

CLIMATE CHANGE IMPACTS ON THE GLOBAL FOOD SUPPLY



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"HOW DOES
CLIMATE
CHANGE
AFFECT THE
FOOD SECURITY
INDEX OF
DIFFERENT
COUNTRIES?"



INTRODUCTION

- Climate change threatens global food security.
- It disrupts food production, availability, and access worldwide.
- This study examines how climate change impacts the food security index of various countries.
- We will utilize the global food security index, a comprehensive dataset encompassing 113 countries.
- The index considers multiple dimensions of food security including affordability, availability, quality, and resilience.



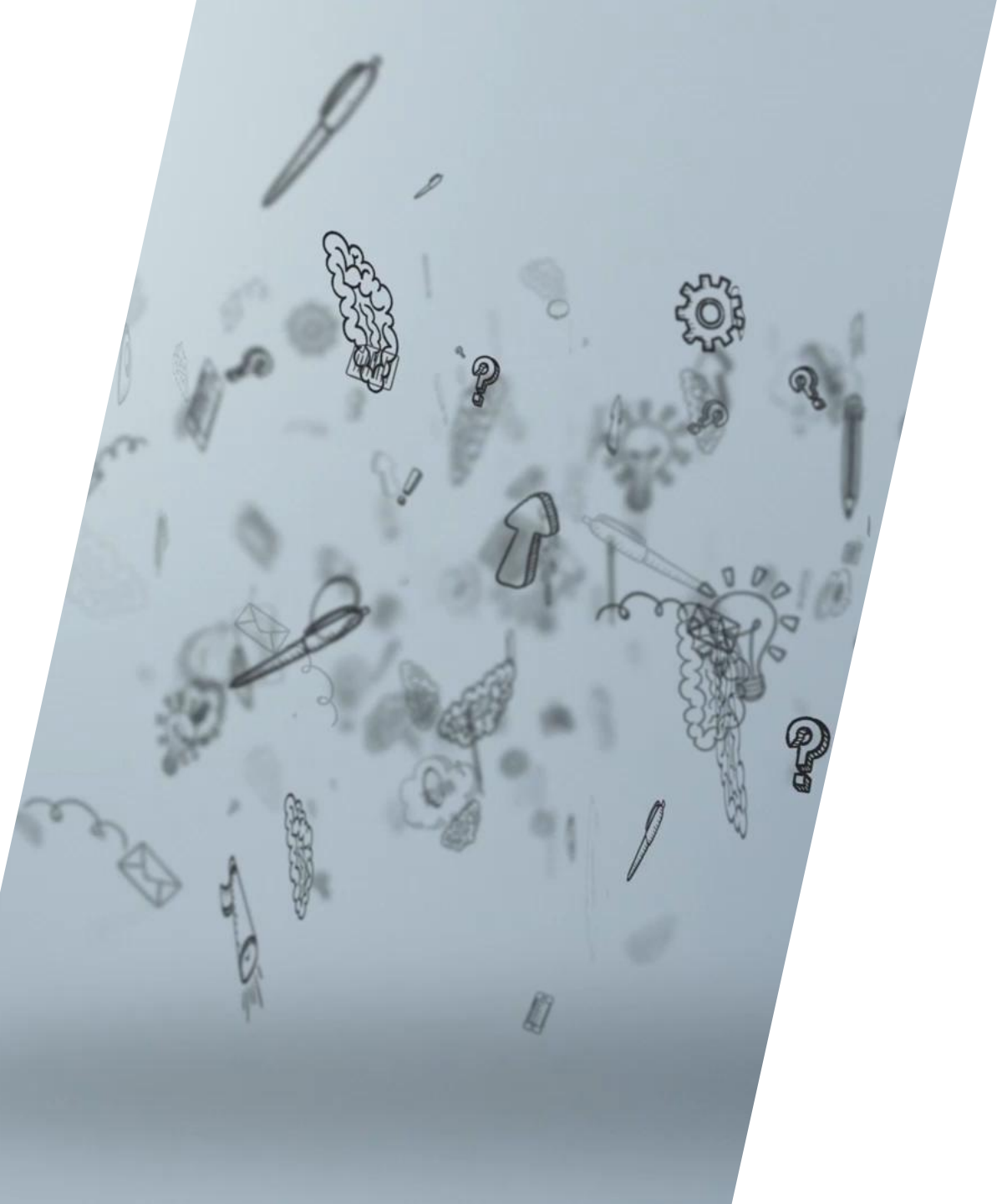
DATASET

Countries : Link: <https://foodsecurityindex.eiu.com/>

Coverage: Global data encompassing 113 countries.

- Affordability & availability (quantitative measures) quality & safety (combines qualitative & quantitative data) natural resources & resilience (both quantitative & qualitative indicators)

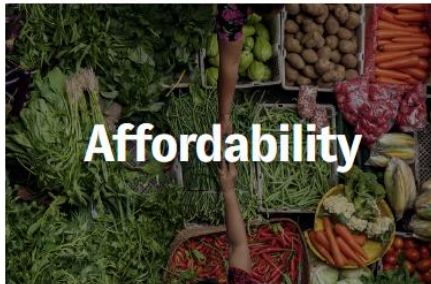
- Widely recognized and comprehensive measure of food security.
- Captures various dimensions crucial for understanding food system stability.



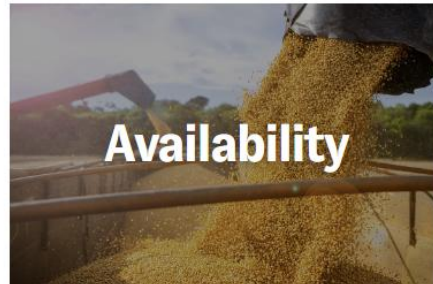
VARIABLES

The 11th Global Food Security Index shows a deterioration in the global food environment for the third year, threatening food security

The GFSI considers the issues of:



Measures the ability of consumers to purchase food, their vulnerability to price shocks and the presence of programmes and policies to support consumers when shocks occur.



Measures agricultural production and on-farm capabilities, the risk of supply disruption, national capacity to disseminate food and research efforts to expand agricultural output.

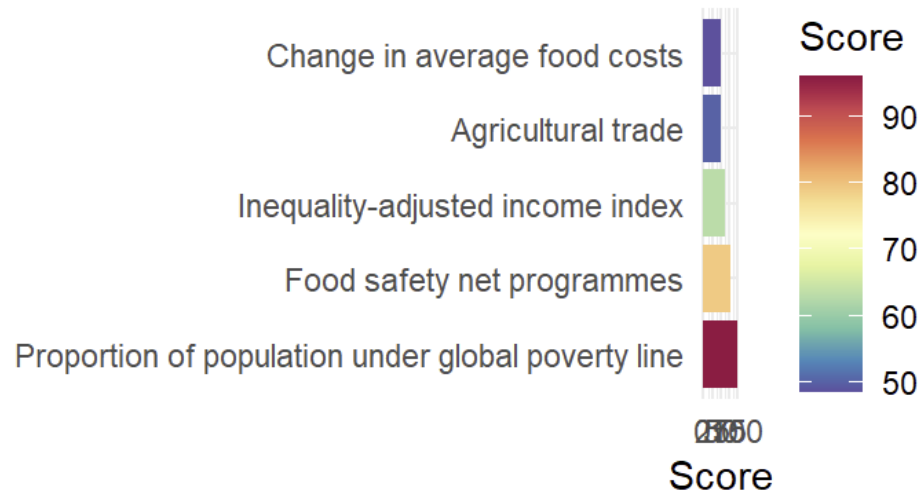


Measures the variety and nutritional quality of average diets, as well as the safety of food.

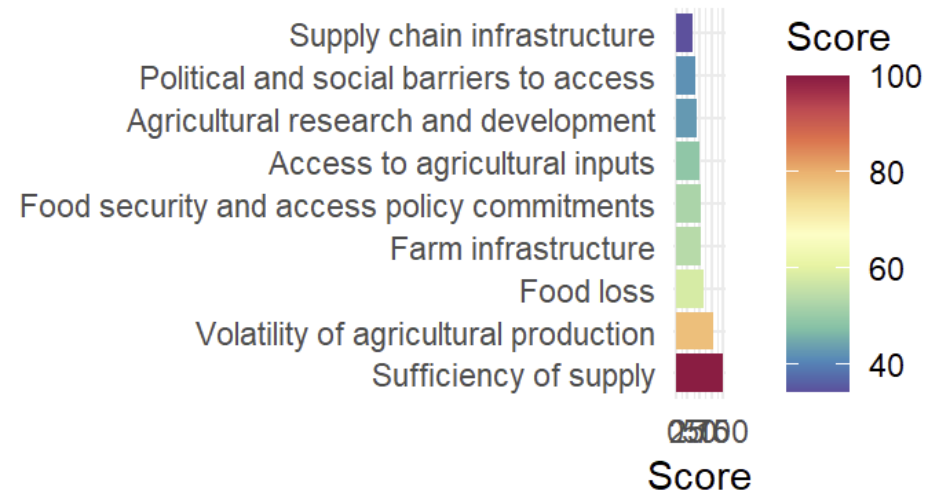


Assesses a country's exposure to the impacts of climate change; its susceptibility to natural resource risks; and how the country is adapting to these risks.

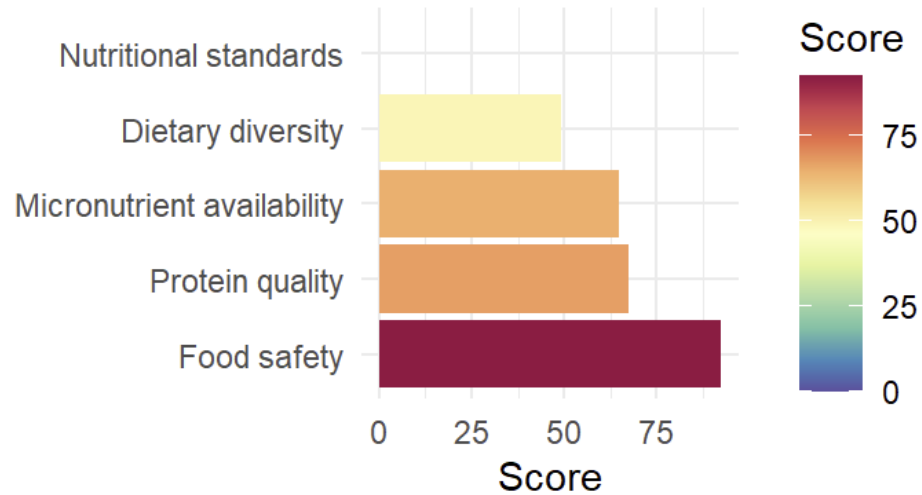
AFFORDABILITY



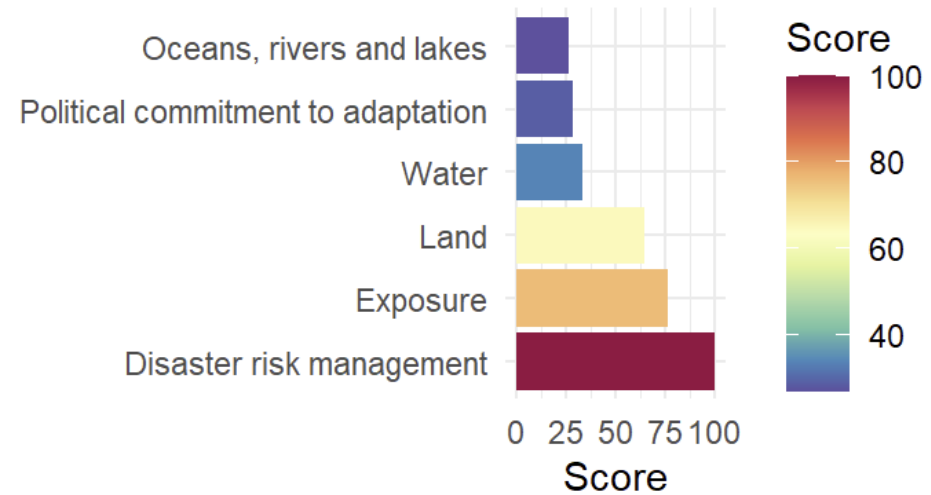
AVAILABILITY



QUALITY AND SAFETY



SUSTAINABILITY





RESEARCH QUESTION AND HYPOTHESIS

- **Research question:** How does climate change affect the food security index of different countries?
- **Hypothesis :** We hypothesize that countries experiencing more severe climate change will have lower food security index scores.
- **Null Hypothesis (H_0):** There is no significant relationship between the examined factors (Affordability, Availability, Quality Safety, Sustainability and Adaptation) and the Overall Score of a country's food security index.
- **Alternative Hypothesis (H_1):** There is a significant relationship between the examined factors and the Overall Score of a country's food security index.

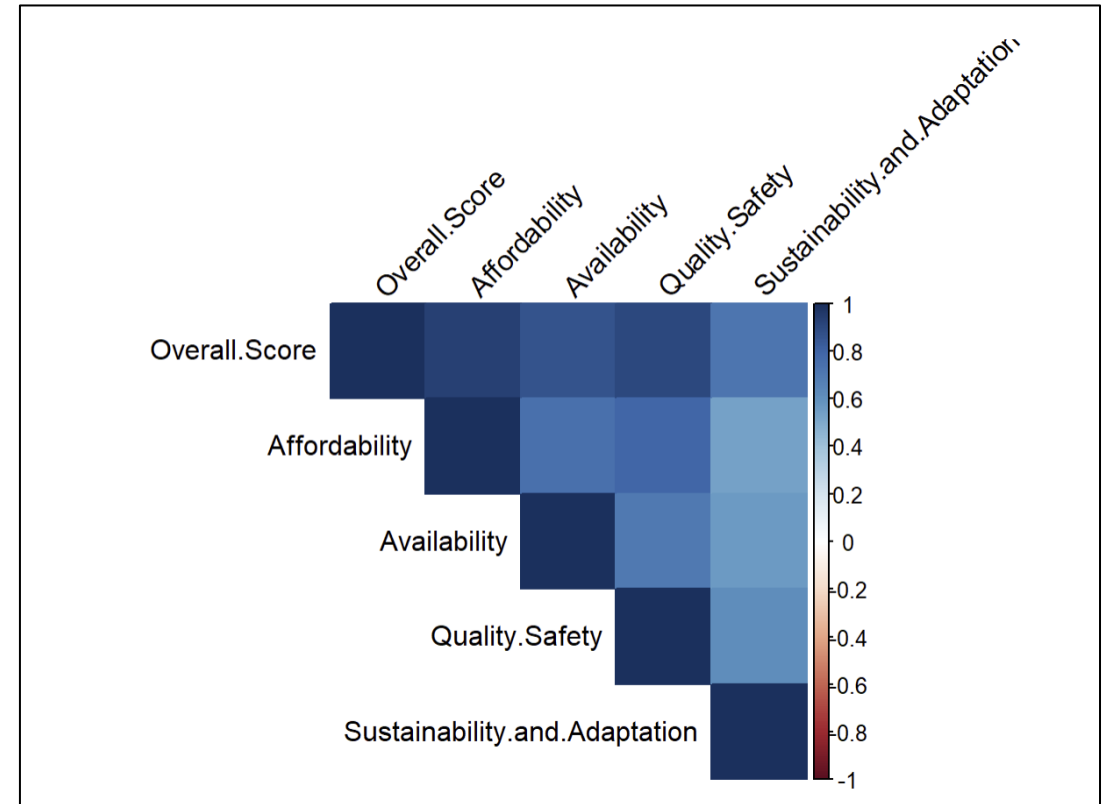


DATA VISUALIZATION



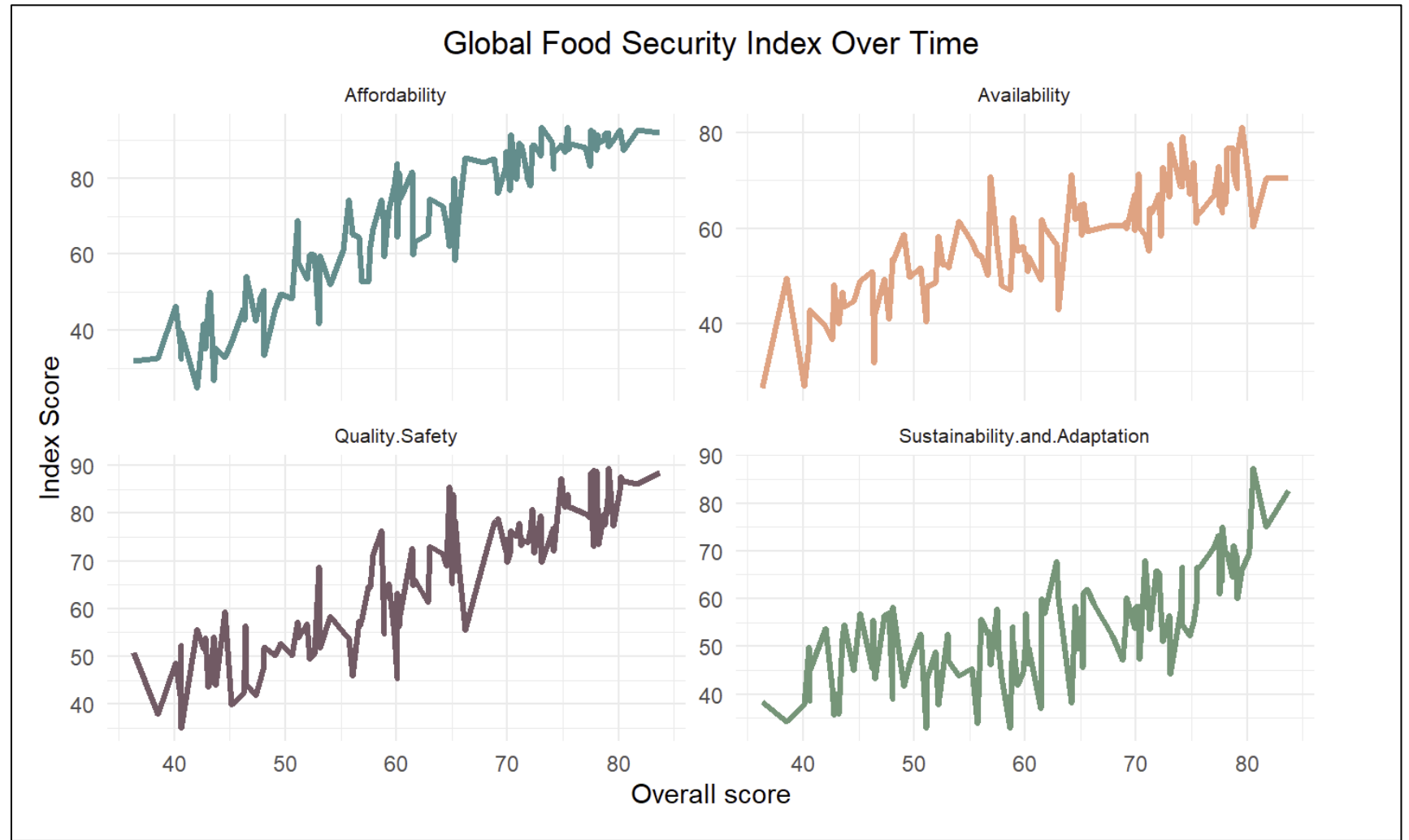
ANALYZING FOOD SECURITY INDICATORS HEAT MAP

- Demonstrates interrelationships between various indicators of food security.
- **Color Coding:** Darker blue shades indicate stronger positive correlations.
- **Symmetrical Matrix:** The diagonal line shows a perfect correlation (1.0) as each variable perfectly correlates with itself.



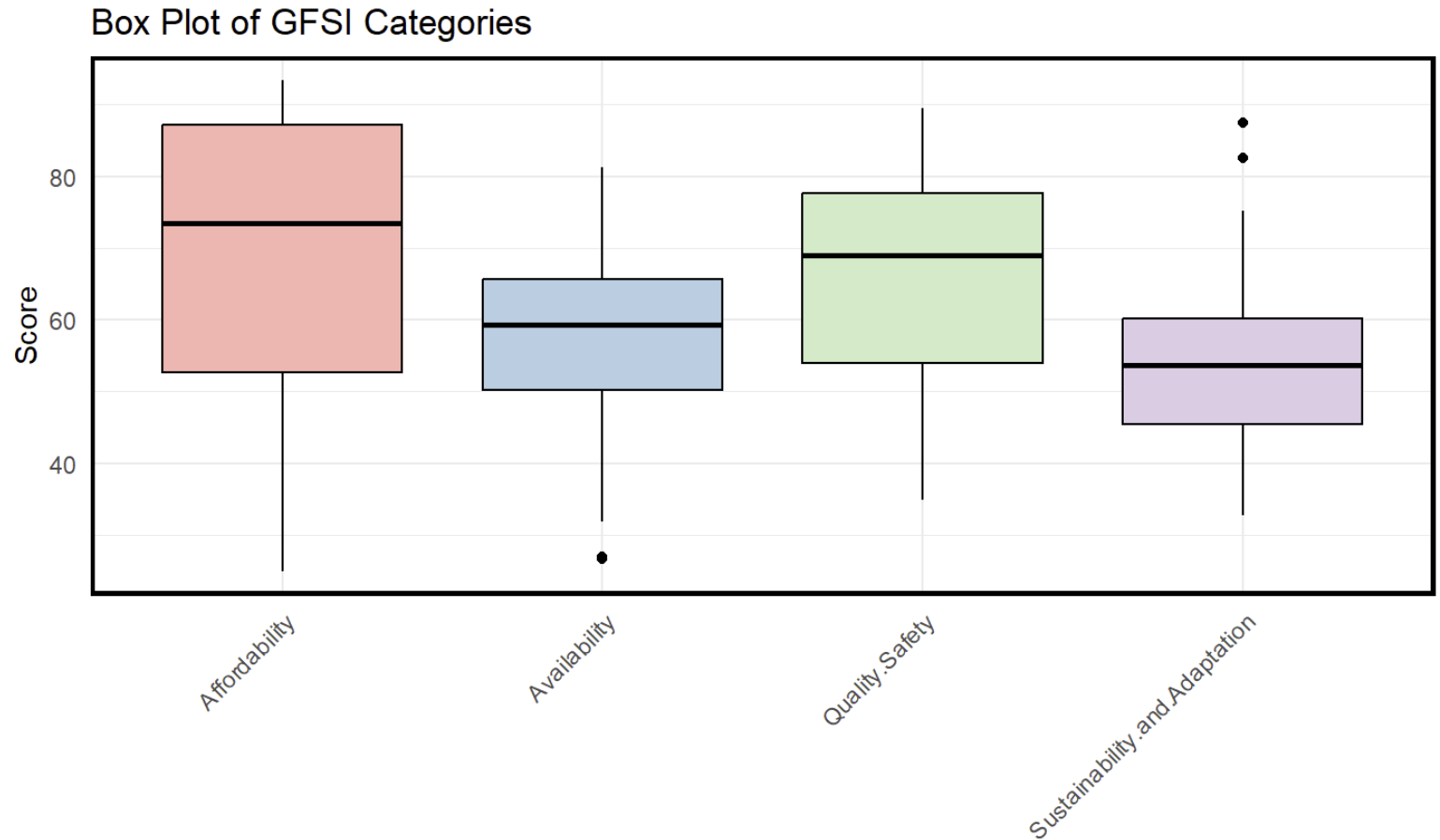
LINE GRAPH

- **Trend Analysis:** The plots show a positive correlation
- **Variability in Availability:** Availability scores exhibit more variability and a less pronounced upward trend.
- Indicating inconsistent impacts on overall food security compared to other factors.

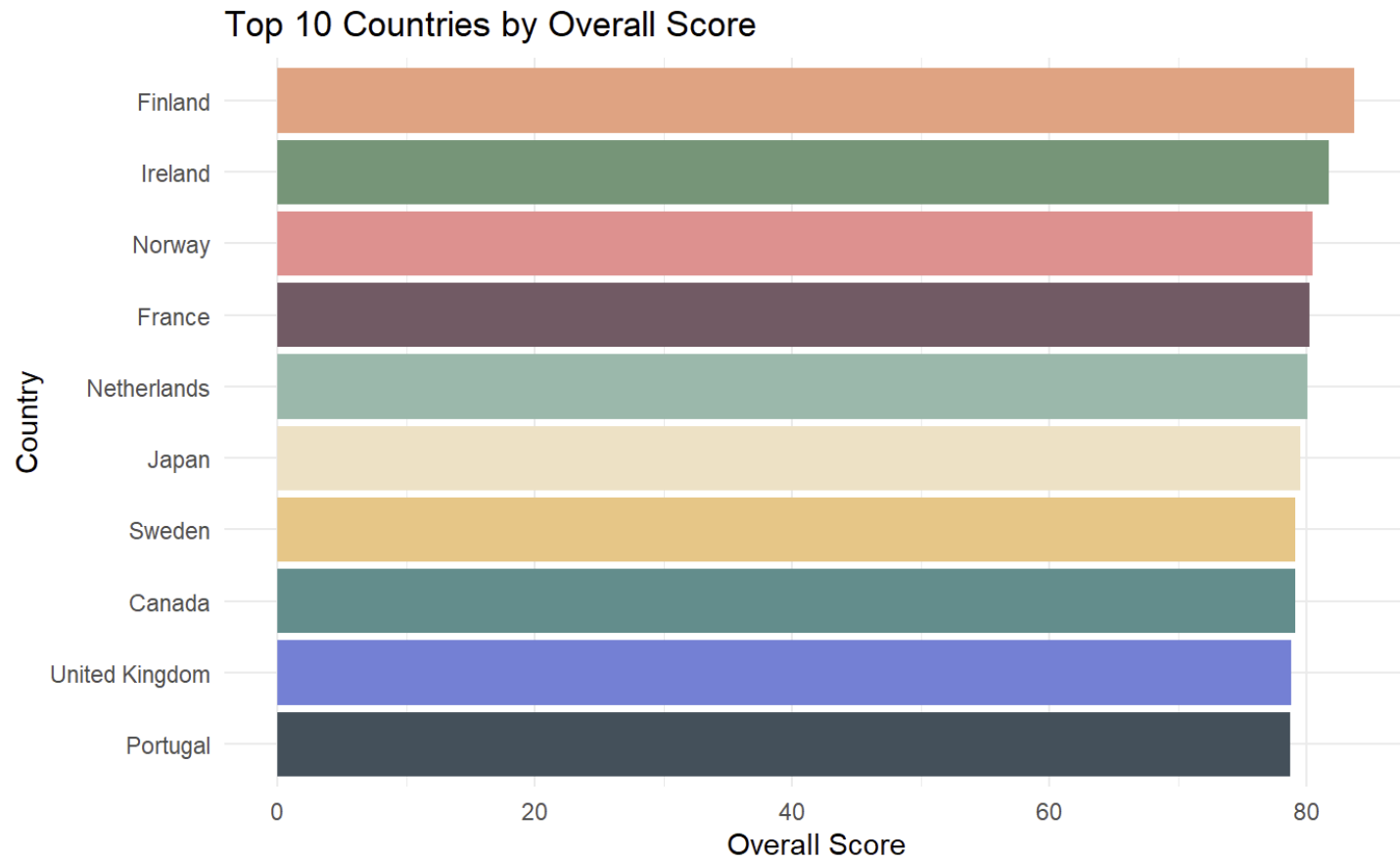


BOX PLOT

- **Insight into Variability:**
"Variability in food security across different countries."
- **Highlighting Gaps:**
"Outliers show significant gaps in food security measures."
- **Sustainability Focus:**
"Diverse approaches to sustainability and climate adaptation."
- **Policy Implications:**
"Data guides policy focus on vulnerable areas."



BAR CHART



OVERVIEW OF MAPS

Affordability:

The map highlights the global distribution of food affordability, using a color scale that deepens with increasing scores. Countries with higher affordability scores are colored in darker shades, indicating greater ease in accessing food at affordable prices. Notably, regions such as North America and Western Europe show higher affordability, whereas parts of Africa and Asia exhibit lower scores.

Availability:

This map illustrates the availability aspect of the food security index, which reflects the physical availability of food. Similar to affordability, darker colors indicate higher availability scores. It appears that regions like North America, Europe, and parts of South America and Asia have better food availability, while many African countries face challenges in this aspect.

Quality Safety:

The map focusing on food quality and safety uses a similar color gradient to depict regions where food safety and quality standards are met or exceeded. Countries with robust food safety mechanisms score higher and are shown in darker colors. This factor is well-addressed in most of Europe, North America, and several countries in Asia and the Middle East.

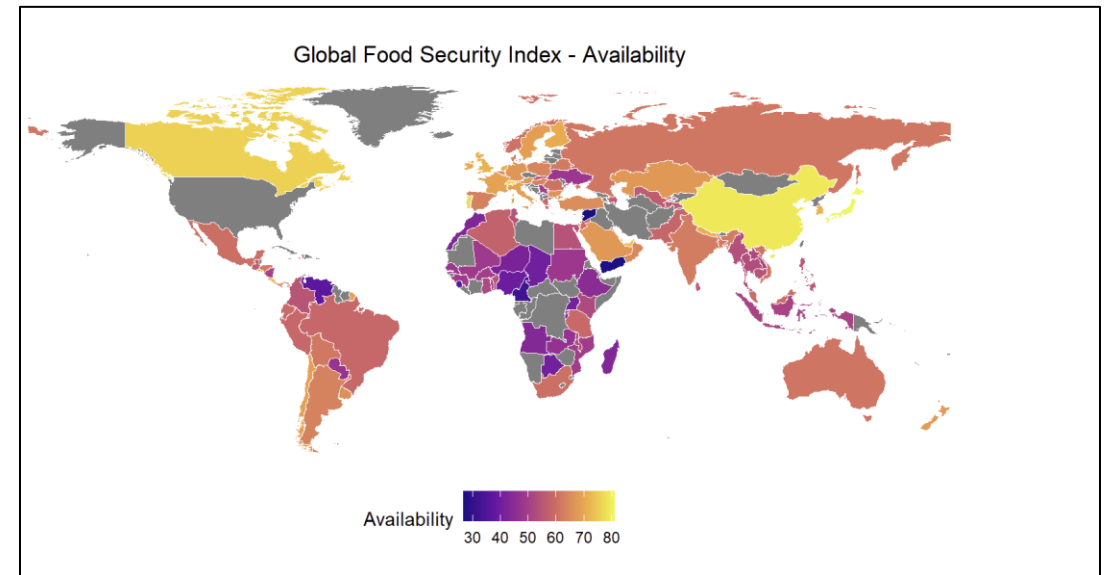
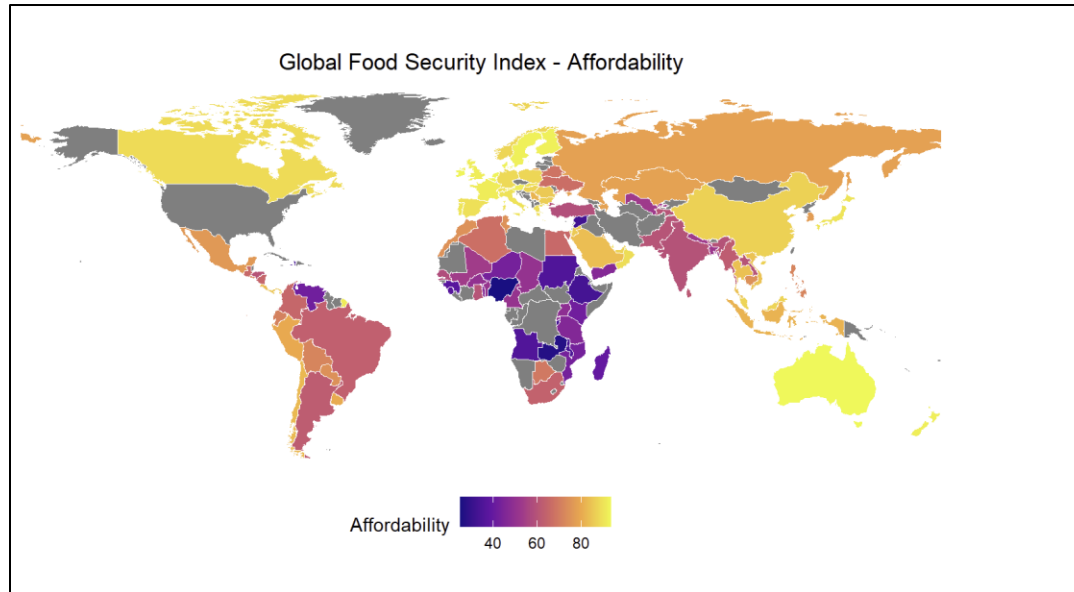
Sustainability and Adaptation:

The final map addresses how countries adapt to and manage food security's sustainability aspects. This includes environmental sustainability considerations in food production and resilience to climate change. Countries with better scores in this metric are also shown in darker shades. Interestingly, some countries that may struggle with other metrics perform better in sustainability, highlighting different national priorities and capabilities

GEOGRAPHICAL DISTRIBUTION OF FOOD SECURITY

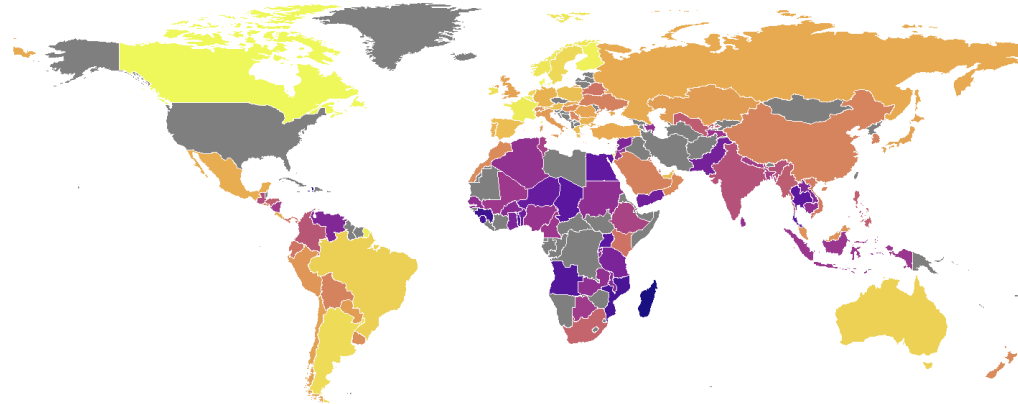
THE MAP SHOWS SIGNIFICANT REGIONAL DIFFERENCES IN QUALITY AND SAFETY SCORES.

HIGHER SCORES (DARKER SHADES) INDICATE BETTER PERFORMANCE IN MAINTAINING FOOD QUALITY AND SAFETY STANDARDS, WHICH ARE CRITICAL FOR ENSURING FOOD SECURITY.



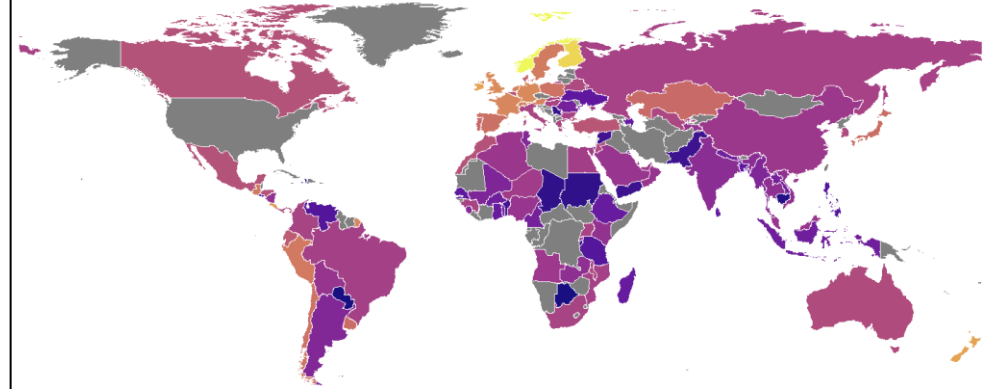
GEOGRAPHICAL DISTRIBUTION OF FOOD SECURITY

Global Food Security Index - Quality.Safety



Quality.Safety
40 50 60 70 80

Global Food Security Index - Sustainability.and.Adaptation



Sustainability.and.Adaptation
40 50 60 70 80

INTERPRETATION

Global Trends:

The maps collectively underscore significant regional disparities in food security, influenced by economic, environmental, and policy factors. Wealthier nations generally score higher across all metrics, reflecting stronger food systems and greater investment in food security.

Developing countries, particularly in sub-Saharan Africa and parts of Asia, frequently show lower scores, reflecting ongoing challenges in these regions.

Implications for Policy:

These visualizations can be powerful tools for policymakers and international organizations, highlighting areas that require urgent attention and improvement.

The maps also suggest that different regions may need tailored strategies. For instance, improving affordability and availability might be prioritized in lower-income regions, while enhancing quality, safety, and sustainability could be the focus in more developed areas.

Role of Sustainability and Climate Adaptation:

The Sustainability and Adaptation map is particularly relevant to discussions on climate change and environmental impacts on food security. It indicates how prepared different regions are to handle changes and challenges affecting food production and distribution

GLOBAL DISTRIBUTION OF THE FOOD SECURITY INDEX 2022



STATISTICAL METHODS

- PEARSON CORRELATION
- LINEAR REGRESSION
- MULTIPLE REGRESSION
- ANOVA
- SHAPIROWILK TEST
- KRUSKAL WALLIS TEST



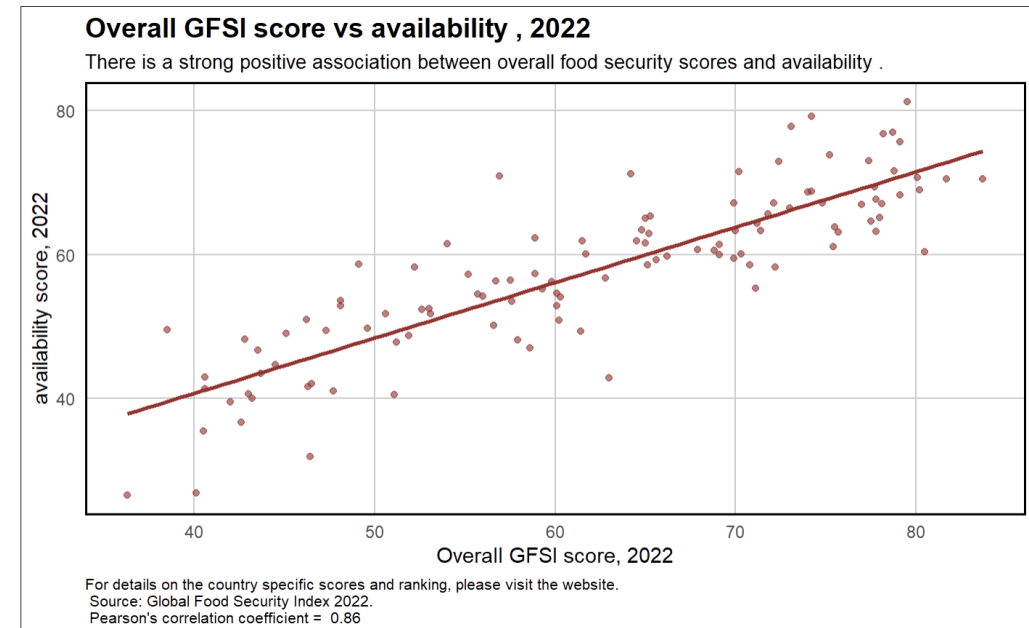
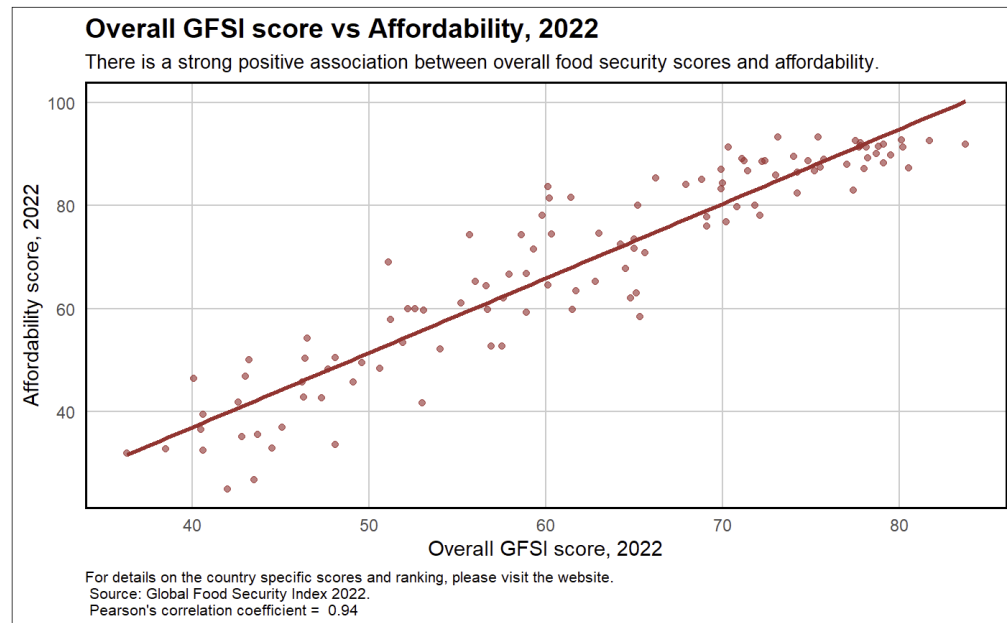
PEARSON CORRELATION TEST

```
'data.frame':  113 obs. of  7 variables:
 $ Number      : chr  "1st" "2nd" "3rd" "4th" ...
 $ Country     : chr  "Finland" "Ireland" "Norway" "France" ...
 $ Overall.Score : num  83.7 81.7 80.5 80.2 80.1 79.5 79.1 79.1 78.8 78.7 ...
 $ Affordability : num  91.9 92.6 87.2 91.3 92.7 89.8 91.9 88.3 91.5 90 ...
 $ Availability : num  70.5 70.5 60.4 69 70.7 81.2 68.3 75.7 71.6 77 ...
 $ Quality.Safety : num  88.4 86.1 86.8 87.7 84.7 77.4 85 89.5 77.6 79.8 ...
 $ Sustainability.and.Adaptation: num  82.6 75.1 87.4 70.3 69.2 66.1 68.3 60.1 71.1 64.5 ...

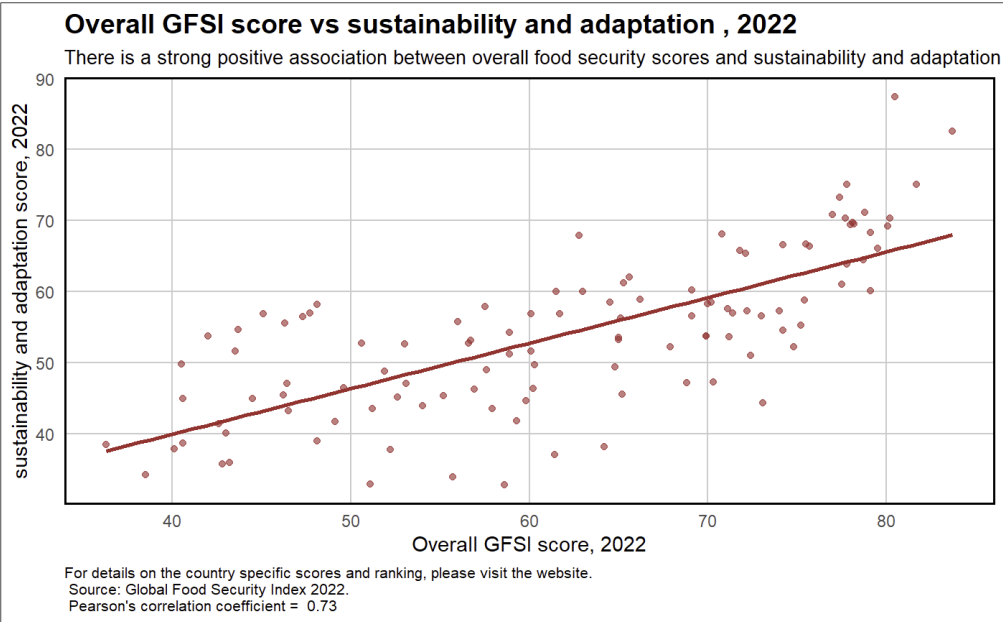
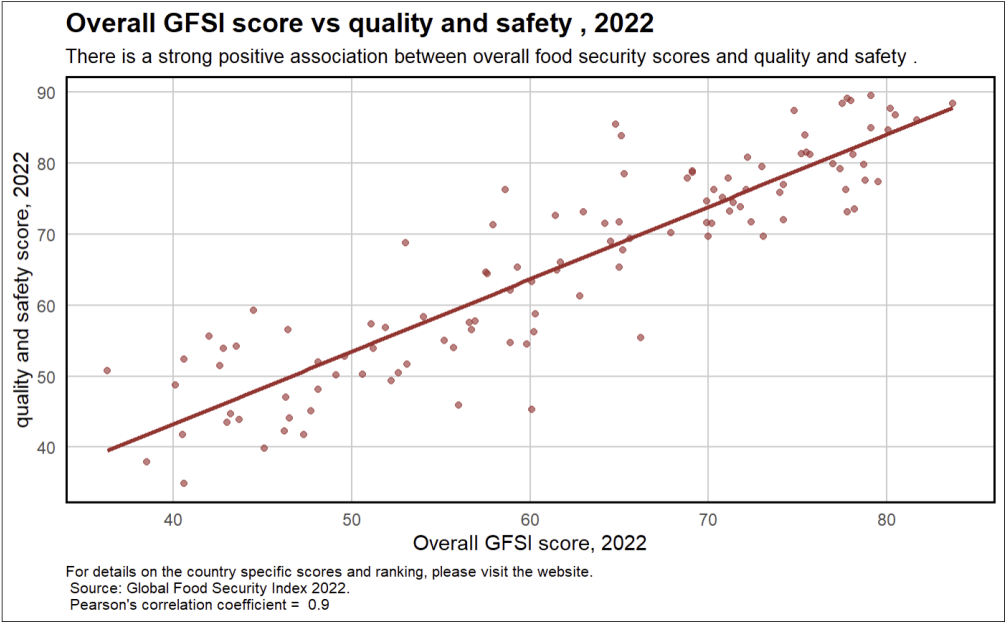
Overall.Score Affordability Availability Quality.Safety
Overall.Score      1.0000000      0.9373218      0.8608440      0.9007715
Affordability       0.9373218      1.0000000      0.7460485      0.7925404
Availability         0.8608440      0.7460485      1.0000000      0.7046659
Quality.Safety       0.9007715      0.7925404      0.7046659      1.0000000
Sustainability.and.Adaptation 0.7291524      0.5350029      0.5683663      0.6148655

Sustainability.and.Adaptation
Overall.Score      0.7291524
Affordability       0.5350029
Availability         0.5683663
Quality.Safety       0.6148655
Sustainability.and.Adaptation 1.0000000
```

PEARSON CORRELATION - 1



PEARSON CORELATION - 2



LINEAR REGRESSION

```
'data.frame':  113 obs. of  7 variables:
 $ Number          : chr  "1st" "2nd" "3rd" "4th" ...
 $ Country          : chr  "Finland" "Ireland" "Norway" "France" ...
 $ Overall.Score    : num  83.7 81.7 80.5 80.2 80.1 79.5 79.1 79.1 78.8 78.7 ...
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 $ Quality.Safety   : num  88.4 86.1 86.8 87.7 84.7 77.4 85 89.5 77.6 79.8 ...
 $ Sustainability.and.Adaptation: num  82.6 75.1 87.4 70.3 69.2 66.1 68.3 60.1 71.1 64.5 ...
```

Call:

```
lm(formula = Overall.Score ~ Affordability, data = data)
```

Residuals:

Min	1Q	Median	3Q	Max
-11.0462	-3.1256	0.6264	2.9869	9.5924

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	20.23455	1.53696	13.16	<2e-16 ***
Affordability	0.60742	0.02143	28.34	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.432 on 111 degrees of freedom

Multiple R-squared: 0.8786, Adjusted R-squared: 0.8775

F-statistic: 803.1 on 1 and 111 DF, p-value: < 2.2e-16

MULTIPLE REGRESSION

```
'data.frame':  113 obs. of  7 variables:
 $ Number      : chr  "1st" "2nd" "3rd" "4th" ...
 $ Country      : chr  "Finland" "Ireland" "Norway" "France" ...
 $ Overall.Score : num  83.7 81.7 80.5 80.2 80.1 79.5 79.1 79.1 78.8 78.7 ...
 $ Affordability : num  91.9 92.6 87.2 91.3 92.7 89.8 91.9 88.3 91.5 90 ...
 $ Availability  : num  70.5 70.5 60.4 69 70.7 81.2 68.3 75.7 71.6 77 ...
 $ Quality.Safety : num  88.4 86.1 86.8 87.7 84.7 77.4 85 89.5 77.6 79.8 ...
 $ Sustainability.and.Adaptation: num  82.6 75.1 87.4 70.3 69.2 66.1 68.3 60.1 71.1 64.5 ...
```

Call:

```
lm(formula = Overall.Score ~ Affordability + Availability + Quality.Safety +
    Sustainability.and.Adaptation, data = data)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.067551	-0.024210	0.000106	0.021552	0.075264

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.0111279	0.0183247	0.607	0.545
Affordability	0.2997854	0.0002878	1041.470	<2e-16 ***
Availability	0.2502815	0.0004380	571.388	<2e-16 ***
Quality.Safety	0.2250127	0.0003874	580.804	<2e-16 ***
Sustainability.and.Adaptation	0.2248175	0.0003625	620.135	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.03271 on 108 degrees of freedom

Multiple R-squared: 1, Adjusted R-squared: 1

F-statistic: 4.196e+06 on 4 and 108 DF, p-value: < 2.2e-16

ANOVA

```
Levene's Test for Homogeneity of Variance (center = median)
      Df F value    Pr(>F)
group   2  18.292 1.386e-07 ***
      110
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

      Shapiro-Wilk normality test

data:  residuals(anova_model)
W = 0.98516, p-value = 0.2477

      Df Sum Sq Mean Sq F value Pr(>F)
Economic_Group   2   33433    16717    197 <2e-16 ***
Residuals       110    9333      85
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

      Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts

Fit: aov(formula = Affordability ~ Economic_Group, data = data)

Linear Hypotheses:
      Estimate Std. Error t value Pr(>|t|)
Middle - Low == 0    24.791     2.127   11.653  <1e-10 ***
High - Low == 0     41.705     2.113   19.736  <1e-10 ***
High - Middle == 0   16.914     2.127    7.951  <1e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)
```

Question:

Does economic status significantly impact food security across different countries in the context of climate change?



Answer:

Yes, our statistical analysis shows significant differences in food affordability among economic groups, highlighting how economic disparities influence food security under varying climate conditions.



CONCLUSION

Rejecting the Null Hypothesis: Given the significant regression coefficients for all variables (Affordability, Availability, Quality Safety, Sustainability and Adaptation), we can reject the null hypothesis (H_0). There is statistically significant evidence to suggest that these factors are associated with the Overall Score of food security.

Accepting the Alternative Hypothesis: By rejecting H_0 , we accept the alternative hypothesis (H_1) that there is a significant relationship between these factors and the Overall Score of food security. This indicates that improvements or changes in any of these factors are likely to impact the overall food security index of a country.



THANK YOU