



VISUALIZATION REPORT

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Introduction

As the recent Head of Data Visualization for the World Bank, my team has been asked to continue the mission of the organization by using data: improve the state of the world by engaging business, political, academic, and other leads of society to shape global, regional, and industry agendas. To do so, my team has gathered data from the Sustainable Development Goals website to propose ideas for 2021's Sustainable Development Atlas. If we can use data visualizations to bring greater attention to important international issues, we have succeeded!

The remainder of the paper summarizes four to twelve different visualizations that can be used in the 2021 Sustainable Development Atlas. These data visualizations are either redesigns of the current graphs/charts or new data visualizations.



Goal

The goal of our analysis is to illustrate our observations in several subjects that the World Bank has included as a [Sustainable Development Goal](#) through data visualizations. The time period of interest is the new millennium, or years after 2000. We hope that these observations will grant us greater insight into the safety and prosperity of peoples around the world.

SDG 1: No poverty The near future of global poverty 	SDG 2: Zero hunger Beyond hunger: ensuring food security for all 	SDG 3: Good health and well-being Global health amid a pandemic 	SDG 4: Quality education Learning poverty: children's education in crisis 
SDG 5: Gender equality Legal progress towards gender equality 	SDG 6: Clean water and sanitation Water, sanitation, and hygiene: essential for well-being 	SDG 7: Affordable and clean energy The dawning promise of energy for all 	SDG 8: Decent work and economic growth Increasing productivity and reducing vulnerable employment 
SDG 9: Industry, innovation and infrastructure Transport at the crossroads: remote rural areas and empty skies 	SDG 10: Reduced inequalities Unequal countries in an unequal world 	SDG 11: Sustainable cities and communities Polluted air plagues cities worldwide 	SDG 12: Responsible consumption and production Reducing waste for a sustainable future 

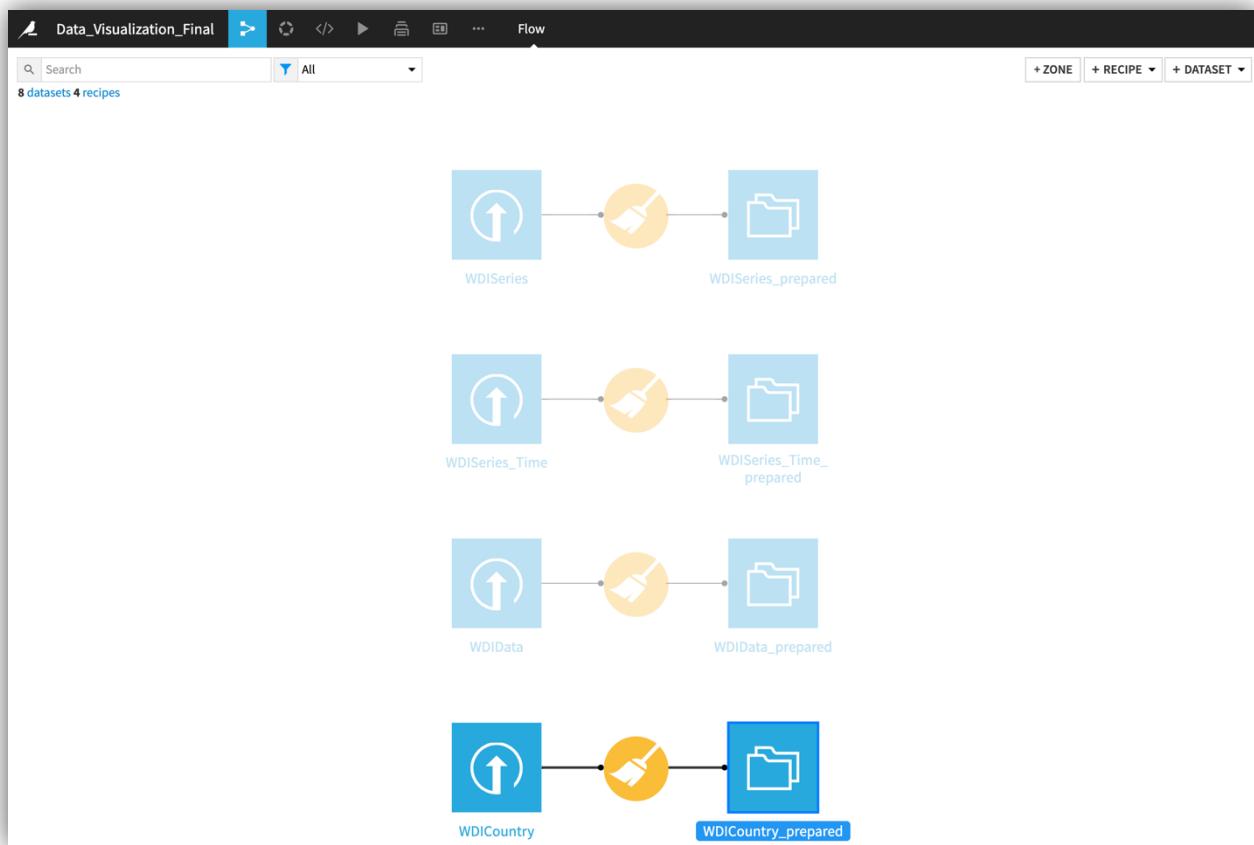
Data Source

The source of all of the data used for the visualizations are the World Bank. There are 4 relevant datasets:

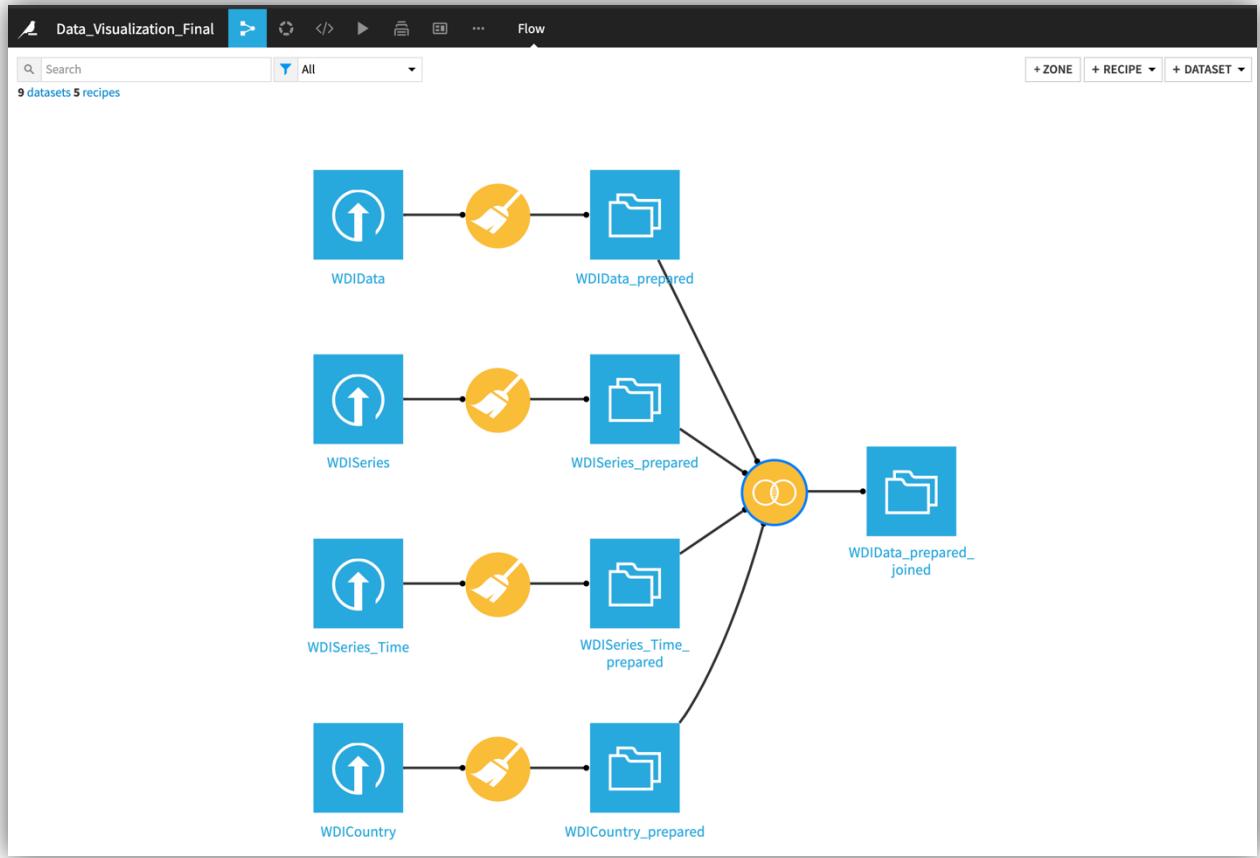
WDIData	<ul style="list-style-type: none">Provides yearly data on sustainable development topics in countries around the world
WDICountry	<ul style="list-style-type: none">Mapping file for geographical information, such as the country and region
WDISeries	<ul style="list-style-type: none">Mapping for descriptions of particular sustainable development topics
WDISeriesTime	<ul style="list-style-type: none">Mapping file for descriptions of particular sustainable development topics, in respect to the period in which the data was recorded

Data Preparation

Given that we only wanted to highlight observations in the new millennium, our data required a myriad of data preparation before building data visualizations. Before joining the aforementioned datasets, several steps were needed to create a wholesome dataset of all data points between 2000 and 2020. The first was [folding multiple columns](#), which takes values from multiple columns and transforms them to one line per column. This was needed for the yearly columns. The second preparation included removing irrelevant columns, or columns that were not needed for the analysis.



Lastly, we combined all datasets to create a single one with data pertaining to geographical and sustainable development information.



New Sustainable Development Insights

There are five subjects we were interested in learning about and reporting on to understand their influence on global prosperity:



What is particularly interesting about these aforementioned topics is the combined effect of their relationship. For example, the relationship between fertility and education is expected and promising. It is understood that education is a leading cause of lower fertility rates; so much so, that the world's population in 2100 could be no higher than it is today mainly due to greater parts of the population becoming educated, particularly women.¹ The education by gender gap articulates a need for educational improvement for women in less developed regions. Furthermore, the type of education received by more affluent students is much different than the education received by less affluent students resulting in a large gap. Not only is educational infrastructure generally underfunded in areas in which disadvantaged youths live², they are likely to not learn fundamental material in subjects such as English and Mathematics, especially via online education during the pandemic.³ Fortunately, with data from the World Bank, we are able to dig much deeper into these subjects to learn more!

¹ The Economist: Thanks to education, global fertility could fall faster than expected.

<https://www.economist.com/international/2019/02/02/thanks-to-education-global-fertility-could-fall-faster-than-expected>

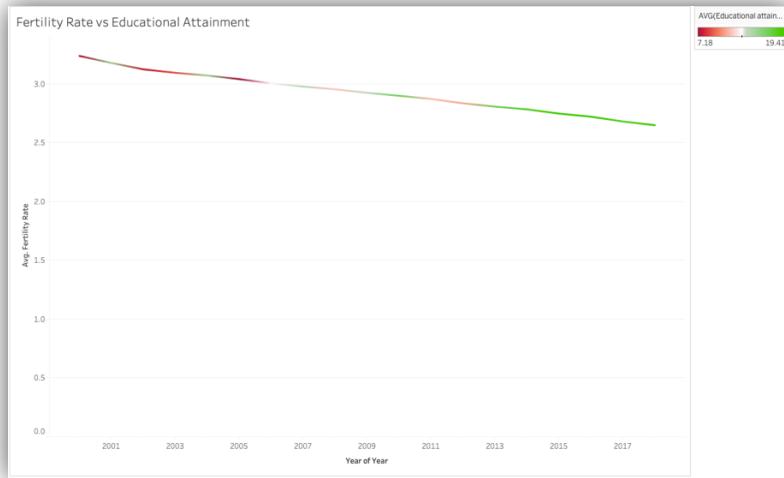
² US News: In Most States, Poorest School Districts Get Less Funding. <https://www.usnews.com/news/best-states/articles/2018-02-27/in-most-states-poorest-school-districts-get-less-funding>

³ The Economist: The pandemic is widening education inequality. <https://www.economist.com/graphic-detail/2020/07/27/the-pandemic-is-widening-educational-inequality>

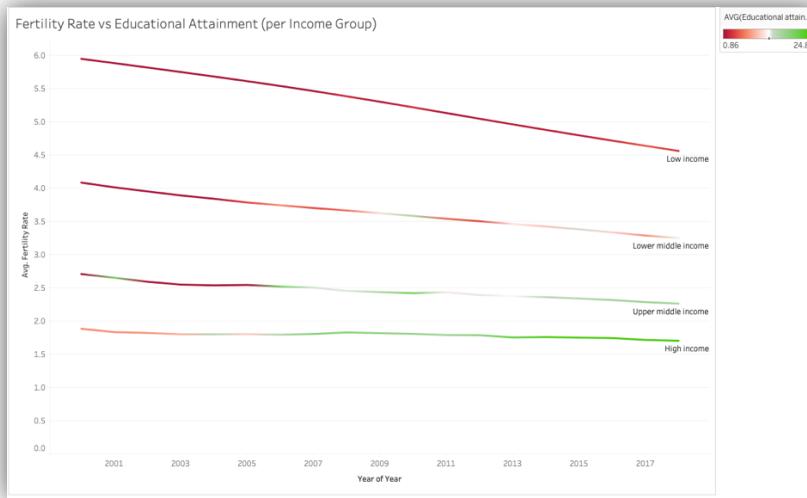
Visualizations

Fertility vs Educational Attainment

The following visualization compares average fertility rate (total of births per year) to Educational attainment throughout the years. This metric is calculated for the people older than 25 years who have attained or completed their Bachelor's degree (or equivalent).

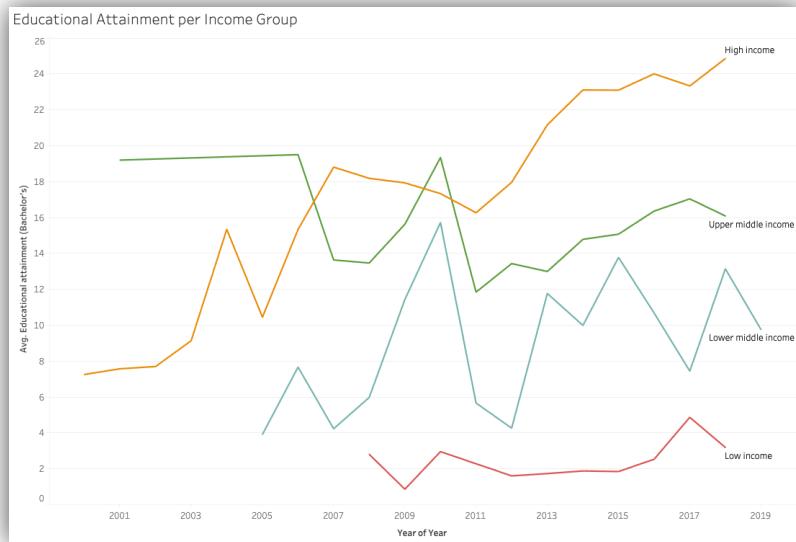


There is a clear tendency through the years of the average fertility rate going down, and at the same time, educational attainment is increasing, starting at 7.26% of the population getting their bachelor's degree and finishing in 2017 at a 19.19%. It seems highly correlated, but to be sure we added the income groups to analyze if this is a general tendency for all of them.



The same analysis applies to lower middle income, upper middle income and high income which have a tendency of growth. But on the other hand, for low income, the fertility rate lowering trend is decreasing more than the other ones and the growth in education is not very clear.

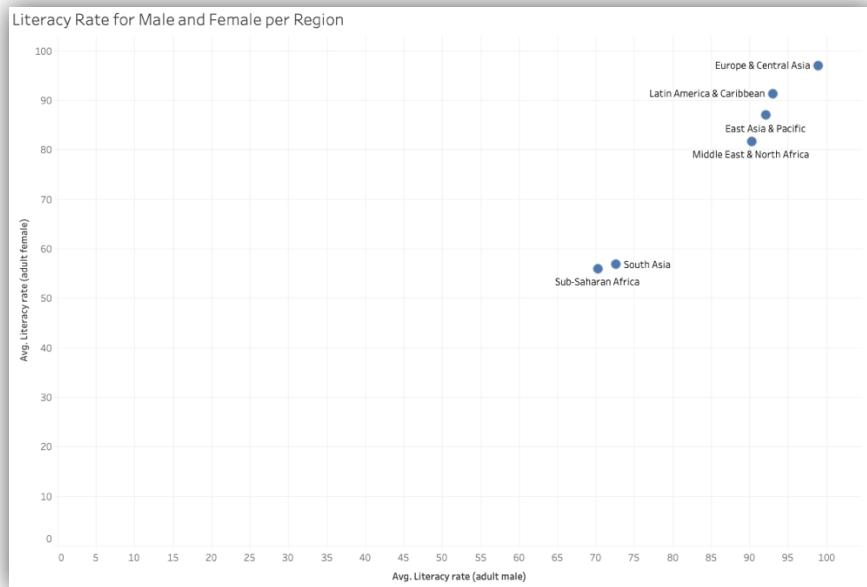
Education and Income



As you can see more clearly here, for low-income populations the educational attainment has a small peak in 2017 but decreases to 3.2 on 2018, very similar to the first couple of years. It seemed the correlation between fertility rate and education was very clear but when including income, it becomes unclear, from what we can conclude that there are more factors affecting the relation between this metrics.

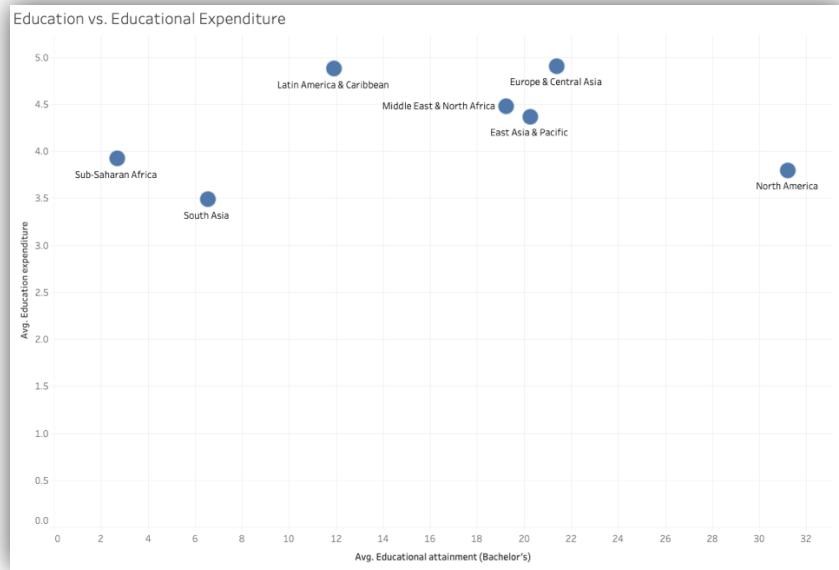
Literacy Rate

The next chart compares Literacy rate between male and female population for each region. Literacy is calculated covering population from ages 15 and older who have passed through basic primary and have acquired a basic knowledge of literacy and numeracy skills.



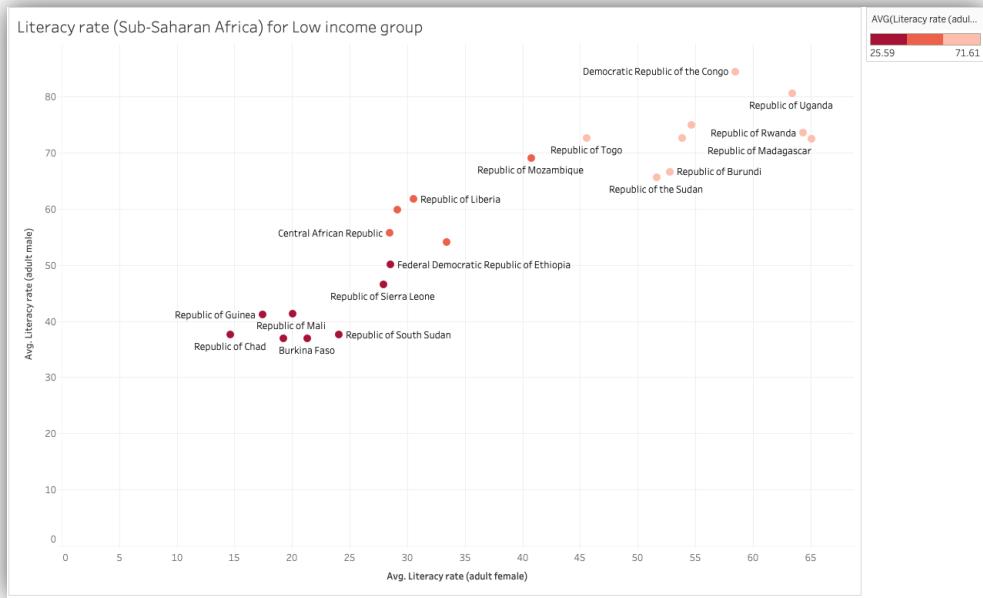
There is no data available for North America. Europe & Asia have the highest Literacy rate, both for male and female population followed by Latin America, East Asia & the pacific, and Middle East & North Africa. As you can see the range between male and female literacy starts to widen in East Asia & Pacific and Middle East & North Africa. South Asia and Sub-Saharan Africa are the regions where the Literacy difference between male and female is wipher, with males between 70 and 73, and females around 56.

To analyze this furthermore we compared Educational Expenditure to Educational attainment by region:



Where educational expenditure is calculated by dividing the total Government expenditure on education and dividing it by the GDP. With this visualization we found some interesting insights:

- The educational expenditure for North America is one of the lowest, however the Educational attainment for bachelor's degree is by far the biggest one.
- Even though Sub-Saharan Africa doesn't have the lowest educational expenditure, they do have the lowest Educational Attainment. This could mean the GDP for this region is lower than South Asia so the impact on education may be less even if the government educational expenditure is higher.
- Finally, we analyzed the literacy rate for male and female for Sub-Saharan Africa, and this time, filtering by the low-income groups and highlighting the literacy rate for the whole population into 3 colors to group the impact.



As you can see in this visualization, even though we are filtering for low-income, the results are not stacked on lower literacy, but instead the spread of the data points are evenly distributed.

A general insight is that Literacy rate is lower for the female population than the one for male population. For example, Countries like Republic of Uganda and Democratic Republic of Congo have a literacy rate for men of 80 and 84, and women 63 and 58.

We can also find a very low literacy set of countries where the maximum literacy rate for men is near 40 and for women 24. This may be due to a number of causes including conflict, poverty and even culture.

Arms and conflict

The following graphs represent both arms export and import.



Both metrics are represented by the sales and distribution of major conventional weapons, such as aircrafts, armored vehicles, artillery, etc. and excluding other military equipment such as small arms and light weapons.

The intensity of the color represents which countries sell or buy arms on open sources. Meaning India is the country which buys the most, followed by China and Saudi Arabia.

Also the United States seems relevant while importing but when we look at the exporting graph, we notice only a few major players from which the United States is by far the most relevant followed by the Russian Federation.

Adding on this notion, we looked at a totally different concept which is “People displaced by armed conflicts” and the findings were shocking.



None of the arms dealership leading countries have displacement conflict issues, while countries like Colombia, Sudan or Syria have a high displacement index.

Conclusions

Fortunately, the world is progressing in many areas. Larger parts of the population, especially women, are gaining access to education; something that is reassuring and unprecedented. Similarly, literacy rates are improving albeit more so for men than for women. If we are able to address this gap, we should expect to see a rise in economic growth. On the other hand, the world is regressing in other areas, such as income and arms trading. Over the past half century, the highest 20% of US households have steadily brought in a larger share of the country's total income. This should come as no surprise given that income inequality in the US is the highest of all the G7 nations.⁴ Furthermore, the stability of many countries is dependent upon their military spending; in other words, the rise in military spending tends to cause greater instability.⁵ Although we have made several strides in the right direction, there is still a lot of work to do around the world for peoples of all backgrounds to live safer and more prosperous lives.

⁴ Pew Research Center. 6 facts about economic inequality in the U.S. <https://www.pewresearch.org/fact-tank/2020/02/07/6-facts-about-economic-inequality-in-the-u-s/>

⁵ The Economist: Why the global arms trade is booming. <https://www.economist.com/the-economist-explains/2017/03/07/why-the-global-arms-trade-is-booming>