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Coast to Classroom: Integrating Small Pelagic Fishes into Eritrea's Nutritional Strategy

In Eritrea, a nation defined by arid landscapes and rugged Red Sea coastline, food security has long been dependent on unpredictable rainfall. Despite possessing a 1,100km maritime border, the country endures a staggering "52.5% of children" stunting rate due to a lack of accessible protein (Global Nutrition Report, n.d.). Although this has occurred despite the country constructing or rehabilitating over 880 dams driven by the 2026 mining boom to improve water access. The nation's vast marine resources remain disconnected from rural food supply chains despite hydrological advancement. There is a substantial gap between the protein-rich Red Sea and the malnourished interior (afdb, 2025). This paper presents a "Blue-Green" approach to unite this divide, through the production of shelf-stable anchovy protein powder.

The average Eritrean household features 4-6 members, led by a total fertility rate of "3.7 children per woman" (World Bank Group, 2023). Their livelihood revolves around a commitment to the national service and subsistence agriculture. The vast majority of Eritrea's population, roughly "75 percent" relies on agriculture, animal herding, and fishing as the "mainstay of livelihoods" (IFAD, n.d.). On small, rain-fed plots where they cultivate staples like sorghum, millet, and barley, these families' success is measured not by a paycheck, but by agricultural yields. Those in the formal sector, working in mining, public work, or state-run enterprises, earn an average wage of approximately "$150 USD" per month (TimeCamp, n.d.).

Their typical diet is culturally rich but remains nutritionally vulnerable. The centerpiece of every meal is Injera, a fermented flatbread made from nutrient-dense teff, sorghum, or wheat. The bread is usually served with Tsebhi, a stew of lentils, chickpeas, or meat. While teff is considered a "superfood," packed with iron and calcium, many families face obstacles in obtaining high-quality protein. Many households struggle to afford or access meat and dairy due to rising living costs, seasonal shortages, and limited cold-chain distribution outside major urban areas. Consequentially, daily protein intake is unmet, leaving rural communities exposed to nutritional deficits.

From the beginning of 2026, the fisheries sector's monumental record-breaking growth is characterized by inherent tension. The present status is one of rapid industrial growth with "a harvest of approximately 400,000 tons" of fish (Ministry of Information, 2026). Compared to 2024, Mussie Efrem states, "...this represents a 73% increase" (2026), a record fueled by national "mining pivot" and infrastructure investment. However, the challenge lies in a persistent consumption gap. Despite this abundance, domestic fish consumption remains flat at "0.5-1kg per person per year" (Tsigh et al., 2017), far below the global average of approximately "20kg" per person per year (World Economic Forum, 2022). The fish are being harvested, but they are not reaching the plate of those who need them most.

The impact of this sector varied between urban and rural areas. In big cities such as Asmara, residents increasingly purchase fresh and processed fish as a more affordable and healthier alternative to expensive beef or lamb. In rural coastal areas, fisheries serve as an economic backbone, providing primary livelihoods. However, for those in the inland highland, fish remains a rare luxury due to difficulties of crossing the rugged geography. Demographically, children are the most impacted group. And the introduction of high-protein fish products is the most effective tool currently available to fight chronic stunting. Gender roles are also shifting, while men continue to dominate the "capture" side of the

industry, women are increasingly being trained in processing and marketing, providing them with newfound economic independence. Marginalized coastal populations have become the primary beneficiaries of “food-for-work" programs, where over “40,000 vulnerable households” receive support in exchange for restoring mangrove forest-natural nurseries that are essential for fish reproduction (UNDP, 2024).

The environmental impact of this habitat is largely positive but faces specific threats. Approximately “80% of Eritrea fishing” is “artisanal” (small-scale), which is inherently more sustainable than industrial alternatives (Efriem, 2026). Furthermore, the rehabilitation of mangroves acts as a vital carbon sink. Balancing this rapid economic growth with the protection of the Red Sea’s fragile ecosystem remains the definitive challenge for Eritrea’s food future.

Eritrea has a long history of attempting localized solutions to food insecurity, most notable through the “Minimum Integrated Household Package” (IFAD, 2020). This program provides rural families with a combination of a cross-bred dairy cow or small ruminants, 25 chicks, and several fruit trees. The impact was significant in terms of increasing household income and providing immediate access to eggs and milk. It however struggled with sustainability in the most arid zones where animal feed and water were scarce. In contrast, the current shift toward marine remains one of the most underexploited and unpolluted fertile grounds in the world. Small marine require no freshwater or arable land, and solar dehydrators bypass cold-chain failure.

To bridge the nutritional divide between Eritrea’s prolific Red Seas coast and its protein-deprived inland highlands, several multi-sectoral solutions are currently being explored. The most prominent of these is the “Nutri-powder” Initiative, which focuses on the industrial processing of small pelagic fish, such as anchovies and sardines, into a shelf-stable, high-protein powder. Unlike fresh fillets, this powder requires no specialized refrigeration and has a shelf life of over a year, making it the ideal product for transporting the Red Sea’s “blue” nutrients across the scorching desert terrain. Alongside the Nutri-powder initiative, preserving the catch remains a challenge. Solar-Powered Cold-Chain Hubs are important to addressing this. The industry can drastically reduce post-harvest spoilage, which currently claims nearly 30% of the catch, ensuring that more whole fish can reach local markets.

Fortunately, things are starting to turn around. Eritrea is finally on track for a strong trade surplus after 2026, led largely by the export of marine products and processed fish. A significant progress comes from improvements on the ground. Facilities like the Eri-Fish processing facility in Massawa, which now handle over “70 tons of fish per day” have transformed the industry (Ministry of Information, 2026). Also upgrades like solar-powered freezing facilities and better ice-distribution services, are making a real difference, allowing fish to be stored longer and transported inland, even in the intense heat that used to make that nearly impossible.

Neighboring countries like Djibouti and Somalia face nearly identical challenges of aridity and high stunting rate. Djibouti has attempted to address this by subsidizing the import of frozen fish from Ethiopia and Yemen, but this has proven expensive and vulnerable to global price shocks. Somalia focused on establishing “fishing cooperatives” supported by international NGOs, which have seen moderate success but are often hampered by security issues (reliefweb, 2013). For Eritrea, implementing a cooperative model similar to Somalia is highly achievable, as the Eritrean government already emphasized communal ownership and “Zoba” (regional) administration. By combining its own mineral-funded infrastructure with a community-led cooperative model, Eritrea can ensure its maritime solutions are both culturally accepted and economically viable.

This program could be called the “Red Seas to School.” A Nutri-powder program aimed to tear down the persistent cycle of malnutrition in Eritrea. This implementation plan focuses on large production and distribution of fortified anchovy protein powder, specifically designed to bridge the gap between the nation’s maritime surplus and its protein-starved inland highlands. The first phase involves the

construction of solar powered processing hubs in port cities such as Massawa and Assab. These facilities will employ industrial dehydrators and high-capacity grinders to convert small pelagic fish into fine, nutrient-dense flour. This powder will then be vacuum sealed and distributed through the existing national school feeding network, targeting primary school students in areas where stunting rates are highest.

To ensure feasibility and measure initial impact, the "Red Seas to School" initiate will begin as a localized pilot program in the inland Debub Region. This regaon is an area facing high stunting rates, establishing a scalable proof-of-concept before expanding nationwide.

- Phase 1 (Months 1-12): Construct two primary solar-powered dehydration hubs in Massawa. Launching the "Red Seas to School" across 20 primary schools in the Debub Region. Partner with local community leaders to test integrating 15 grams of anchovy powder into traditional stews (Tsebhi) and porridges to evaluate taste acceptance and mask aroma.
- Phase 2 (Months 13-36): Expand processing operations to additional regions. Formally enact the National Nutrition Mandate to reserve 15% of commercial catches for domestic uses. This policy would require that 15% of all commercial fish catches be reserved for domestic processing and the school feeding program. Scale distribution to cover all primary schools around the inland highland.

The "Red Seas to school" initiative addresses the needs of multiple key groups across both the short-term and long-term. For primary school children as the main beneficiary, the program gives swift access to daily nutritional needs in school lunches. This program paves the way for an expected reduction in stunting and improves cognitive development. Artisanal fishermen gain a reliable domestic market for small pelagic at stable prices in the short term, supporting long-term financial stability and reduce post-harvest spoilage. To ensure cultural acceptance, community elders and school committees act as cultural ambassadors by leading demonstrations that address initial resistance to the fish scent. Ultimately, achieving the long-term normalization of fish protein within food. Finally, government officials would oversee policy enforcement, building coastal links to public health.

The impact I hope to achieve is a 25% reduction in childhood stunting within 5 years. By integrating just 15 grams of this high-protein, Omega-3 rich powder into daily school lunch, the program can effectively meet the micronutrient requirements for thousands of children. Beyond health, this creates a stable domestic market for local fishermen, ensuring the marine harvest benefits the citizens of Eritrea even before it is considered for export.

Every plan has a limit. The biggest barriers are the difficulty of transporting goods into remote villages where road infrastructure may be damaged by seasonal rains or limited by fuel shortages. Eating habits of Eritreans must be considered. Many individuals may initially resist the fishy scent or unfamiliar taste of concentrated fish powder. To solve this, the program will be led by a partnership between the Ministry of Marine resource and local community leaders, who can campaign for health benefits and help integrate the powder into meals.

While these solutions address the acute protein and micronutrient deficiencies that drive stunting, they are not a panacea. They primarily meet the nutritional quality needs of the population rather than their caloric volume needs. A family cannot survive on fish powder alone, they still require the caloric bulk provided by traditional staples like sorghum and pearl millet. Therefore, these fisheries-based solutions are designed to be a fortification strategy filling the specific gaps in iron, zinc, and vitamin A, rather than a replacement for existing agricultural systems.

The funding for this initiative will be secured through a "Blue-Green Dividend" source from the 2026 profits of mining projects or the expansion of the fishing industry. This ensures the project remains domestic and free from violent conditions of international debt.

Eritrea’s philosophy of self-reliance provides a unique framework capable of building large-scale infrastructure like the expansion of the Massawa port (Yah, 2026). Rather than depending on foreign contractors or international debt, Eritrea can leverage its workforce to construct and operate solar-powered processing hubs. By directing local residents and physical assets toward domestic fish processing, the country ensures that coastal fish serve the nutritional need of the inland population.

The greatest asset for this solution is the Red Sea itself, a vast, unpolluted reservoir of high-quality protein that remains one of Eritrea's most underutilized resources. The solution is sustainable because anchovies are at the bottom of the food chain. They replenish quickly, preventing the ecological collapse often seen with larger predatory fish. By using solar energy for processing and existing military networks for transport, the carbon footprint remains small. Given Eritrea’s currents economic state, and its proven ability to execute massive large-scale national initiatives, this recommendation is not only feasible but represents a logical path toward a food-secure future.

The transformation of Eritrea’s chronic food insecurity to a “Blue Green” country that utilizes its marine resources depends on its ability to bridge the gap between its maritime wealth and its inland needs. With a successful integration of the “Red Seas to School” protein program, the nation has a clear path to ending the cycle of malnutrition. This does more than provide nutrients, it harnesses the strength of Eritrea’s self-reliance and strategic infrastructure to foster long-term independence. Ultimately, by turning the Red Sea’s resource into a staple of national diet, Eritrea can ensure that its most valuable resources (youth) can grow healthy, strong, and secure.

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