Climate and Food Production: The Case for Resiliency and Sustainability

By:

Adam Nutt

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Shawnee McDaniel

**Abstract**

This case study delves into the critical role of sustainability practices in agriculture to bolster the resiliency of food systems and mitigate the far-reaching impacts of climate change. As global populations rise and climate variability intensifies, traditional agricultural methods face mounting challenges in meeting the demands for food security while maintaining ecological balance. Through a comprehensive examination of real-world examples and empirical data, this study highlights how sustainable agricultural practices contribute to fostering resilient food systems capable of withstanding climate shocks.

As the EPA reports, climate change presents widespread effects ranging from impacting the productivity of yields to degradation of soil and water resources to the human element of the health impacts for farm workers. In the United States, agriculture contributed over $1.1 trillion to 2019 GDP figures and accounted for more than 22 million jobs, nearly 11% of the total workforce (EPA, 2023). With the US being one of the world’s top agricultural producers, any disruptions will lead to ripple effects throughout the country and global trade partners. When you consider nations within the Global South whose economies are more tightly connected to agriculture and are dealing with the brunt of early climate change events, it becomes even more critical to ensure our food systems can meet the demand of a growing global population while mitigating its impact on climate change.

**Data and Question**

The data used in this case study was compiled by the International Food Policy Research Institute. This utilizes data from the 2022 Global Food Policy Report on projections of total production with and without climate change. Production is measured by million metric tons and examines project food production under five timelines: 2010 without climate change, 2030 with and without climate change and 2050 with and without climate change.

From this analysis I’ll seek to identify the potential for great disparities in production as a result of climate change. I intend to highlight the hypothesis that regions within the Global South face greater challenges in food production. With the results of the study, my goal is to further the conversation on sustainable agricultural practices and provide thoughts to the question “How might sustainable farming methods, such as hydroponics, and practices (cover cropping, no-till, rotational grazing) improve our global food systems?”

**Analysis**

Step 1. Begin by either creating a new diagram.

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Step 2. From the Sample tab, drag File Import into the diagram.

Step 3. In the General section, open the Imported Data tab. You will then want to select the spreadsheet totalProduction\_IMPACT\_GFPR\_2022 if retrieved from the database. If retrieved from case study, BAN620 Case Study – Final -- GFPR 2022 Total Food Production.xlsx.

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Step 4. In the Train section, select the Variables tab and ensure it looks as follows:

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Step 5. Drag the StatExplore node from the Explore tab and connect to the File Import node.

Step 6. Run the connection and view results.

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A table of numbers with letters

Description automatically generated with medium confidence

A table of numbers with numbers

Description automatically generated

Step 7. Drag the Regression node from the Model tab and add it to the diagram, connected to the File Import node.

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Step 8. Select the Variables for the Regression node and ensure they are as follows:

\*Note: Regression node allows for one target. You can run for Region by repeating this step and selecting Region as the target in place of Commodity.

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Step 9. Run Regression model and view results

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Step 10. Open the spreadsheet provided with this case study

Step 11. Highlight the headers “Commodity” and Region. On the Home tab select Sort & Filter -> Filter in order to narrow results to specific regions and commodities for timeline comparisons.

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**Results**

While reviewing the data, there are a few points that stick out to me most. From this I gather that the presence, or lack thereof, has little impact on projected meat production. I find this to be interesting as the traditional raising of livestock is one of the most consequential in terms of greenhouse gas emissions. As expected, most regions experience reduced production in timelines afflicted by climate change.

I won’t state it fully confirms my hypothesis, but strongly suggests that nations within the Global South face greater challenges in their food systems. A specific example of this is within the Western and Central Africa region (WCA). The region is home to the continent’s most populous country, Nigeria, which is projected to surpass China as the 2nd most populous country by 2100. Most nations within the region (and Africa as a whole) are experiencing incredible growth rates between 2-3%. The WCA region would be projected to lose the most in crop production due to climate change out of any other region.

Another point of concern I noticed is within North America. Without climate change’s effects, this region would anticipate significant increases in cereals yields. So much so that the region could become the leading global producer. Instead, the region could expect a roughly 200 million metric ton differential in production as a result of climate change.

**Recommendations**

With the diversity across our global food system, our solutions must be equally diverse in order to best utilize the resources available and best equipped to handle the challenges each region, country or locality may face. Below are a few recommendations that could be implemented throughout these regions. Many are increasing in their implementation while some have been in use for centuries. Together these solutions can work to strengthen our food systems, preserve security and stability, and mitigate climate change.

**Agroforestry**: Incorporate trees and shrubs into agricultural landscapes to enhance biodiversity, improve soil health, and provide shade and windbreaks. Agroforestry systems sequester carbon and create microclimates that support diverse crop growth.

**Crop Rotation and Diversification**: Implement crop rotation and diversification to improve soil fertility, reduce pest and disease pressure, and increase resilience to changing weather patterns. Diverse cropping systems can also contribute to better resource use efficiency.

**Cover Cropping**: Plant cover crops during fallow periods to prevent soil erosion, improve soil structure, enhance nutrient cycling, and reduce weed pressure. Cover crops also sequester carbon and increase water retention.

**No-Till and Reduced Tillage**: Adopt no-till or reduced tillage practices to minimize soil disturbance. This helps preserve soil structure, reduces carbon loss from soil, and enhances water infiltration, thereby mitigating erosion and improving soil moisture retention.

**Precision Agriculture**: Use technology such as GPS-guided machinery and remote sensing to optimize input use. Precision agriculture minimizes chemical and resource wastage, leading to improved efficiency and reduced environmental impact.

**Climate-Resilient Crop Varieties**: Plant crop varieties that are adapted to changing climatic conditions, such as drought-resistant or heat-tolerant cultivars. This helps maintain productivity despite climate fluctuations.

**Water Management**: Implement efficient irrigation techniques such as drip or sprinkler irrigation to minimize water wastage. Collect rainwater for irrigation during dry periods, reducing reliance on unsustainable water sources. Scaling hydroponic and vertical farm systems to reduce water usage and waste, improve yield size and production. This would enable urban farming that can repurpose space within cities and strengthen local food systems.

**Livestock Integration**: Integrate livestock into farming systems to optimize nutrient cycling and reduce waste. Well-managed rotational grazing and mixed farming systems can improve soil health and minimize methane emissions. This prevents overgrazing, allowing the land to regenerate before consumption once again.

**Agrobiodiversity Conservation**: Preserve and utilize diverse crop and livestock varieties to enhance resilience to pests, diseases, and climate variations. Traditional and indigenous knowledge can contribute to agrobiodiversity conservation.

**Resources**

International Food Policy Research Institute (IFPRI). 2022. IMPACT Projections of Total Production (Million Metric Tons) With and Without Climate Change: Extended Commodity-Level Results for 2022 GFPR Table 2A. Washington, DC: IFPRI [Dataset]. [https://doi.org/10.7910/DVN/IRUH4G. Harvard Dataverse. Version 1](https://doi.org/10.7910/DVN/IRUH4G.%20Harvard%20Dataverse.%20Version%201).

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Oluwole, Victor. “Nigeria to Overtake China as the Second Most Populous Country in the World by 2100.” *Business Insider*, 26 Feb. 2022, africa.businessinsider.com/local/markets/nigeria-to-overtake-china-as-the-second-most-populous-country-in-the-world-by-2100/tvrhcng.

“Countries in the World by Population (2023).” *Worldometer*, 2023, www.worldometers.info/world-population/population-by-country/.