Indicators of Food Insecurity in Global Regions

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Abstract: *Although the agricultural industry is prevalent in many countries, much of the world still suffers from malnutrition and undernourishment. In recent years, the re-emergence of famine has been observed correlating with a reduced trend of hunger. Given this alarming issue, solutions that supply enough food, while providing a balanced diet are vital. This study uses data from the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT) to pinpoint the most critical factors in global agriculture and food security. Using the R programming language and libraries including Plotly, Tidyverse, Knitr, and DT, exploratory data analyses were conducted; trends for the specified indicators were visualized in graphs. The study established that food insecurity is most prevalent in African and Asian regions with a country's gross domestic product (GDP) and political instability being the strongest indicators of such. Furthermore, child undernutrition is decreasing while adult obesity is increasing. These findings will guide global organizations toward creating strategies that can target the root issues of hunger and malnutrition.*

Keywords: *Food and Agriculture Organization Corporate Statistical Database, Food Insecurity, Hunger, GDP, Malnutrition, Nutrition, Undernourishment.*

I.   INTRODUCTION

1.1 Significance of Study

In the modern world, agricultural abundance coexists with hunger and malnutrition. Recently, there has been a reversal of a decades-long downward trend of hunger as well as that of the re-emergence of famine, putting the United Nations' Zero Hunger goal of eliminating global food insecurity by 2030 in jeopardy. Global consensus shows that providing a sufficient food supply is still a critical component of ending world hunger. However, simply producing additional staple grains is shown to be insufficient. Proper nutrition and the elimination of hunger both require that the population consumes a balanced diet.

The World Committee on Food Security states that malnutrition is a significant concern in both third and first-world countries. Malnutrition encompasses both extreme hunger and obesity. Furthermore, malnutrition exists in all countries where the general population does not have access to high-quality foods, regardless of their economic stability. Thus, solutions to malnutrition must focus on providing an appropriate supply of food and a nutritious diet.

1.2 Objectives

The goal of this study is to conduct an exploratory data analysis to identify the critical macro-level factors that impact food security. In this analysis, countries with severe food security problems will be identified to ensure that adequate resources can be diverted to such regions. Using the database from the Food and Agricultural Organization (FAO), data from 245 countries will be analyzed to determine the elements that influence hunger and food security as well as a report on the global state of food security. The following topics will be addressed:

1. Trends in the global gross domestic product (GDP). GDP is a measure of the total goods and products produced within a nation, serving as a good indicator of the strength of an economy and its implied food security.
2. The current state of undernourishment and malnutrition around the world.
3. The relationship between hunger, malnutrition, and country stability.

<center>II.   METHODOLOGY</center>

2.1 Programs

This study uses the R programming language to visualize the specific indicators of hunger trends, such as GDP (see Fig. 1 as an example). Then, the data was further analyzed on Plotly, Tidyverse, Knitr, and DT.


```
GDP_tidy <- clean_data %>% filter(Item.Code == 22013)
p3 <- GDP_tidy %>%
    filter(Area.Code %in% c('5000','5100','5300','5400','5500','5207','5203')) %>%
    plot_ly(x = ~Year_From, y = ~Value,color = ~Area, type = 'scatter', mode = 'lines+markers',
            hoverinfo = 'text',
            text = ~paste("Region: ', Area,
                          '</br></br> GDP Value: ', Value,
                          '</br> Year: ', Year_From)) %>%
    layout(title = "World GDP value changes over time(2000-2016). <br>Source: FAO.",
           xaxis = list(title = "Year"),
           yaxis = list(title = "GDP Vaue in USD"))
p3
```

Figure 1. Example R Code to Visualize GDP of Six Continents

2.2 Data Sources

The data used in this study was compiled by the Food and Agricultural Organization (FAO) and displayed on its website portal. The food security indicators dataset provided an overview of key indicators from 1999 to 2016. Examples of entries in the dataset are shown in Fig. 2, and each entry in the dataset represents a single data point. Area Code/Area represents the country (numerical and string respectively), Item Code/Item represents the measured quantity, Element Code/Element represents the type of entry, Year Code/Year represents the year in which the measurement was performed, and Flag represents the data source.

According to the data dictionary, there are a total of 248 distinct area codes, 248 distinct area values, 23 distinct item codes, 23 distinct item values, 9 distinct element codes, 9 distinct element values, 7 distinct flag values, and 9 distinct unit values.

Figure 2. Raw Dataset Provided by FAO

2.3 Data Organization

Exploratory data analysis was performed on the dataset; the data was first scraped, cleaned, and normalized. It was then transformed into smaller subsets which were used to determine trends for specific indicators. This reduced the number of entries, allowing for faster data processing. Examples of entries of the pre-processed data are shown in Fig. 3. The trends were then presented in the form of intuitive and interactive visuals.

Figure 3. Example of Pre-processed Data

III.   DATA VISUALIZATION AND RESULTS

3.1 Gross Domestic Product (GDP)

The average GDP of most countries increased by approximately 40 percent from 2000 to 2016 (see Fig. 4). Furthermore, North America, Europe, and Oceania were above the world average, while the regions of Asia and Africa were below. The fastest-growing region was Asia with over 100% GDP growth while the slowest was Africa with only 33% GDP growth.
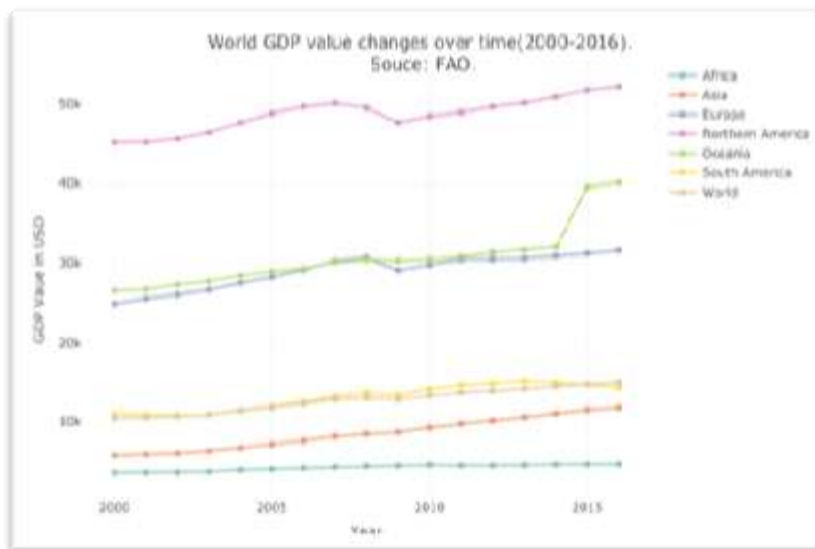

Figure 4. Global Average GDP and GDP by Continent from 2000 to 2016

3.2 Undernourishment and Impaired Growth

Next, trends in undernourishment and impaired growth are examined. Fig 5. reveals that undernourishment significantly decreased in the Asia region by over 100 million people. Most regions, other than Africa, observed a decrease in undernourishment. Yet, the rise in undernourishment must be reflected in nutritional outcomes.
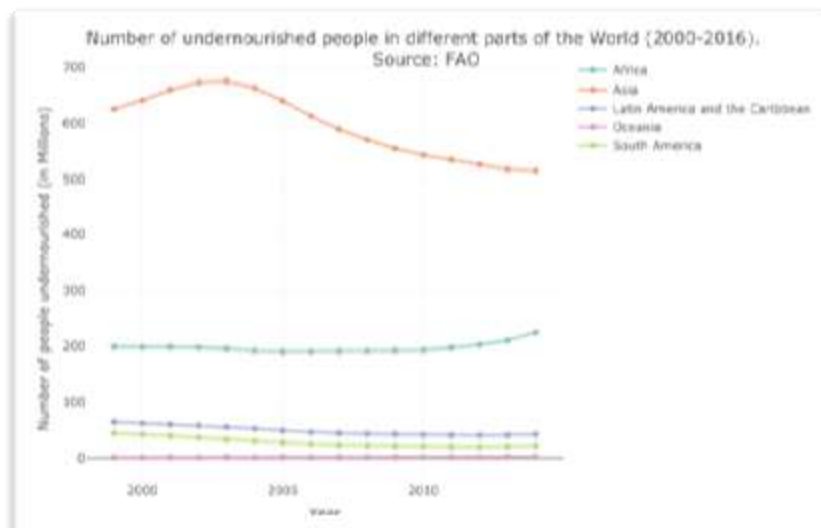

Figure 5. Number of Undernourished People by Region from 2000 to 2016

Evidence of continuing declines in malnutrition, as reflected in global and regional averages, is available. An example of such can be observed in stunting - impaired growth. Fig. 6 displays the global rates of stunting among children when compared to the number of overweight children There exists an inverse relationship between the rate of stunting and the number of overweight children.
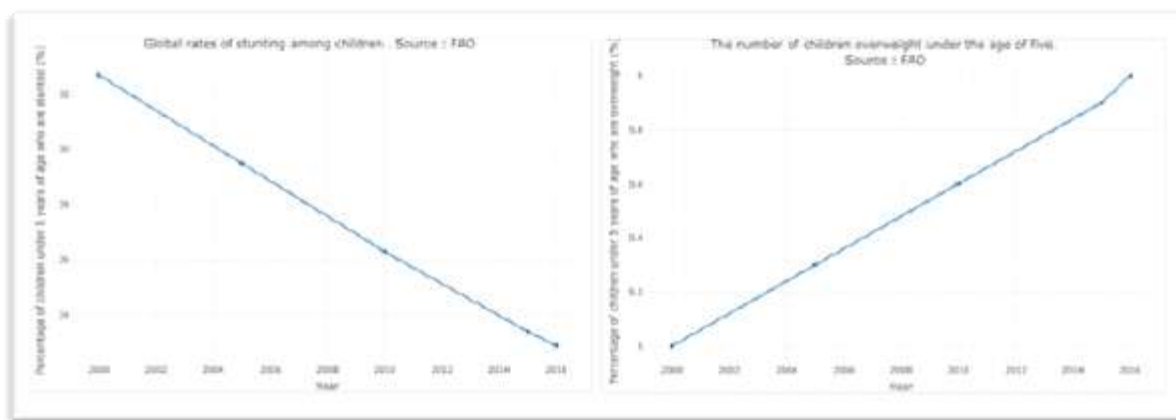

Figure 6. *The Global Rate of Stunting in Children Compared to the Global Rate of Overweight Children*

3.3 Country Stability

Fig. 7 displays the ten most stable countries and ten least stable countries around the world; stability values were determined by the Stability Index. Among the most stable countries are Greenland and New Zealand; the least stable countries are Syria, Yemen, and Pakistan.
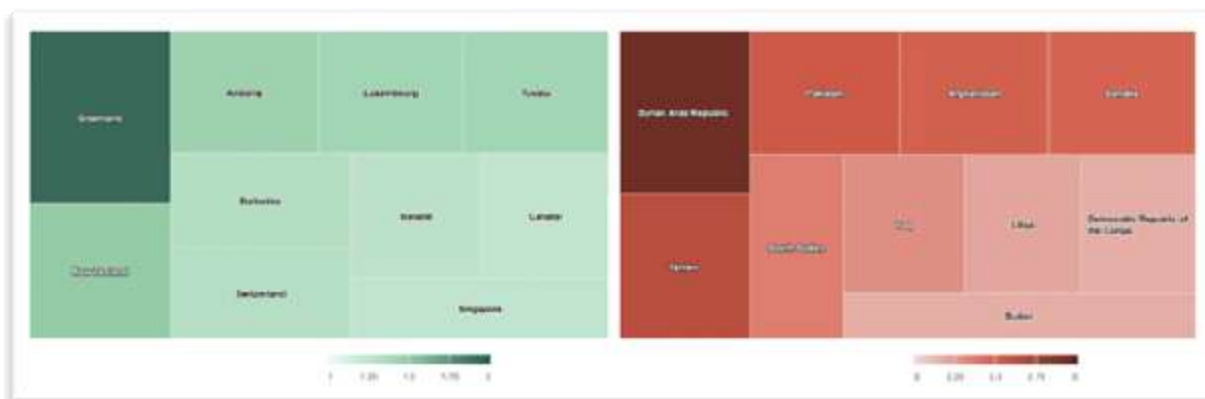

Figure 7. *Ten Most Stable Countries (Left) and Ten Least Stable Countries (Right)*

IV. DISCUSSION

Hunger is interconnected with political stability. This research shows that stable countries tend to exist with low rates of malnourishment. From this data, we can extrapolate that political conflict is highly correlated with food security. Political conflict can influence food security if the economy and individuals are heavily reliant on agriculture. It erodes resilience and pressures individuals to engage in damaging and irreversible coping behaviors, putting their livelihoods, food security, and nutrition at risk. In situations characterized by pervasive inequities and political conflict, food security can be a catalyst for violence and instability.

This study also established the inverse correlation between child malnutrition and adult obesity. As the price of food falls, it is easy to over-satiate, increasing the levels of obesity. Furthermore, food insecurity is affected by several variables beyond an individual's direct control. For instance, despite Africa receiving a plethora of humanitarian aid, its undernourished population continues to rise. Food insecurity is most prevalent in African and Asian regions with a country's gross domestic product (GDP) and political instability being the

strongest indicators of such. In addition, child undernutrition was found to be decreasing while adult obesity is increasing.

V. CONCLUSION

Although the Zero Hunger goal of the United Nations was set to eliminate global food insecurity by 2030, according to the 2020 global hunger index, the world is not on track for this goal. Much of the world still live in hunger. Despite the global average of undernourishment decreasing, food insecurity is still prevalent in Asian and African countries. This study found that food insecurity is related to both country's stability as well as economic output, measured by GDP. This is expected as more stable or wealthier countries have more access to food while those that are more unstable or have a low GDP are more prone to food insecurity.

One limitation of the study is that this analysis includes data from 2000 to 2016. This is because we used the raw dataset publicly available on the Food and Agricultural Organization (FAO) website. It will be interesting to see what the data would look like in 2017 and onwards, however, we need to keep in mind that there may be other confounding factors that would affect global hunger such as the Covid-19 pandemic that started in 2020. Furthermore, this study alludes to the correlation between indicators of food insecurity but has not analyzed the actual correlation values. Thus, the next step for this study is to use statistical analysis to identify correlations between hunger and indicators such as gross domestic product (GDP) per capita, the number of undernourished people, the rate of stunting in children, the rate of overweight children, and country stability. Furthermore, we can also explore the correlation between hunger and other specific macro-level factors such as government health and literature rate. From these findings, we will be better equipped to address the question: how do we build the best predictor for food insecurity given the knowledge of these variables?

Addressing this question is important because to ameliorate hunger, malnourishment, and undernourishment in other nations, it is key to understand the underlying causes and variables of this. Ultimately, innovative methods that factor in these variables must be established. These findings will guide global organizations toward creating strategies that can target the root issues of hunger and malnutrition.

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