Measuring Global Sustainability

By: Sheri Kusatzky, Kiran Gaulee, Austin Barton, and John Muniz-Aleman

Main Goal

The objective of our project is to measure the progress of each country by their sustainability. The ability to provide the basic, economic and social needs for the current populations without compromising the needs of the future generations.

Background

The problem statement is measuring the state of the world by United Nations Indicators using indicators that are often overlooked. United Nations has three main dimensions for human development index: long and healthy life, knowledge and decent standard of living. The long and healthy life measures the life expectancy, knowledge measures education levels and the standard of living measures GNI per capita. All of these measures are missing an important part of a country's well being which is sustainability. Sustainability is the ability to provide basic economic and social needs without compromising the needs of future generations. Our team believes, if a country is not able to sustain its future generation with the same life expectancy, knowledge and standard of living, it is not doing as well as it needs to. Therefore, we specifically collected data on sustainability with four chosen progress indicators. We chose Energy, Land use, Water and Budget. We collected data on these indicators from a total of 216 countries and analyzed it in ArcGIS software to see how many qualities overlap. Through these measurements, we ranked each country by how they are measuring up to our chosen progress indicators. Within these four indicators, there are different sub measures that we will fully explain later in this paper.

Scope and Characteristics

Our group chose sustainability indicators to judge the progress of each country because a country’s sustainability is the ability to sustain the people and future generations that inhabit the country. Also, the growing problem of climate change is also something that needs to be address by the countries if they want to be fully sustainable. Therefore, a country’s response to climate change is extremely important when measuring how well they are doing in the world. Climate change impacts economic, social, and political factors so it is key to measure the combative measures taken by countries. A country that invests in sustainable practices is one that is moving

towards reducing their pollution impact on the world and towards creating a better future for upcoming generations that will be most affected by the results of climate change.

Objectives and Criteria for Accomplishing the Goal

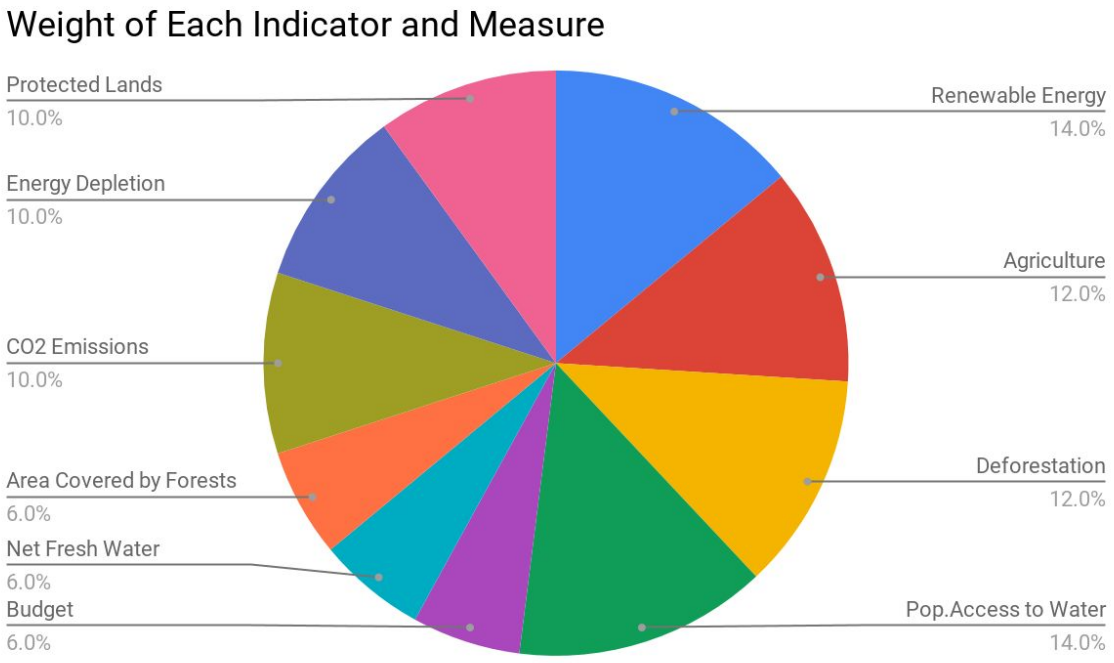
The objective of our project is to measure sustainability of the countries based on our four indicators and twelve measures. Their place in our ranking shows whether they are a sustainable country based on how we weighted each measurement. We chose measurements that encompass each of the world issues mentioned in the Social Progress Index—climate change, food, oceans, population, and water. Our map reflects each of these measurements and we distributed the indicators and their weights. Our group measured the sustainability of a country against the "normal" sustainability of all countries.

Methodology

As an open project, we had a lot of freedom to choose our own data, our own composite indexes from measures and indicators. We started out with wide ranges of indicators such as healthcare, literacy rate, GDP, and sustainability in order to rank the countries on their overall well-being. After prioritizing and eliminating different topics, we agreed that sustainability of a country provides us the best understanding of a country's stage of development and its impacts on nature. We collected data from State of the World United Nations Indicators and World data. Based on our four measures we created three indicators for each indicator. For our first indicator - energy, we chose percent of energy produced on renewable energy, CO2 emissions per capita, and energy depletion. For our second indicator - land use, we chose net deforestation rates, percentage of land covered by forests, agriculture, and percent of protected lands. For our third indicator - water, we chose net fresh water supplied by the water industry and drinking water supplied by percent of population. Lastly, our fourth indicator - budget, we chose budget spent on subsidies, percent of budget spent on research into new practices, and money in country's currency spent on environmental protection. We compiled all the data for these measures and weighted them based on the ranking percentages we assigned to the indicators. We then added our data in ArcGIS to visualize the information. Weighing our indicators helps us organize our data to know which indicators are more valued or weighed heavily in our map to display which country is ranked higher than another.

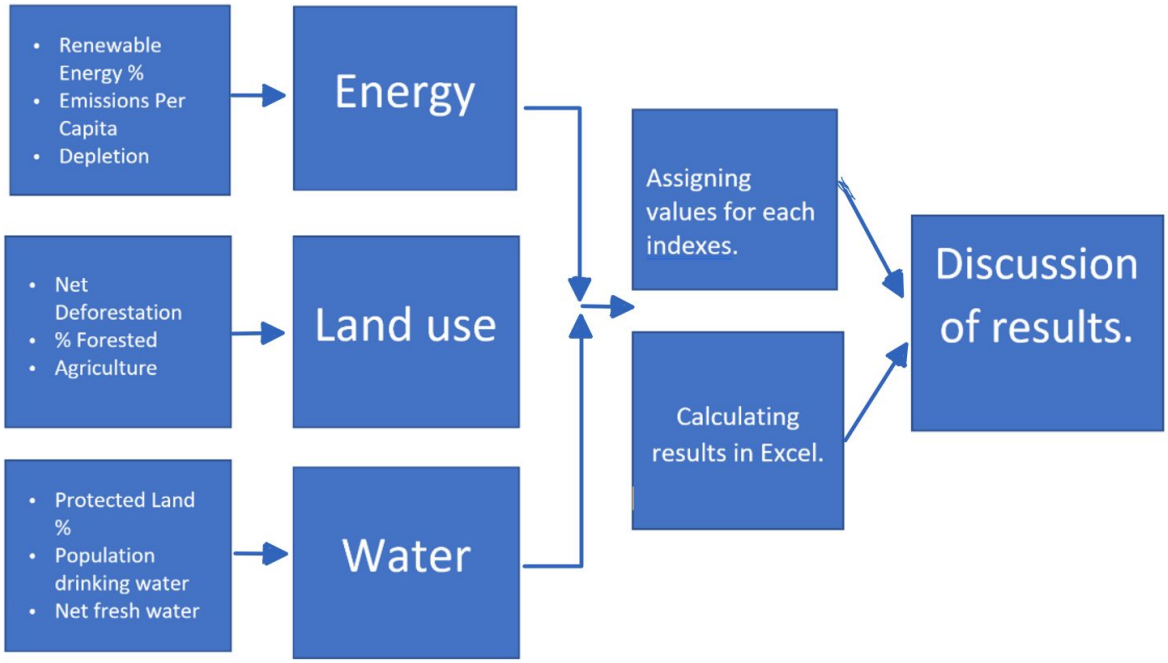
Our process for assigning a value to the indicators was influenced by the amount of data on each country and how important we deemed it to determining sustainability. We gave population access to water a weight of fourteen percent because if a population does not have clean drinking water then they will be limited within the survival mode and not be able to contribute to the country's well being. In addition some countries had limited data but are still a valued indicator of sustainability, therefore, they were weighted less.

For example, some data sets did have information on country's currency spent on environmental protection that had data from only 77 countries. This is an important measure of a country's dedication and effort to environmental protection but because half of the countries are not included in the data set, we weighed it lower to not punish countries that do not have the data. We created a system to weigh the indicators and measures all out of a 100 percent shown in the pie chart labeled 'Weight of Each Indicator and Measure'. In addition to that, we researched the threshold or ideal percentage for an indicator. For example, ideally a country would have 100% population access to water. We compared countries to that ideal. Obviously, no country is perfect because we do not live in a utopian society. We have limited resources and subjectivity exists.



Our group felt more comfortable formatting our data in Excel Spreadsheets instead of ArcGIS. Most of our data came from the State of the World United Nations Indicators and World Data. The data came in different formats but because of our ranking system we calculated each data set into a percent rank. Using excel, we created a percent rank for the data that ranks the data points with one another within the data set.

Flow Chart



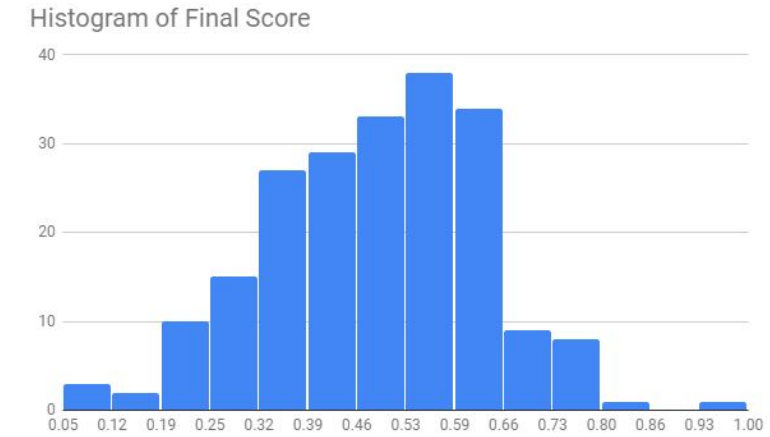
Results and Discussions

Based on our data Australia (0.98), Canada (0.81), and Latvia (0.79) are the top three countries. Kosovo was the lowest and deemed the least sustainable. Other notable countries are Iceland at number 6 (0.76) and Sweden at number 8 (0.74). These results are what we expected based on what we know about these countries especially the Scandinavian countries which are known for being sustainable. On our map the darker blue countries are more sustainable and colors in the lightest blue are countries that are less sustainable. Countries with a score of zero had no data on

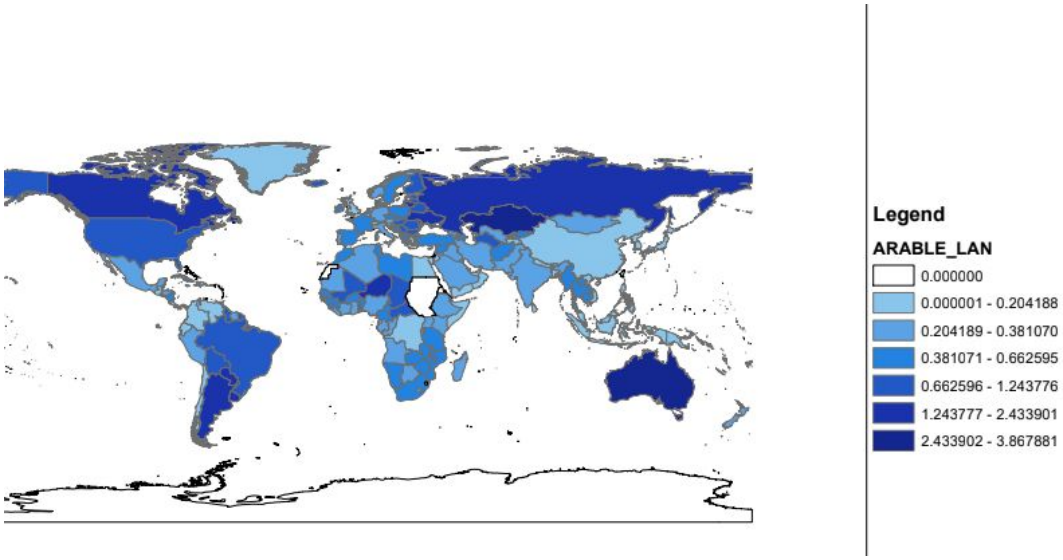
them like Antarctica since so few people live there. Some of the data is biased like Kosovo because there was limited data on it so it is most likely ranked lower than its reality. We created a histogram to display the data and it showed that the majority of countries are underperforming and are not sustainable. Our data is 0.7 points apart and these small gaps indicate that there are close similarities between many countries in the world in terms of sustainability.

Table of Results:

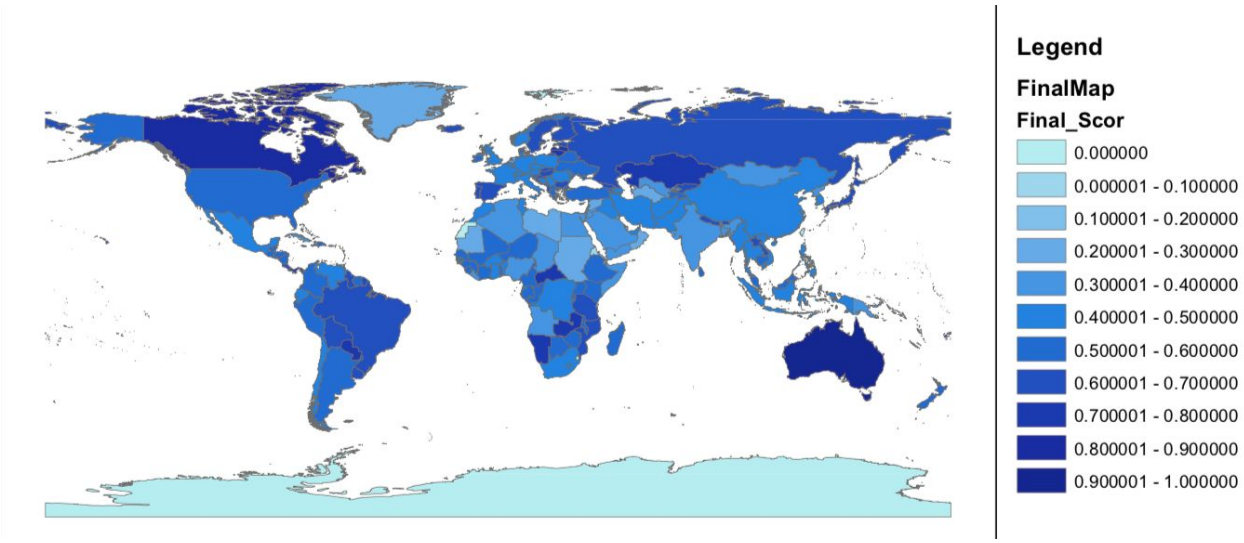
Country Name		Deforestation	Forested	Agriculture	Lands	Drinking Water	Net Fresh	Budget	Renewable	Emmissions	Depletion		Final Score
Australia		1	0.339	3.8678812	0.632	0.99968702	0.96774	0.942	0.13637841	0.0657	0.33523		0.9814124
Canada		1	0.61	2.4339013	0.338	0.989		0.961	0.6301145	0.0707	0.40909		0.8147832
Latvia		1	0.822	1.2437757	0.588	0.985955608	0.25806	0.776	0.50171697	0.4545	1		0.7931411
Kosovo				0	0			0	0.02287956	0	0.5		0.0532031



Map of Agriculture Measure:



Final Map:



Conclusions

We concluded that our map was accurate based on the information we know about sustainable countries and the countries that were at the top of our list, according to the indicators we chose. We acknowledge that there are flaws in our project like lack of data, inconsistent thresholds, and our weights being inaccurate. Some countries did not have data so they were given a zero which impacted their overall ranking but in reality the country could have not reported their data to the UN Database or the World Bank database which is where most of our data came from. In addition, the data for energy depletion was vague as to what the data exactly meant so our group had to interpret the data which leads to bias. Some of the measurements we weighted too much like net deforestation and access to drinking water because even though those are strong measurements of a country's sustainability, the data itself was net deforestation as a whole regardless of countries with minimal forested land and access to drinking water was drinking water available not if it was clean. Since these measurements are not exactly what we had in mind when weighing them, it led to some countries being ranked higher due to majority of their population having access to water but the water is not suitable for drinking. Lastly, the net thresholds were not consistent. For example, our agriculture indicator threshold was determined by researching the average amount of food a person needs. The information we used was for a European diet which is not the most accurate portrayal of each country's population diet because

due to cultural practices or availability issues diets vary around the world. If we did the project again, these are issues that we would change to improve our map.

Looking at the trendlines for our indicators, agriculture was our most effective indicator. There is a clear positive correlation shown in the trendline and agriculture acts as a composite indicator because it includes freshwater because crops need water and net deforestation to create land for farming. Budget, renewable energy, and budget have consistent positive trends and even though they are weak trends, they indicate that our group chose reliable indicators. Drinking water and deforestation were our least effective indicators because they were weighted too heavily in calculations. Overall, our project was successful in the percent rank provided a fair and unbiased representation of the data and that many indicators had that positive correlation. It is important to recognize that this map does not show that one country is better than another only showing which country is deemed to be most sustainable based on our chosen indicators. As shown by our map, no country received a perfect score because no country is perfect and there is room for improvement within every country.