanitarian response cannot be overstated. With continued donor support and the determination of all staff and partners in the crisis, IOM aims to expand upon the BTF's programming – providing a more sustainable and environmentally friendly option to enhancing the durability of shelters across Rohingya communities in Cox's Bazar.



For funding information and all other inquiries, please contact the IOM Cox's Bazar Programme Support Unit at: cxbpsuinfo@iom.int

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Text, Layout and Photography: Nathan Webb / IOM

The names of the beneficiaries have been changed in line with IOM's data protection principles.