Robert White
Chicago High School for Agricultural Sciences
Chicago-Illinois
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Water, Trade, and Hunger: Examining Panama's Overlooked Rural Crisis

The Panama Canal, among the most vital trade routes in the world, is heading toward a potential crisis engendered by unseen implications. Water scarcity refers to the finite or unreliable access to adequate water sources to a lack of finances, resources, or infrastructure. Efforts from organizations like the U.N., Sustainable Development Goals, the World Food Prize, have made great difference in limiting this phenomenon(United Nations Development Programme, 2024). In Panama, however, their insecurity significantly stems from one place, the Panama Canal (Ortuste et al, 2024).

With a nationwide population of 4.5 million people (World Bank, 2021), and a canal that uses roughly 65% of the freshwater in major lakes Gatun and Alajuela (Garcia, 2025), problems are sure to arise. 30.5 percent rural residents, leaving about a 69.5 percent urban population (FAO 2025). An F.A.O. study illustrates that the 2023-2024 Panama drought caused freshwater levels to decrease dramatically (AJOT - Beyond Scarcity). Agriculture accounts for an estimated 2.45% of Panama's GDP (Statista, 2025) while supporting over`15% of all rural workers (TheGlobalEconomy - Employment in Agriculture). Food and water shortages can ripple through the economy, worsening hunger and malnutrition (IFAD, 2023).

Panama's agricultural system is both diverse and vulnerable. The nation's major crops include bananas, sugarcane, coffee, rice, and corn (U.S. International Trade Administration), key exports that serve as a local food source. Despite this diversity, the country cultivates only a small share of its available land. The FAO found that about 565,000 of Panama's 7 million hectares are permanently cultivated (IndexMundi, 2019), mostly operated by small families, and about 249,000 farms across the country (MDPI 2023), many producing only a few hectares each.

To battle financial adversity, farmers work a life of labor: morning planting, crop maintenance under intense weather conditions, transporting goods, and repeat for roughly seven dollars an hour (ILO, 2022). The median size of farm families in Panama is between four and five people, considerably unsustainable given that 32.3 percent of rural residents are impoverished (FAO Drought Portal - FAO 2025), a number higher for Indigenous rural populations, which experience poverty rates over double that of the national average (World Bank Indigenous Poverty Report, 2025). Additionally, in 2011, researchers found that 52% of farmers do not have formal education and 40% do not finish high school (World Bank, 2011), hence why farmers tend to live off the land. Panamanian diets usually consist of rice, beans, vegetables, and bananas, mainly grown by these farmers, though water scarcity makes this instance of subsistence and commercial farming particularly challenging (Krause et al, 2019). A loss of access to this sustenance can shift food intake to less viable options, constructing a society more prone to health concerns. The concentration of resources toward urban areas, leave shortages of facilities, equipment, and professionals regarding healthcare in rural regions makes this a distinct hardship (FAO Drought Portal - FAO 2025) (Tzoy, Moreno, 2023).

Preventing such matters, major ag commodities farmers produce are outstandingly relevant to the country's culinary culture (Trade.gov). Their national dish, sancocho, and others, tend to derive from these crops. Other prominent dishes such as ceviche, or their high famed rice and beans, also derive from these commodities (Pan American Health Organization, 2023). It is beneficial as a country to have dishes with nutritional value at the heart of consumption. Sancocho is a vegetable-and-meat blend of soup, serving as a valuable source of protein, fiber, and vitamins (Krause et al, 2019). Ceviche, similarly, as a cold seafood dish, is rich in protein and Vitamin C, while rice and beans is an outstanding source of plant-based protein (Krause et al, 2019).

COVID exposed Panama’s aggressive economy, leaving it in recovery (IMF, 2024). Drought conditions worsened along with freshwater levels. Without consistent investment or infrastructure to capture and store rainfall, the dip in canal use did little to provide for the rural water supply (NOAA, 2025). According to the I.L.O., Panama’s unemployment rate rose to an estimated 18.5 percent (OECD, 2025/ILO 2022). The number still remains worse for rural civilians (ILO 2022). Additionally, an FAO report implied that food prices in rural provinces are higher than urban centers (FAO Drought Portal - FAO 2025), forcing many to rely on cheaper, less nutritious imports. With reduced incomes and higher prices, rural Panamanians are more susceptible to food and water insecurity, especially during droughts and dry seasons (IFAD, 2023).

Rural agricultural production in Panama continues to face challenging barriers, stemming from environmental, economic, and infrastructural limitations. The FAO says that over 40% of rural producers lack consistent access to irrigation or modern water-management systems, which increases the likelihood of crop failures during dry years (FAO Drought Portal - FAO 2025). Droughts in relation to climate change and inconsistent rainfall (NOAA, 2025), reduce farmer reliability on irrigation, while deforestation and soil degradation further limit fertile land (United Nations Environment Programme). Only about 8% of Panama's land is currently arable, and much of it is of poor soil quality, considering erosion and overuse (FAO, 2023). On top of environmental strain, rural farmers often lack access to modern equipment, financial stability, and other crucial variables, leaving them unable to compete with the rather large-scale production of imports. The Panamanian government, along with international organizations such as the Inter-American Development Bank, have initiated projects to improve irrigation systems, restore degraded soils, and promote sustainable water management (IDB, 2021;FAO, 2023). However, these efforts are only in their early stages, and progress is slowed by regional inequalities of investment (Global Water Partnership, 2022).

Without an ample water source, rural residents are put at high risk of food and water insecurity, especially subsistence farmers (FAO, 2022). With fewer resources, crop yields become vulnerable, and although yields have generally increased over time (World Bank, 2023), environmental factors involving the canal, freshwater pollution, climate change, and a lack of investment, have led to a vulnerable agricultural sector (World Resources Institute, 2021). This leads to decreased food production, resulting in insufficient income and a lack of necessary nutrients. Panama has experienced a prolonged drought since 2023 (United Nations Environment Programme); with all accounted for, it is fair to say that the situation is severe and must be taken seriously, as the people of rural Panama are not to be sacrificed for the development of urban living, especially not in the midst of a climate crisis. Therefore, deforestation, soil erosion, and endangered biodiversity must be considered (Ministry of Environment of Panama, 2023). Considering everything, rural residents and farmers are put at an outstanding disadvantage. With the environment, climate, investment, water retainability pollution, and yields against them, farmers stand against a resistant opponent. The Panamanian government must step in.

Panama's water crisis is not just seasonal. The country has undergone below-average rainfall for years, prompting a fall in Gatun and Alajuela Lakes water levels from 88 to 82 feet, the lowest in decades (Panama Canal Authority Hydrology Data, 2024), which limits the canal's operations, impacting their overall freshwater supply (Przyborski, 2024). Deforestation, poorly regulated land use, and sedimentation all reduce the country's capacity to retain water (Ministry of Environment of Panama, 2023), applying further pressure on the agriculture sector, reducing access to both land and water. The impact is not evenly distributed, as rural farming communities, especially indigenous regions, face severe disadvantages as they rely heavily on direct rainfall, river access, and small-scale irrigation. Women in rural households are disproportionately affected given they are often responsible for water collection and household food preparation (Tzoy, Moreno, 2023), making scarcity a direct threat to daily responsibilities. Collecting water develops as a daily requirement, reducing time for education, ultimately elevating household stress.

Current trends insinuate that Panama's water scarcity problem has become more unpredictable, and the Canal Authority reports that lake levels are dropping frequently and remaining low commonly (AJOT, "Beyond Scarcity") (World Resources Institute). For rural families who depend on rain-fed farming, this means smaller harvests and lower incomes, making it challenging to afford nutritious food. The government has started some programs to save water and protect watersheds. The improvements though, are unhurried and have not paced with climate change (Global Water Partnership, 2022).

As for a way forward, Panama should apply a tax to vessels entering the canal. A 3% tax on small vessels, 7% on large vessels, and 9% on medium vessels. By funding rural water infrastructure, the tax ensures farmers have the irrigation needed to grow food, making it a direct driver of food security. A base estimate suggests this policy could generate roughly $400 million annually. Revenue would direct toward rural residents recovering from the ongoing drought and freshwater pollution tied to the canal. Although the Panama Canal Authority is investing $8 - 8.5 billion into the Río Indio reservoir, watershed management, and hydrological modernization, its mandate remains focused on canal operations. A vessel-transit water resilience tax would redirect a new fund subject to rural Panama. Funding would partially go toward producing and installing modular, AI-supported rainwater storage systems called Aqua-Nodes in rural and watershed-edge communities, provided by a developing company by the name of "Waterway Collective".

AI would track rainfall, quantity collected, water quality, and rate of use, allowing cleaner, more reliable water, prioritizing drinking and sanitation. Instead of relying on one central control system, Aqua-Nodes operate as a distributed network that shares summarized trend data across communities. Overall, this approach transforms rainwater into a managed, adaptive resource that strengthens long-term water security throughout Panama. These systems would form the backbone of a distributed water-resilience network. The fund would operate with strict transparency and support five tightly coordinated programs: improving rural water systems, restoring watersheds, strengthening community leadership, expanding climate-tracking technology, and enforcing strong auditing standards. Rural water teams would install or rehabilitate 300–400 aqueducts annually using updated construction standards.

Embedded within many of these installations, Aqua-Nodes would introduce a novel approach to water management by treating stored rainfall as a time-sensitive resource. Each unit would use localized AI to record when rainfall occurs, how much is collected, and how quickly it is used, allowing higher-quality or

more reliable rainfall to be prioritized for drinking and sanitation while preserving other supplies for agriculture. This “water memory” approach ensures that water is allocated based on both necessity and reliability rather than simple availability. Watershed restoration groups would plant 12–15 million native trees annually, reconstructing the environment. These efforts would be monitored using drones, satellite imagery, and environmental sensors.

To guarantee long-term sustainability, water governance academies would train thousands of local operators each year in maintenance, chlorination, leak detection, and emergency response. Hundreds of climate watch stations and distributed Aqua-Nodes would feed into a National Water Intelligence Platform, where insights, not raw data, are shared across regions. This distributed AI structure allows each community system to adapt independently while collectively identifying regional drought trends and watershed stress, eliminating dependence on a single centralized control system. All budgets and performance reports would be published publicly, and a 10% emergency reserve would be maintained to support rural communities during extreme droughts or climate-related disasters. Together, these programs would create a nationwide water-resilience system that reaches rural communities directly, providing reliable access to clean water, healthier watersheds, and more stable freshwater supplies. Overall, this approach strengthens both rural livelihoods and Panama’s most critical economic resource, the Panama Canal, by combining environmental protection, intelligent water management, community capacity-building, and modern climate technology. Given Panama’s population distribution and existing access gaps (World Bank, 2021; FAO, 2025; Newsroom Panama, 2024; Tzoy & Moreno, 2023), this funding structure is capable of addressing the scale and urgency of the crisis.

Limitations exist, for example, the global shipping industry may complain of higher costs, pressuring for reformation, but given that the canal handles five to six percent of global trade, countries are extremely unlikely to eliminate use. The challenge of ensuring the money does not get lost or misused in government processes is equally present, but transparency laws will be in place with the intention of modulating this possibility. Additionally, rural communities in Panama often have strong cultural traditions relating to land, farming, and local leadership, though this plan focuses not on the citizens, but the foreign entities that affect them, which is ideal for implementation under these circumstances. This project requires management from the Panamanian government, and local community leaders to carry out legislative matters, and water focused organizations, as they hold the necessary power and expertise to physically carry out this plan. The Ministry of Environment, the Panama Canal Authority, and other organizations are already present in rural areas and could help lead this effort.

To ensure success, transparent policies guarantee that all tax revenue goes to rural water systems and not unrelated programs, allowing for the public to monitor their actions, along with experts and trained workers who can maintain the new systems (Ortuste et al, 2024). Luckily, Panama already has strengths like experience in managing the canal, and a population that understands the importance of water security. These strengths will help move the propel project. The solution is built on sustainability, as the tax creates a continuous source of funding that does not depend on other countries. Panama will continue to receive money to maintain and improve water systems through constant port use, reducing pressure on Lake Alajuela, helping the canal operate reliably (World Resources Institute). Precautionary measures such as a canal-efficiency surcharge applied to optional services such as tug assistance, mooring, scheduling priority, or expedited passage, could apply in the spontaneous event of decreased canal use. These

services remain in demand even when total vessel numbers fluctuate, allowing the fund to maintain stable revenue without altering the base tax rate.

This recommendation is incredibly feasible as it does not require Panama to build completely new structures or rely on unpredictable outside aid. The canal is already a vital trade route of the world, ships will continue using it, port use will likely not decrease under normal circumstances, and a small tax increase is realistic. This initiative fits the country’s strengths (United Nations Development Programme, 2024), making it a practical strategy for improving food and water security.

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