WaterWeDoing

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Abstract

Around 771 million people don't have access to safe drinking water around the world [1], and the lack of safe water coverage, sanitation, and hygiene facilities remains a significant challenge in many developing countries. A common misconception is that countries are sufficient in water coverage as long as they have access to water. However, this does not guarantee that the water is safe to drink and clean for use. It also doesn't guarantee that the water is distributed evenly throughout the country. To address this issue, we developed an interactive dashboard to present comprehensive data on service level factors in water, sanitation, and hygiene. We hypothesized that if water coverage was lower in certain regions, then sanitation and hygiene would be lower as well. Our goal was to make it easier for policy makers to understand the challenges presented in water and identify areas that require more attention. The results we received suggest that the dashboard helped identify gaps in coverage and prioritized the need for interventions to improve access to sanitation and hygiene facilities. Our project highlights the need for continued efforts in improving safe drinking water and promoting long-term sustainable sanitation and hygiene facilities.

Introduction

The availability of clean water and proper sanitation and hygiene practices are crucial factors for the overall health and well-being of communities and individuals. Unfortunately, these necessities are not always easily accessible, especially in developing countries. Water coverage, hygiene, and sanitation are interconnected and should be addressed together to achieve sustainable outcomes. We aim to explore the relationship between these factors and understand a holistic approach that is necessary to ensure that communities have access to clean and safe water and proper sanitation facilities and move into the adoption of hygienic practices. Not only did we aspire to establish the relationship between water coverage, hygiene, and sanitation, but we also wanted to see if the gross domestic product (GDP) was potentially the underlying factor influencing all three factors. GDP is the total value of goods produced and services provided in a country during one year and is a good indicator of the wealth of a country. We had several project goals that we hoped to implement on an interactive dashboard. To begin, we aimed to consolidate the status of clean drinking water globally by allowing the user to select data based on country and service level. We also hoped to find trends in drinking water supplies that can be created using country and year filters. We can also determine areas of inequalities between regions and therefore visualize the coverage of drinking water in different regions. Another goal is to investigate the difference in suppliers across different residency types based on user selection, whether that be rural or urban. Our working hypothesis was that trends between water coverage, sanitation, and hygiene as sanitation and hygiene are dependent upon access to clean water. Our work throughout this project is extremely significant because water is vital for human health. More concerningly, there is enough freshwater on Earth to supply everyone, and yet lack of clean water still poses one of the top global crises in the world today.

Methods

The data used in this project was obtained from the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation, and Hygiene (JMP) [2]. The household data we utilized provides detailed information on water, sanitation, and hygiene, including associated service levels and coverage percentages for each country across the world. To prepare the data for analysis, we used numpy and pandas arrays to filter the data by country and to focus on the coverage of the three topics. We then grouped the coverage data by service level, categorizing each service level into different variables depending on the topic. For example, available water coverage service levels have types of basic, limited, unimproved, or surface water. Additionally, we grouped by residence type including national, rural, and urban. Finally, we utilized Plotly graph objects to generate a choropleth map of all the countries, and Matplotlib to plot the coverage percentages of different variables across the years spanning from 2000 to 2020.

Analysis

In the creation of our dashboard, we developed many different outcomes utilizing a combination of different features.

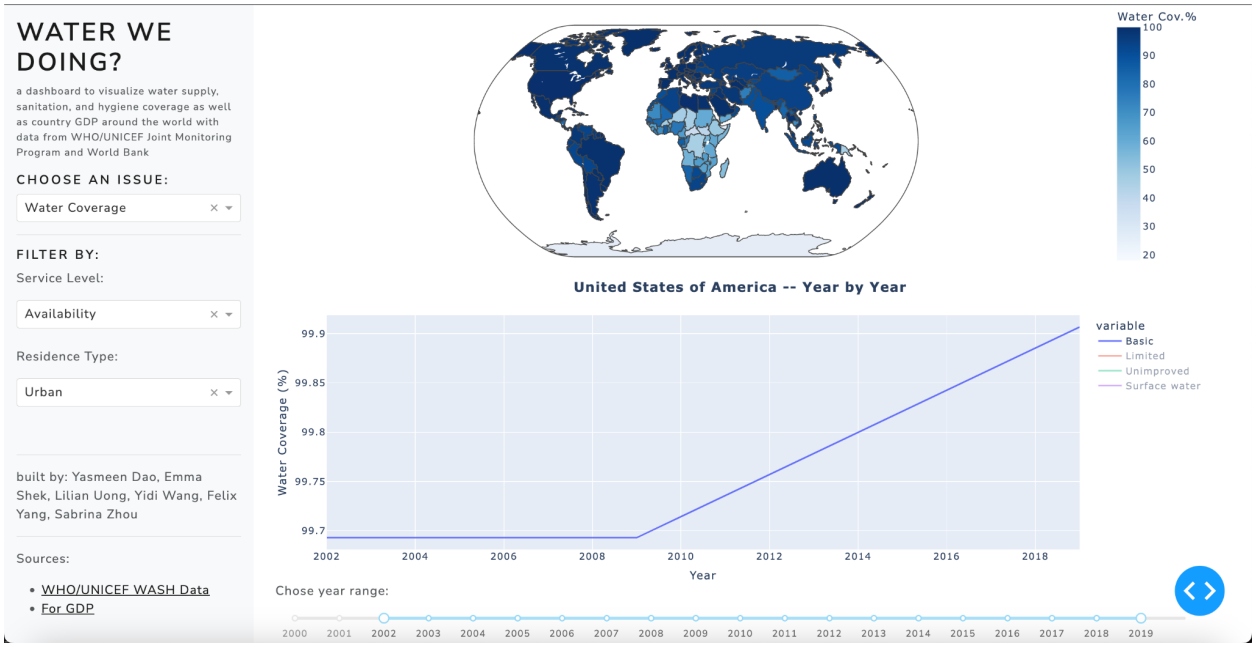

Fig 1: This is the final design of our interactive dashboard.

In support of our hypothesis, we found that countries with lower water coverage also experienced lower sanitation levels. The same was deemed true about hygiene coverage.

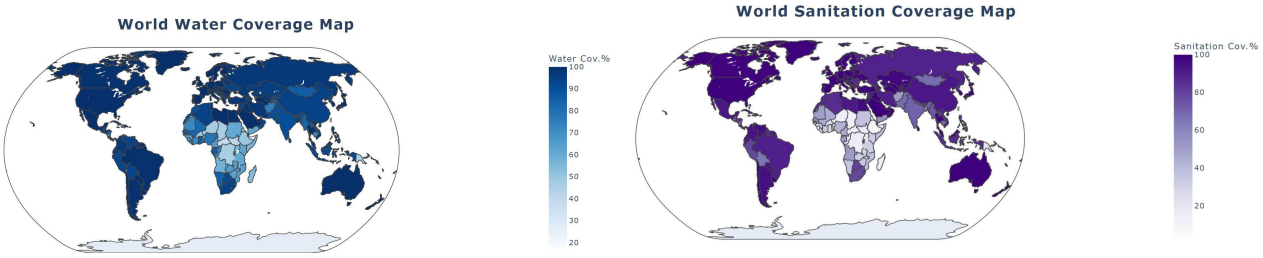

Fig 2: Side-by-side comparison of percentage water coverage versus percentage of sanitation coverage.

When examining the water coverage map and sanitation map side by side, we see that regions with insufficient water coverage also suffer from low levels of sanitation and vice versa. This ties into our research that the level of water coverage is directly correlated to levels of sanitation and hygiene. The inaccessibility to clean water determines a region's sanitation levels as it affects the day-to-day life of its inhabitants. From not being able to properly bathe themselves, effectively wash their hands, or adequately wash/grow food, those without a reliable source of clean water suffer dearly [1]. Due to their inability to access unsafe drinking water, almost 300,000 children under five die yearly from diarrheal diseases linked to their poor sanitation practices.

When utilizing our line chart feature, we can see that there, fortunately, has been an increase in water and sanitation coverage as a whole throughout the years.

Fig 3: Above graph shows sanitation coverage in Chad with basic service level availability. The graph below shows water coverage in Chad displaying piped and non-piped infrastructure service levels for national residence.

Chad is one of the least developed countries however, in the above chart (Fig 3), the percentage of sanitation and water coverage seems to be increasing. This could be related to the investment in improving infrastructure and resources, such as building new sanitation facilities or improving access to water sources. The bottom chart specifically displays this conclusion where piped and non-piped infrastructure service levels are plotted. Piped water refers to water that is supplied typically from a central water treatment plant or well, to individual homes and businesses. These systems are more common in urban areas and are usually treated and tested to ensure that it is safe for consumption. On the other hand, non-piped water is supplied from wells or springs. It is generally apparent in more rural areas such as Chad. Although the amount of water coverage is increasing in Chad, the Non-piped service level of water provides more water coverage than the piped. Non-piped water may be more sustainable and cost-effective, but it can also pose health risks if not properly managed and treated. Nevertheless, these charts show signs of improvement in the sanitation and clean water coverage of a less developed region.

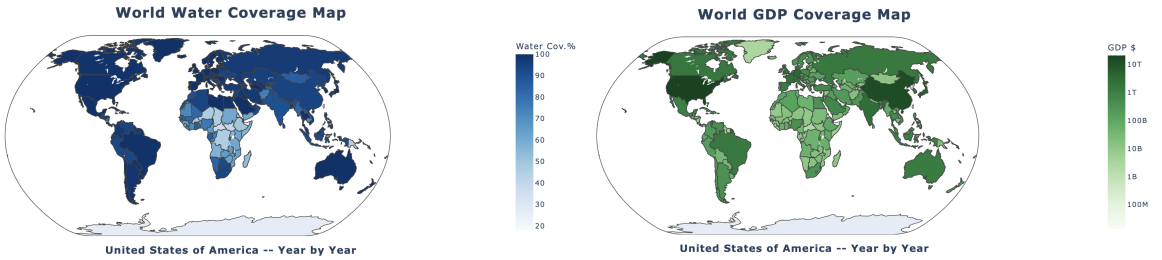

Fig 4: Side-by-side comparison of percentage water coverage versus GDP.

Based on the coverage maps above, it is interesting to see the inconsistencies between water coverage and GDP. Despite our initial hypothesis that a higher GDP would imply a high water coverage, and vice versa, our maps provide some surprising insights. It is evident that some countries prioritize water coverage more than others and policies must be implemented to push for change in those with lower water coverage percentages.

It is important to note that water coverage is not just about access to water sources but also the quality of water. It is crucial to address not only the quantity but also the quality of water available.

Conclusions

After implementing the dashboard, our project has highlighted the critical need for improved sanitation facilities and hygiene practices in less developed countries. We discovered that GDP is an underlying contributor to a country's access to quality water, but not a perfect indicator of quality water. Wealthier countries generally tend to have greater investments in infrastructure and resources. Some countries with a lower GDP, like Greenland, appear to have close to 100% water coverage, which is similar to countries with higher GDPs. This contrasts countries in central Africa which have GDPs similar or even greater than Greenland, and still fall closer to 50% water coverage. From a policy maker's point of view, this can be used as leverage to push for reform for the overall health of the population. It also indicates that the distribution of resources is not being allocated efficiently in less developed regions. Adding on, the residence types of urban and rural weren't as effective in determining trends because most less developed countries that had lower water coverage have generally more rural areas. While our findings have shed

light on the distribution of water coverage and regions that have limited accessibility, we acknowledge that our project has some limitations. First, our data collection displays data across each country. Therefore there may be a lack of granularity and a limited scope. For example, within each country, there might be more information about the specific quality of sanitation facilities or amount of villages/towns that have access to them. Second, the dataset doesn't provide enough contextual information to understand the underlying causes of water and sanitation challenges within a country. We only touched on GDP as a contributor, but many contributing factors such as war, poverty, and disease aren't represented. Therefore, we can only make general assumptions about the likely causes of increased or decreased water, sanitation, and hygiene factors. This can limit the ability to develop defective policy interventions or solutions. Despite these limitations, we believe that our project has made a significant contribution to the understanding and importance of water quality availability. We hope that our findings will be used to inform policy and action in generating effective tools to improve the lives of those living in these countries.

Author Contributions

Everyone contributed to the initial design of the dashboard and presentation. Felix Yang performed the data cleaning operations, and the final implementation of the map, and connected all the tools to the dashboard. Yidi Wang worked on the research of Python packages and the initial implementation of the map. Lilian Uong and Yasmeen Dao worked on the coverage graph and organization of the GitHub files. Emma Shek and Sabrina Zhou worked on creating the interactivity of the dashboard, the drop downs and sliders, and connecting to the graph. Emma Shek, Sabrina Zhou, Lilian Uong, Yidi Wang, and Yasmeen Dao contributed to the final report write-up.

References

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