ON THE GREEN AGENDA

Leveraging new technologies to mitigate climate risks in food production

TABLE 1: RANKING OF WORLD PRODUCTION OF MAJOR FOOD CROPS (2020)

	Commodity	Russia Rank	Ukraine Rank
	Sunflower seed or cottonseed oil	2nd	1st
	Wheat or meslin	4th	7th
	Barley	2nd	6th
	Maize	10th	6th
	Fertilisers	4th	18th
	Fuel	3rd	n/a

SOURCE: WORLD INTEGRATED TRADE SOLUTION. WITS (2022)

> As several Caribbean leaders passionately expressed to COP 26 audiences, failure to act swiftly to address climate change will have dire implications for the region

In 2022, on the heels of the COVID-19 pandemic, the war in Ukraine has placed the issue of global food security squarely on the front burner as societies grapple with food supply challenges.

Disruption to important food crop supplies out of Ukraine and Russia has forced producing countries to halt exports to satisfy domestic demand (see Table 1 for Ukraine's and Russia's ranking in world production of major food crops in 2020). This situation has adversely affected net importers of food such as Trinidad and Tobago, leading to inflation of prices for wheat products (as an example) by as much as 33 percent in June 2022.

Notwithstanding the impact of the Russia-Ukraine war, food security is expected to remain a global concern well beyond the conflict, as food systems are increasingly affected by the impacts of climate change.

According to the World Bank: "Climate change is already increasing average temperatures around the globe and, in the future, temperatures are projected to be not only hotter but more volatile too. This, in turn, will alter how much precipitation falls, where and when. Combined, these changes will increase the frequency and intensity of extreme weather events such as hurricanes, floods, heat waves, snowstorms and droughts.

They may cause sea level rise and salinisation, as well as perturbations across entire ecosystems. All of these changes will have profound impacts on agriculture, forestry and fisheries."

In the Caribbean, food security is perennially plagued by systemic issues such as inadequate access to land and land tenure, praedial larceny, lack of infrastructure and irrigation. These issues make farming as a livelihood a risky proposition, and act as a deterrent to prospective 'agripreneurs' who may be considering investing in farming or agriculture.

Climate change adds to this level of uncertainty and risk, further exposing our region's farmers to the prospect of losing their investments and jeopardising their ability to earn a living.

Despite this uncertainty, there is good news for farmers.
Modern technologies linked to Climate Smart Agriculture or CSA, and digital or smart farming, are emerging as important tools in the modern farmer's tool belt to survive and thrive in a hotter, riskier climate change-impacted world.

According to the World Bank Group: "Climate-Smart Agriculture (CSA) is an integrated approach to managing landscapes—cropland, livestock, forests, and fisheries—that addresses the interlinked challenges of food security and accelerating climate change. CSA aims to simultaneously achieve three outcomes:

1. Increased productivity: Produce more and better food to improve nutrition security and boost incomes, especially of 75 percent of the world's poor who live in rural areas and mainly rely on agriculture for their livelihoods.

2. Enhanced resilience: Reduce vulnerability to drought, pests, diseases and other climate-related risks and shocks; and improve capacity to adapt and grow in the face of longer-term stresses like shortened seasons and erratic weather patterns.

3. Reduced emissions: Pursue lower emissions for each calorie or kilo of food produced, avoid deforestation from agriculture and identify ways to absorb carbon out of the atmosphere."

FIGURE 1: AN EXAMPLE OF AN INDOOR VERTICAL FARM IN TRINIDAD AND TOBAGO GROWING A VARIETY OF LEAFY GREEN VEGETABLES AND STRAWBERRIES (IMAGE COURTESY CUBE ROOT FARMS).

While all forms of technology in this space may not be perfectly suited to the Caribbean region due to our smaller scale, several technological applications have the potential to spur a new wave of 'agripreneurs' to meet the region's food and nutritional needs.

1. Indoor Vertical Farms

"Indoor vertical farming can be defined as the practice of growing produce stacked one above another in a closed and controlled environment. By using growing shelves mounted vertically, it significantly reduces the amount of land space needed to grow plants compared to traditional farming methods."[1]

[1] Plugandplaytechcenter.com

Indoor vertical farming has the potential to change how societies view farming. Rather than being limited to rural areas, urban and sub-urban areas can be potentially converted to hubs of food production. Underutilised spaces in institutions such as schools, hospitals, and community centres provide ideal spaces to start vertical indoor farms. Vertical farms typically do not require soil for plants to grow. One acre of vertical farming can produce the equivalent of 10-20 acres of conventional production.

Benefits of indoor vertical farms include:

- **They use less water** – These farms can typically use up to 70-95 percent less water than traditional farms.

- **They are unaffected by adverse weather conditions** - Growing in a fully enclosed and climate-controlled environment completely eradicates the need to rely on - or worry about - the weather.

ON THE GREEN AGENDA

Traditional Farming	VS	Vertical Farming

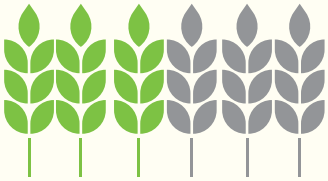
80% arable land already **IN USE**

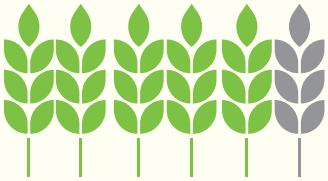
0% LAND

0.4 ha vertical farm

4-8 ha land-based traditional farm depending on crop

50% of crops are **NOT HARVESTED**



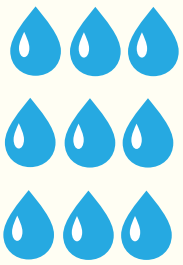


90% of crops are **HARVESTED**

70% GLOBAL

FRESH WATER USED FOR SOIL-BASED FARMING

50-80% of which is lost to evaporation and runoff



70-95% LESS

FRESH WATER USED FOR VERTICAL FARMING

using aquaponics or aeroponics method of farming

FOOD MILES

On average food travels from 1,500 to 2,500 miles on its way to our plate

LOCAL

Reduces the need for long distance transport decreasing the need for fossil fuels and ensuring quality

Leveraging new technologies to mitigate climate risks in food production | CONTINUED

- **Reliable year-round crop production**- Because these systems are not dependent on weather, or seasons, consistent year-round crop production can be achieved. Additionally, precisely controlled environmental conditions eliminate the variability in crop yields to improve consistency and reliability of supply of crops to the market.
- **Improved security** – Producing in a secure indoor environment reduces the risk of praedial larceny and minimises crop losses leading to greater profitability.
- **Reduced carbon emissions** – Using less inputs such as water, fertilisers and pesticides means lower carbon emissions. Additionally, vertical farms located closer to end users and markets lower overall emissions from transportation.

Drawbacks of vertical farming:

- **High capital cost** - Establishing a vertical farm requires access to a facility, and capital for equipment, inventory, software, marketing, advertising and overheads. According to StarterStory.com the average start-up cost is estimated at around US$20,000.
- **Training and expertise** – Establishing a vertical farm has no room for guesswork. Operators need to be properly trained in all aspects of the business well before start-up.
- **A limited number of crops can be grown economically** - A vertical farm can be customised to support the growth of many plant species, however, only a limited number can be grown economically. In the global vertical farming industry, leafy greens and herbs remain the primary crops due to their rapid growth cycle, high cost, and short shelf life.

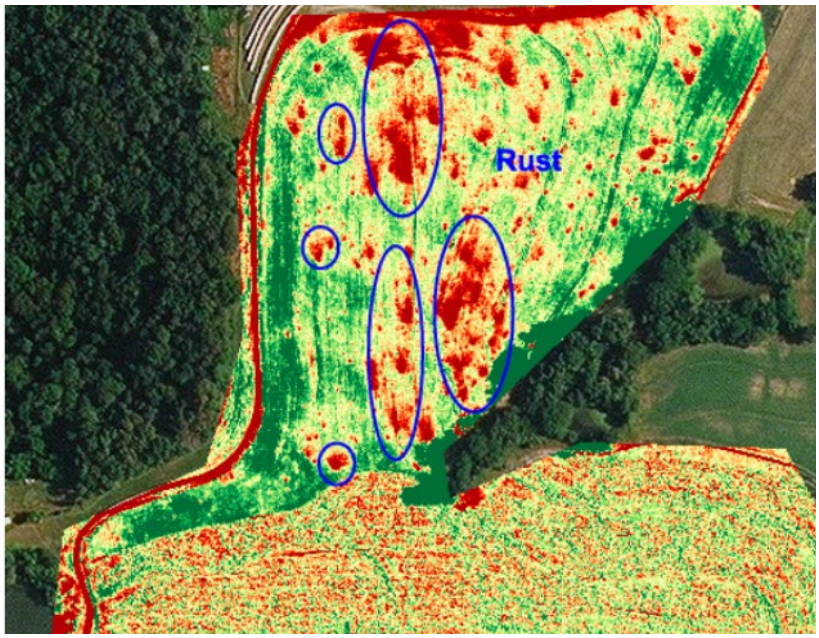


FIGURE 2: BUILT-IN PLANT HEALTH TOOLS IN DRONE MAPPING SOFTWARE ALLOW FOR QUICK IDENTIFICATION OF PROBLEMS THAT ARE NOT DETECTED BY THE NAKED EYE. AREAS IN RED INDICATE PLANT HEAT STRESS IN A FIELD.

2. Drones in Precision Agriculture

Drones or Unmanned Aerial Vehicles (UAVs) are powerful tools that farmers can use to take the guesswork out of field production. With a drone not much bigger than the size of one's palm, along with mapping software, a farmer can gain invaluable insights in minutes to help eliminate risks, improve productivity, and reduce costs.

Here are some ways that drones are helping farmers become more productive:

- **Early detection and timely prevention of plant health problems** - In the world of agriculture, timing is everything. Diseases and invasive species spread fast. Drones can provide a high-resolution map of a field in a matter of minutes. Powerful plant health monitoring tools built directly into mapping software allow users to visualise issues and make decisions on the spot.
- **An aerial view of fields** - Drones provide high-resolution, low-cost aerial maps that allow farmers to make quick informed decisions about where to plant. Drones can also perform automated crop counts in minutes compared to manual counts which can take hours to do.
- **Assess damage to crops** - High-resolution imagery from drones can help farmers quickly and accurately assess damage to crops after adverse weather events. This information can be used to document and support claims to insurance companies or to government authorities for compensation.
- **Monitor livestock** - Drones with thermal or night-vision cameras can quickly scout a farm from above to monitor livestock or detect potential predators or intruders.

Potential drawbacks of using drone technology in farming:

- **Expensive** - Drones and the associated software are expensive and may be out of reach of the typical farmer. Exploring shared-service models such as purchasing and deploying drone technology through agricultural societies or co-operatives may be required to reduce the cost of acquiring the technology.

- **Local regulations and safety** - Drones are regulated by the local Civil Aviation Authorities. 'No-fly' zones such as close to airports, industrial and military facilities usually restrict the use of drones. Exemptions typically require special permits supported by liability insurance, manufacturer training, and having a legally registered company.

- **Impact on labour requirements** - Drones usually automate tasks that are traditionally done manually. This could lead to reductions in the number of jobs in the agricultural sector.

- **Weather-dependent** – Drones cannot be deployed in rainy or windy conditions, which limits the number of productive days per year in the Caribbean region due to the rainy seasons.

3. Digital or Smart Agriculture Monitoring

IBM predicts that through the Internet of Things (IOT) and Smart Agriculture, by 2050, farmers will be able to increase their production rates by 70 percent. Digital or Smart Agriculture includes a range of technologies that allow farmers to precisely monitor and control key activities and inputs such as planting, watering, harvesting and pest control.

Some examples of the potential applications of Digital or Smart Agriculture include:

- **Soil condition monitoring** - Soil condition is key to deciding on the optimal times for planting and harvesting. Using sensors, farmers can get instant alerts on soil conditions and metrics such as temperature, moisture levels, and salinity, all critical to successful crop management.

- **Crop monitoring systems** - "As crops grow and ripen, so many things can go wrong: diseases, infestations with pests, or adverse environmental conditions can potentially cause irrevocable harm before farmers even notice. Applied in crop monitoring, smart sensing technology collects metrics about the state of the crops (temperature, humidity, health indicators)."[2] This enables farmers to take timely measures should anything go wrong.

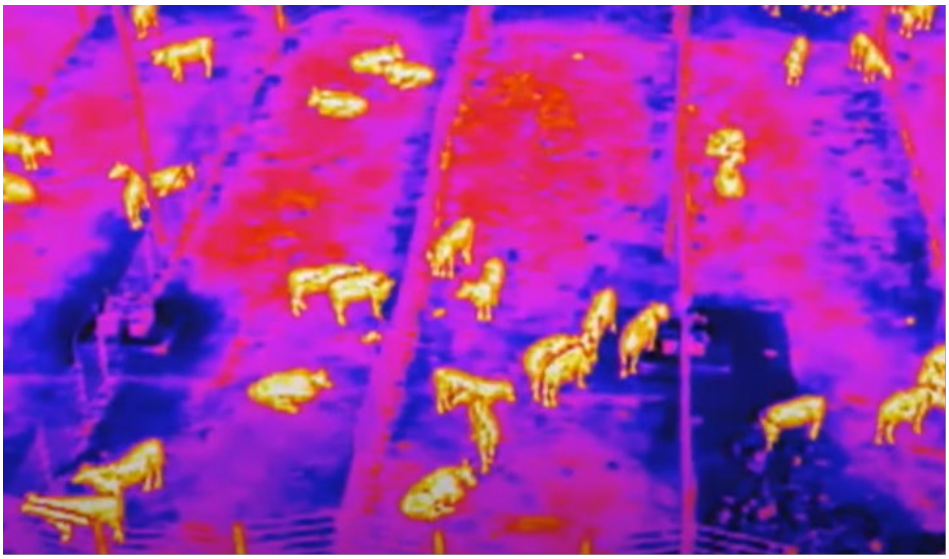


FIGURE 3: SCREENSHOT FROM A DRONE BEING USED AT NIGHT TO MONITOR CATTLE.

NGC's Role in Supporting Food and Nutrition Security

In June 2022, NGC and global fertiliser producer Nutrien announced the intention to collaborate to explore opportunities to improve Trinidad and Tobago's food and nutrition security. The partnership will explore the promotion and adoption of CSA and associated digital technologies as pathways to improve adaptation of our food systems to the impacts of climate change. Both companies will work closely with stakeholders along the local food value chain to identify opportunities in five main areas.

Some of these opportunities have been discussed above:

1. **Praedial Larceny**: to improve detection and intervention through the deployment of shared remote sensing technologies such as closed-circuit cameras, sensors, and UAVs.

2. **Precision Agriculture**: to introduce, test and deploy precision agriculture methods through UAVs and satellite technology. This model will aim to improve plant health monitoring efficiency and sustainability in the use of agricultural inputs.

3. **Food Waste:** to identify opportunities to reduce food waste. This will support the country's efforts to reduce carbon emissions and help the most vulnerable to meet their daily nutritional needs.

4. **Community Climate Smart Agriculture:** promote food production at the community level using CSA.

[2] Chalimov, 2019

FIGURE 4: IAN WALCOTT MANAGING, DIRECTOR OF NUTRIEN TRINIDAD, AND MARK LOQUAN, PRESIDENT OF NGC SIGN A PARTNERSHIP AGREEMENT IN JUNE 2022 TO COLLABORATE ON FOOD AND NUTRITION SECURITY IN TRINIDAD AND TOBAGO.

5. **Food, Health, and Nutritional Awareness:** build public awareness regarding the health benefits of boosting the production and consumption of fresh, locally produced foods, especially those with a high plant-based content.

Conclusion

Climate change is expected to continue impacting the ability of our global food systems to meet the growing demand for readily available, affordable, and nutritious food for the rapidly increasing world population. Climate Smart Agriculture and technologies that allow farmers to become more productive while reducing their exposure to risk are critical to success.

Technologies such as indoor vertical farms, precision agriculture tools such as drones, and smart monitoring devices that provide real-time and accurate data about crop conditions are likely to be commonplace in the farm of the future.

NGC and its partner Nutrien will explore how these technologies, along with greater public awareness on issues such as food waste, could be implemented to help the country build resilience against the threats posed to food and nutrition security by climate change.■

References

Chalimov, A. 2019. Eastern Peak, Smart Agriculture Monitoring Solutions to Optimize Farming Productivity. Accessed 19/07/2022 at https://easternpeak.com/blog/smart-agriculture-monitoring-solutions-to-optimize-farming-productivity/

Ku, L. in Plug and Play, 2021. Accessed on 19/07/2022 at https://www.plugandplaytechcenter.com/resources/indoor-vertical-farming-new-era-agriculture/

World Bank 2022. Climate Smart Agriculture. Accessed on 19/07/2022 at https://www.worldbank.org/en/topic/climate-smart-agriculture).