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### **Guinea Bissau: Iodized Solar Salt Production in Guinea Bissau to provide Income to Women and fight Iodine Deficiency Disorders (IDD)**

Traditional salt-making methods in Guinea Bissau require destruction of mangrove trees and therefore compromise Guinea Bissau's other chief food sources and agriculture. Converting to iodized solar salt production would provide several health benefits, create income for impoverished coastal women, and preserve Guinea Bissau's precious coastline.

Guinea Bissau is a small country – about three times the size of Connecticut – located on the west coast of Africa, between Guinea and Senegal. The land is a low-lying coastal plain with many estuaries (transitions between freshwater rivers and saltwater) and inlets as well as many offshore islands. The country has a rainy season from June to November and a dry season from December to May. About 45% of its land is agricultural while 55% is forest. Approximately one-fifth of its residents live in the coastal capital of Bissau (“Guinea-Bissau”). Guinea Bissau's coastline and related industries are very important to its people.

Agriculture, forestry and fishing provide income and sustenance to the people of Guinea-Bissau. The country produces its own food: cashew nuts, rice, vegetables, beans, cassava, peanuts, potatoes and palm oil are its most common crops. Citizens raise livestock and catch fish and shrimp, which are consumed and exported for income (Burtis 1). Despite being a food-producing economy, 17% of children under the age of 5 years are underweight (“Guinea-Bissau”).

Guinea-Bissau's population is young and growing. About 60% of the population is under the age of 25. An average of 4.75 children are born to each woman (as of 2020) and only 16% of the population has access to contraceptives. The country favors male education: the literacy rate for men is 72% but only 48% for women over the age of 15 (15).

A typical family living in Guinea Bissau is poor, young, undereducated and perhaps fearful of the unfortunate dangers that face many children in this country, such as human trafficking. Guinea-Bissau's population is among the poorest in the world. Education (2% of GDP) and healthcare are both underfunded. The government of Guinea-Bissau has a history of political instability and coups, but the peaceful election in March 2019 marked a hopeful end to the political turmoil existing since President José Mário Vaz dissolved his government in 2015 (“Top 10 Facts”).

As a result of the country's poverty and instability, “Some young men lacking in education and job prospects become involved in the flourishing international drug trade. Local drug use and associated violent crime are growing” (“Guinea-Bissau”). Without many economic options available to its young and growing population, it is extremely important to protect farming, forestry and fishing as well as expand growing industries such as salt production.

Salt production is exclusively a female industry in Guinea Bissau. Annual production is 3,640 tons, or just over 60% of the country's needs; the balance is imported from nearby Senegal ("Developing Solar Salt Production"). Traditional salt production methods involve boiling brine to evaporate water from salt crystals. Over three tons of firewood are required to produce each ton of salt ("Developing Solar Salt Production"). Women scrape salted fields, then filter to obtain a brine which is heated in metal trays over fire. Firewood located closest to the source of brine is harvested and burned to create boiling stations. The traditional method is environmentally harmful as it causes smoke inhalation by women who tend their fires and salt trays, and significant deforestation – often of coastal mangroves.

Mangrove preservation and restoration is vital because the health of Guinea Bissau's greater economy - farming, forestry and fishing industries – is linked to the health of its mangroves. Mangroves provide daily shoreline protection from regular coastal erosion and also from more significant events such as storms, tsunamis and monsoons. The International Union for Conservation of Nature (IUCN) studied the death toll from two nearby villages in Sri Lanka hit by a tsunami. Two people died in the settlement protected by dense mangrove and scrub forest, while up to 6,000 people died in the nearby village without similar coverage. Research has revealed that mangroves are vital to the protection of these villages from storms because they "are able to absorb between 70-90% of the energy from a normal wave" (Kinver 1). Defending the shoreline not only means protecting lives, but also homes, businesses, and essential farmlands.

Coastal mangrove forests also provide protective breeding grounds for fish and crustaceans – a key source of nutrition and income for locals (3). In fact, mangroves provide homes and refuge to a wide variety of plant, fish, bird and other animal varieties including endangered species (2). Mangroves are an important part of the route of bird migrations as well (Kamano).

Natural mangroves provide a far more economical erosion barrier than a humanmade land-based erosion wall or seawall. They are also more effective since humanmade barriers can create new erosion patterns in front of and adjacent to the structure due to coastal currents (Prasetya 15).

Switching to solar salt production is key to preserving Guinea-Bissau's precious mangroves. The French organization Univers-Sel was the 2019 Technical Solutions winner of the Women Gender Constituency Award for its work introducing solar salt production to Guinea-Bissau. Solar salt production relies on the sun and the wind instead of firewood to evaporate the brine and crystallize salt. Brine is poured onto a large, inexpensive tarps (each tarp is about 100 square feet) where natural evaporation occurs, spurred by the sun and wind. Each tarp can produce up to one metric tonne (1.1 US tons) of salt per season ("Univers Sel"). The elimination of burning firewood promotes mangrove restoration and cleaner air, especially for the women who work the salt industry. The simplicity of solar salt production can also increase production, thereby increasing revenue for the women producing salt.

Iodizing this salt can also tackle a world health problem – iodine deficiency disorders (IDD). The most easily recognized form of iodine deficiency is goiter – an enlarged thyroid gland which causes a swollen neck. Because iodine plays a vital role in development of the central nervous

system, iodine deficiency is also believed to be the most common preventable cause of mental retardation throughout the world. The thyroid gland needs iodine to make hormones, so iodine deficiency can cause women to stop ovulating, leading to infertility. Iodine deficiency can cause an autoimmune disease of the thyroid and may increase the risk of thyroid cancer and other cancers such as prostate, breast, endometrial, and ovarian cancer (“Iodine”).

Early in the twentieth century, iodine deficiency was common in the US and Canada, as there is very little iodine in food, unless it has been added during processing. The addition of iodine to salt has improved public health. The addition of iodine to salt is required in Canada. In the US, iodized salt is not required, but it is commonly available (“Iodine”).

Micronutrient deficiencies, or a lack of the essential vitamins and minerals required for healthy development and function, affect approximately 2 billion people worldwide and are commonly due to overreliance on starchy foods such as maize, wheat and rice (“Large-Scale Food Fortification”).

Salt fortification is a cost-effective way of providing a diet with a steady supply of iodine. The most popular ways to fortify salt with iodine include adding potassium iodide, potassium iodate, or calcium iodate (“Iodized Salt Production”). The largest producers of salt are the US, China and India and demand for iodized salt is estimated at 413,412 tons in 2020 (“Iodized Salt Production”).

In 2016, only 3% of salt produced in Guinea-Bissau was iodized (Locatelli-Rossi 1). UNICEF began working with salt producers of Guinea-Bissau’s in 2014 to identify the need for iodized salt. In late 2015, UNICEF and the Ministry of Health conducted workshops designed to train salt producers in iodizing technology and boost production of iodized salt. UNICEF also provided new equipment and materials in order to produce and package iodized salt (1).

There has been remarkable progress in recent years to control iodine deficiency disorders (IDD) through universal salt iodization (USI). In 2019, using the median urinary iodine concentration (MUIC) method, a test done during a physical checkup, only 19 countries in the world are still classified as iodine deficient (Gorstein 3). According to the Iodine Global Network, only 4.8% of African children were born with iodine deficiency disease, down significantly from 15.6% in 1993 (20).

In summary, Guinea-Bissau is a poor country with limited economic options available to its young and rapidly growing population. It is extremely important to protect its current farming, forestry and fishing industries as well as expand growing industries such as salt production. Salt production in Guinea-Bissau is a strictly female industry, providing an income to undereducated females living in a patriarchal culture. Over half of females over age 15 cannot read and write. Traditional salt production is labor intensive and burns over three tons of firewood – usually precious mangroves – to produce one ton of salt. Mangroves protect Guinea-Bissau coastal farm and forestlands from erosion as well as provide ideal breeding environment for Guinea-Bissau’s fish population. Consuming coastal mangroves for salt production threatens the health of Guinea-Bissau’s other main economies. Switching to solar salt production is key to preserving Guinea-Bissau’s precious mangroves. Iodizing this salt can also tackle a world health problem –

iodine deficiency disorders (IDD). Thanks to organizations like UNICEF, UNIVERS-SEL and the Iodine Global Network, there has been progress made toward reducing iodine deficiency disorders (IDD) such as goiter, mental retardation and other thyroid and hormone imbalances such as female infertility and depression.

Given the underfunded education, historical political unrest and a very young and growing Guinea-Bissauan population, there are several steps to take in order to approach a more sustainable and secure method of salt production.

First, distributing low-cost tarps to coastal women involved in salt production will allow them to adopt a more efficient method of salt extraction almost instantly. Increasing salt production will increase income for impoverished women engaged in the salt-producing industry. As Guinea-Bissau is a relatively poor country, any increase in income will have an immediate effect on quality of life. Using simple, economical materials such as tarps will be effective without adding excessive complications or cost.

In addition to simple material distribution, education is vital to shifting practices to solar salt production. With an adequate understanding of the health, environmental and economic benefits of solar salt production and a hands-on tutorial and demonstration of producing salt using the tarps, women will not only be capable of transitioning to solar production but will be able to embrace the practice long-term. Educational workshops, brochures, and exhibitions at villages and schools should allow for smooth implementation of this solution.

In order to then iodize this salt and decrease Iodine Deficiency Disorders, organizations such as UNICEF and Univers-Sel should also distribute iodizing kits to salt workers in Guinea-Bissau. Salt fortification is a cost-effective way of providing a diet with a steady supply of iodine. Including how to use iodizing kits in educational workshops should make it easy for salt workers and increase local health.

Once communities are introduced to and begin using solar salt production methods, local communities should create laws to protect mangroves from consumption and deforestation. With mangrove burning no longer a necessary aspect of the salt production process, they should be left and protected in order to sustain Guinea Bissau's coastline and farmland. The mangroves would naturally defend against coastal erosion and significant storms. Halting the erosion of its fishing and farming grounds will have a stabilizing effect on citizens of a nation plagued by instability.

Furthermore, mangrove regrowth and restoration will create health benefits for citizens and animal species of Guinea-Bissau. Salt workers and local populations will inhale less smoke from burning mangroves. The natural evaporation or solar production requires less labor and frees women to engage in less manual labor. It also affords them additional time to look after their own health and the health of their children and elders.

Finally, continued oversight and guidance from organizations like UNICEF, Univers-Sel, and the Iodine Global Network should perpetuate and preserve progress in Guinea-Bissau's salt industry and mangrove preservation. These organizations provide funding and resources to create

opportunities for growth in Guinea-Bissau and stimulate solutions such as the ones previously proposed.

These recommendations will improve human health by reducing Iodine Deficiency Disorders, smoke inhalation and difficult manual labor of cutting mangroves. It will increase access to education and economic growth for impoverished women in the salt industry. Solar salt production will also preserve Guinea-Bissau's coastal mangrove forests which protect its fishing, farming and forestry industries.

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