Team Space X

HACKERTON SUBMISSION REPORT

Health Facilities Assessment and Identification of Optimal Suitable Locations using GIS

In

Zamfara State, Nigeria.

DSN Data Science Nigeria

Meta

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1.0 Introduction

Despite Nigeria's strategic position in Africa, her healthcare sector is still inadequate and underserving. According to World Health Organization, Nigeria's healthcare system ranks as one of the worst in the world.

According to The ONE Campaign in partnership with National Advocates for Health, Nigeria Health Watch, Public & Private Development Centre (PPDC), 18 out of the 36 states and the Federal Capital Territory have fragile health systems. Zamfara is a state in the North-Western part of Nigeria, and its capital city is Gusau. This state is recorded to be the state in Nigeria with the most difficult access to Primary Healthcare.

According to the Basic Health Care Provision Fund (BHCPF), Zamfara state is the state with the most difficult access primary healthcare in Nigeria. Zamfara is ranked the poorest state in terms of Healthcare in Nigeria, out of the 18 states with fragile healthcare system (Sahara Reporters, 2022).

Zamfara State has an estimated population of 5,833,500 people as of March 2022 (National Population Commission of Nigeria, National Bureau of Statistics). There are 14 Local Government Areas and 139 Wards in the state.

This report detailed every steps that was carried out to achieve the objectives and aim of this project.

1.1 Aim and Objectives of the Project

The aim of this project is to develop a notebook and a webGIS platform that can be used to measure accessibility of healthcare facilities in Zamfara state and also identify locations that are suitable to site health facilities. The objectives of the project are as follows:

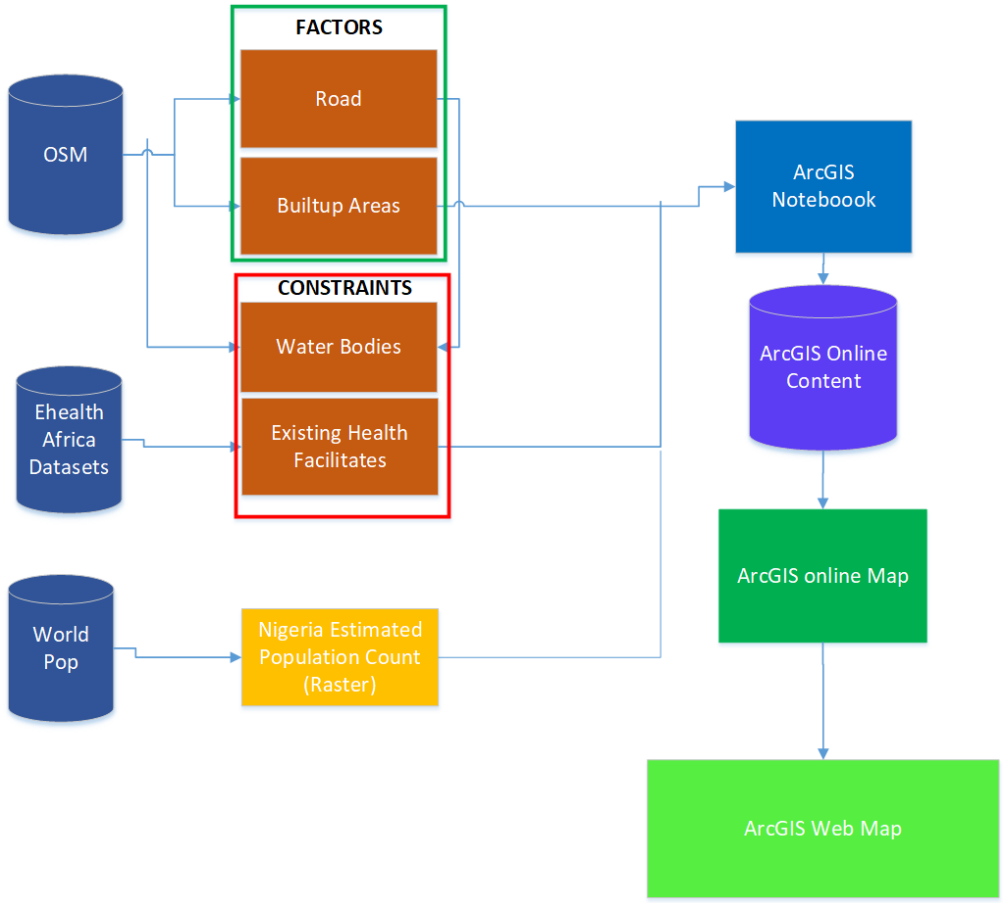
- Facebook movement range data was used to understand the movement of people within the state, this aids us in setting our distance buffer around the existing hospitals and around the road network.
- To know the population of people within 500m radius of the existing health care facilities
- To identify the most suitable areas to site healthcare facilities.
- To identify areas with low accessibility to healthcare facilities
- To validate the health care facilities data and identify non-existing health centers

1.2 Purpose of the Project

- This project will help government, policy planners, and health practitioners intending to open new healthcare facilities, know the suitable locations to site new health facilities in the wards and LGAs in Zamfara State.
- It helps individuals know the nearest valid or existing healthcare facilities to them.
- This project serves as an eye-opener to areas/locations within the state that are underserved, i.e. highly populated areas with low access to healthcare facilities.

1.3 Methodology

The aim and objectives of this project was achieved using Python on ArcGIS Online Notebook and ArcGIS Web Map. The Notebook was divided into two sections, section one for Data analysis and section two for Geospatial analysis. Before the analysis, data used in this project was uploaded to the Notebook home folder, which is the path all data and solution were saved for future references.



Workflow

1.4 Data Used

Data	Source	Format
health care facilities - point	eHealth Africa	GeoJson(vector)
road - polyline	Openstreetmap	GeoJson (vector)
residential area - polygon	Openstreetmap	GeoJson(vector)
Zamfara Admin - polygon	grid3.gov.ng	GeoJson(vector)
water_body - polygon	Openstreetmap	GeoJson(vector)
water way - polyline	Openstreetmap	GeoJson(vector)
Nigeria Population	datagrid3.gov.ng	Geotiff(raster)

1.5 Data Analysis

The healthcare facilities dataset was loaded into the ArcGIS Online Notebook using python geopandas framework. Python framework for data analysis and visualization (Pandas and seaborn) was used to analyze the attributes information of the healthcare facilities dataset, the following analysis was carried out;

- Total number of health care facilities in the different LGAs and Wards across the state
- Count of the Healthcare Facilities categories.

1.6 Geospatial Analysis

The python libraries used for the Geospatial Analysis include: Rasterio, Geopandas, ArcGIS Python API. These are the steps followed in carrying out the geospatial analysis:

Step 1: Facebook Movement data was analyzed to understand the mobility of people within the state. Distance buffer used in this analysis was determine based on movement of people within the study area.

Step 2: A buffer of 5km was created around the healthcare facilities and was overlaid on the raster population dataset, the buffer polygon was used to extract the population count within each polygon to know the total population of people that are within the buffer region and see how many people each healthcare facilities serves.

Step 3: The constraints which are Distance to waterways, Distance to water bodies, and Distance to existing healthcare facilities were identified, all these identified layers were merged together as a single vector file (constraint)

Step 4: The important factors considered when siting a health facilities are distance to residential area and distance to road. Every Residential area that is within 100m distance to a road network were considered suitable for siting a healthcare facility. The 100m distance was selected due to the low movement index within the state according to Facebook movement data.

Step 5: Areas with low accessibility to healthcare facilities were identified by using the merged constraint vector to erase the residential polygon, the output of the area is a polygon file that depicts location that are underserved based on the defined criteria. The output polygon was used to run zonal statistics on the population raster layer to extract total population that are within the underserved area.

Step 6: The underserved area population were filtered, area with less than 1000 population are only exported and will be included in the web map.

Step 7: To generate the polygon that indicates the suitable area, the overlay function in geopandas was used the constraint layer to erase the factor layer. The final result is the suitable areas polygon that depicts location to site new healthcare facilities.

1.7 Building of Web Map

All output from the Geospatial analysis section of the notebook were saved in a single folder on ArcGIS online content, the data were all added to the ArcGIS online map view, the data was symbolized and arranged appropriately, the map application file was then converted into a web map where other functionalities such as zoom, imagery button, and many other functionalities were added to create a functional web map that enable users to click, hover, check and have different view to the data. ***The web App works better with Microsoft Edge.***

1.8 Results

- Facebook movement range data was analyzed to determine the distance that was specified when creating a buffer around health facilities and road network in this analysis.
- From movement range analysis, we found out that the daily average movement index and the average mobility change per day index is very low in Zamfara State across all days of the week, this denotes that there is very low movement range within the state.
- Using the underserved population layer enable users to identify optimal areas that need health care facilities.
- The suitable layer, shows area that are suitable for siting health facilities across the states.
- The valid health centers point shows health centers that exist in locations where people live at least 500m buffer around it, other health centers that cannot be validated show that they are points that fall within a bush, farmland or water body when overlaid on a satellite imagery, therefore they do not exist.

- The buffer layer, is the 1km buffer around the healthcare facilities.
- The Zamfara State, Ward, LGA Boundaries enable users to streamline their data view to a specific Ward or LGA
- The infographics button allows users to have access to more information such as the total valid health care facilities, counts of different categories of health facilities across the state. The Grid3 Population Estimate data shows the Estimated Population Distribution.

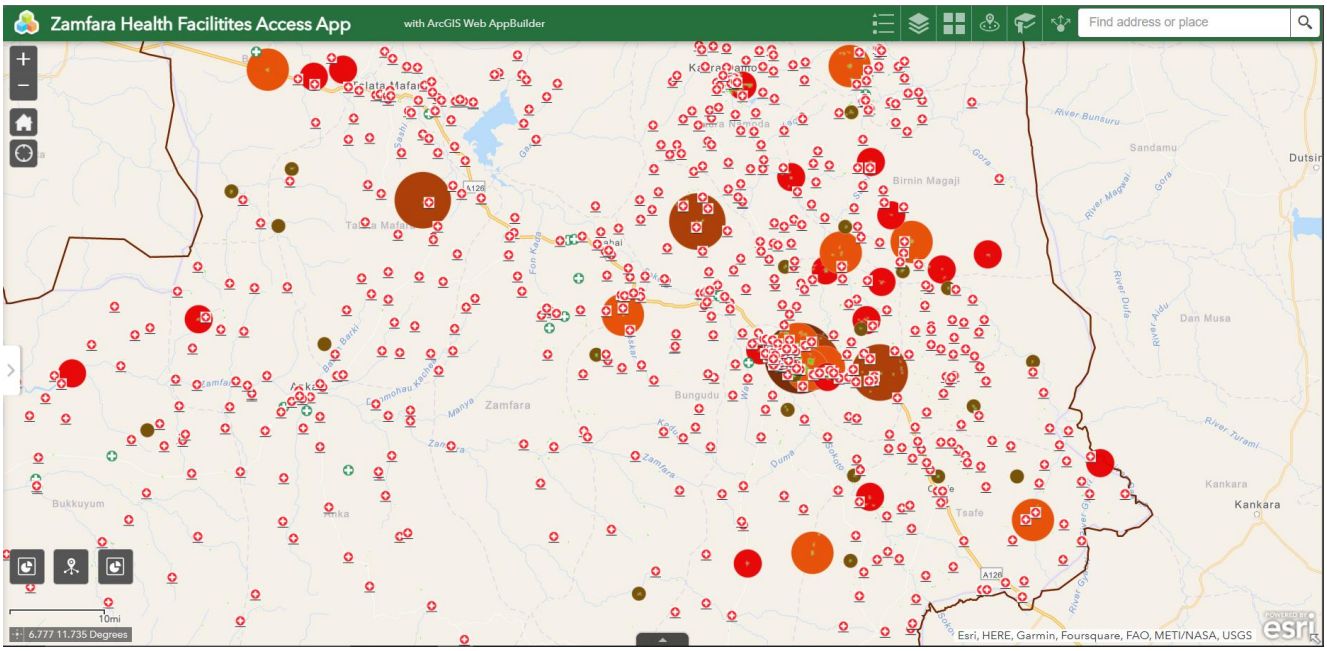
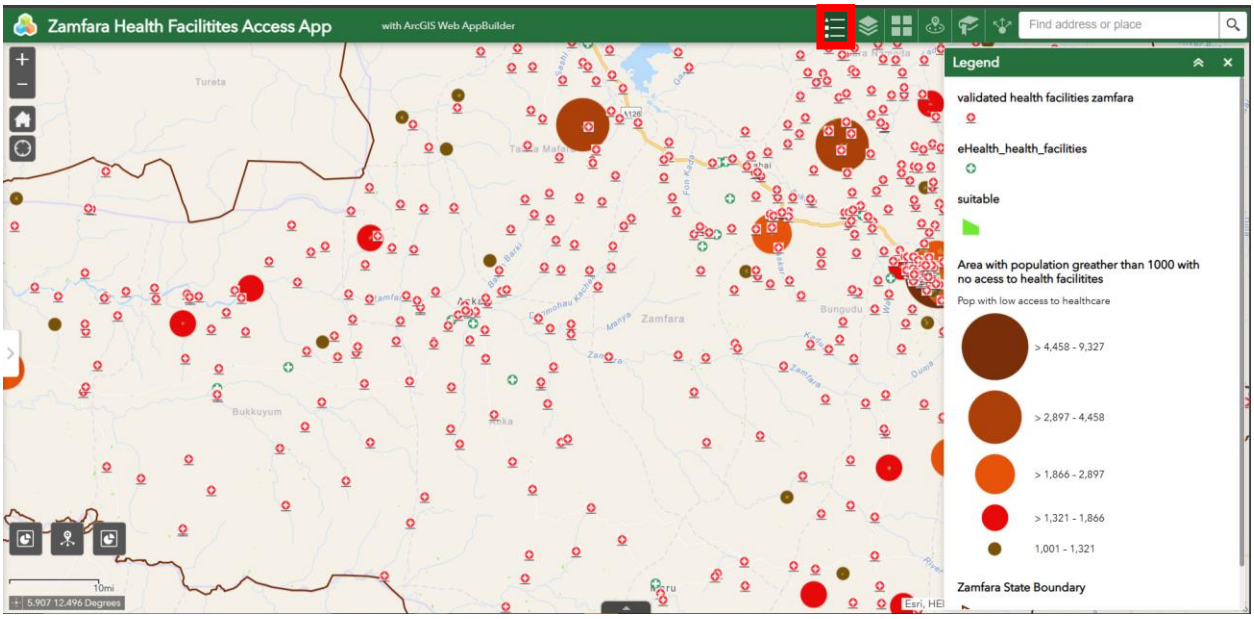


Figure 1: The web map view.

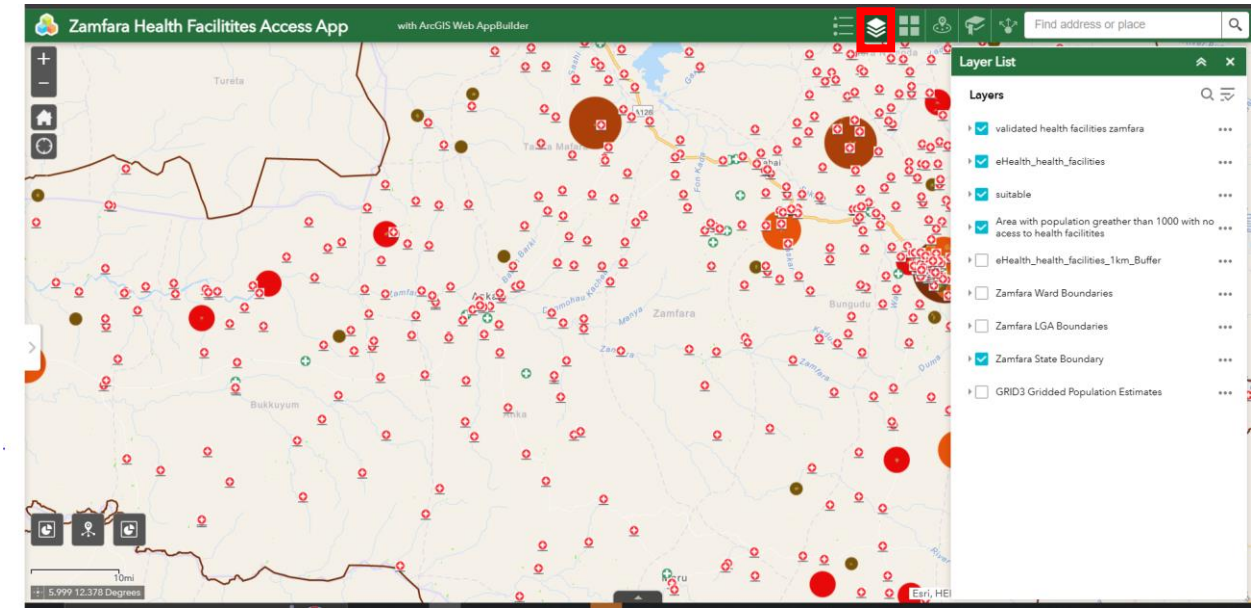
Link to the web map:
https://africageoportal.maps.arcgis.com/apps/webappviewer/index.html?id=129ec4eac15c42e9878df1361ff55d25

1.8.1 WEB MAP BUTTONS AND ITS FUNCTION

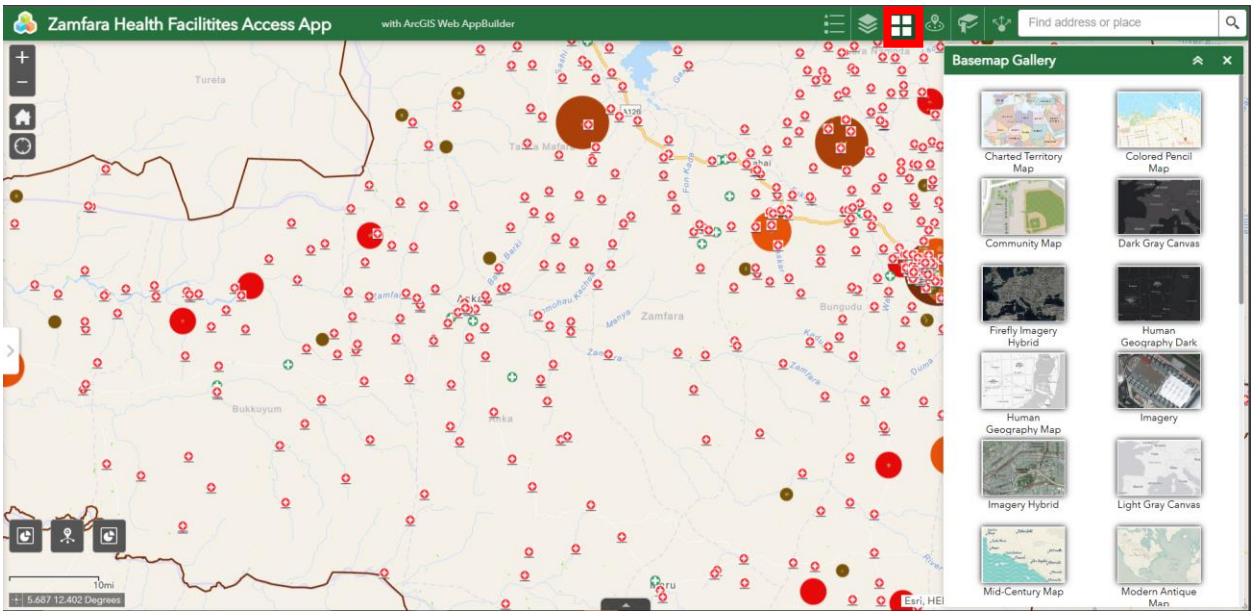
I. Legend: The legend shows what each symbols mean.



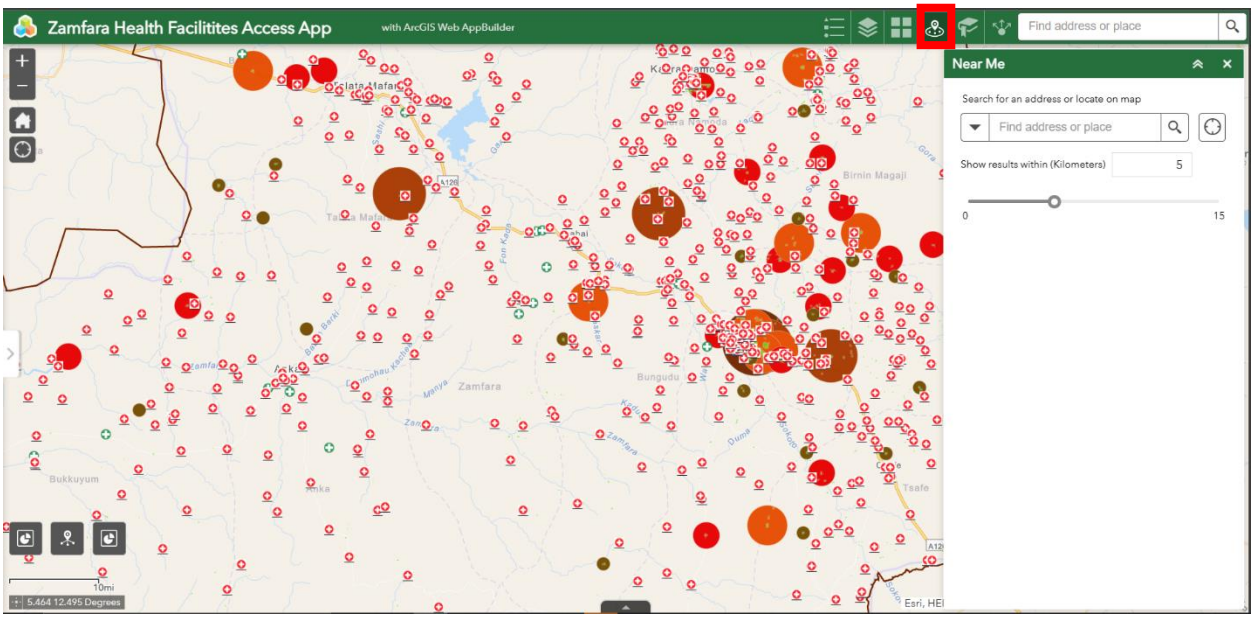
II. Layer List: This shows the layers of dataset used, and it can be checked or unchecked.



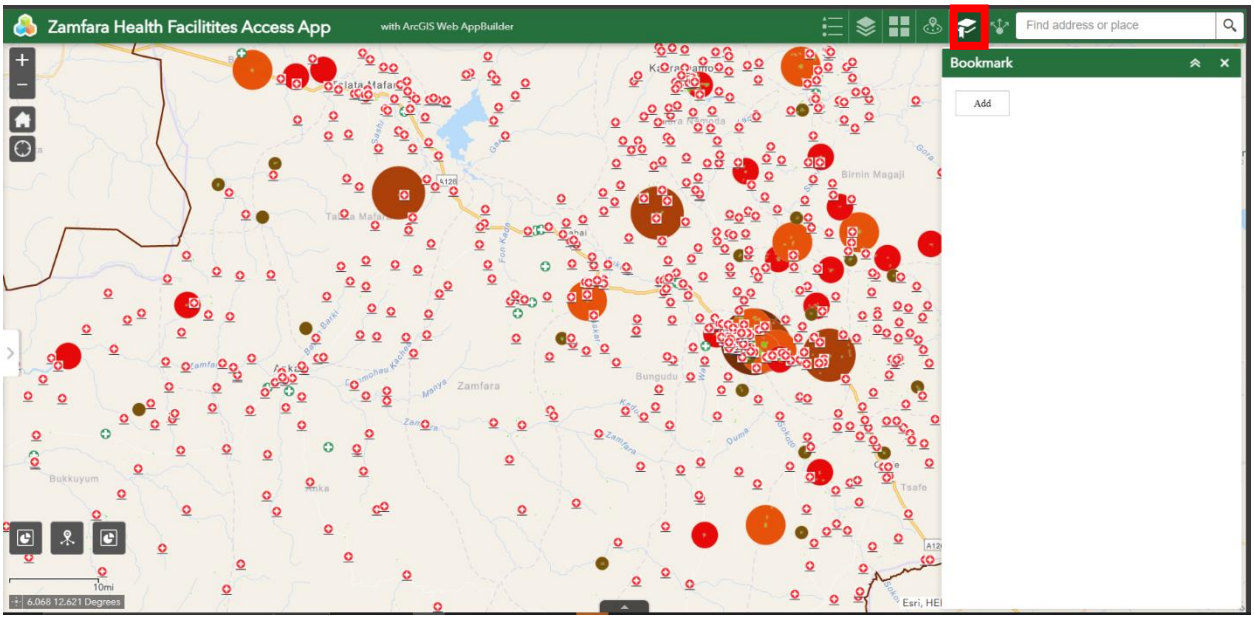
III. **Base map Gallery:** This shows the various kinds of base map that can be selected



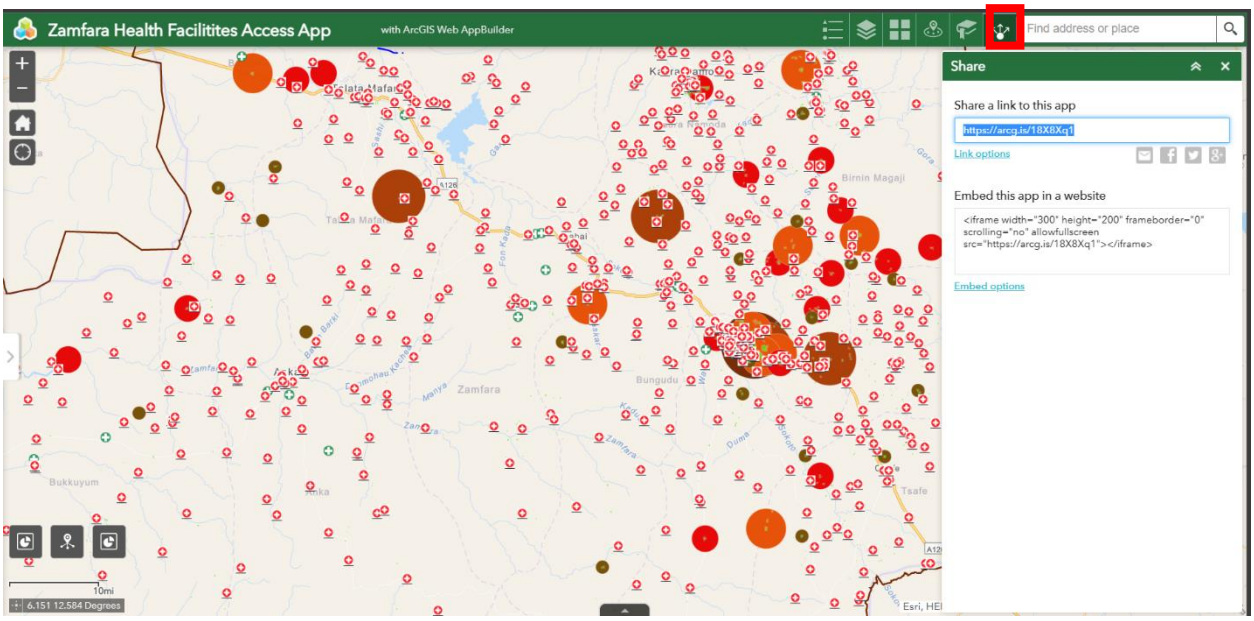
IV. **Near Me:** This functionality enables users to find an existing valid health care facilities around a particular radius of their locations.



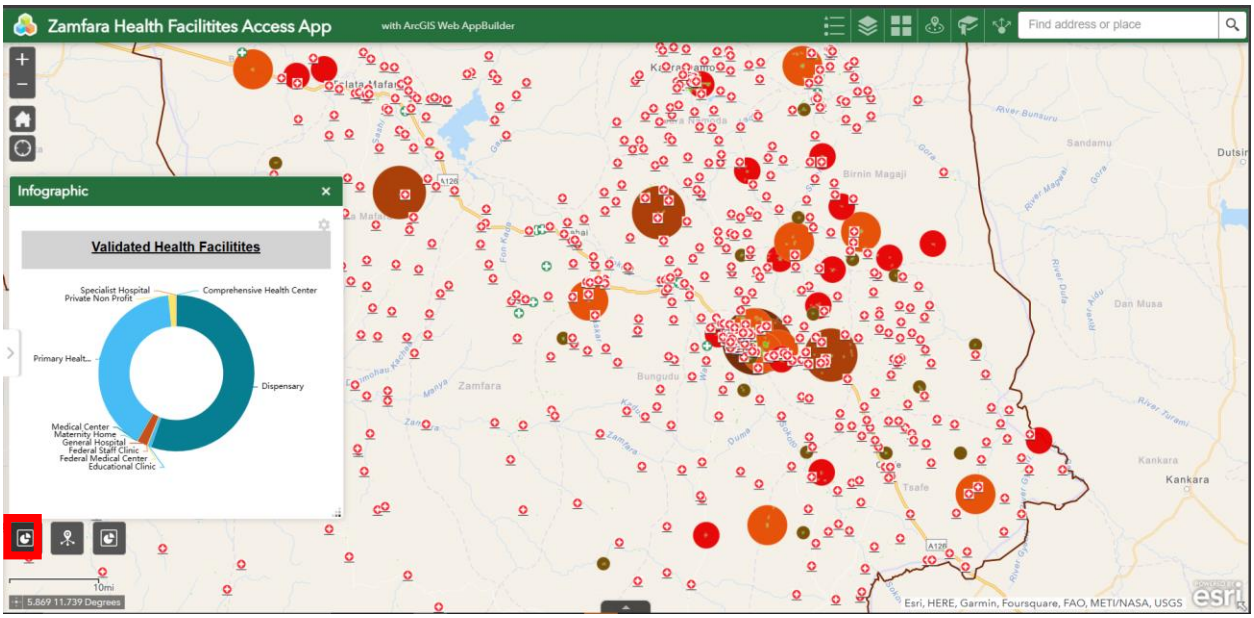
V. Bookmark: Users can bookmark their search or current view for later use



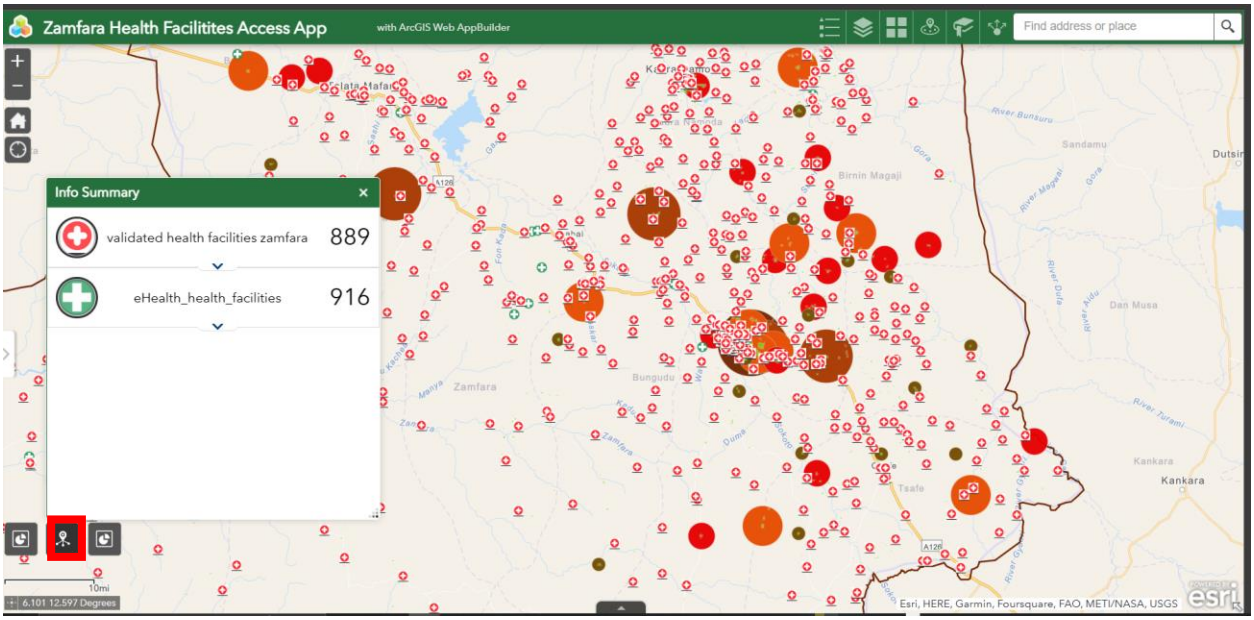
VI. Share: This button makes the app easily shareable and can also create a link that can be used to embed the app in other applications



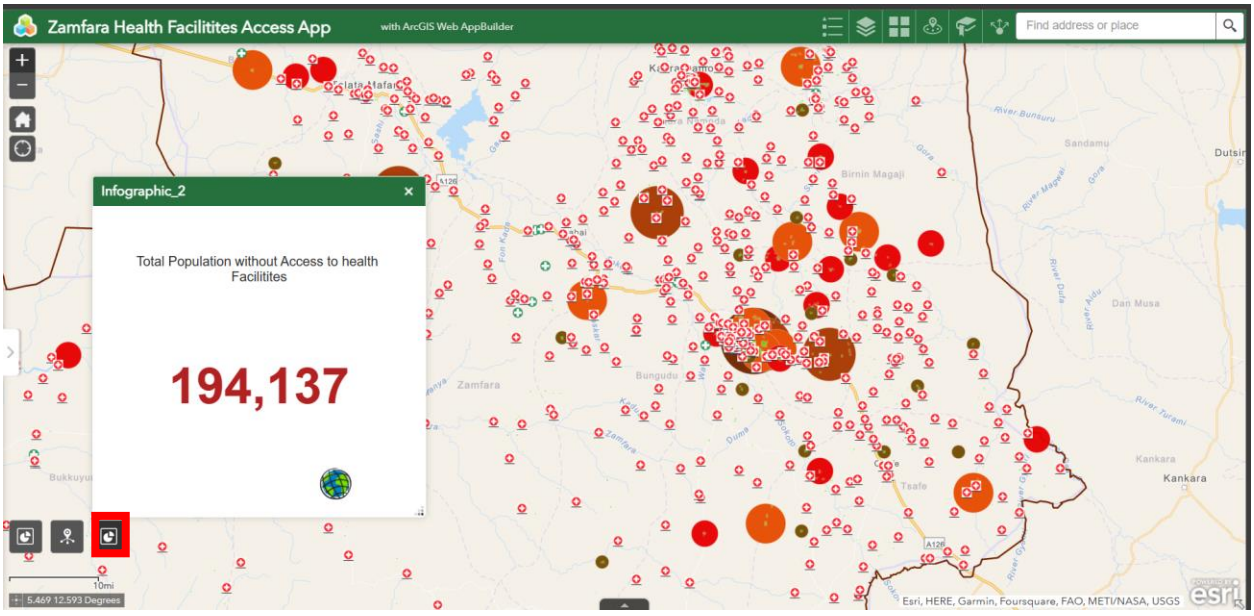
VII. Infographics: It contains a pie chart that shows the distribution of health facilities categories in Zamfara State.



VIII. Info Summary: This show the list and total validated health care facilities location against the total Health facilities points in Zamfara State.



IX: Inforgraphics_2: This shows the total population that have low to no access to health facilities in the state.



1.9 CONCLUSION

Healthcare accessibility is one of the most significant measurement of health care performance in a particular location, this application will help individuals to know the existing health care facilities around them, and it will also aid Government and NGOs to identify locations that needs urgent health intervention in the state. The Application also recommend locations that are suitable to constructing health care facilities in the state. The app also provides an overview to different population that have access to the facilities.

1.10 LIMITATIONS OF THE STUDY

- Unavailability of Facilitates condition data such as number of bed spaces and beds in the facilities, number of doctors available in each facilities, etc.
- Inability to identify government lands or open space where health facilities can be built, this will help to stream line our accessibility analysis to the smallest unit.
- Time Constraint: There was only a limited time available during this project.
- The movement range data for Zamfara State is only available for the State Capital LGA, Gusau, so the movement for other areas were assumed based on Gusau LGA.

References:

Nigeria improves on WHO health system ranking, says ACPN. (2021, November 26). The Guardian Nigeria News - Nigeria and World News. https://guardian.ng/news/nigeria-improves-on-who-health-system-ranking-says-acpn/

GeoPandas 0.12.1 — GeoPandas 0.12.1+0.g195f70b.dirty documentation. (n.d.). Geopandas.org. https://geopandas.org/en/stable/index.html

Rasterio: access to geospatial raster data — rasterio documentation. (n.d.). Rasterio.readthedocs.io. https://rasterio.readthedocs.io/en/latest/

GRID3 Nigeria Gridded Population Estimates, Version 2.0. (n.d.). Data.grid3.org. Retrieved January 11, 2023, from https://data.grid3.org/maps/GRID3::grid3-nigeria-gridded-population-estimates-version-2-0/about