

# Plastic Bottle Houses for Sahwari Refugees - Algeria

## Organisation implementing the project

The idea to build plastic bottle houses in the Sahrawi Refugee Camps was initiated by [Tateh Lehbib Barika](#), a refugee born in the camps who received a UNHCR ([UN Refugee Agency](#)) scholarship to study renewable energy.

After completing a Masters in Energy Efficiency, Tateh Lehbib built a prototype house for his grandmother using his own resources. The approach attracted attention from the UNHCR office in Tindouf. Together, Tateh Lehbib and representatives from the UNHCR Tindouf office approached the UNHCR (United Nations High Commissioner for Refugees) [Innovation Service](#), which provided funding to build 25 of the plastic bottle houses across each of the five Sahrawi refugee camps in Algeria, to demonstrate the solution across the community.

The UNHCR Innovation Service acts as a facilitator to support innovation among refugee communities. The project was led by Tateh Lehbib and delivered collaboratively with Sahrawi people living inside the camps.

## Project Description

The Sahrawi camps were originally built over 40 years ago and intended to be temporary. Houses in the camps are typically constructed using adobe, fabric, and metal sheets. Because of high salinity in the desert the adobe becomes fragile and less resilient to rain and extreme weather conditions. Homes are often destroyed by sandstorms and torrential rains.

This work aims to improve the situation for people stuck in a permanent 'temporary' state of housing. Plastic bottle houses use materials that can be found for free or funded by the refugees themselves. It has provided an opportunity to improve housing in the camps without heavy reliance on external aid.

The houses are built using recycled plastic bottles filled with sand. The bottles are stacked horizontally and the gaps packed with sand to make the basic structure (a simple cylinder with two windows). The inside is covered with a layer of earth and straw, followed by a thin layer of cement. A layer of cement is also added to the outside of the structure. The homes have a double layer ceiling which helps reduce the level of heat coming in. Each home requires the use of around 6,000 recycled plastic bottles.

The materials can be sourced locally by the community themselves. Basic building materials (sand, cement) are sold in shops within the camps and others (straw and plastic bottles) can be acquired from residents.

Compared to the typical adobe structures found in the camps, plastic bottle houses increase protection from fire, sandstorms and floods. The temperature inside the plastic bottle houses is up to five degrees lower than the typical adobe structures.

The project has built 27 homes in total. The UNHCR Innovation Service funded the construction of 25 homes, which were built between November 2016 and April 2017.

## Aims and Objectives

The project aims are to improve the thermal well-being and living conditions of Sahrawi (and non-Sahrawi) refugees; to improve the self-sufficiency of refugees through self-build; and to reduce plastic waste in the desert.

The focus is the Sahrawi refugee population, with priority given to vulnerable groups (the elderly, people with special needs, people with very limited economic resources).

Employment and education options for people living in the camps are severely limited. Another objective of the project is to reach and motivate young people living in the camps, to help them develop ideas, and provide them with opportunities.

Twenty-seven homes (housing a total of approximately 50 people) have been completed. The intention of the project was to demonstrate the approach to the communities.

The ambition of Tateh Lehbib is to establish plastic bottle housing construction as a common practice across other refugee camps and beyond, by providing training and awareness raising. He also plans to use plastic bottle construction to build more resources for his community - including schools and health centres. He is currently engaged in a research project with his professors at the University of Las Palmas de Gran Canaria to develop further solutions. There is currently no further funding commitment from the UNHCR Innovation Service.

## Context

The Sahrawi people originate from Western Sahara. In 1975, many were forced to flee because of territorial disputes and violent conflict in the country<sup>1</sup>. They took refuge in Tindouf province in Algeria, setting up five camps in the desert (Laayoune, Ausserd, Boujdour, Smara, and Dakhla). Homes were only ever meant to be temporary, built hastily using light or easily eroded materials.

The conflict in Western Sahara continued until 1991 when a ceasefire was agreed, however an arrangement for the return of the Sahrawi refugee communities to their original homeland has yet to be reached. There are now generations in the camps that have never known life anywhere else.

In 2015, the Sahrawi camps suffered catastrophic floods which destroyed or damaged around 80 per cent of their homes. This disaster was the motivation for Tateh Lehbib to begin this project.

A bit about life in the camps, provided by Tateh Lehbib (translated from Spanish):

*Life in a refugee camp is hard. We are talking about people who have been displaced from their land and homes - where they worked, had a house and a family, a monthly salary, some of them (like my grandmother) were living by the sea. Then suddenly they have to go to a neighbouring country and live in tents and mud houses in harsh weather conditions.*

*This takes a toll on people - especially those who weren't born in the camps. Despite all this the Sahrawi people have a great will and tenacity that enables them to keep*

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<sup>1</sup> The population size within the camps is contested and politically sensitive (see [https://en.wikipedia.org/wiki/Sahrawi\\_refugee\\_camps](https://en.wikipedia.org/wiki/Sahrawi_refugee_camps))

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*striving for better conditions and working to resist everything that frustrates their will and affects their lives.*

*A great interdependence and cooperation exists between Sahrawi people. Many Sahrawi volunteers work for humanitarian organisations in the camps and many others are interested in science - in most Sahrawi families you will find the children hold university degrees. These factors significantly contributed to the awareness and willingness of the Sahrawi community to accept ideas like plastic bottle construction.*

## Key Features

Project activities included:

- Awareness raising and open days in each of the five camps to present the plastic bottle design.
- Training young people about construction methods and recycling of materials.
- Developing equipment to collect plastic bottles.
- Forming a work team to fill the bottles with sand.
- Setting up transportation to move materials to construction sites.
- Construction of the houses.

The community forms a number of groups to gather and prepare the materials to build the houses. One group goes out to collect plastic bottles. Another is tasked with filling the bottles with sand from the dunes. Once the bottles are filled, a truck transports them to trained masons who use them to build the houses. Each house takes approximately one week to build and requires the use of around 6,000 recycled plastic bottles. During implementation the project directly employed 200 people within the camps. Those 200 people paid a further 1,500 (approximately) to collect bottles and fill them with sand.

The homes funded by UNCHR Innovation Service are targeted towards people on very low incomes; elderly people; people with special needs and disabilities. The selection process has been managed by the Directorate of Family Care (a public sector department which coordinates with UNHCR).

Tateh Lehib, who developed the plastic bottle houses, is a member of the Sahrawi refugee community, with first-hand experience and sensitivity to the challenges of living in the camps. The project has involved coordination and cooperation with the Red Cross, the national government's Ministry of Water Resources and Environment, and local governors in each camp.

Awareness-raising and training workshops have been aimed in particular at educational centres, women's associations and youth groups, with emphasis on the education and empowerment of young people.

## Funding

The average cost of building an adobe mud-brick home is around €500 to €1,000 Euros (USD\$582 to USD\$1,160).

The original plastic bottle home (built independently by Tateh Lehib) cost €250 Euros (USD\$291) to build. The 25 homes supported by the UNHCR Innovation Service have a higher unit cost, as they include labour costs (e.g. staff to fill bottles with sand and staff trained in construction, as well as additional project staff), training and communication costs.

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UNHCR Innovation Service provided a total of USD\$60,000 for the project, which covers the following costs:

- Staff to collect plastic bottles.
- Empty bottles acquired from institutions, schools and hospitals.
- Staff to fill plastic bottles in preparation for construction.
- Transport to move the filled bottles to construction sites.
- Supply of Foundation loads (materials that form the base of the houses).
- Tools and equipment for construction.
- Other construction materials (sawdust, hay, heat absorbing rugs).
- Doors and Windows.
- Training and awareness raising workshops.

The UNHCR Tindouf Office also provided a small amount of additional funding (approximately USD\$2,000) and human resources to support the project.

Initial cost per unit (including all elements funded by the project such as training and awareness workshops) amounted to USD\$2,400 per home. As the need for training and awareness raising reduced, the unit cost decreased to €1,400 Euros (USD\$1,630). This covers the costs of labour (€300 or USD\$350) and materials and transport (€1,100 or USD\$1,280). Certain elements can be replicated at a much lower cost – in particular people can fill their own bottles and procure their own construction materials.

The project funded by UNHCR Innovation Service has effectively completed. Future plastic bottle houses are likely to be funded either by refugees themselves, or grants raised by others wanting to apply the method.

## Innovation

A number of examples of using plastic bottles in building can be observed in Africa and Latin America. As waste they represent a huge environmental challenge, but as a building material their durability and abundance make them a significant potential resource. There are a number of people and organisations exploring and developing plastic bottle construction, though it is still very much emerging as an approach.

This project combines emerging building techniques and an environmentally conscious approach with empowerment. The shelters (albeit very basic ones) are safe, durable and replicable. The technique has the potential to evolve considerably beyond its current use in the camps, and the nature of the demonstration project has provided an impetus for more people to benefit without the need for large amounts of external funding.

## Environmental Impact

There are no formal recycling strategies locally, so this use of plastic bottles helps to reduce their negative impact on the environment (removing them from landfill or collecting them from the streets). Gathering building materials locally reduces the overall carbon footprint of construction. The building methodology also reduces the consumption of water (usually required to make adobe blocks).

The shape and design of the homes make them more resilient to extreme weather conditions (floods and sandstorms) which have affected people in the camps.

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More broadly, the use of plastic bottles in construction offers one potential route to addressing the global challenge of plastic disposal and recycling. The [UN Environment Programme](#) (UNEP) has estimated that 280 million tonnes of plastic are manufactured worldwide each year. Hardly any of this plastic ends up being recycled, and much of it ends up in the ocean.

### **Financial Sustainability**

There is no long-term funding stream secured from the UNHCR Innovation Service. However, because plastic bottle construction relies on materials that can be sourced locally, and by the communities themselves, the approach can be maintained to some extent with no external funding.

The ability of the most vulnerable groups (the target of UNHCR Innovation Service funding) to take advantage of the plastic bottle house method beyond the project may be more limited. However, the dissemination and embedding of skills and knowledge has created a foundation to build on, and there is an existing culture of interdependence and support across the Sahrawi community. It is clear from the approach and resolution of Tateh Lehib that every effort will be made to continue helping as many people as possible.

### **Social Impact**

The project provided capacity building workshops and training programmes which have increased its social impact. Others are now able to apply and share the methodology. Awareness raising, and training were aimed in particular at educational centres, women's associations and youth groups, with particular emphasis on the education and empowerment of young people.

The homes provide additional safety and a cooler, more comfortable living space for residents of the camps.

The approach demonstrates the capacity of people to come up with solutions for themselves. It also provides an example of involving and engaging communities in transferring a solution to a shared problem.

The level of contention around policy for refugee housing makes this a very difficult area to influence at a national level. However, the interest and support of UNHCR has implications for potential transfer across refugee support networks.

### **Barriers**

Refugee households were initially sceptical about the plastic bottle houses and apprehensive about initiatives taking resources away from other areas (like food assistance). Tateh Lehib did a lot of preparatory work building awareness and sharing the approach on social media so that people were more accepting of the idea.

There were also practical challenges relating to transporting plastic bottles without damaging them. There was an element of trial and error in figuring out the best way of managing the logistics for the project.

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## Lessons learned

Initial evaluation found significant added value was gained (by both the refugees and UNHCR staff) from non-financial support. In particular matchmaking, mentorship, technical support and learning/training opportunities were highlighted.

Excerpts from the evaluation are provided in 'Evaluation' (below).

## Evaluation

The UNHCR Tindouf Office carried out a preliminary evaluation and produced a Mission Report in June 2017. The report found (p.1-2):

*A wealth of enabling factors exist in the refugee camps that can be leveraged to support innovation. These include considerable numbers of educated and trained youth, connectivity, high levels of female participation in social and political spheres and the existence of democratic and societal Sahrawi structures that manage the camps and the distribution of aid.*

*Refugee innovators identified in the camps stressed the importance and value of non-financial forms of support over the provision of financial support alone.*

*Matchmaking, mentorship, technical support and learning/training opportunities were identified by both refugees and UNHCR staff as primary forms of non-financial support that can be facilitated by UNHCR Innovation.*

*Those we spoke to in receipt of the homes all mentioned that they felt safer in the "bottle homes" than in the tents and adobe mud homes with metal sheet roofing since they were susceptible to damage by strong winds. The homes were also noticeably cooler than the other shelter solutions but the prototypes built were smaller in size compared to what the Sahrawi community is normally used to.*

Other impacts observed by the evaluation include:

- Generating new energy and discussions with refugees and donors inside the camps.
- Supporting advocacy and directing media attention towards the camps.
- Helping to change perceptions of UNHCR as an organisation operating within the 'status quo'.
- Adoption of the approach by other refugees outside of the project.

A further evaluation is planned to obtain more information about the impact on refugees living in the new homes.

## Recognition

The plastic bottle house project in the Sahrawi refugee camps has been documented in a number of media outlets including The Guardian, Huffington Post, the BBC, the World Economic Forum, the Global Agenda, EU Neighbours, El País, and Middle East Eye.

Numerous visits to the project have been made by politicians, artists, journalists, activists, and international delegates from Germany, France, Spain and Sweden. The project has also been visited by ambassadors from donor countries and the United States Embassy in Algeria.

## Transfer

The approach is starting to be used elsewhere in the refugee community. Many people have been observed collecting and filling plastic bottles across the camps. Although this is not being formally monitored and not everyone completes their construction, Tateh Lehbib has seen a few completed homes using or adapting the approach - one built with bottles (in Dakhla), one with carafes of sand (in Laayoune), and an artist in Ausserd who is using plastic bottles filled with water to create illuminated windows.

Project managers and leaders from the Sahrawi camps are keen to expand the approach so more families can benefit. Tateh Lehbib intends to continue contributing his knowledge and expertise regarding the construction process and facilitating plastic bottle collection in collaboration with the Sahrawi authorities. He will also continue to promote the approach through national radio, television and social networks. This includes regular talks in the camps and in other countries to share the plastic bottle design and approach, and the story behind it.

New plans are being formed to develop the approach further, replacing cement with lime and earth, and improving the ventilation and roofing design. This will involve further 'pilot' builds working with the community. Tateh Lehbib intends to build a centre inside the camps to investigate climatic building design with plastic bottles. His ambition is to attract engineers and creative architects to help improve design and efficiency in the camps, generate further research and build more homes.

While it is possible to replicate the approach independently (by collecting your own bottles) it will be difficult for many others to achieve this without further training and activism to spread the approach. Transfer could be supported through continued awareness-raising campaigns and activities across the media, environmental protection organisations, and social networks.

In addition, knowledge about the approach can be disseminated by developing and working with networks of engineers and experts as well as refugees in other countries. Tateh Lehbib has liaised with peers working in Mexico and the United States and visited several other countries and institutions to develop his design. He continues to collaborate with institutions in Paris and Stuttgart to build on the energy efficiency and ventilation of the plastic bottle structures.