the natural ecology. A number of key measures were undertaken:

Firstly, the area along the river was set back and the campus was integrated into the waterfront space. Prior to renovation, the ECUPL waterside trail could only accommodate two people side by side, and at its widest the trail was less than 2 m, separated from the campus by a fence. Following renovation, the fences and 18 temporary buildings were demolished and the public riverside area was opened and extended at its widest point to approximately 98 m, providing public access to the historic buildings for the first time.

Secondly, trail greenspace was optimized to create an ecological space with clean water and trees: the total green area on the 900 m long shoreline now reaches 6,600 m^2. These green habitats were carefully designed. Any shrubs that intruded or affected the landscape of historical buildings were completely removed. Suitable flowers and trees were then planted along the entirety of the waterfront, including the trail, with consideration given to diversity. Indigenous plants more acclimatized to the local environment were also introduced along with plants in harmony with the architectural landscapes to improve the appeal of the space.

Building facades were repaired ensuring their historical features were preserved to maintain their traditional and low-carbon vision. In this case, the public waterfront space has the distinct local advantage of being a historical building complex at ECUPL – a feature that has been highlighted by paying close attention to the historical features of the buildings and structures. The construction team collected an extensive range of historical photos and materials in an effort to restore the original appearance of the buildings while capitalizing on the know-how of traditional, low-carbon architectural technologies. One example is that of the Gezhi building which contained original clear brick walls covered with less breathable red and grey coatings that prevented the original brick from breathing. Experts from the Shanghai Cultural Relics Bureau were able to guide the construction team in their adoption of a series of traditional processes that included paint removal, cleaning, polishing, repairing, jointing, pointing, strengthening and waterproofing to repair the surface of the wall, helping it regain its smooth, naturally breathable qualities. The construction team also discovered circular vent holes in the lower part of the Gezhi building which had managed to keep the building dry for a hundred years despite its location on the riverside, and renovations have further protected the elevated space to ensure the floor remains dry for even longer. These buildings perfectly illustrate the long human history and traditional local wisdom as it is expressed in architectural technologies that deserve to be continued.

This case highlights the power of integration, offering a green and open public space suitable for walking as well as connecting the campus with the surrounding communities. In terms of cultural inheritance, the local historical continuity is maintained by combining historic relics and modern restoration technologies. This optimized ecological environment with profound humanistic characteristics makes Shanghai a strong model for sustainable development.

Minawao, Cameroon: Creating an Environmentally Sustainable and Resilient Green Refugee Camp[5]

Case background

As global temperatures continue to rise, changes to socio-ecological systems are becoming increasingly pronounced intensifying the impact on both humans and the natural world. Coinciding with an unprecedented surge in human displacement, many migrants are today forced to inhabit some of the most inhospitable environments around the world, faced with extreme conditions in which cultivating sustainable livelihoods is near impossible. As much as 86 percent of the world's refugees are fleeing to countries where

5 This case was co-authored by the UN-Habitat experts and the team of Dr. Chen Haiyun from Tongji University.

resources are already scarce.[6] As this trend intensifies, the sustainable planning and management of refugee communities will be critical to increase livelihood opportunities for migrants and displaced individuals. Given the socio-spatial negotiations between the humanitarian agenda and refugees, refugee camps exist under an increasingly permanent humanitarian governance model whilst their inhabitants also organize themselves in ways that create space to sustain a livelihood within their communities, making them important forms of urban life. Refugee communities are therefore playing an increasingly important role in urbanization processes, highlighting their status as key components of sustainable urban development.

Since the Boko Haram insurgency in Nigeria in 2014, tens of thousands of refugees have fled the border to Cameroon to escape the conflict and extreme violence. The Minawao refugee camp opened in July 2013 in northern Cameroon, was first designed to accommodate 15,000 refugees; however, with a continuous influx of new refugees, the camp population has continued to grow receiving an average of 692 new arrivals and more than 287 births per month. As of January 2021, there were a total of 69,622 Nigerian refugees (of which 61 percent were under 18 years old, and 54 percent were women and girls).[7] Situated in Cameroon's far north, an arid region scarce in natural resources, the impact of climate change in Minawao has already been pronounced and the emergence of the rapidly expanding refugee community has only exacerbated the already pressing environmental challenges. Accelerated deforestation and desertification have brought about severe water shortages and damage to critical pasturelands. This ecological deterioration has led to inter-community conflict where there is a heavy reliance on local wood for energy with many families forced to sell the rations provided by the United Nations because wood grew so scarce it threatened their livelihoods.

To address these challenges, in 2017 the United Nations High Commissioner for Refugees (UNHCR) in cooperation with the Land Life Company and the support of the Dutch National Postcode Lottery, planned to transform the Minawao camp into a green, ecologically-sustainable community as part of a larger reforestation project. The cooperation aimed to reduce deforestation around the camp and in surrounding villages, mitigate soil erosion to maintain fertility, improve soil permeability and improve living conditions, creating a model best practice for other refugee communities within the Sahel region. A green refugee community has since been developed in Minawao addressing the two most pressing challenges of today, transforming the plight of refugees and improving the environmental health of their communities via a sustainable approach. The project demonstrates unique methods with which to minimize the environmental footprint of humanitarian work, reduce costs, improve the health of refugees, and enhance the environmental quality of host communities. It has transformed the relationship between refugees and their host community, providing a more prosperous environment with new livelihood opportunities, whilst empowering and protecting women and girls (see Figure 4.5).

Source: The Lutheran World Federation - (photo by Justin Toukap). URL: https://www. lutheranworld. org/news/cameroon-protect-environment-create-employment (2020) (Accessed: 04/08/2022)

Figure 4.5 Green space number 1, one of the 26 green spaces within the Minawao Refugee Camp

6 United Nations Human Settlements Programme. URL: https://www.urbanagendaplatform.org/best-practice/building-green-refugee-camp (Accessed: 30/07/2022).

7 United Nations High Commissioner for Refugees. URL: https://data.unhcr.org/en/documents/details/84914 (2021) (Accessed: 30/07/2022).

Implementation process

In 2017, UNHCR, the Lutheran World Federation (LWF) and the Land Life Company received a donation of USD 2.7 million from the Dutch National Postcode Lottery and subsequently initiated work on the Minawao camp, facilitating proactive greening measures to tackle the social and environmental crisis at hand. Cooperating under a public-private partnership model, the support of all three entities produced staggering results over just a few years developing a sustainable, green refugee camp model which integrated innovative ecological preservation techniques. In order to create a more sustainable lifestyle for the refugees and their host community, the focus was given to four core elements: guaranteeing environmentally sustainable shelter; reforesting degraded land; transition to sustainable cooking alternatives; and capacity building for local refugees.

1. Developing eco-friendly housing and energy production methods

Emergency shelters had originally been built using wooden poles and plastic sheets but these temporary solutions were quickly damaged, eventually becoming sources of litter polluting the community and surrounding areas. The project facilitated a movement towards eco-friendly alternatives for sustainable housing solutions. Under the green refugee camp model, transitional shelters were introduced incorporating sustainability principles via the use of locally-produced non-baked bricks (produced sparing wood and other fuels). Local sourcing of these bricks also eliminated the carbon footprint resulting from conventional production and transportation. Subsequently, a total of 14,850 community members were offered sustainable shelters with 22,445 people benefitting from UNHCR's efforts to construct eco-friendly family shelters throughout the camp.[6]

In addition, where 95 percent of people living in the northernmost part of Cameroon have been reliant on wood for cooking and heating,[8] the project facilitated the transition to eco-friendly alternatives manufactured within the camp itself. Previously, the use of firewood would spark conflict between refugees and locals due to the scarcity of trees, but the project alleviated this issue through the introduction of locally-produced energy-efficient, pollution-reducing charcoal briquettes made from agricultural waste such as peanut shells or wheat husks. Besides providing more sustainable cooking fuel, this also eliminated the toxic fumes emitted by traditional wood stoves. And critically, it also reduced internal friction caused by fuel shortages and reduced the risks faced by refugees when embarking on dangerous trips outside of the camp to source fuel where women and girls, in particular, were exposed to attacks.

LWF also established an energy-efficient stove production centre along with two eco-friendly briquette production centres in which families can transport their waste for recycling via conversion into usable briquettes; promoting the circular use of materials. As of 2020, 11,460 energy-efficient stoves had been distributed to families in the camp, and over 5,000 families had received training in briquette production. Specific efforts were made to train local women in briquette and stove production, as shown in Figure 4.6, to empower them through income-generating opportunities. In return, they played a key role in educating the local community on the use of eco-friendly energy/stoves, for example through three

Source: United Nations Human Settlements Programme. URL: https://www.urbanagendaplatform.org/best-practice/building-green-refugee-camp (Accessed: 30/07/2022)

Figure 4.6 Community members making energy-saving stoves

8 The Lutheran World Federation. URL: https://www. lutheranworld. org/news/cameroon-protect-environment-create-employment (2020) (Accessed: 04/08/2022).

community fairs in 2018 including National Youth Day and International Women's Day. Where 1,019 of the planned 5,100 households had access to alternative and/or renewable energy as of January 2021, this highlighted that solid foundations had been established; however, further work is required to expand access to a greater number of homes.[7]

2. Enhancing ecological resilience through reforestation and education

Where a 18 km (approximately) radius of land had been cleared around Minawao, the project's reforestation pillar as led by LWF was subject to underlying tension around the Gawar community and in the nearby Zamay Forest Reserve – a site of strong cultural significance to the Zamay people. Afforestation has remained a key activity with over 300,000 trees planted since the project's launch in 2017.[7] Using 'cocoon technology', a novel method developed by Land Life, planted seedlings were provided the best chance of survival in the harsh conditions. The process involved burying donut-shaped water tanks made from recycled boxes, encircling plant roots and feeding them with a steady supply of water via a string that connects to the young shoot as shown in Figure 4.7. Previously, due to a lack of technical knowledge, the tree survival rate was less than 10 percent leading to largely unsuccessful reforestation efforts. However, the introduction of this new technique has increased their survival rate to 85 percent while reducing water consumption by 61 percent, with some trees growing up to 3 m in height.[8] These trees are providing invaluable protection from sun and wind in the face of extreme heat and windstorms. In subsequent years, the tree canopies are expected to continue to grow, forming mini-forests between houses that will further bolster living conditions and environmental protection by reducing soil erosion and increasing carbon sequestration.[6]

Source: Land Life Company. URL: https://landlifecompany. Com/projects/minawao-refugee-camp-cameroon/ (Accessed: 05/08/2022)

Figure 4.7 Residents in the Minawao refugee camp plant trees using cocoon technology

To date, 119 hectares of land has been reforested and 26 tree nurseries developed within the camp and in nearby villages.[9] These have provided job opportunities for local community members and also allowed residents to come together and learn new skills. Gaining knowledge on seedling growth and maintenance has enabled the Minawao refugees to become more self-sufficient. A five-year tree planting cycle is ensuring that the local community has a continuous supply of wood, which can be used as firewood while the vines are used in roof construction. Fruit from trees donated by LWF can be harvested after two years, and after three years most of these trees are large enough to be pruned. Over the next 20 years, it is projected that 2,160 tons of cashew nuts will be produced, as well as 8,400 tons of neem oil and 160,000 tons of fodder over the next 40 years allowing for a long-term local food production system.[9] In addition to providing job opportunities for men and women, the planting activities have also opened up educational opportunities for children with 12 new nature clubs established in local schools. These clubs help care for the community's newly-planted vegetation and educate the children about the importance of protecting the environment.

As a highly replicable initiative, the project has been designed to permit a flexible and transferable approach to environmental restoration in similar environments. The project has demonstrated the role of afforestation in rebuilding and empowering refugee communities, combining ecological conservation with agroforestry and vocational skills training to cultivate an eco-

9 The Lutheran World Federation - (photo by Justin Toukap). URL: https://www. lutheranworld. org/news/cameroon-protect-environment-create-employment (2020) (Accessed: 04/08/2022).

friendly living environment with new socio-economic opportunities to improve quality of life (see Figure 4.8). However, it must be acknowledged that the project's scalability relies heavily on funding and donations from external organizations, and these remain the main obstacles to project continuation. It is key to note that interventions undertaken by international institutions such as those in Minawao should be conducted in close collaboration with local authorities to help streamline institutional ownership and facilitate long-term sustainability making more impactful change to these local communities.

Source: United Nations High Commissioner for Refugees - (photo by Xavier Bourgois). URL: https://www. unhcr. org/uk/news/stories/2021/9/614854b14/refugees-cameroon-help-build-great-green-wall-combat-desertification. html (2021) (Accessed: 05/08/2022)

Figure 4.8 Women from the Minawao refugee camp working in the fields

Reference experiences

1. Understand the protection of natural assets and ecology as a priority for the sustainable management of refugee communities

While refugee communities often face extremely harsh conditions, natural resources also remain a precious commodity and equal consideration must be given to the accessibility and quality of these assets. As exemplified in Minawao, the continuing influx of refugees led to severe environmental degradation depriving what was already barren land of its essential ecological capital, destabilizing living conditions even further.[10] In order to accommodate highly marginalized populations, the planning and development of refugee communities should prioritize environmental management through conservation and restoration efforts, understanding ecological resources as critical components to sustain the livelihoods of local inhabitants and foster more resilient communities. In addition, as highlighted through the development of renewable energy sources in which local products were regenerated to create eco-friendly briquettes and stoves, the protection of natural capital can feed into circular systems creating long-term sustainability achieved through the recycling and reuse of organic materials. Building on the project to date, it is equally important that greening activity is extended to neighbouring villages in order to more effectively combat desertification and in this regard, the careful selection of reforestation species will help to prevent imbalances in local ecosystems.

2. Promote green infrastructure as a multifunctional tool to enhance livelihoods in refugee communities

When deployed on the metropolitan scale, green infrastructure has proven its value in creating a diverse range of benefits for municipalities and their inhabitants. As emerging urban environments where initial transience often transpires into long-term settlement, green infrastructure integration should also be sought as a key tool to build socio-environmental resilience and sustain livelihoods in refugee communities. With an array of benefits, the value of reforestation in Minawao was apparent, improving soil quality and water retention, and facilitating shade and wind protection. It also enabled local food production and associated job creation in a more self-sufficient and adaptive community. The use of innovative technology to improve afforestation is also impactful where state-of-the-art reforestation cocoon technology, global positioning system (GPS) tools and drones used in the planting, tracking and monitoring of individual trees, enabled the facilitation of sustainable agroforestry creating a greener, more prosperous community in which refugees and their hosts can build secure livelihoods.[8]

10 Land Life Company. URL: https://landlifecompany. Com/projects/minawao-refugee-camp-cameroon/ (Accessed: 05/08/2022).

3. Raise awareness among refugee communities on the importance of environmental protection and build skills to foster local action

Refugees often lack education and knowledge concerning the critical value of ecological systems and a lack of resources hampers their acquisition of important skills.[11] Concerted efforts should be made to reduce this deficit, mainstreaming environmental protection education into refugee communities, in particular for children and youths, to encourage a long-term role in protection efforts. Where environmental protection has created jobs and income in Minawao, it is important to understand the intrinsic connections between environmental protection and local economic development in which skills transfer – cutting across key areas such as reforestation, eco-friendly stove and briquette production, and land management – contributes to the formation of symbiotic relationships between environmental sustainability and livelihood prosperity. In this regard, the greening of the Minawao community has also empowered local women and girls, improving their position in families and increasing their safety and independence.

Yokohama, Japan: Blue Carbon Project[12]

Case background

As a major port city situated in eastern Kanagawa-ken[13] on the western coast of Tokyo Bay, Yokohama is afforded an abundance of blue resources and marine ecosystems, covering an area of 437.78 km^2 with a population of approximately 3.7 million people. Along with numerous associated industry and warehousing facilities, the Yokohama port, as shown in Figure 4.9, is often viewed as Tokyo's 'outer port' and thus plays a key role in the city's economy, in addition to the fishing industry. In 2018, Yokohama was selected as a 'SDGs future city' and a 'local government model project for the SDGs', as part of the Japanese government's larger SDG Action Plan, where the city has declared its determination to reach carbon neutrality by 2050.[14] This declaration has positioned Yokohama at the forefront of Japanese cities in tackling climate change and promoting environmental integrity, and has enhanced traction on progressive initiatives in urban

Sourse: Carbon Neutral Cities Alliance. URL: https://carbonneutralcities.org/cities/yokohama/ (Accessed: 10/08/2022)

Figure 4.9 Yokohama's port area

11 The Lutheran World Federation. URL: https://www.lutheranworld.org/news/nigerian-refugees-cameroon-transform-desert-land-great-green-wall (2021) (Accessed: 08/08/2022).

12 This case was co-authored by the UN-Habitat experts and the team of Dr. Chen Haiyun from Tongji University.

13 Kanagawa-ken: A prefecture of Japan located in the Kanto region of Honshu.

14 Open Yokohama. URL: https://businessyokohama.com/sdgs/future-city-net-zero-carbon/#:~:text=Yokohama%20was%20designated%20an%20%E2%80%9CSDGs,those%20efforts%20into%20the%20future (2022) (Accessed: 20/08/2022).