**Food Security and Nutritional Vulnerability in Ghana: Analytical Report**

**Team work:**

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**Executive Summary**

This analysis evaluates food security and nutritional vulnerability across Ghana, focusing on household diet composition, nutrient availability, and resilience to climate-induced shocks. Using composite vulnerability indices, nutrient–vulnerability correlations, and scenario simulations, the study provides an evidence base for policy and program interventions. In addition, an interactive Streamlit dashboard was developed to complement the analysis, allowing policymakers and practitioners to explore regional data in real time, visualize nutrient gaps, assess vulnerabilities, and generate tailored policy briefs. Together, the report and dashboard provide both rigorous evidence and a practical decision-support tool for strengthening food and nutrition security strategies in Ghana.

**1. Introduction**

Food security in Ghana is influenced by production, markets, nutrition, and vulnerability. Despite progress, regional disparities persist, especially in the north. This study assesses food security with composite indicators, explores nutrient–vulnerability links, visualizes disparities, and simulates shocks, offering insights to guide evidence-based policy and development interventions.

**2. Methodology**

The analysis was conducted in four stages:

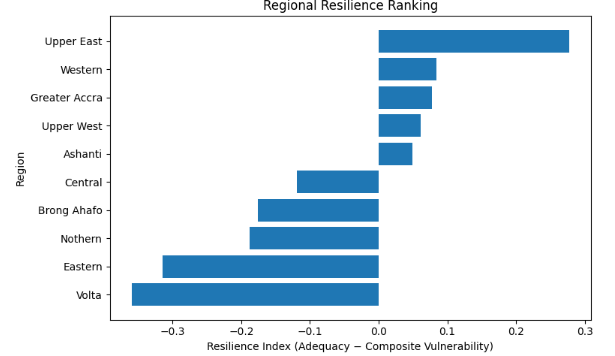
1. **Data Preparation**: Regional food availability, nutrient composition, and vulnerability scores were harmonized from secondary datasets. A composite index of food security was constructed using normalization and weighted aggregation.
2. **Ranking and Comparison**: Regions were ranked based on composite vulnerability scores, highlighting disparities.
3. **Visualization and Mapping**: Dashboards, scatter plots, and choropleth maps were used to reveal relationships and geographic patterns.
4. **Scenario Simulation**: Shocks such as a +10% drought effect (reducing yields) and a −5% protein availability reduction were modeled to assess system resilience.

**3. Results**

**3.1 Composite Vulnerability Scores and Ranking**

Analysis shows that vulnerability is unevenly distributed across Ghana. Regions in the north (Northern, Upper East, Upper West) exhibit the **highest vulnerability scores**, driven by limited dietary diversity, climate exposure, and higher poverty levels. In contrast, southern and urbanized regions (Greater Accra, Ashanti, Western) show lower vulnerability due to diversified livelihoods and stronger market integration.

Figure 1: Regional composite vulnerability scores and ranking.



This ranking underscores the need for spatially differentiated policy strategies.

**3.2 Correlation Between Nutrients and Vulnerability**

Scatter plots with fitted trend lines indicate significant associations between nutrient availability and vulnerability. For example, protein availability demonstrates a strong negative correlation with vulnerability, suggesting that regions with higher protein access are less nutritionally insecure. Micronutrients such as iron and vitamin A also show meaningful relationships, reflecting their role in overall health resilience.

Figure 2: Scatter Plot of Hotspot Thresholds at 0.5

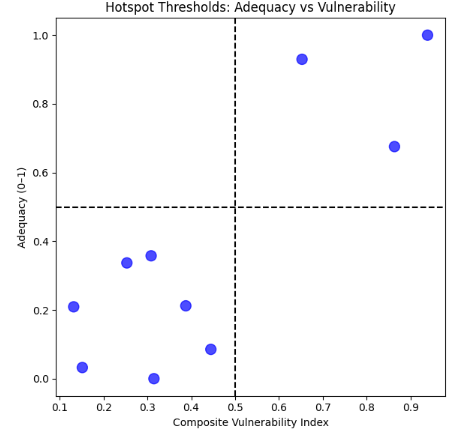
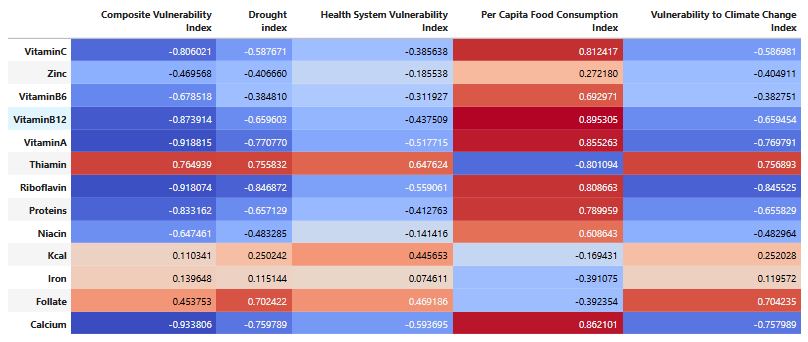


Figure 3: Nutrient × Vulnerability (Protein, Iron, Vitamin A).

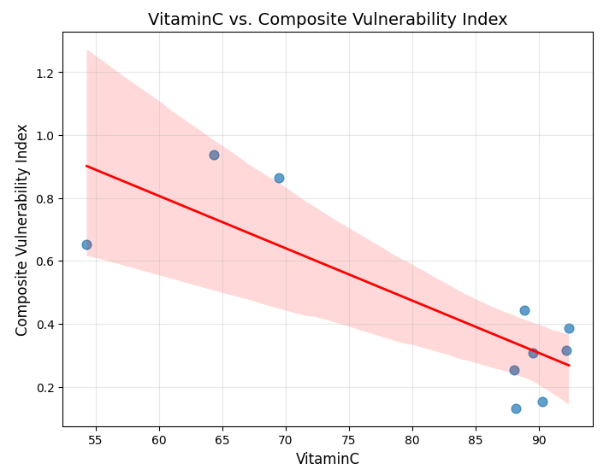


The analysis highlights that not only caloric sufficiency but also nutrient diversity is critical in reducing vulnerability.

**3.3 VitaminC intake plotted against the Composite Vulnerability Index (CVI)**

The analysis shows a clear **inverse relationship between VitaminC intake and the Composite Vulnerability Index (CVI)**. As VitaminC consumption increases, vulnerability consistently decreases, highlighting its protective role in strengthening immunity and resilience. The regression line confirms this negative trend, while the confidence band indicates stronger reliability at higher VitaminC levels. Some variation exists at lower intake levels, suggesting other factors also influence vulnerability. Nonetheless, the overall pattern emphasizes the importance of VitaminC in reducing susceptibility to external stresses. This finding supports prioritizing VitaminC availability in nutrition strategies to mitigate vulnerability risks across affected populations.

Figure 4: VitaminC vs Composite Vulnerability index



**3.4 Spatial Patterns: Choropleth Mapping**

The choropleth map of Ghana’s regions reveals **a north–south divide** in vulnerability. The Upper East, Upper West, and Northern regions appear as high-risk “hotspots,” while the coastal and southern regions display relatively lower risk.

Figure 5: Ghana regions, colored by vulnerability score.

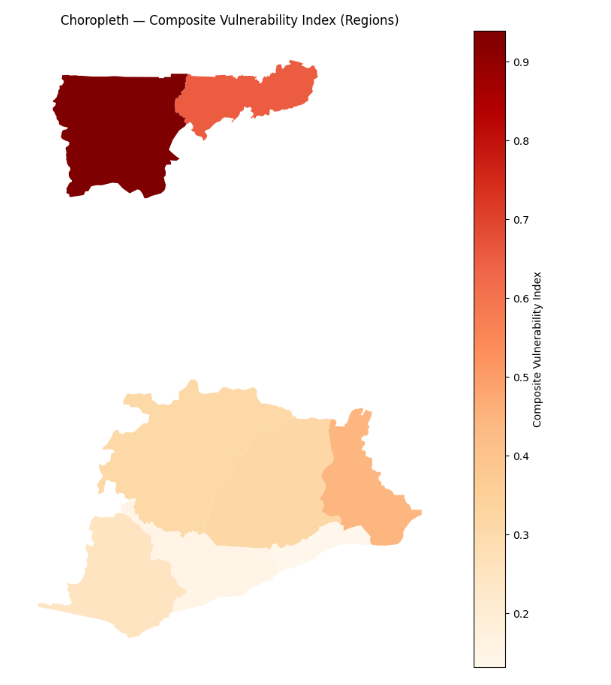
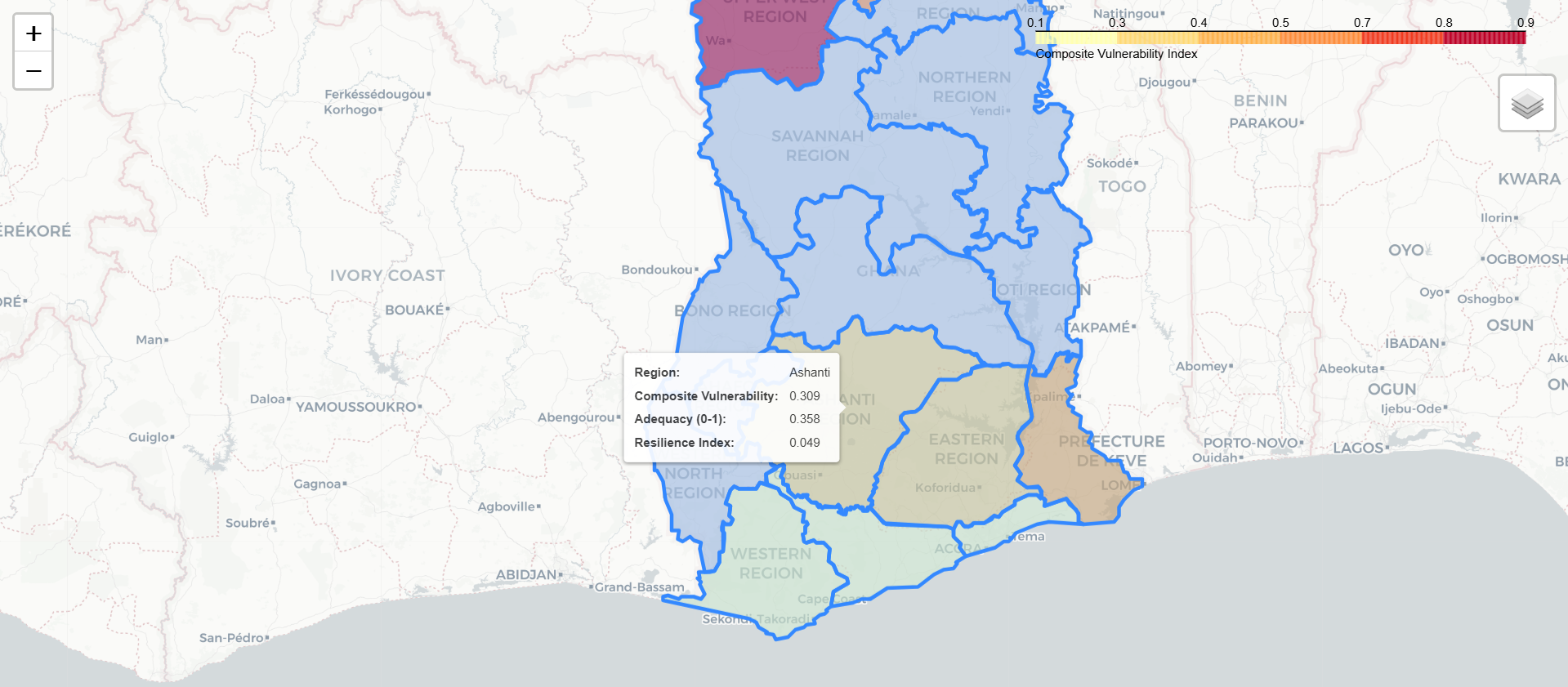


Figure 6: Interactive Chloropeth map



(See Appendix C)

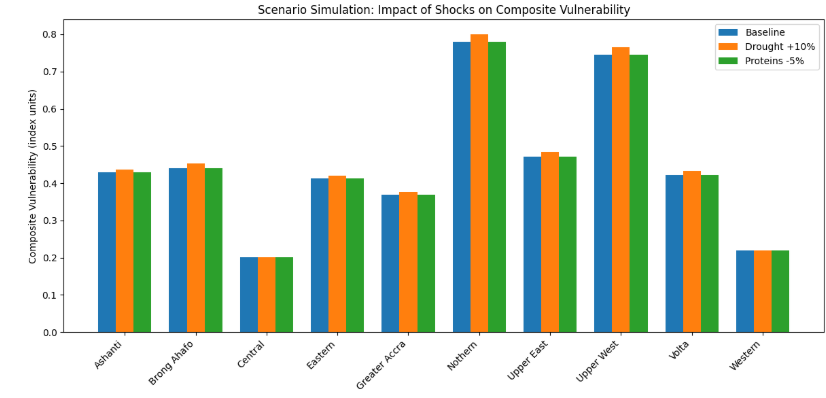
These spatial disparities align with national survey findings that consistently show higher food insecurity in the north due to rainfall variability, infrastructural deficits, and lower agricultural productivity.

**3.5 Scenario Simulations**

Two scenarios were tested to explore system resilience:

1. **Drought (+10% reduction in yields)**: Results indicate a marked increase in vulnerability in already fragile regions, particularly Upper East and Northern. The impact is less pronounced in Accra and Ashanti, where stronger market systems buffer production shocks.
2. **Protein −5% Availability**: This scenario highlights how even small declines in protein intake disproportionately increase vulnerability. Protein is a critical driver of resilience; reductions lead to heightened nutritional risk, especially in regions already facing dietary limitations.

Figure 7: Vulnerability shifts under drought and protein scenarios.



Together, these simulations show that **nutritional vulnerability is highly sensitive to both climatic and dietary shocks**, reinforcing the importance of dietary diversity and resilient agricultural systems.

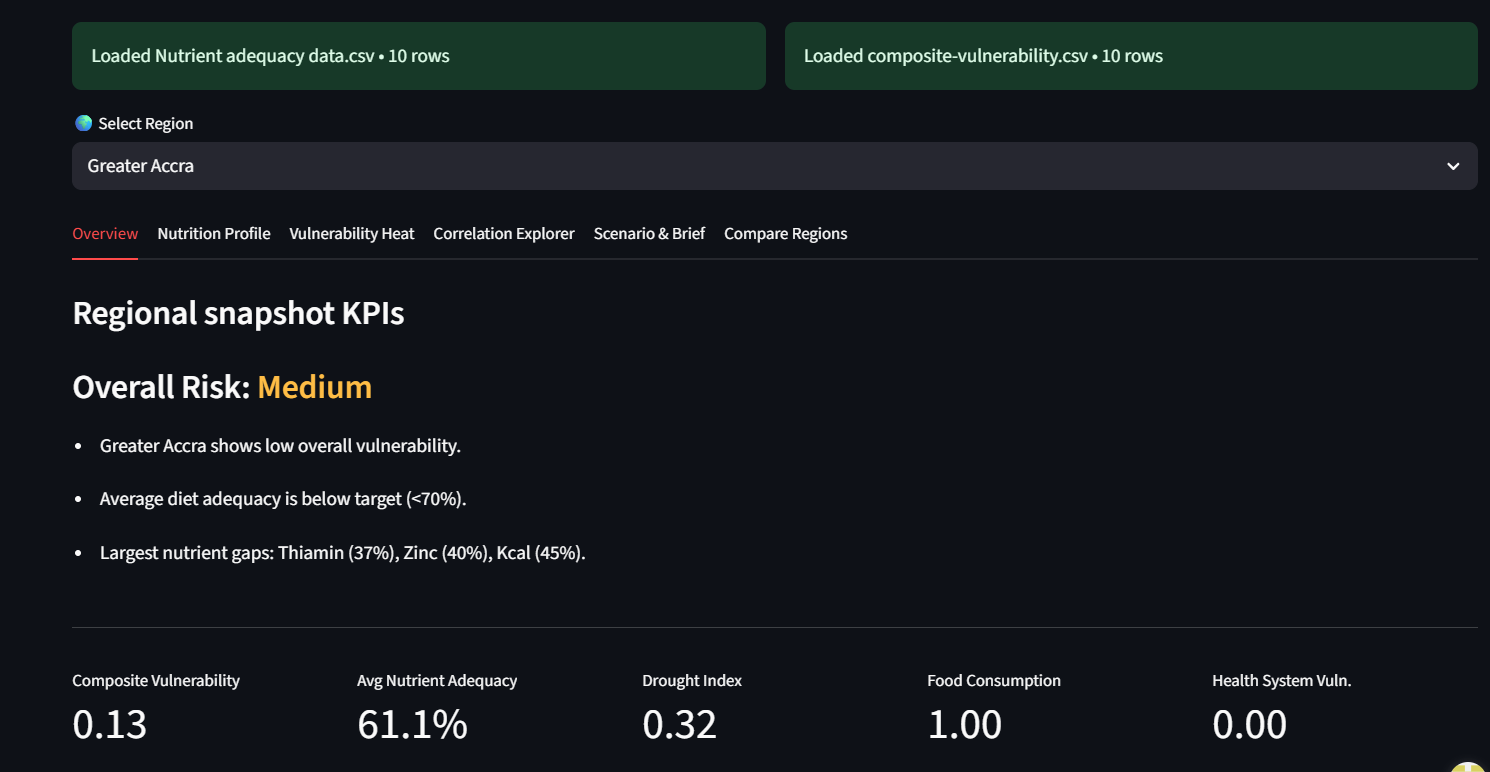
**4 Dashboard Analysis (Streamlit)**

In addition to the statistical and visualization work carried out in Jupyter, an interactive **Streamlit dashboard** was developed and hosted (<https://resilisence.streamlit.app> ). This platform enables policymakers and practitioners to interact with the data in real time, switching between regions, visualizing key indicators, setting hotspot thresholds, and simulating policy scenarios. Importantly, the dashboard also includes a **policy brief generator**, allowing users to download evidence-based summaries tailored to each region.

Key features of the dashboard include:

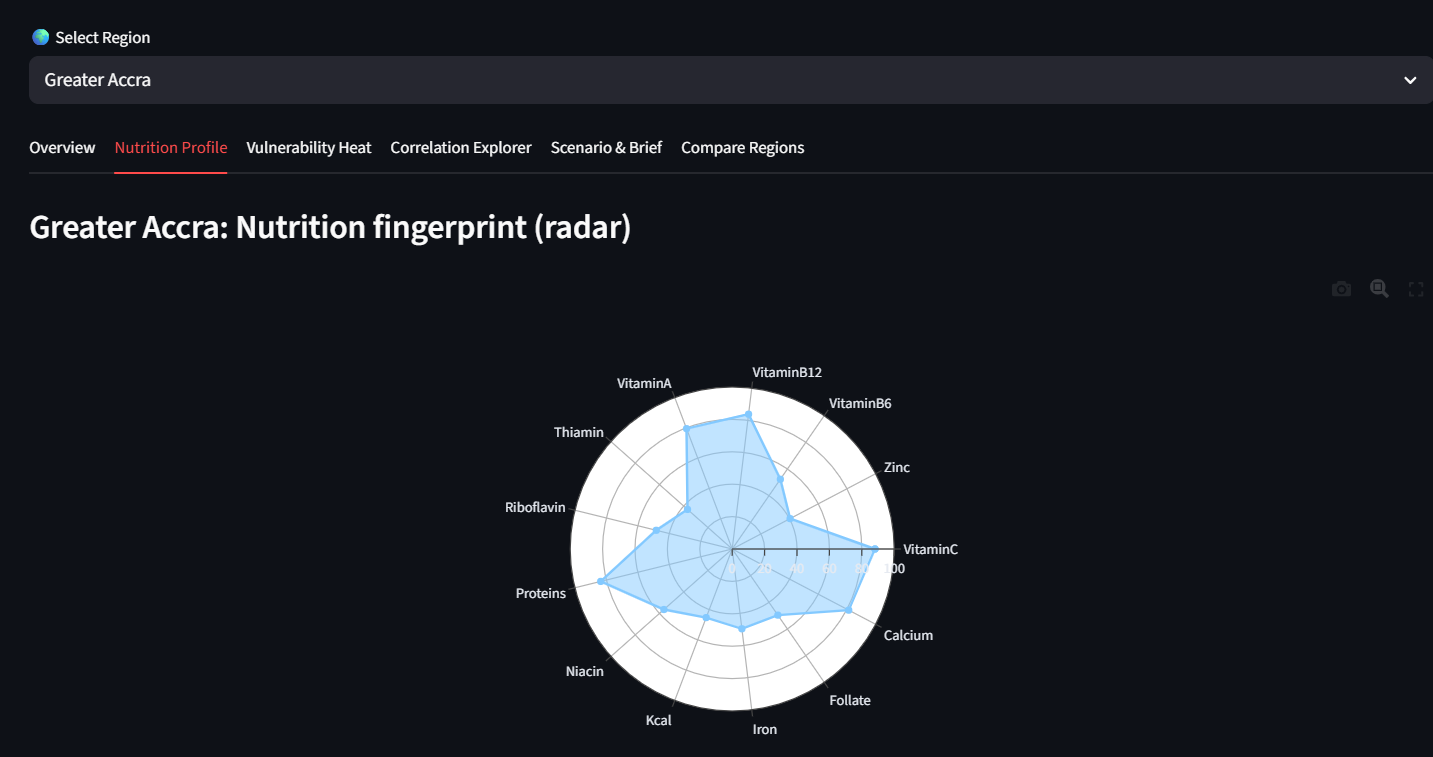
* **Overview Tab** – Regional snapshots of KPIs.

*Example (Greater Accra):* Risk level: *Medium*; diet adequacy: *61.1%* (<70% threshold); key gaps in Thiamin (37%), Zinc (40%), Kcal (45%). Moderate drought stress (0.32).



* **Nutrition Profile (Radar Chart)** – Fingerprint visualization of nutrient adequacy.

*Example (Greater Accra):* Adequate Vitamin A, B6, B12; shortfalls in Vitamin C, Calcium, Zinc, Thiamin, Kcal.



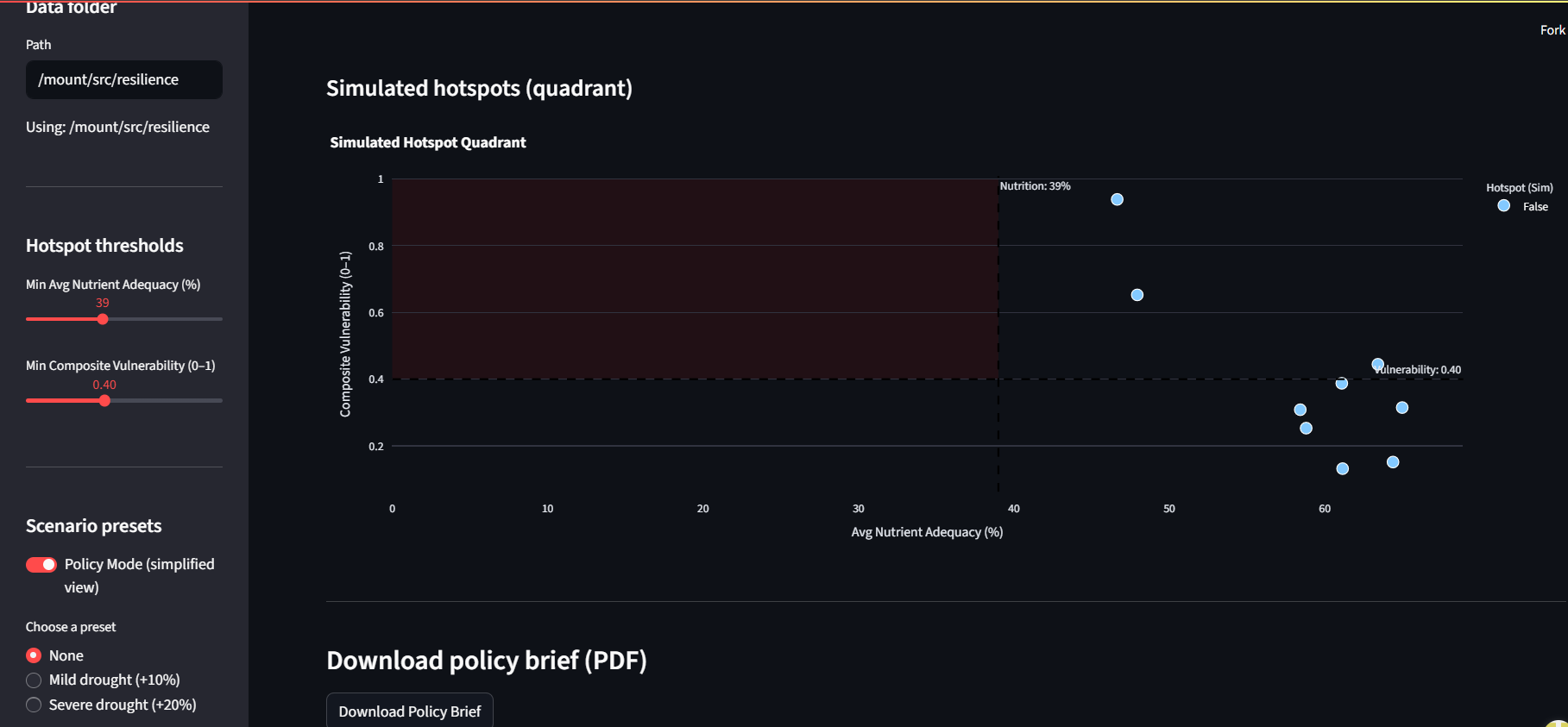
* **Vulnerability Heat** – Heatmaps of composite and domain-specific vulnerabilities.
* **Correlation Explorer** – Interactive scatter plots to analyze nutrient–vulnerability relationships.
* **Compare Regions** – Side-by-side comparisons.

*Example: Ashanti vs. Brong Ahafo:* Ashanti shows lower composite vulnerability (0.31 vs. 0.39) but weaker nutrient adequacy (58.4% vs. 61.1%).



* **Scenario & Brief** – Users can simulate shocks (e.g., drought +10%) and automatically generate **policy briefs** with targeted recommendations.

*Example (Greater Accra brief):* Composite 0.13; key nutrient gaps: Thiamin 36.8%, Zinc 40.4%, Kcal 45.3%. Suggested actions: expand iron-rich food programs and strengthen anemia screening.



**4. Discussion**

The findings demonstrate that Ghana’s food security challenge is not uniform but regionally differentiated. Three key themes emerge:

1. **Nutritional Diversity is Central**: Calorie sufficiency does not guarantee resilience. Regions with greater access to proteins and micronutrients show markedly lower vulnerability. This underscores the need for nutrition-sensitive agriculture and dietary diversification policies.
2. **North–South Inequality**: The vulnerability gap between northern and southern regions highlights structural inequalities. Investments in irrigation, storage, and infrastructure in northern Ghana are essential to reduce reliance on rain-fed agriculture.
3. **Sensitivity to Shocks**: The scenario simulations confirm that even modest shocks can significantly worsen vulnerability. Climate change is likely to exacerbate drought risks, while economic shocks may restrict access to proteins. Strengthening adaptive capacity at both household and regional levels is crucial.

These insights align with broader evidence that food security interventions must combine agricultural productivity gains with nutrition education, market access, and social safety nets.

**5. Policy Implications and Recommendations**

1. **Nutrition-Sensitive Agriculture**: Promote production and consumption of protein-rich and micronutrient-dense foods (legumes, poultry, vegetables).
2. **Regional Investment Priorities**: Focus infrastructure, irrigation, and storage development in northern regions to mitigate climatic vulnerability.
3. **Resilience Planning**: Integrate climate adaptation strategies into national food security frameworks, including drought-resistant crops and early warning systems.
4. **Targeted Social Protection**: Expand nutrition assistance programs and safety nets in high-vulnerability regions to reduce risk exposure.
5. **Data-Driven Dashboards**: Institutionalize the use of food security dashboards for continuous monitoring and timely decision-making.

**Appendix**

1. Streamlit Dashboard analysis: [**https://resilisence.streamlit.app**](https://resilisence.streamlit.app)
2. Jupyter notebook: data merging sorting, analysis, simulations (**Ghana Food Security and Nutritional Vulnerability.ipynb**)
3. An interactive Ghana Chloropeth showing region vulnerability indexes for each region on hoover (**ghana\_choropleth.html**)
4. Github link: <https://github.com/grande254/Resilience>