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**Using *Moringa Oleifera* to Fight Malnutrition and Sanitation Concerns at Kutupalong Refugee Camp in Bangladesh**

In August 2017, hundreds of thousands of Rohingya refugees escaped into southern Bangladesh to avoid religious persecution (UNICEF). According to an ancient prophecy, the Buddhist faith will “disappear” in Myanmar, though it consists of an 80-90% Buddhist population (HuffPost). The Rohingya, an Indo-Aryan ethnic group who follow Islam in Myanmar, were believed to be the root cause. As a result, unspeakable brutality and violence occurred against the Rohingya, and over 960,000 were forced to move to Bangladesh during the Rohingya genocide, which still persists to the present day (UN). In addition, they were denied citizenship under the 1982 Myanmar nationality law (UN). Without a country to live in, they were forced to stay in the Kutupalong Refugee Camps in Ukhia, Cox's Bazar, Bangladesh.

Thirty-three refugee camps make up the Kutupalong Expansion Site in the Cox’s Bazar area (UN). While the Kutupalong Registered Camp contains only approximately 18,000 inhabitants, there are many more unregistered inhabitants in the surrounding camps of the Kutupalong Expansion Site. Combining all of the camps, the area is the world’s largest refugee site, exceeding 960,000 inhabitants and making up around 200,000 families (UN). About 55% of the population consists of children under 18, and the average family size consists of four to five members (UN). Inhabitants in the camp live in shelters made of tarp and bamboo, which are prone to collapsing due to commonly occurring monsoons (UNICEF). Families rely on humanitarian aid for food sources. Their access to education and healthcare is strictly limited, as they are dependent only on humanitarian organizations. A 35-year-old father of four from Camp 16, Suleman, explains how his children have to work by collecting firewood and water instead of receiving a proper education (HRW). The family relies on the children to work to make an income, which illustrates another pressing issue.

Although the Bangladeshi government works with the United Nations High Commissioner for Refugees (UNHCR) to aid the refugees, they believe that voluntary repatriation is the best solution for the refugees and that their residence in Bangladesh should be temporary (UN). There is also no national legislation that provides for the administration of refugee and asylum affairs in Bangladesh, leaving the refugees with no legal protection under the Bangladeshi government. Frequent military coups in Bangladesh might also interrupt the government’s ability to provide aid and protection to the refugees. The Bangladesh Rural Advancement Committee (BRAC), a local non-governmental organization, has provided medical care, vaccinations, and other health services for the refugees, as well as basic education for the Rohingya children (HPN). While there have been some local efforts, most of the aid comes from foreign humanitarian organizations.

The UNHCR camp office at Kutupalong is supported by the European Union and various countries (UN). UNICEF has contributed by providing clean water, health care, nutritious food, and education, especially to the large population of children. They have enrolled over 300,000 children in classes and have given them an education based on the Myanmar curriculum (UNICEF). However, due to the large population, there have been several issues within the refugee camp. Overcrowding and inadequate living conditions add to the problems of health and sanitation. Children are not only faced with disease outbreaks and malnutrition but also inadequate educational opportunities that place them at risk of becoming a “lost generation” (UNICEF). Another primary problem is caused by yearly monsoons, which cause widespread flooding and damage to shelters, as well as limit their supply of clean water (UN). These problems present serious challenges to the health and welfare of the refugees within the Kutupalong refugee camp.

Although many countries have provided aid to the refugees, their attempts have not reduced all of the refugees’ difficulties. In 2018 and 2019, there were two failed attempts to convince refugees to return to Myanmar because they were not assured citizenship and livelihood opportunities by the Myanmar government. USAID’s Food for Peace and the UN World Food Program (WFP) were the first to send aid in the form of high-energy biscuits to serve as a temporary meal replacement, but main food sources such as rice were needed. The WFP faced a food shortage as their supplies couldn’t arrive in Bangladesh due to outside circumstances (such as transportation issues), so they called on other international partners such as CARE International to supply food commodities (USAID). Another organization, Action Against Hunger, developed hot meal services by providing food for the refugees to make a local porridge called *khichuri*, which consists of rice, lentils, vegetables, and spices (USAID). Despite this foreign aid, living conditions in Kutupalong are still insufficient and overly dependent on emergency humanitarian services.

What if the refugees could be empowered to act for themselves to improve living conditions and ensure the health and sanitation of their camp? The South Asia Institute at Harvard University has taken action to analyze the camp and provide opportunities for the empowerment of the refugees. They interviewed several refugees and took an architectural survey of the area, analyzing different areas such as kitchens, houses, learning centers, and clinics (Gilliard). Working with the refugees to test and prototype a community kitchen allowed them to learn about architectural design and spatial planning, which was important for the welfare and stability of the community (Gilliard). Another solution could be to provide a reliable and sustainable source of energy. Clean energy sources not only provide the refugees a chance to cook meals and spend time with their families, but also ensure their safety. The refugees relied on firewood for energy sources, but the deforestation of the area was a serious environmental concern. The UNHCR later sent liquified petroleum gas (LPG) tanks to Rohingya refugees and members of the host community; these tanks were reusable and led to more sustainable cooking methods in the community (UN). These actions provide possible solutions to some of the pressing issues in the community, but more work is still needed to address other concerns.

There are multiple perspectives and approaches to address regarding the living conditions of the refugees. The South Asia Institute at Harvard has contributed by teaching the refugees about architectural design, and the UNHCR has lessened environmental concern by introducing more sustainable sources of energy. Statelessness and loss of citizenship remain concerns, although the refugees can find ways to thrive in their community at Kutupalong. However, malnutrition and sanitation still remain as current issues in the community due to overcrowding. To solve this, there may be one plant species that can address several areas of concern.

*Moringa oleifera* is a tree native to the Indian subcontinent. It is drought-resistant, fast-growing, and generally cultivated for its medicinal and cleaning properties (Wiginton). The seed pods and leaves of *Moringa* are used in Indian traditional herbal medicine (Sultana). The leaves provide significant sources of vitamins and minerals. 100 grams of *Moringa* leaves contain as much as 278 milligrams of vitamin C, 2 grams of potassium, 0.3 grams of phosphorus, and many other nutrients, as well as a high protein content (Sultana). The functional properties and nutritional value of *Moringa* give many opportunities to use it to solve malnutrition and other critical issues. Not only can it provide a plethora of quality nutritional benefits, but it can also be used as soap, fertilizer, cooking oil, and even for water purification (Tsai). Exploring the different uses of *Moringa* while educating the refugees on how to grow and cultivate it will allow for opportunities to solve malnutrition, sanitation, and other health concerns in the community.

Since *Moringa* is commonly found in Bangladesh, access to this plant will not be a problem. *Moringa* seeds can be harvested in large amounts and distributed in packets to the community. With an abundance of Moringa, the refugees can start building a community garden in the Kutupalong refugee camp. After learning about the wondrous properties of *Moringa*, the Rohingya refugees will develop an interest in growing *Moringa* to help the community fight malnutrition and sanitation issues. A planning committee will be elected from the refugees, and the UNHCR and other humanitarian organizations can assist in organizing goals and schedules with the refugee leaders. Leadership roles, administration, and planning for this project will be determined by the refugees with the help of humanitarian organizations.

Subsequently, a site will need to be chosen. The Kutupalong refugee camps span an area of about 13 square kilometers (UN). Although the land is mostly used for shelters, a plot of land near the center of the camps can be cleared to allow for a community garden. The *Moringa* plants will need to be placed three meters apart in rows three meters apart to allow for healthy growing space (Fuglie, et al.). An additional benefit for the land is that the root system of *Moringa* does not compete with other crops for surface nutrients. It will also provide some light shade, which benefits plants that are less tolerant to direct sunlight and helps other crops grow faster as well (Fuglie, et al.). Intercropping with *Moringa* could provide more sustainable food sources for the refugees. Vegetables and legumes could be grown in the spaces between the *Moringa* plants, giving the refugees more nutritional food sources.

Gathering the Rohingya refugees and creating a schedule to water and provide for the *Moringa* is the next step. Organizing a schedule and enforcing it within the community will require the efforts of the refugee leaders and the community as a whole. *Moringa* only needs to be watered once a week, but it will take nearly eight months for the pods to fully develop and be harvested (Nielsen). Although the tree can grow well without fertilizer, it will yield more pods when fertilizer is added. Fertilizer can be made from compost or manure in the community, as well as other chemical substances and nutrients provided by outside humanitarian organizations. According to research in India, using a combination of farmyard manure and ammonium sulfate can increase pod yields threefold (Fuglie, et al.). Also, *Moringa* can be used before it fully matures; some of the leaves, seeds, and pods can be harvested in the process. Young pods are about one centimeter in diameter and can be easily collected from the tree (Nielsen).

After harvesting the *Moringa*, it can be used in many different ways. All parts of *Moringa* are edible and provide multiple nutritional benefits (Sultana). First, the leaves can be used in teas or soups or dried and crushed into a powder and added to different dishes to improve the nutritional quality of the meal. The seeds can be removed from mature pods, cooked, and eaten as a healthy snack. The pods are commonly used in curries in India and Bangladesh, and boiling them provides a great source of potassium, dietary fiber, magnesium, and manganese, along with other nutrients (Sultana). Also, extracts from the leaves provide polyphenols with antioxidant properties, which help protect against inflammation and disease (Cadman). This includes protecting against foodborne illnesses such as *E. coli*, which can be found in contaminated water in the refugee camps (Cadman). Effectively using the nutritional properties of *Moringa* will help deal with the issue of malnutrition in the community.

Another way the *Moringa* plant can be used is for water purification. The process of water purification includes pretreatment, coagulation, sedimentation, clarification, and disinfection (Britannica). First, pretreatment occurs, removing particles such as minerals or plants. Next, coagulation adds chemicals to cause smaller particles in the water to form chunks. The chunks sink towards the bottom, where sedimentation occurs to remove those particles. Then, clarification removes even smaller particles from the water using a similar process. Finally, disinfecting the water with methods like chlorine compounds or UV light allows for clean drinking water.

Because *Moringa* is both non-toxic and biodegradable, it can help with the purification process. It has even been shown to outcompete the efficiency of various aluminum salts, which are common coagulating agents (Nelson et al.). *Moringa* has proven to be effective in purifying water in many studies in parts of rural Sudan and Malawi (Nelson et al.). The process of using it to purify water is also simple. First, grind the *Moringa* seeds into a powder, mix it with clean water, add the mixture to dirty water, and wait for about one to two hours (Tsai). The seeds will remove most bacteria and viruses from the water. This would help with water sanitation concerns, as following this process allows for safe, clean drinking water to ensure the health of the refugees.

However, there are some potential side effects and risks to using and consuming *Moringa*. The leaves have laxative properties that may cause an upset stomach, heartburn, and diarrhea. In addition, the taste of *Moringa* can also cause nausea, as it does not have a pleasant taste for some people. Chemicals in the plant may make it unsafe for infants while breastfeeding (Majumdar). Despite these risks, however, the benefits provided by *Moringa* far outweigh the potential side effects and dangers of consuming this plant, as it provides multiple nutritional benefits and helps to fight the more serious concern of malnutrition in the community.

Growing *Moringa* in the community garden will not only provide several nutritional health benefits and solutions for water sanitation, but it will also bring the Rohingya refugees together as a community working together to help each other. Despite not having citizenship in their home country, they can develop a sense of belonging by connecting with each other during this project and working together to reach a common goal. Sharing a common practice by working in a community garden fosters a sense of unity and collaboration. In conclusion, this project is not only aimed at solving malnutrition and sanitation challenges in the Rohingya community but also at empowering the refugees to discover a sense of belonging and to strive for the development of their home.

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