Sustainable Efficacy Index

Group 6 Final Research Report

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Main Goal/Objective

Our main goal is to measure high sustainable efficacy in the world through low CO2 emissions, a high Human Development Index, and a high percent of land used for agriculture. After taking those indicators into account it is found that when sustainable efficacy rates are high the GDP is also high, and when the GDP is low the sustainable efficacy rates should be low. Therefore, we hope to prove that the GDP is an important factor in determining the sustainable efficacy of a county.

Background

Sustainability is always considered as a significant way of development. Social, environmental and economic are three ways to measure sustainability. GDP is the core indicator for evaluating a country's financial situation. The problem that most of the world's countries are facing lies directly within feeding their populations. For example there are large countries such as Japan who do not have a large percentage of their land in agricultural production but they have the means to import goods from other places. Then you have other countries such as the United States who even though they have the money to import food they still have large amounts of land in production, and on the other side there are poor countries in Africa like Niger who have neither natural resources or money to import food. In countries like Niger most of the people practice subsistence farming and are living on just enough to get by. With the ability to produce food, there is now a negative trade off that increases CO2 emissions. This increase in emission of greenhouse gases comes from the burning of more fossil fuels and can harm the environment which may affect long-term sustainability. Therefore, the success of a country directly lies in its ability to combine the ideals of all indicators mentioned in this paper.

Scope and characteristics of the study area

"Sustainability is an adaptive art wedded to science in service to ethical vision. It entails satisfying current needs without sacrificing future well-being through the balanced pursuit of ecological, health, economic welfare, social empowerment, and cultural creativity."(thiele)

Carbon dioxide emissions result from several possibilities such as industries, gas, decreasing forests. In 2011, the top carbon dioxide (CO2) emitters were China, the United States, the European Union, India, the Russian Federation, Japan, and Canada. These data include CO2 emissions from fossil fuel combustion, as well as cement manufacturing and gas flaring. Together, these sources represent a large proportion of total global CO2 emissions. Changes in land use are significant. Estimates indicate that net global greenhouse gas emissions come from agriculture, forestry, and other land use. Traditionally, a country with a high GDP has high CO2 emissions due to plenty of industries and running vehicles.

Human development index is a composite statistic based on life expectancy, education and living standard. It helps excavate countries' potential of economic development. By measuring cultural development level, HDI reflects the progress of a country and provide a new train of thought for people to easily evaluate social development. According to the data collected year by year, Norway has the highest HDI almost every year. The higher GDP, the higher HDI should be.

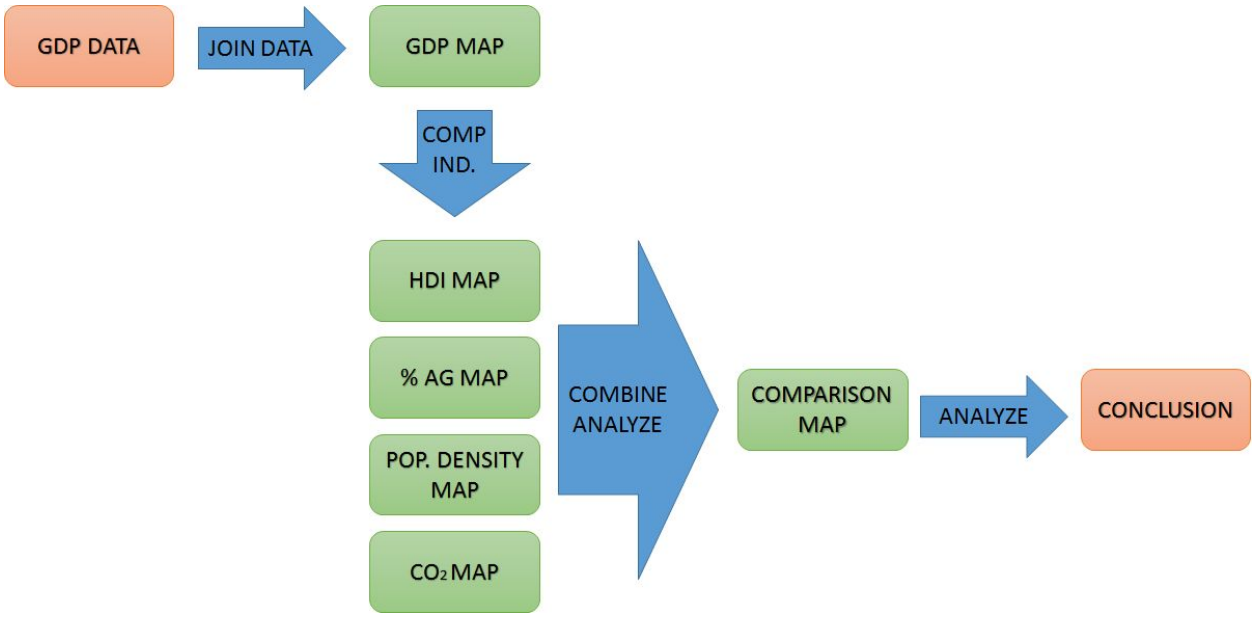
The percentage of land use in agriculture is an indicator that shows the investment in land. It is hard to use this indicator to determine the relationship between land use and GDP because agriculture products may import and export from country to country. The own GDP of a country can not simply be judged by the single parameter since the agricultural products may also be provided by other country.

Population density is supposed to have a positive relationship with GDP. However, due to some countries' large population, less money would be put into education or income for each person, it may result in low HDI.

Objectives

The objective of this project is to determine the sustainable efficacy of different countries through the world by comparison of one chosen indicator with the other given indicators using ArcGIS software. As a group we will use the GDP indicator that we created to check the overall sustainability of country in comparison with the other indicators we have selected.

Methodology



Our process as reflected in the the above flowchart and explained in the following steps:

- We utilized the ArcGIS v.10.3 program to take the excel data on GDP from the World Bank and joined the data to the county list.
- Then by comparing each indices (HDI, %AG Map, Population Density and CO_2) to GDP to compare the relationship and how they relate to the country's GDP to validate our hypothesis
- Next to combine all the indices that make up the Sustainable Efficacy Index to create the rankings and analyze the results.
- Concluding with our opinion that the Index is a valid reflection of our Objective/Goal.
- Tools that drove this process was ArcGis by ERSI and Microsoft Excel
- With HDI being the main component in the ranking with the %AG and CO2 production to how well they utilized their own resources and effects on the environment with population density used as a control check.

Results and discussions

Based on the analysis by ArcGIS program, figures 1 to 5 show the differences among countries for each indicator. The colors showed from light to dark refer to the degree of each indicator from low to high. Figures 6 to 9 show the comparison between GDP and each of the indicator. After looking at all of the data we collected we noticed several things to be true.

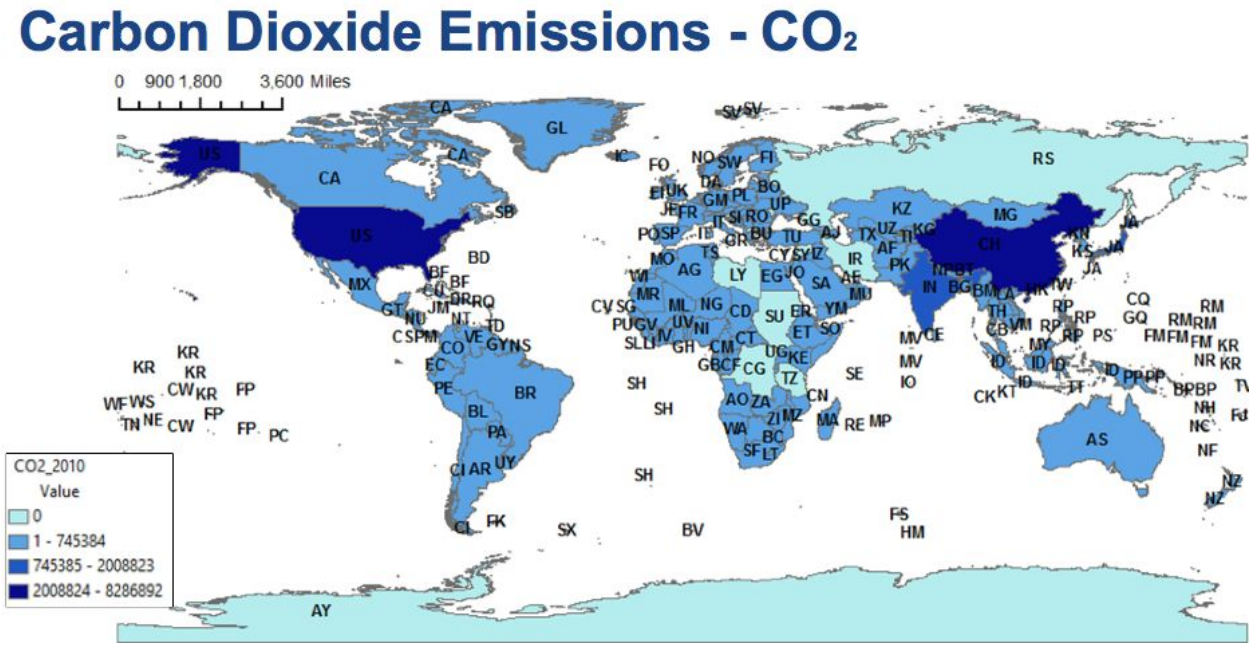


Figure 1. CO2 emissions comparison among countries

In this map it is shown that the United States and China have the largest CO2 emissions in the world.

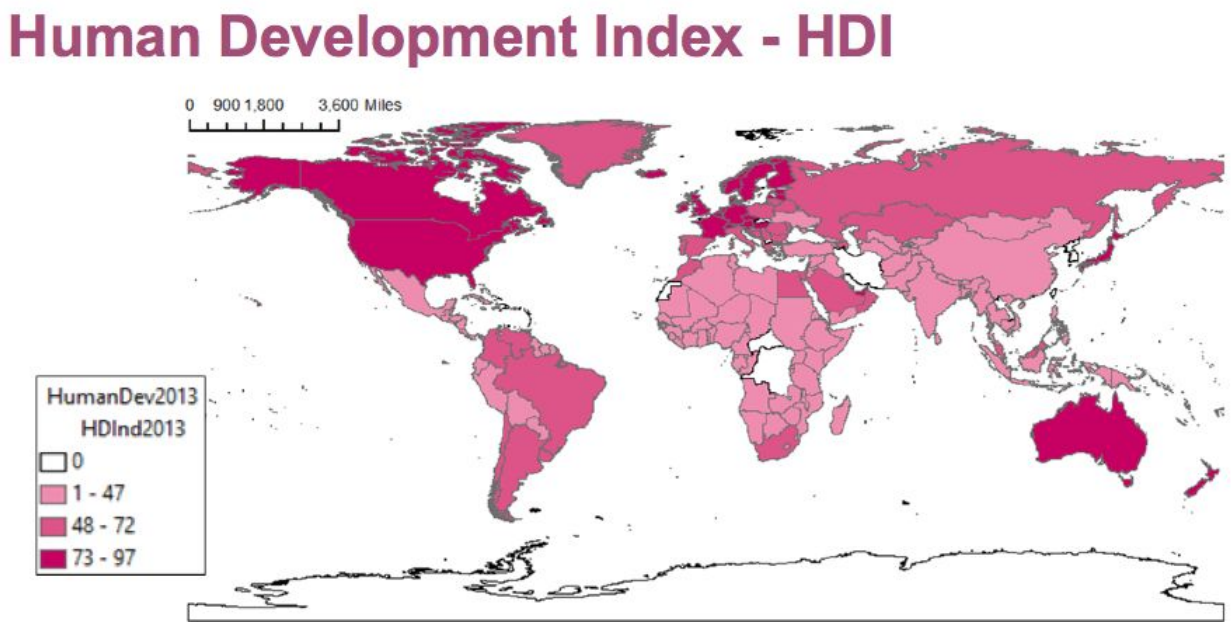


Figure 2. HDI comparison among countries

This map shows that Australia, the United States, and several countries within western Europe have the highest human development indices.

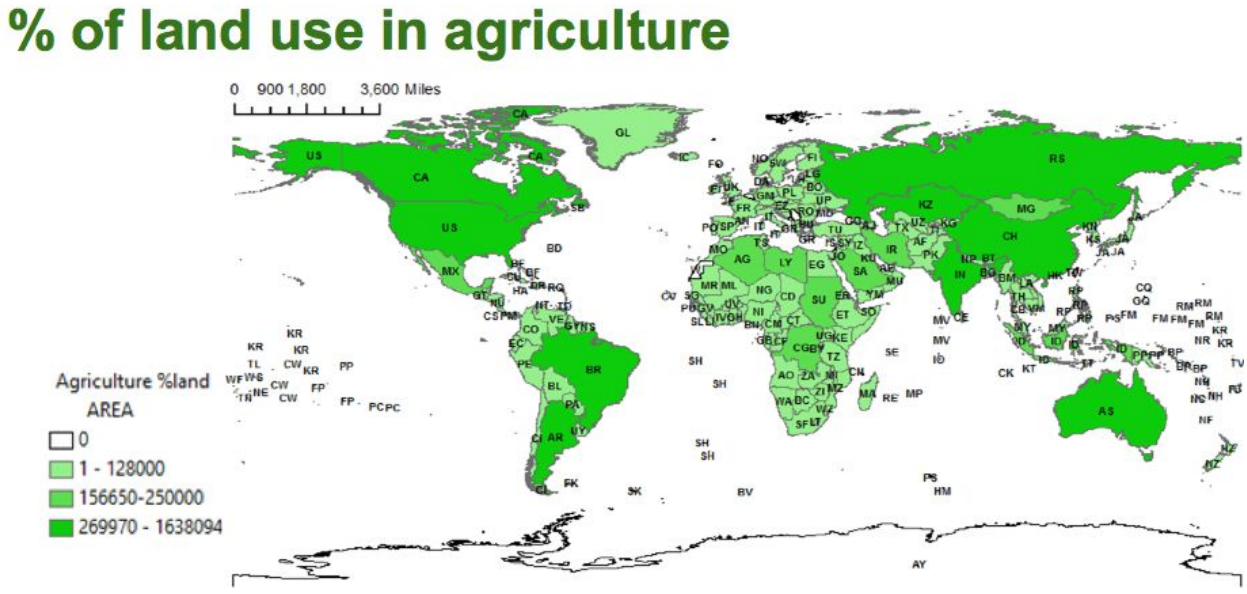


Figure 3. Percentage of land use comparison among countries

This map shows the percent of land use in a country dedicated to agriculture. As you can see above countries like the United States, China, Canada, Brazil and the other countries highlighted in lime green have the most land in agricultural production.

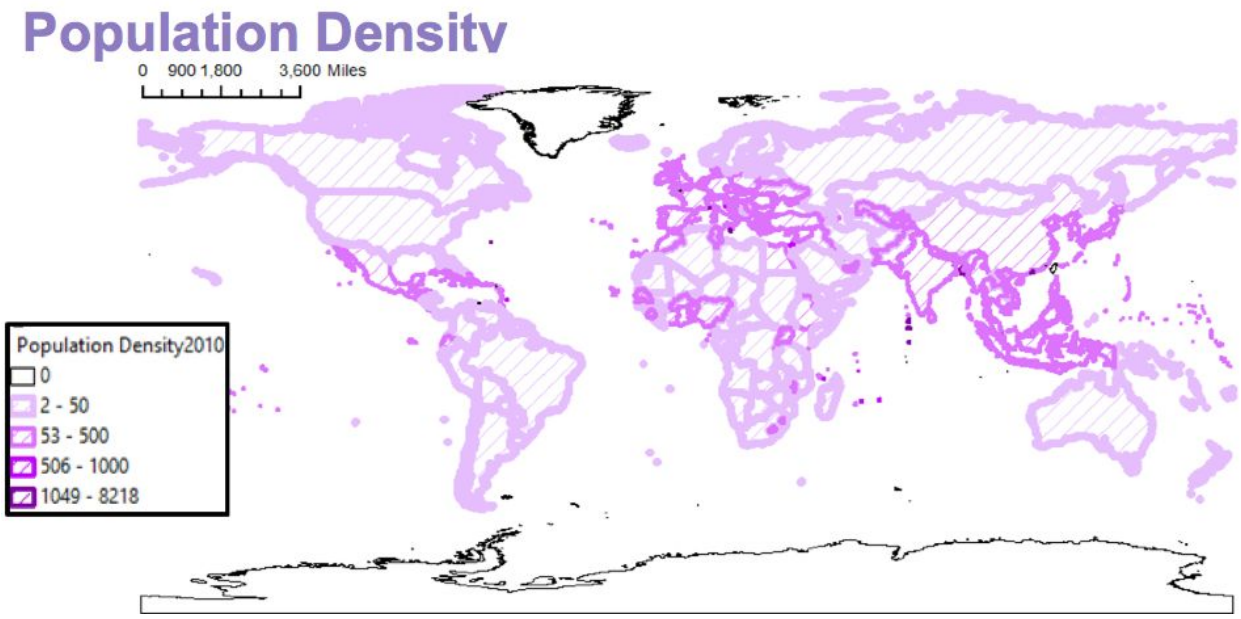


Figure 4. Population density comparison among countries

The map above shows the population density within a country. Countries like India show a very large population density.

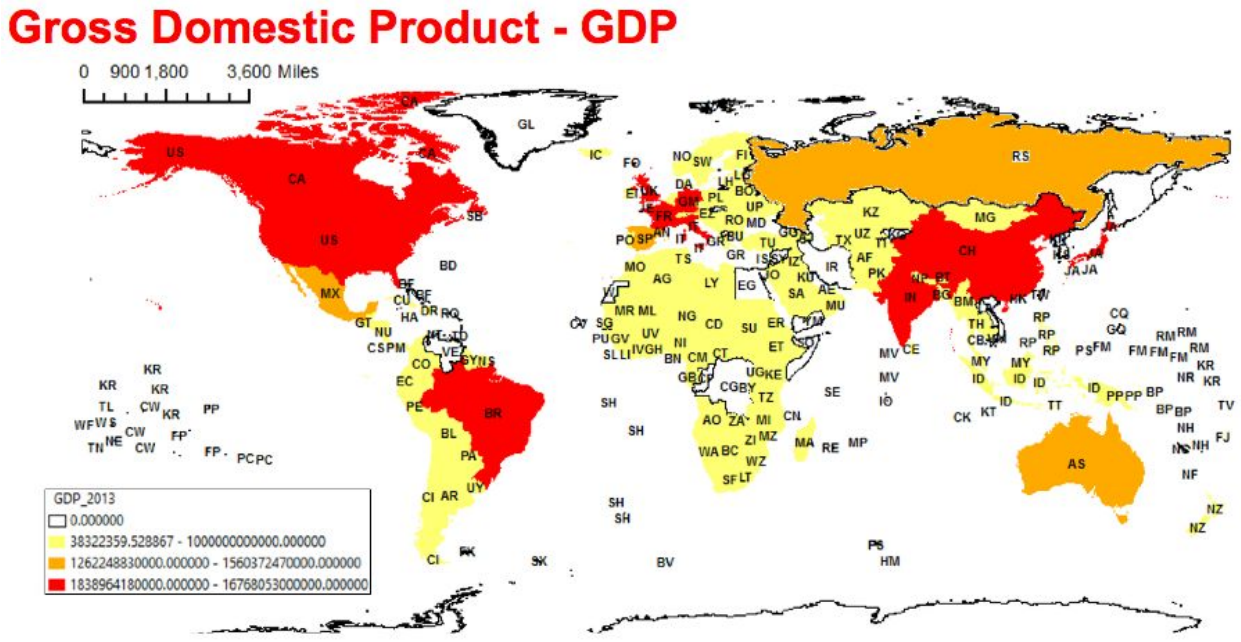


Figure 5. Gross Domestic Product comparison among countries

This map shows the GDP within a country. The United States, Canada, Brazil, China, several countries in western Europe, and India all demonstrate a high GDP.

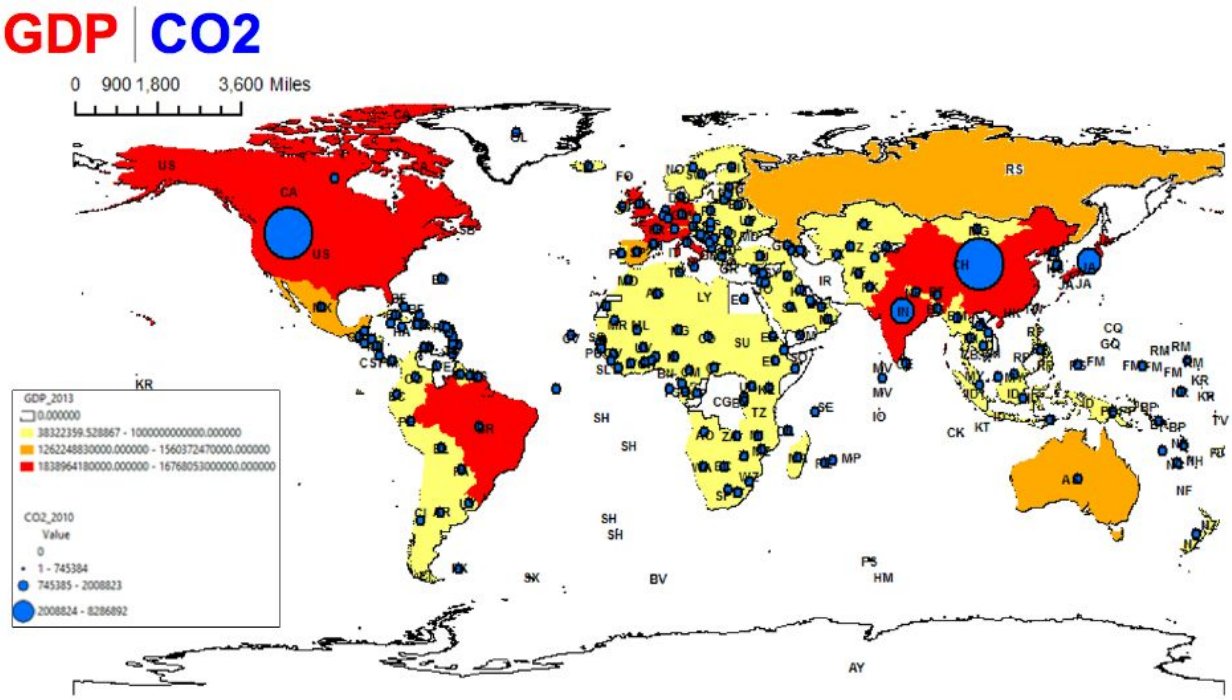


Figure 6. Comparison between GDP and CO2 emissions

Here we see that countries with a high GDP also seem to have high CO2 emissions. This contradicts what we thought to be true. We thought before starting this project that the ideal situation in a country for sustainability would include, low CO2 emissions with a high GDP. This result however, lets us know that there is work to be done within these already successful countries to make some changes to protect the environment.

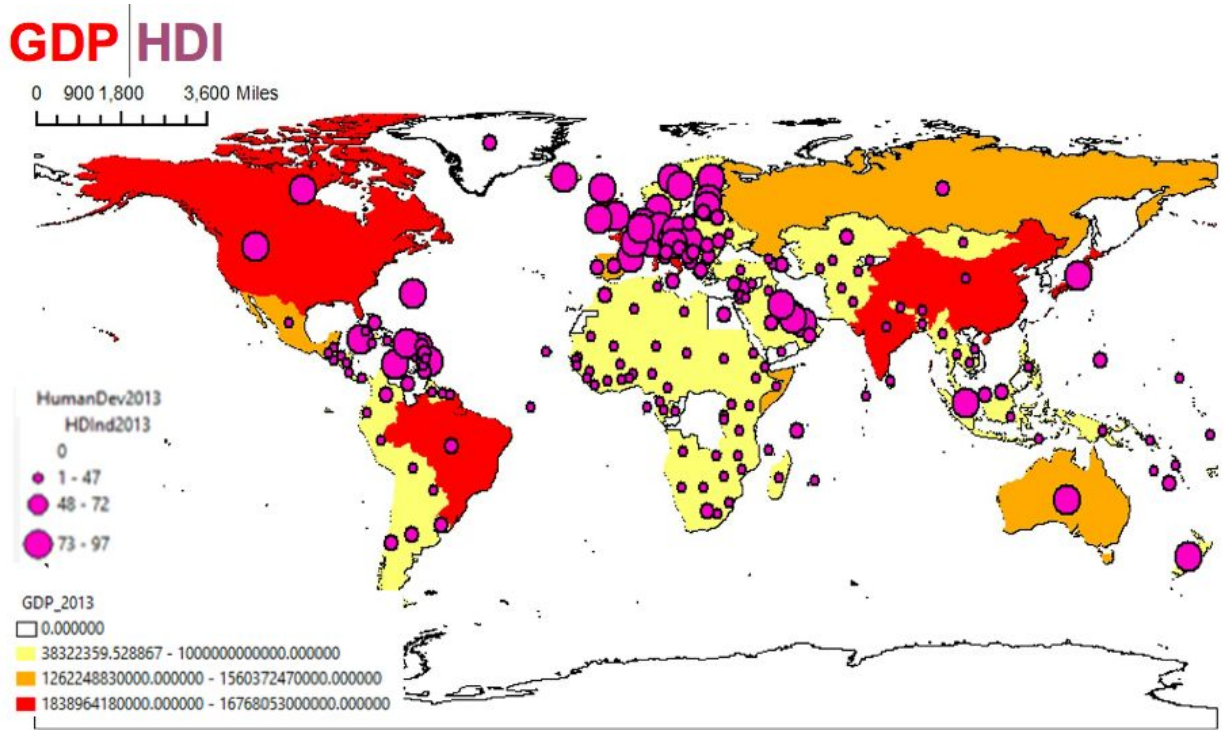


Figure 7. Comparison between GDP and HDI

This map shows the comparison between the Human Development Index and GDP. This map is not terribly conclusive because we have opposing results. For example, the United States along with several countries in western Europe have a high GDP as well as high HDI's. However, in China the opposite is true, they have a high GDP and a much lower HDI. These results do not fully support our hypothesis because the results are not uniform across the world.

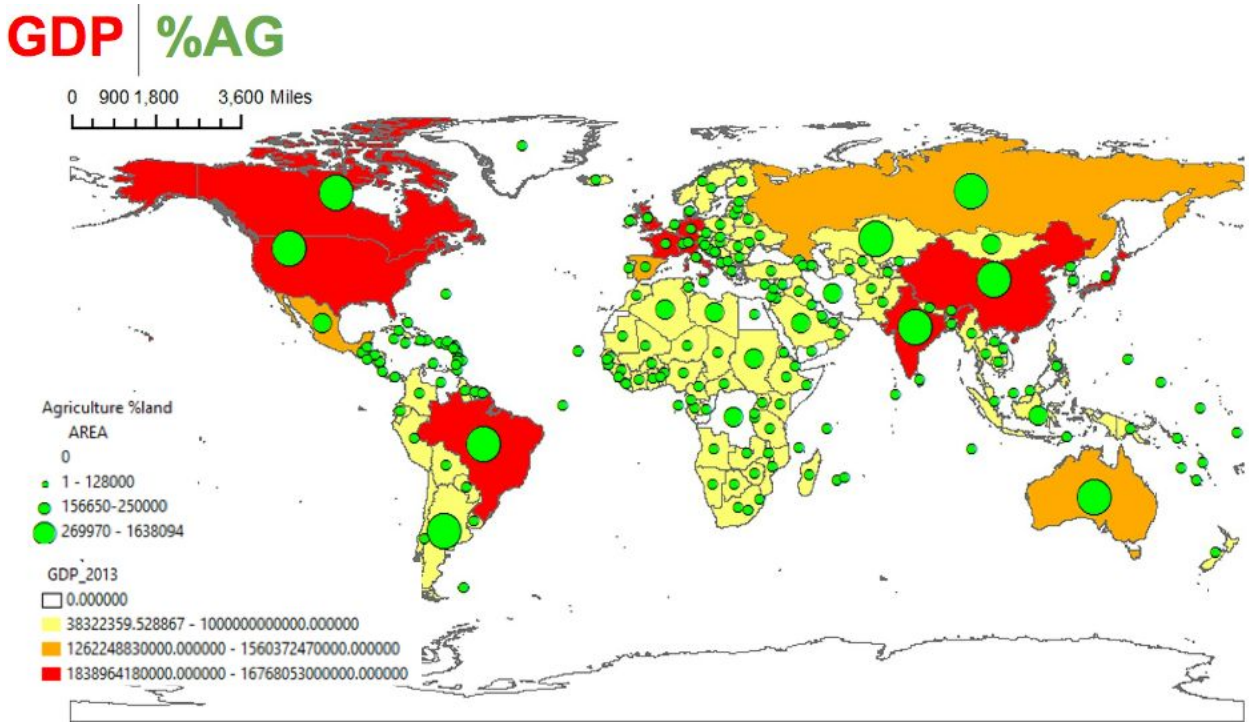


Figure 8. Comparison between GDP and percentage of land use

In the map above we look at the GDP of a country and the percent of land in agricultural production within that country. Our predictions were correct when looking at the comparison for these two indicators, earlier we stated that countries with high GDPs would also have large amounts of land and this map proves it to be true. This indicator also proved to be the most difficult overall because when looking at the agricultural data we do not have conclusive data to show what exactly the crops produced on that land are used for. For example, when looking at a country with large amounts of land producing crops we have no way of knowing where exactly those crops are going, we don't know whether the crops are going feed the people within that country or going to exports to increase the monetary wealth of the nation. Overall we believe that this indicator does not give us a very creditable result because there are just so many unknowns.

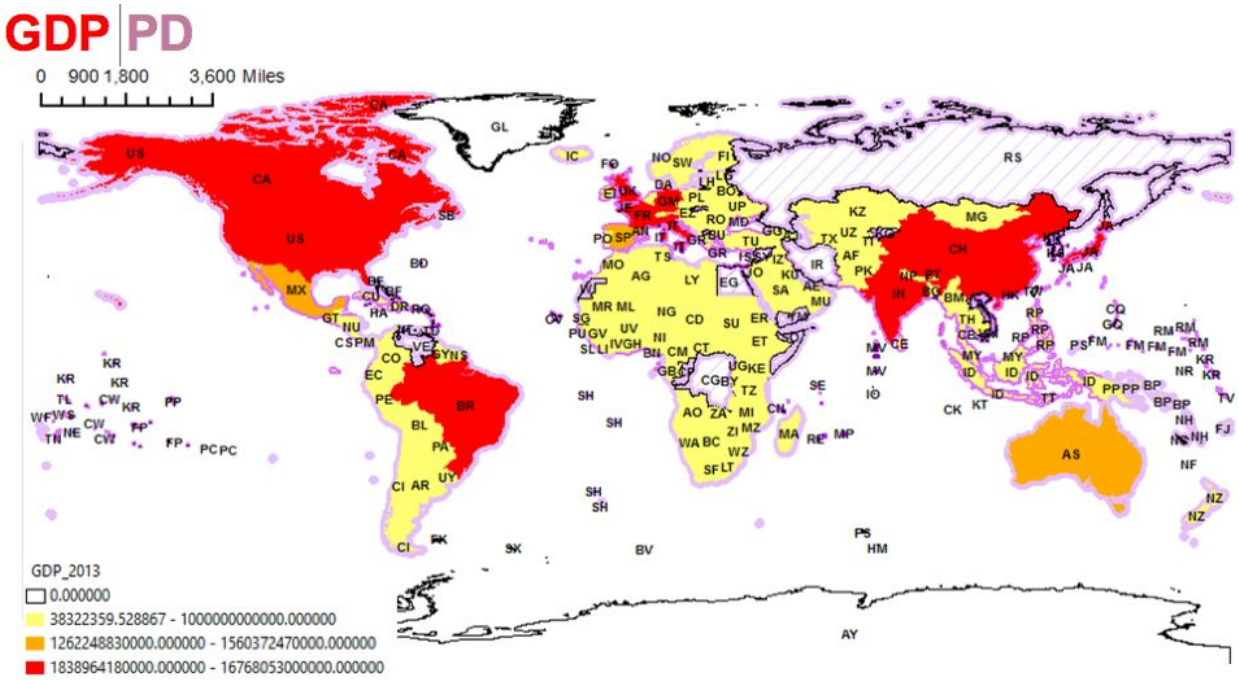


Figure 9. comparison between GDP and population density

The map above follows our hypothesis for the most part, proving that countries with a high GDP also have moderate populations densities.

Conclusion

In conclusion, Smaller population densities with moderate food production fell into line with less CO2/Carbon footprint with less production and industrial emissions. With northern Europe being at the top of the class with the UK and then the US rounding out the bottom of the top tier. With the middle class Brazil, Australia balancing out with others. Then the least being in Eastern Europe and Africa. Figure 10 shows the overall results. We also found that the ideal that we stated in the introduction to this project is extremely hard to attain and even harder to maintain. The best case scenario for overall sustainability includes a high GDP, moderate population density, high percentages of land in agricultural production, a high HDI, and low CO2 emission. However, during this project we found that there is no country on the planet that has attained the ideal of what we just described. Hopefully, we can take the information that we have detailed in this project and use it for good to try and better our planet for future generations.

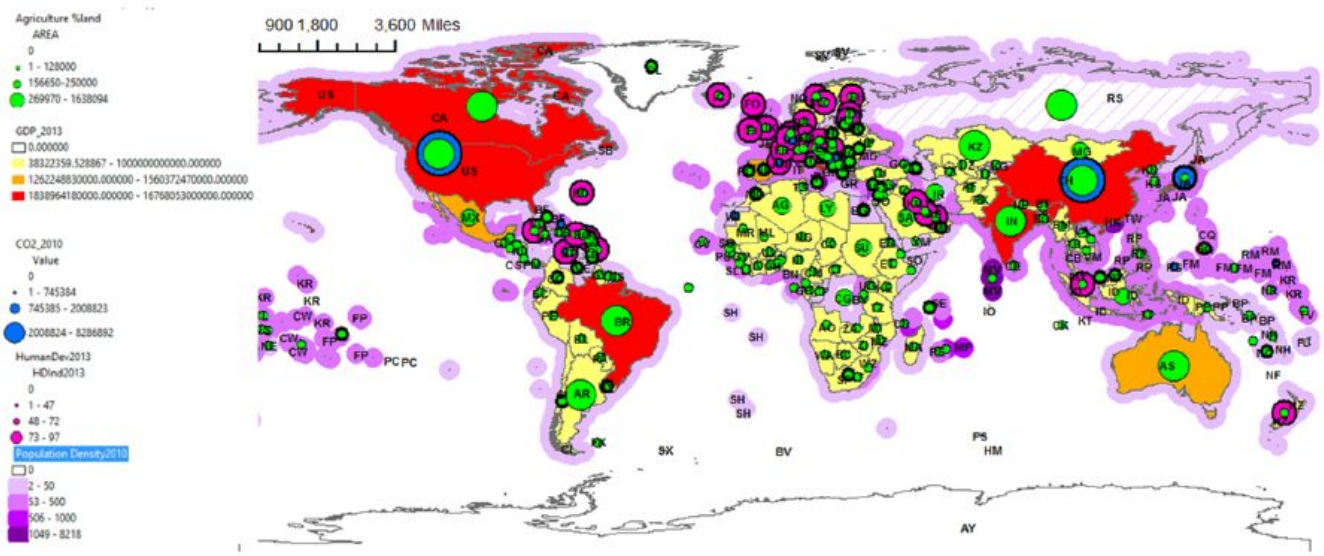


Figure 10. Integrated comparison of all four indicators throughout the world