

# Improving the Quality of Life in Low-Income Countries

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## Executive Summary

### Introduction

According to The World Bank, a country is classified as a high-income economy when its gross national income (GNI) is \$12,696 or more (World Bank 1). While they have different technical definitions, “high-income” and “developed” are used interchangeably and almost always refer to the same set of countries. Citizens of these countries typically have a high quality of life, a high level of economic growth, a high standard of living, and a large amount of technological infrastructure (Majaski 1).

### Main Questions

What are the main drivers behind a country being classified as high income?

How do interactions among drivers lead to a higher likelihood of classification as high income?

### Data Discussion

The data used in this study was provided by The World Bank and included information about countries and their World Development Indicators in the year 2019. Initially there were a total of 218 rows (one for each country and/or territory) and 1,444 columns. However, there were many columns that were missing most, if not all values, and after cleaning there were 291 columns that contained less than 15% of missing values. The columns included demographic information, such as Birth Rates, Mortality Rates, Fertility Rates, Lower Secondary School Starting Age, Immunization Rates, Percent Employed in Services, and Percent Employed in Agriculture as well as economic information such as Foreign Direct Investment, Export and Import Volume Indices, GDP per capita, and Merchandise Trade as a Percent of GDP. The data also indicated information about each country’s resources, such as Mineral Rents, Forest Rents, Total Natural Resources Rents, the amount of Forest Areas in square kilometers, the percent of the population with Access to Electricity, Access to Basic Sanitation Services and Drinking Water, and Secure Internet Servers per 1 million people. Information about businesses, including the Ease of Starting a Business in Days and Cost of Start Up Procedures was recorded as well. This data is quite general and makes the following analyses applicable past just 2019, since much of this information will continue being collected by The World Bank moving forward.

### Major Drivers Behind Being Classified as High Income

Overall, the probability of a country being classified as high income is about 36%

- **Mortality Rate Under 5 Years of Age** – If between **1 and 5 deaths** per 1000 live births, there is a statistically significant 95% probability that country is considered high income
- **Female Life Expectancy at Birth** – If the country’s female life expectancy at birth is **81 to 90 years old**, there is about an 84% chance that country is high income
- **Percent of Women Who Survive to Age 65** – If between **91 and 100%**, that country has an 88% statistically significant probability of being high income

- **Percent of Males Employed in Agriculture** – If between **0 and 5%**, that country has a 95% probability of being classified as high income
- **Percent of Population Using At Least Basic Sanitation Services** – If **100%** of the country's population is using at least basic sanitation services, that country has an 88% chance of being high income

#### Which Factors to Target During Upcoming Years

The most likely indicators of a country or territory being high income – and therefore the best factors to target – include:

- A mortality rate under 5 years old of 1 to 5 deaths per 1000 live births
- Female life expectancy between 81 to 90 years
- 91% to 100% of women surviving to age 65
- 0% to 5% of males being employed in agriculture
- 100% of the population having access to basic sanitation services

#### Data to Gather in the Future

The data used in this study included a large amount of information, but there were many columns with few values or no values at all. The World Bank should focus on gathering information for columns that have been empty in the past. Once these columns have values, there are other predictors that may help The World Bank better understand which factors make a country more likely to be high income, including:

- Whether there are wage and working condition regulations and how strict they are
- Fossil fuel vs Renewable energy use
- Immigration and Emigration rates
- Whether citizens have access to universal healthcare

## Discussion of Findings

### In-Depth Discussion of Main Drivers

Main Drivers were chosen based on the largest differences among levels within a predictor as well as the overall difference between the predictor's highest probability percentage and the overall average probability of a country being high income, which was 36.4%. Differences between levels were found to be statistically significant unless otherwise stated.

*Figure 1*

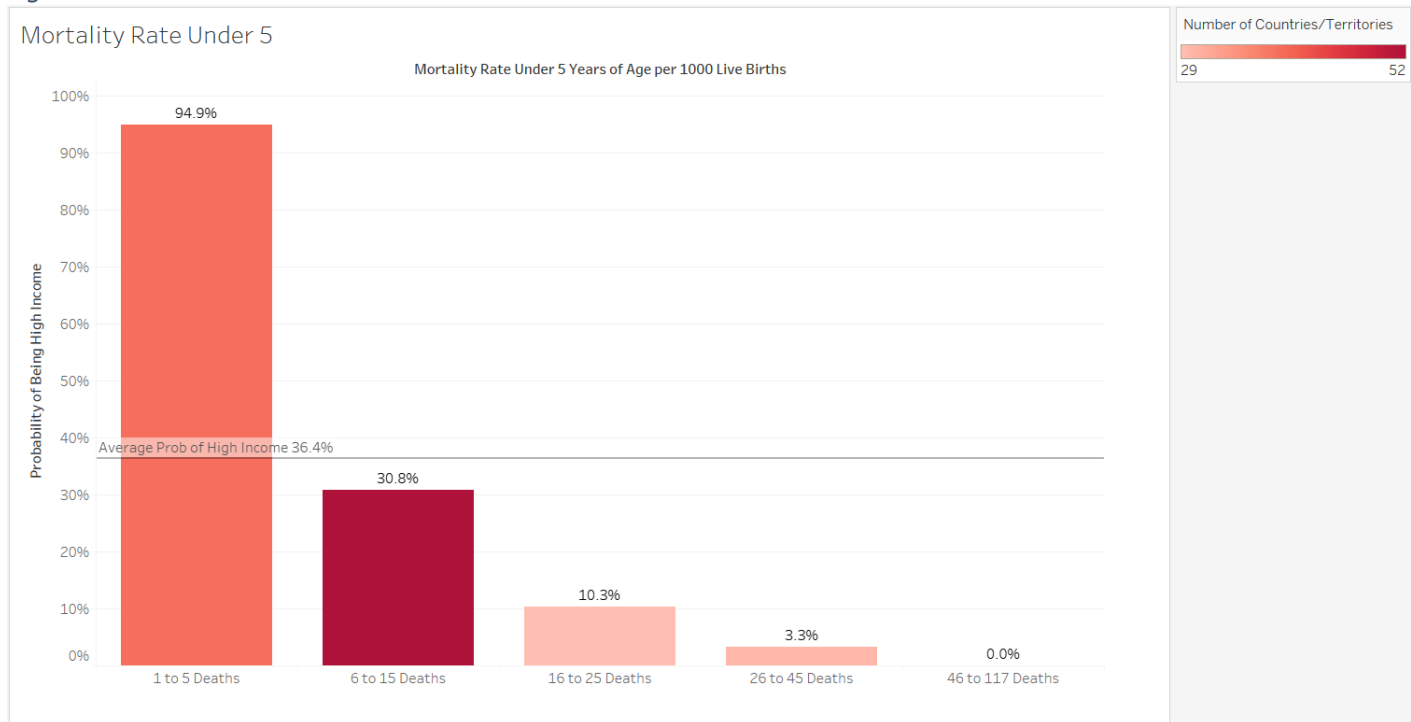


Figure 1 shows that if a country's mortality rate for children under 5 years old is between 1 to 5 deaths per 1000 live births, it is 58.5% more likely to be classified as high income than average. This may be because countries with fewer deaths have access to better medical resources and these citizens are able to afford better care for their children, which is possible when a country is wealthier and high income. A country's mortality rate having 16 to 25 deaths, 26 to 45 deaths, and 46 to 117 deaths are not statistically significantly different from each other, but those levels are statically different from the other levels.

Figure 2

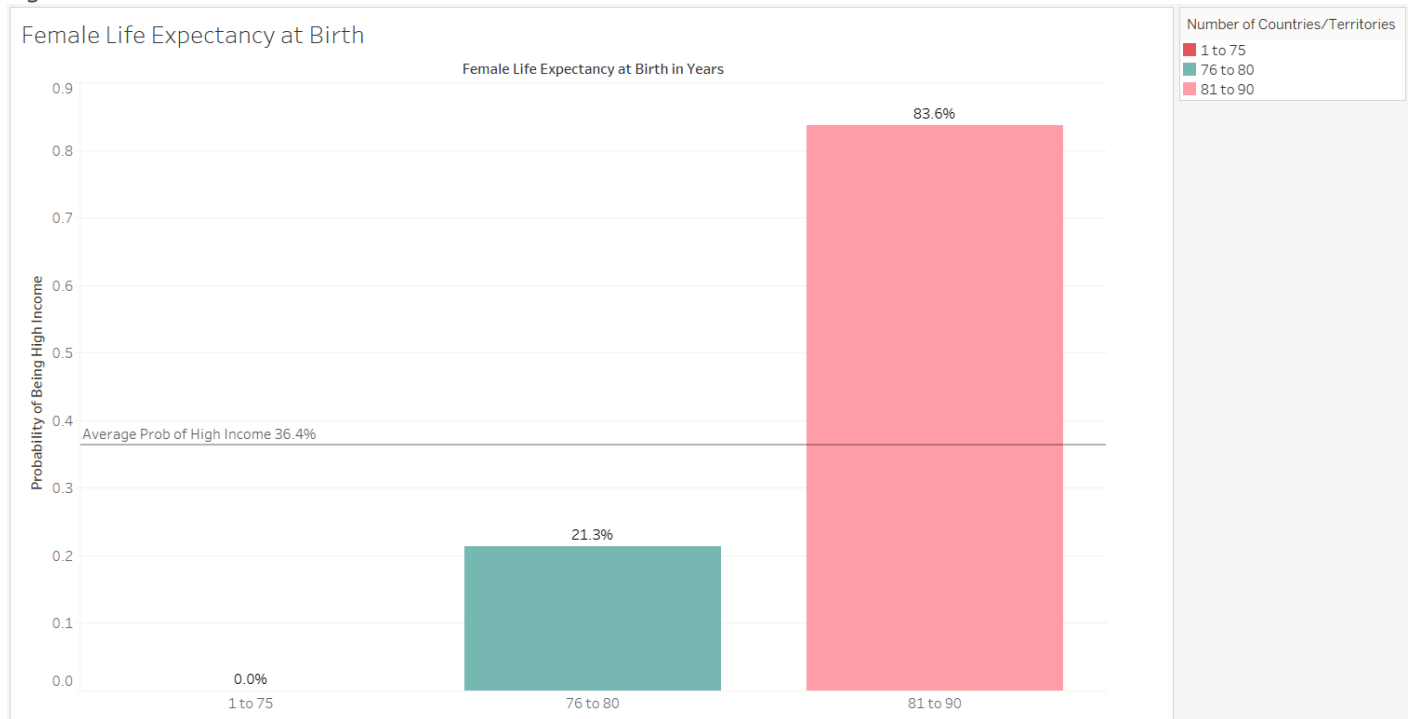


Figure 2 indicates that a country with a female life expectancy of 81 to 90 years is 47.4% more likely than average to be high income and is 62.3% and 83.6% more likely to be high income than countries with female life expectancies of 76 to 80 years or 1 to 75 years, respectively. This is likely because as women's empowerment and therefore life expectancy increase, a country's economic growth increases as well, leading to a higher likelihood of being high income (Fabrizio et al 4).

Figure 3

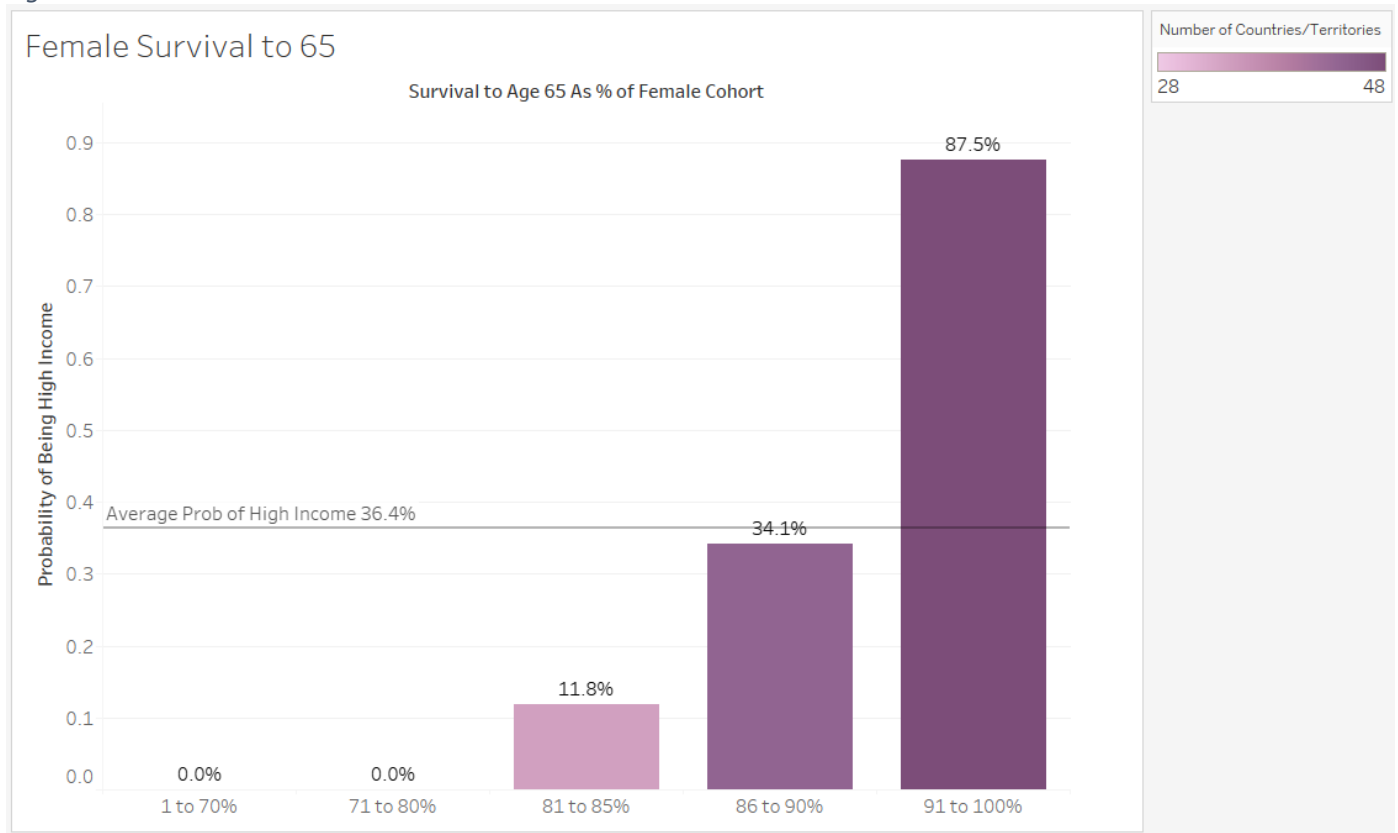


Figure 3 demonstrates how much the percentage of women who survive to age 65 affects the probability of a country being high income. 91 to 100% of women surviving to age 65 means that a country has an 87.5% probability of being high income. This is about a 53% higher probability of high-income classification than countries with 86 to 90% of women surviving to age 65. Survival of 1 to 70% of women along with survival of 71 to 80% and 81 to 85% do not have statistically significant differences from one another, but they are statistically significantly different from the other two levels.

The large discrepancy between even an 86 to 90% survival rate and a 91 to 100% survival rate underscores the importance of improving conditions for women to improve the economic conditions of a country as a whole.

Figure 4

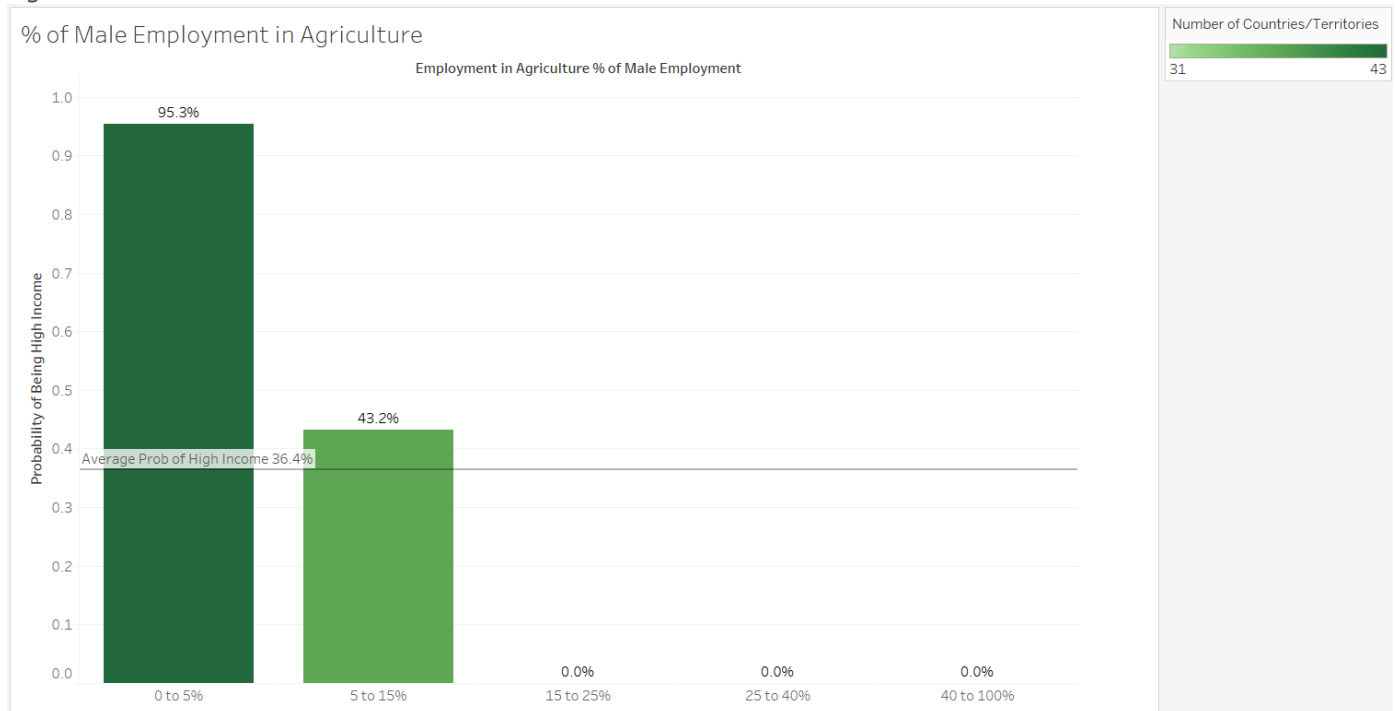


Figure 4 shows that the smaller the percentage of men employed in agriculture, the more likely a country is high income. When 0 to 5% of men are employed in agriculture, a country has a 95.3% probability of being high income, which is 58.9% higher than average. This difference is likely because agriculture workers worldwide are paid very little and undervalued, while service jobs are seen as more valuable and increase a country's capital more than agriculture does (Hurst et al 43). Countries having 15 to 25%, 25 to 40%, and 40 to 100% of men employed in agriculture are not statistically significantly different from each other but are statistically significantly different from the other levels.

Figure 5

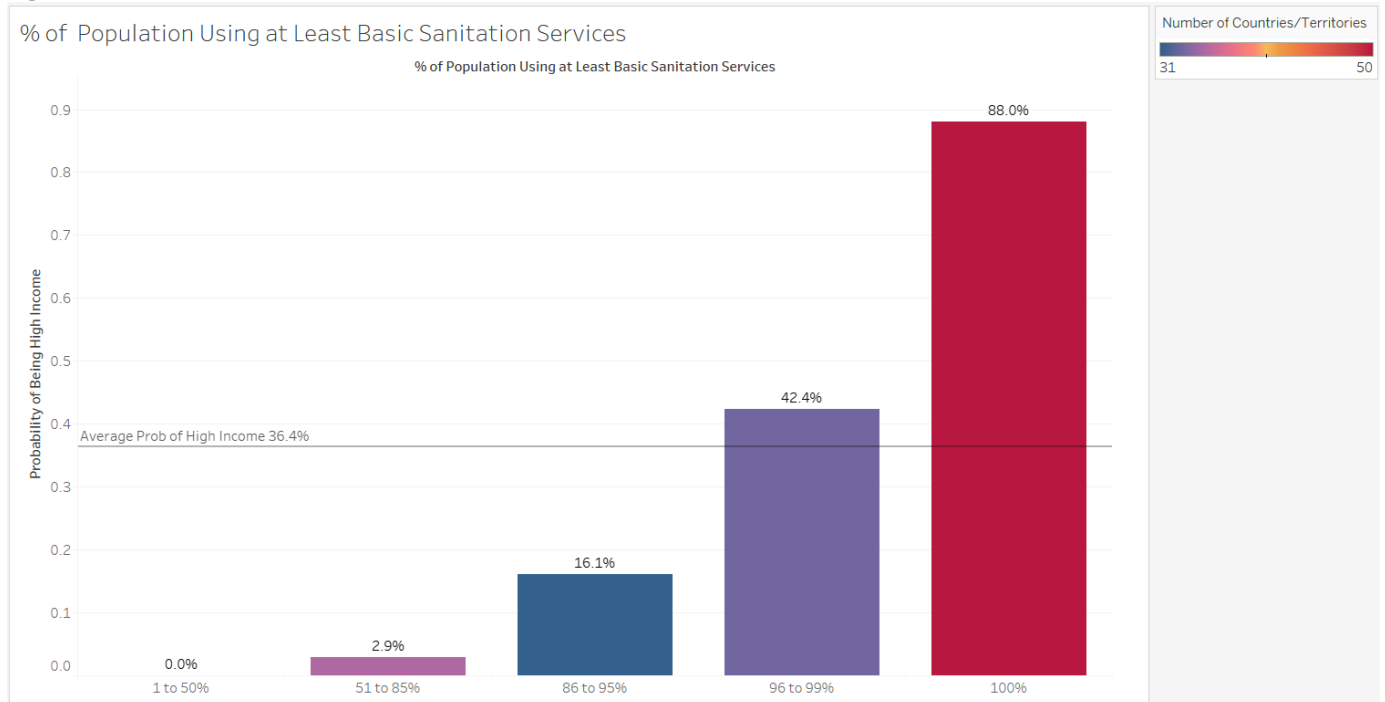


Figure 5 indicates that a country in which 100% of the population is using at least basic sanitation services is 51.6% more likely to be high income than average. This is most likely tied to income classification since without basic services to meet the base needs of its citizens, a country will struggle to create and sustain profitable jobs. Countries having 1 to 50%, 51 to 85%, and 86 to 95% of the population with basic sanitation services are not statistically significantly different from one other. These levels are however statistically significantly different from the other two levels.

#### Maps Comparing Countries with Drivers

Figure 6

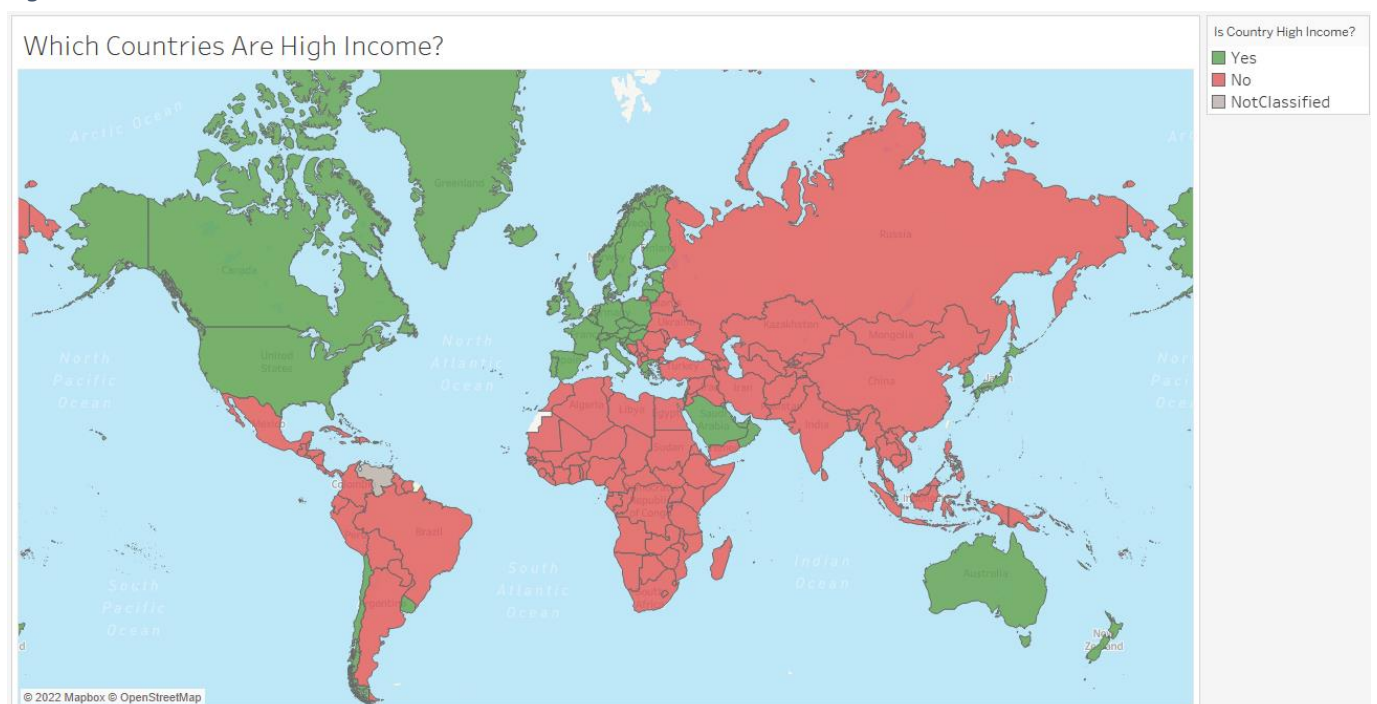


Figure 6 shows which countries are considered high income by The World Bank. The World Bank has not classified Venezuela by income, so it is not included in the analyses. Additionally, The World Bank does not have sufficient data on all countries that are shaded in white, which includes Western Sahara, Taiwan, and French Guiana.

Figure 7

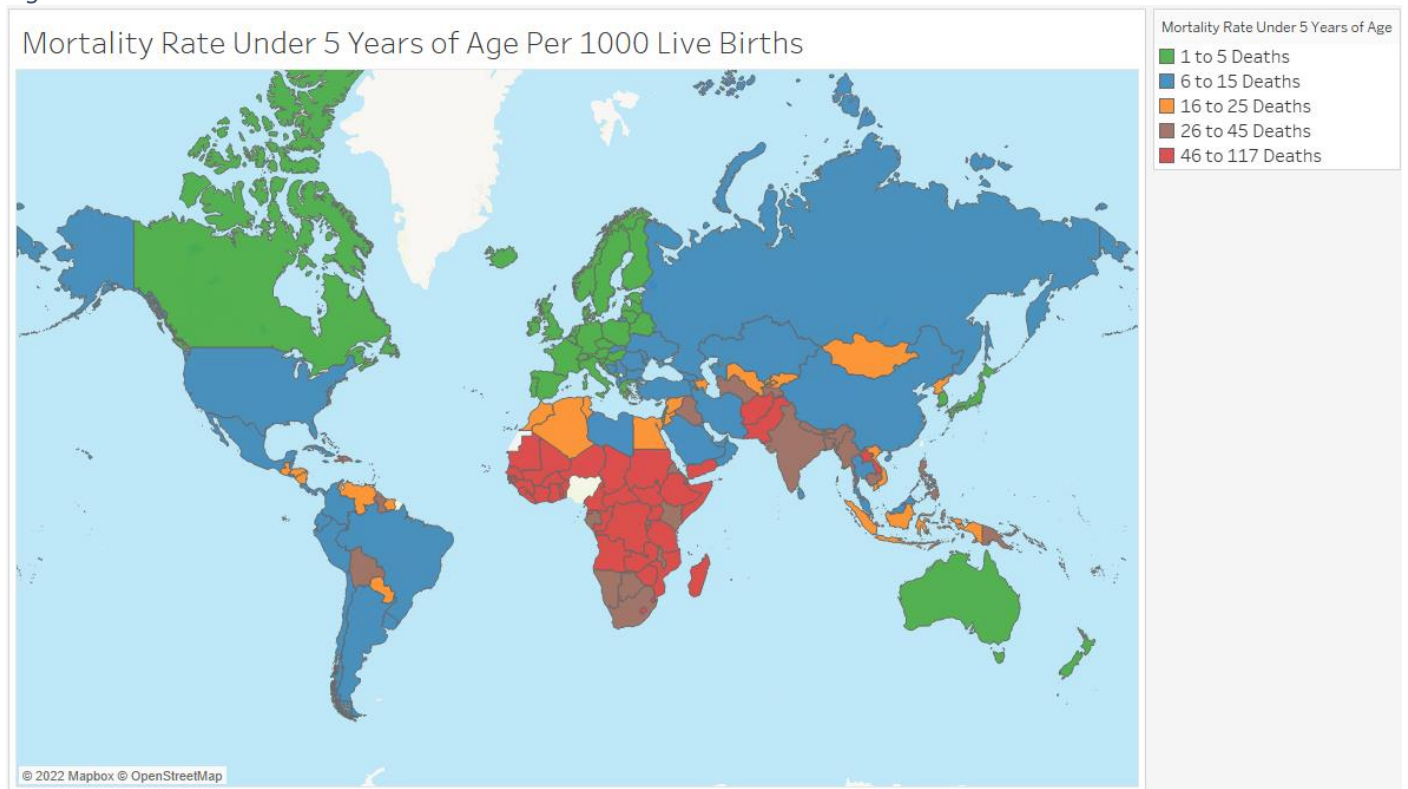


Figure 7 displays the mortality rate under 5 years of age per 1000 live births for each country. As discussed in Figure 1, a rate of 1 to 5 deaths gives a country a 94.9% probability of being high income. Despite being classified as high income, the United States, Saudi Arabia, Oman, Kuwait, United Arab Emirates, Qatar, Slovak Republic, Chile, the Bahamas, and Uruguay have a rate of 6 to 15 deaths indicating potential health care issues in these countries. Trinidad and Tobago are also considered high income but have a mortality rate of 16 to 25 deaths, suggesting a large discrepancy between economic well-being and human well-being.

Figure 8

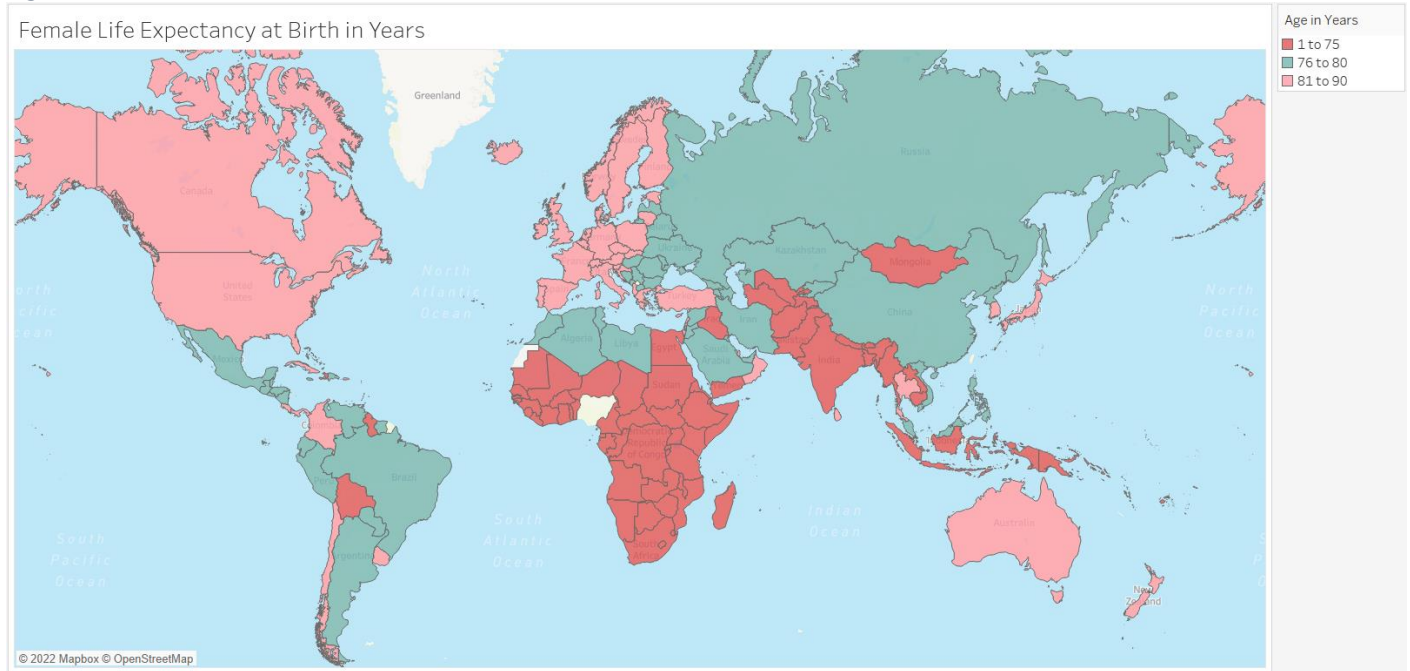


Figure 8 demonstrates each country's female life expectancy at birth. Figure 2 shows that a life expectancy of 81 to 90 years makes a country 47.4% more likely to be classified as high income than average. Colombia, Panama, Costa Rica, Thailand, Albania, and Turkey are not high-income countries, but all have female life expectancies of 81 to 90 years. This may indicate that these countries will reach high income classification within the next few decades, considering how vital the success of women are to a country's economic growth.

Figure 9

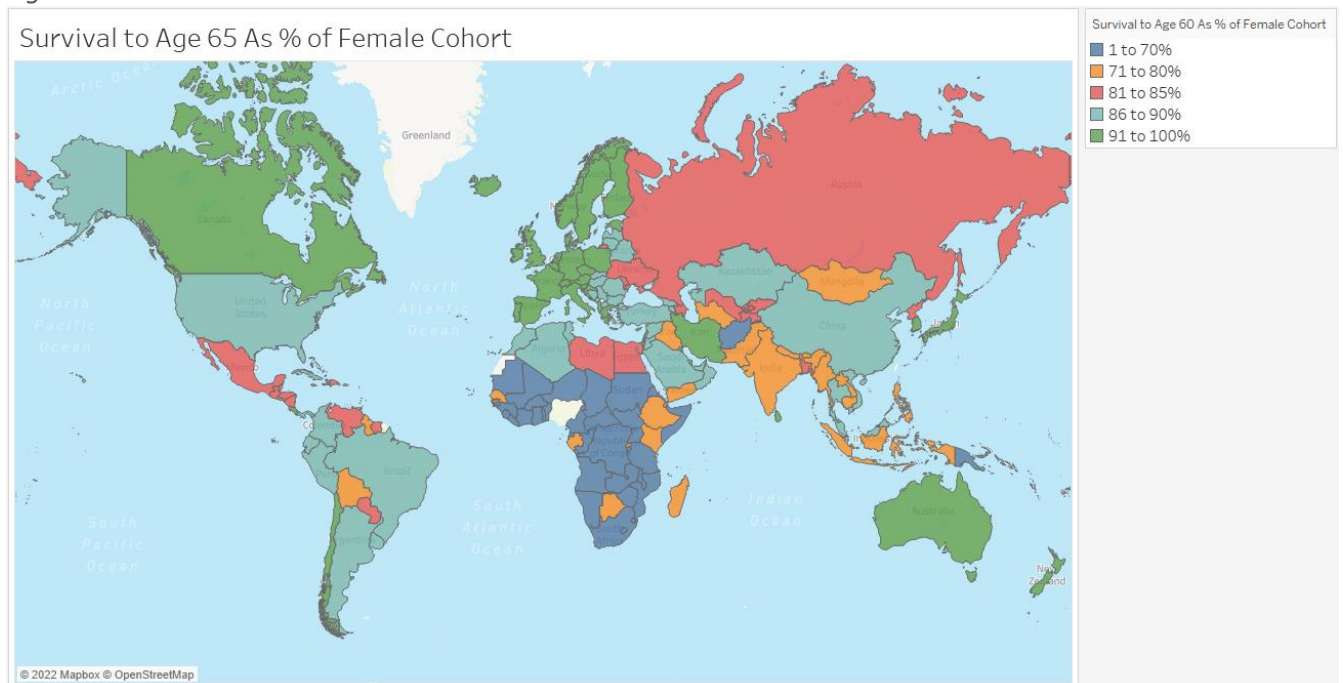


Figure 9 shows what percent of each country's female population survives to age 65, and Figure 3 indicates that a country having 91 to 100% of its female population survive to age 65 gives it an 87.5% chance of being high income. The United States, Uruguay, Saudi Arabia, Oman, United Arab Emirates, Lithuania, Latvia, Trinidad and Tobago, and the Bahamas are all considered high-income countries but do not meet the expected level of 91 to 100% survival. Many of these countries also do not meet the mortality rate standard mentioned in Figure 7. These inconsistencies likely indicate issues with health care systems in these countries because despite being economically well-off, they cannot meet the highest standards for human health.

*Figure 10*

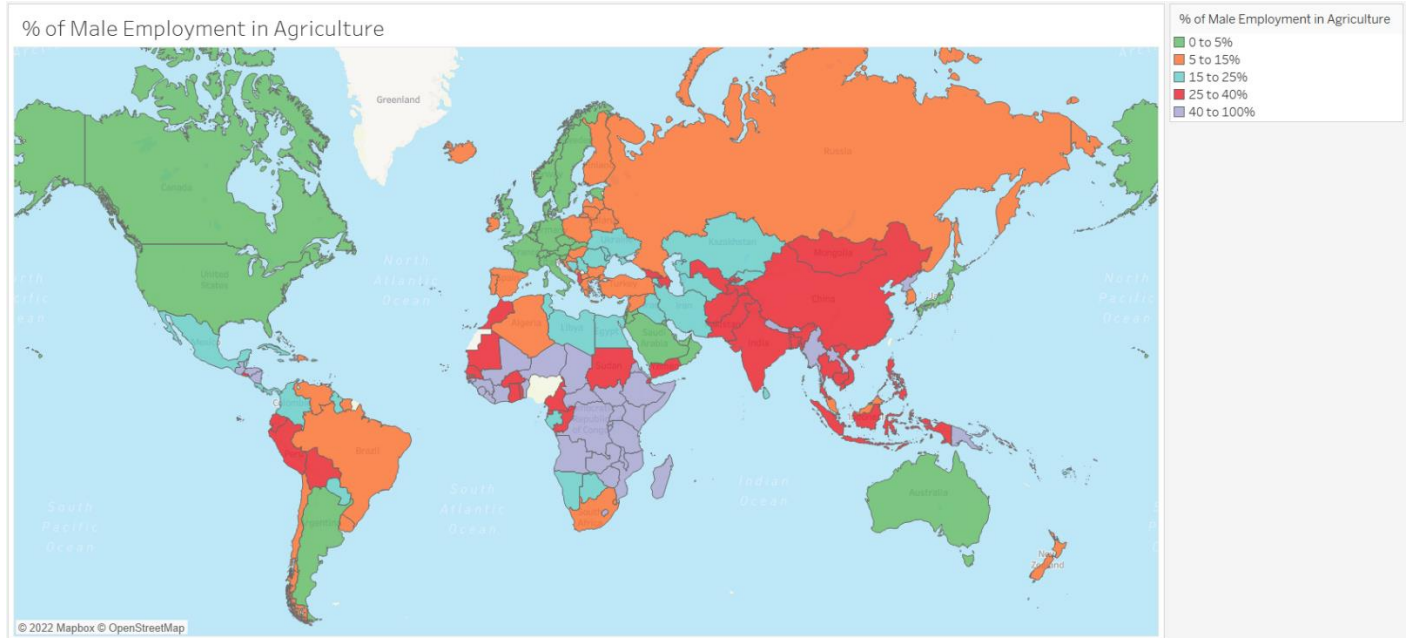


Figure 10 shows the percent of men employed in agriculture globally, with 0 to 5% of men working in agriculture leading to a 95.3% probability of that country being high income. The notable exceptions to this are Chile, Uruguay, Poland, Hungary, Ireland, New Zealand, South Korea, Greece, Croatia, Poland, Latvia, and Lithuania, which are considered high income but have 5 to 15% of men employed in agriculture.

Figure 11

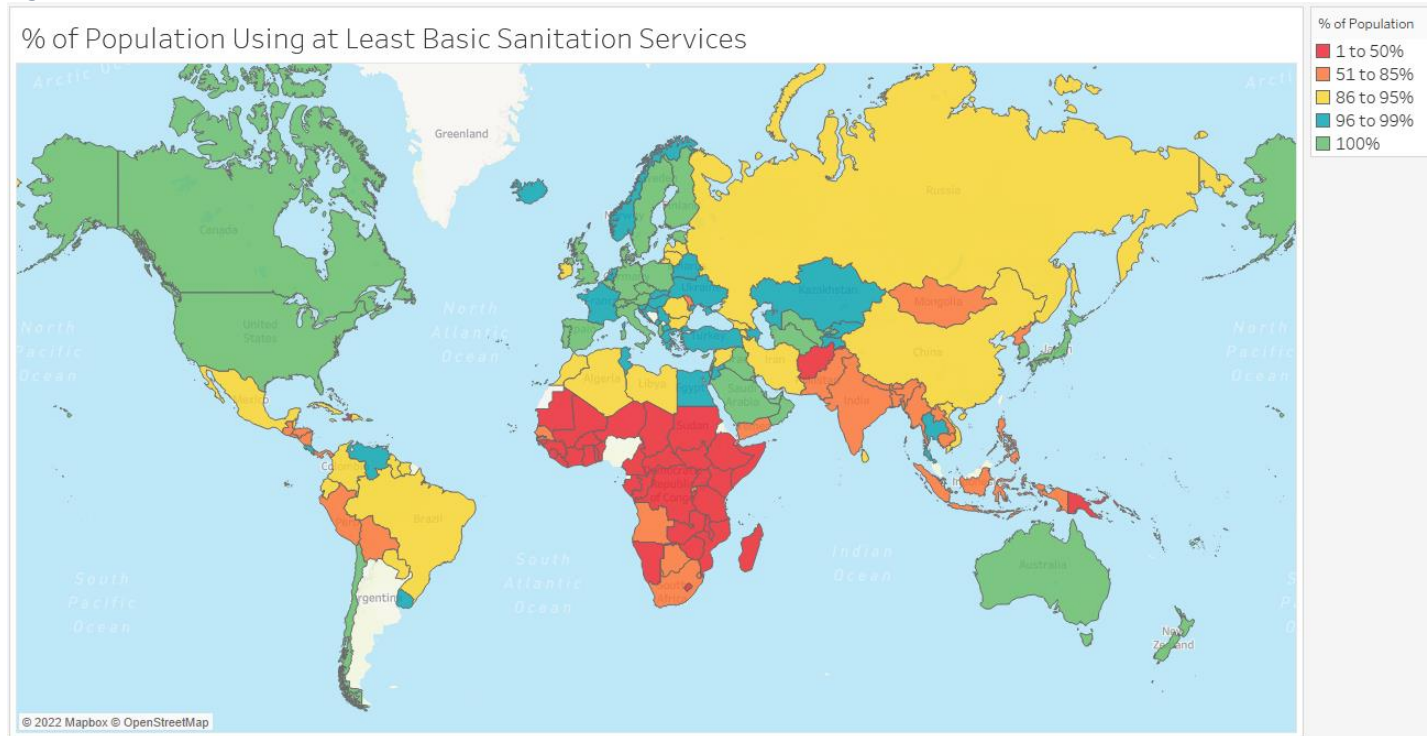


Figure 11 shows what percent of each country's population that has access to at least basic sanitation services, with 100% access to basic sanitation services meaning a country has an 88% chance of being high income. Despite not being high income countries, 100% of Turkmenistan, Uzbekistan, and Iraq's populations have access to at least basic sanitation services.

### Association Rules

Figure 12

| Factor 1                                                          | Factor 2                                                                                  | Times More Likely to be High Income | Probability of High Income (Overall Average of 36.4%) |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------------------------|
| Male Employment in Agriculture % of Male Population = 1% To 5%    | None                                                                                      | 2.56                                | 95.3%                                                 |
| Basic Drinking Water Services Percent of Population = 96% to 100% | Basic Sanitation Services Percent of Population = 100%                                    | 2.56                                | 93.3%                                                 |
| % of Urban Population's Access to Electricity = 100%              | Merchandise Imports From High Income Economies of Total Merchandise Imports = 76% to 100% | 2.51                                | 91.3%                                                 |
| % of People Practicing Open Defecation = 0% to 1%                 | Survival to Age 65 Female of Cohort = 91% to 100%                                         | 2.5                                 | 90.1%                                                 |
| Access to Electricity % of Rural Population = 100%                | Self Employed % of Male Employment = 1% to 20%                                            | 2.45                                | 89.4%                                                 |
| Life Expectancy at Birth for Females = 81 to 90 Years             | Survival to Age 65 Female of Cohort = 91% to 100%                                         | 2.45                                | 89.1%                                                 |

Each combination listed in Figure 12 occurred at least 40 times in the data to ensure the number of countries being counted is not too small to matter.

When almost all of a country's population has access to basic drinking water and sanitation services, that country is 2.6 times more likely to be high income on average, potentially due to the importance of meeting basic human needs before being able to excel economically. Both urban and rural populations having 100% access to electricity, when combined with other factors led to the likelihood of a country being high income more than doubling, likely because of how essential electricity is to economic growth in terms of even basic technology access. Women having a life expectancy of 81 to 90 years and 91 to 100% of women surviving to 65 make a country 2.5 times more likely to be high income, further emphasizing the importance of female empowerment when talking about improving economic growth.

### Variable Importance

Figure 13

Variable Importance to High Income Classification

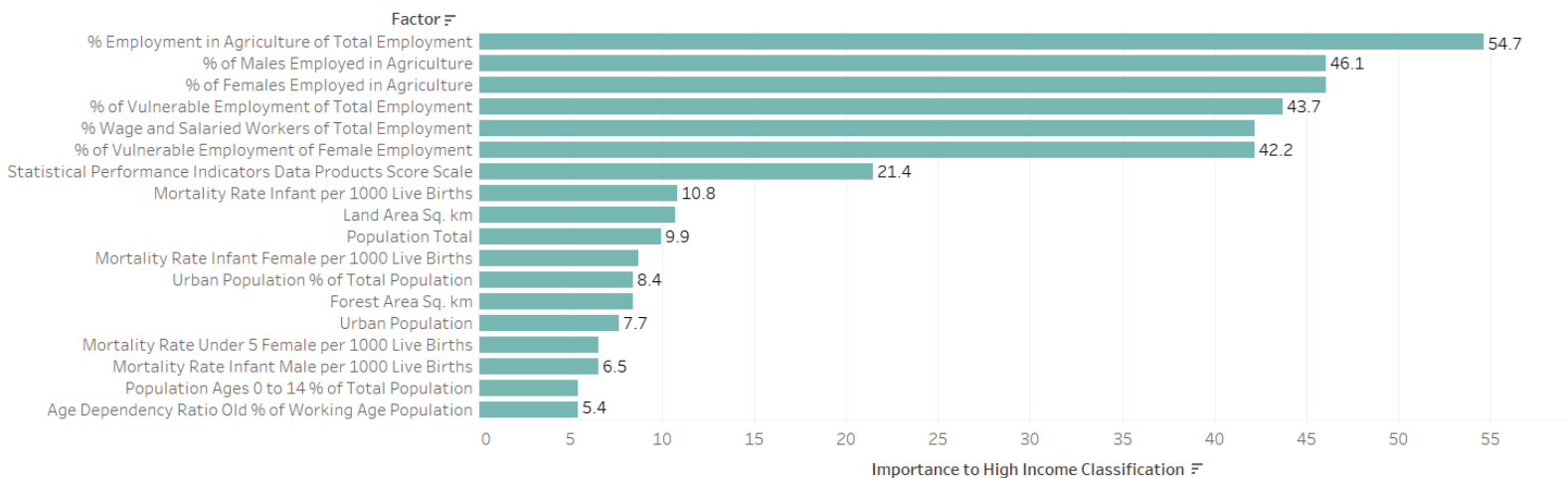


Figure 13 shows how much the top predictors and their importance to predicting whether a country is classified as high income. As mentioned in the major drivers, factors such as % of employment in agriculture as well as mortality rates are some of the most important categories when predicting whether a country is high income. The top 6 most important predictors are all tied to employment, which is unsurprising since a country having better employment opportunities and more capital make that country more likely to have a higher GNI, which is how The World Bank classifies income.

## Technical Summary

### Data Cleaning

#### *Initial Action*

“WDIData\_Original.csv” contained the original World Development Indicators data from 1960 to 2020, which needed to be cleaned extensively.

Data from 2019 was chosen rather than 2020 because 2019 contained more data due to COVID restricting data collection in 2020. The 2019 column and each Country Name were transposed and placed into a new csv file to begin data cleaning.

#### *Missing Values*

Initially, there were 1,444 columns. However, many columns included only NAs and many others included majority NAs. All columns with more than 15% of values being NAs were excluded from the analyses, leaving a total of 291 columns with 217 countries/territories. Missing values were left as is because if there was not a data point for that country in 2019, there was also not a data point within at least 10 years and therefore could not be accurately estimated.

#### *Discretization*

For all numerical variables, `discretize()` and subsequently `cut()` were used to create categorical variables with levels, such as with `Adjusted.savings.carbon.dioxide.damage.current.US.` and `Self.employed.total.of.total.employment.modeled.ILO.estimate.`

For each numerical variable that was discretized, `cut()` was used to create relatively equivalent levels that were easily understandable (such as going by values of 10 for percentages), leading to around 40 instances for each level. Once discretized, all categorical variables were converted to factors.

#### *Variable Importance*

To run a vanilla partition model using `rpart()`, a subset of the data was created without several unnecessary columns such as Country and X (an indicator variable). Additionally, Venezuela’s NotClassified status was removed, and all columns to do with GNI and GDP were removed since The World Bank creates its income classifications based on each country’s GNI.

## Works Cited

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