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Growing Up: How AgriTech Innovation Can Solve Rwanda's Food Security Crisis

35-year-old farmer Nadine kneels in the dirt behind her home, working soil that her family has depended on for generations. Rain is both necessary and dangerous. Her beans need it to grow, but on Rwanda's steep hills, a hard storm can carry away the topsoil with it. For her three children, the "lean season" is the time when hunger is in their stomachs as the last of the cassava runs out weeks before the next harvest is due. Rwanda's food insecurity is not caused by farmer laziness or lack of knowledge, but by extreme land scarcity and population pressure.

Rwanda is one of Africa's most densely populated countries, with over 600 people per square kilometer competing for limited land for agriculture ("Population Density"). 20% of the population, around 2.3 million people, remain food insecure ("Health, Nutrition"). With 90% of its land on steep hills, Rwanda's environment makes farming especially challenging, as rainfall can wash away soil and nutrients.

Food insecurity is a large challenge in Rwanda. According to the 2022 Comprehensive Food Security and Vulnerability Analysis, 22% of Rwandans are moderately food insecure and another 2% are severely food insecure. The problem also extends beyond getting enough calories. Among children between 6 and 59 months old, "at least 33%... are stunted (short for their age), 1% are wasted (thin for their height), 8% are underweight (thin for their age), and 6% are overweight (heavy for their height)" ("Health, Nutrition"). For families like Nadine's, these numbers represent weeks without enough cassava or beans for the children.

Rwandan farms are also extremely small. The average farm is less than one hectare, leaving many families with too little land to reliably support themselves through conventional agriculture alone (Ali et al.). Beans, maize, cassava, bananas, and potatoes are among the country's major crops. Rwanda's Strategic Plan for Agriculture Transformation Phase 5, covering 2024-2029, commits $5.2 billion to agricultural modernization and irrigation expansion (Gachague and Kabano). However, while PSTA 5 strengthens conventional agriculture, it does not address the fundamental problem of the scarcity of arable land. Irrigation requires significant land, but land is already in short supply.

Most families depend on agriculture or informal-sector work, which accounts for 90.4% of employment ("Labour Force"). The living wage reference value for rural Rwanda is RWF 217,987 (about USD 166) per month ("Living Wage"). The minimum wage of 100 RWF per day traces back to 1974 and has never been updated, and more than half of the population lives below the international poverty line of $2.15 a day ("Average Salary") ("Rwanda"). These economic realities force families like Nadine's to prioritize filling stomachs over nutritional quality.

For Nadine's children, this diet means insufficient nutrients. Protein sources are scarce, limited to small fish and occasional meat. Access to vegetables is limited. Even when families consume enough calories, poor diversity in their diet causes problems. Only 22% of children receive a minimum acceptable diet (Umwali et al.).

Rwanda faces a perfect storm of agricultural challenges. Farm size continues to decrease while population density increases. The average farm of less than one hectare is too small to feed families using traditional farming methods. The problem becomes worse as farms are divided between children from one generation to the next. Rwanda's geography creates another difficulty. Much of the country is steep, so heavy rainfall can carry fertile soil downhill. Climate change makes that rainfall less predictable as well. Farmers can face drought or dry periods when crops need water most, followed by storms strong enough to cause flooding and further erosion.

Perhaps most concerning is youth rejection of traditional farming. Young Rwandans increasingly view agriculture as dirty, backbreaking work offering no path from poverty, and only 5% want to go into agriculture as a profession (Awiti and Scott). They see parents toiling on small plots for meager returns and choose to migrate to the city instead. This creates a dangerous situation where the average farmer age rises, which threatens future food production. The farming stigma is reinforced by low technology and potential for profitability that fails to match the aspirations of an increasingly educated and digitally connected generation.

A modern approach to directly address land scarcity involves growing crops vertically in stacked layers using hydroponic or aquaponic systems, where plants grow in nutrient-rich water in lieu of soil. These systems are highly efficient. Hydroponic systems produce around 11 times more food per square meter than traditional farming (Barbosa et al). These systems could be even further strengthened through rainwater harvesting systems to maximize sustainability.

Eza Neza shows this approach's viability. Founded in 2019, Eza Neza operates Rwanda's first commercial hydroponic greenhouse, selling vegetables to hotels, restaurants, and supermarkets in Kigali. Its success provides a working example of hydroponics as a business rather than just an experimental technology, while also creating jobs. Critically, it appeals to youth who see it as modern, technology-based work rather than traditional "dirty" farming. Building on this success, the FAO partnered with Eza Neza in 2024-2025 to establish demo farms and train 39 young agri-entrepreneurs in hydroponics, business management, and marketing.

Hydroponics does have an important limitation. These farms are best suited to vegetables such as lettuce and tomatoes, not the beans and cassava that provide much of the calories in a Rwandan diet. Vertical farming therefore cannot simply replace conventional agriculture. Its contribution to food security is different: it can put more vegetables into markets throughout the year while creating jobs that give families more money to spend on a varied diet. Instead of taking the place of all conventional staple crop production, vertical farming is best viewed as a supplementary approach that enhances incomes and nutrition.

However, such an approach has limitations. Often, the high initial investments for a greenhouse can be out of reach without financing. Another barrier is the knowledge needed to run these systems. Rwanda still has only a small number of hydroponic farms, so the technology has not yet reached a scale that substantially affects national food production. Most existing projects are also concentrated around urban markets, leaving rural farmers with little direct benefit. Programs supported by the Mastercard Foundation and the Hanga Agritech Innovation Challenge have begun encouraging young people to enter agricultural entrepreneurship, but they remain too small to change this on a national scale.

Rwanda should respond by establishing 30 district-level AgriTech Innovation Hubs for training, production, business support, and market access. These hubs would not require 30 entirely new facilities. Rwanda already has Technical and Vocational Education and Training (TVET) centers across its districts, along with instructors, classrooms, and students looking for employable skills. Existing TVET centers could therefore provide the base for the network. Anchoring each AgriTech Hub to an existing TVET could reduce the costs drastically. This integration also gives the program durability. Rather than depending on a standalone initiative that could lose funding, the hubs become a permanent feature of Rwanda's national workforce development infrastructure.

Each hub would combine multiple components to lead young entrepreneurs to success. Training would cover hydroponics and aquaponics alongside business management, financial literacy, and marketing. Trainees would also work directly in demonstration greenhouses. Instead of learning the system only in a classroom, they would have to manage actual crops, solve problems as they arise, and learn how to improve yields. Produce sold from these greenhouses could also bring some revenue back into the hubs. The hubs would also serve surrounding rural communities rather than only the entrepreneurs operating their greenhouses. Further, there could be short training programs for nearby farmers on techniques such as rainwater harvesting, soil conversation, irrigation, and lower cost hydroponic systems that can supplement conventional farming. Farmers who do not operate commercial greenhouses could therefore still benefit from the technology, training, and infrastructure concentrated at each district hub.

The demonstration farms themselves would consist of five to ten commercial greenhouse units that serve the dual purpose of teaching facilities and as businesses. These units would be operated by recent graduates of the training program, providing them with employment while they gain experience and save capital to establish their own operation. This model would ensure that trainees gain practical experience managing real production in addition to theory before becoming independent workers. The demonstration farms could also be a medium for other farmers, students, policymakers, and potential investors to observe technology in action and understand its potential.

Even with training and experience, the initial cost of greenhouse infrastructure would be a barrier for many entrepreneurs. Each hub should therefore connect graduates with a financing system combining cooperative ownership and low interest microloans. Rather than necessitating each graduate to immediately finance an entire greenhouse on their own, several entrepreneurs could form a cooperative and share the cost of a greenhouse and equipment while dividing profits according to their investment and labor. Graduates seeking to establish independent operations could apply for small loans through banks or microfinance institutions. The government can reduce lenders' risk by partially guaranteeing loans for entrepreneurs who complete the hub's training program. Repayment could begin after an initial

production period. This would ensure time for the businesses to generate revenue before taking on payments. This would turn the hubs from training programs into actual pathways to business ownership.

Finding buyers would be just as important as learning how to grow the crops. Each hub could build relationships with hotels, restaurants, supermarkets, and other large buyers in nearby cities. Interaction with school feeding programs would be particularly important, as government procurement would be a stable baseline demand that allows producers to plan for production levels with confidence while also directing nutrient dense foods toward children who may otherwise have limited dietary diversity. The hubs could also aggregate a portion of production for sale in surrounding district markets. Some of the vegetables should also remain within the surrounding district rather than being sold only into higher-income urban markets. Hubs could aggregate produce for local markets while handling quality control, transportation, and relationships with buyers. Individual growers would then spend less time finding customers and more time managing production. As the network matures, hubs could also explore the opportunities to sell exports and increase profitability.

Implementation of this policy would occur through a phased five-year rollout beginning with five carefully selected pilot districts representing different geographic and economic conditions across Rwanda. These pilots would train the first 100 entrepreneurs and establish 50 greenhouse units during the first year. The first year would be used to test the model before expanding it. The five pilot districts would reveal practical problems that cannot be predicted in advance and allow the training, financing, and production systems to be adjusted before the program reaches additional districts. The next two years would focus on expansion to 15 additional districts and scaling up operations. All during this, maintaining quality and establishing regional networks for input supply and product distribution. Years four and five would complete national coverage with hubs in all remaining districts. By the end of year five, the network would aim to have trained 1,500 young entrepreneurs and established 300 greenhouse units producing throughout the year. Just as importantly, the hubs would have built connections between growers and the markets buying their produce.

In direct production terms, the scale of just this five-year plan is not the full solution to the problem. If each of the 300 greenhouse units produced about 25-30 tons of vegetables per year, together they would produce approximately 7,500-9,000 tons annually. The World Health Organization recommends that people aged 10 and older consume at least 400 grams of fruits and vegetables per day, equivalent to about 146 kilograms per year (“Healthy Diet”). At that benchmark, the program’s annual vegetable production would be equivalent to the recommended yearly fruit-and-vegetable intake of roughly 51,000-62,000 people. Compared with the millions of Rwandans affected by food insecurity, this is clearly not enough to solve the problem by itself. However, the purpose of such an initiative is catalytic, not comprehensive. This would establish proof of concept at scale, would have trained 1,500 skilled agri-entrepreneurs, and would show commercial viability that can help spur further investment.

A general estimate of the required investment for such a project is $50 million. This estimate is built from core program components. First, greenhouse infrastructure at approximately 50,000 to 100,000 per unit for 300 units (15-30 million). Second, the establishment of 30 district hubs, including training facilities at roughly 200,000 each (6 million). Next, solar power installations at around 150,000 per hub (4.5 million), and approximately 10 million to be allocated for staffing and operations costs. Three sources could

contribute to this. One possible funding structure would have the government provide about 35% of the $50 million cost, or $17.5 million, using funding associated with PSTA 5. Private investment could cover approximately 45%, with the remaining 20%, or about $10 million, coming from organizations such as the FAO, Mastercard Foundation, and other international partners.

By 2030, the goal is not to replace Rwanda's existing farms with greenhouses. It is to make limited land more productive while giving young people another way to make a living from agriculture. If the hub model works, more vegetables could reach markets throughout the year, more young people could build agricultural businesses, and Rwanda could reduce some of the pressure that land scarcity places on its food system.

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