Philippine Library Accessibility Navigator (PLAN)
User Manual

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Chapter 1

Philippine Library Accessibility Navigator (PLAN) User Manual

Welcome to the user manual for the Philippine Library Accessibility Navigator (PLAN). This guide will help you install, configure, and use PLAN effectively.

1.1 Overview

The Philippine Library Accessibility Navigator (PLAN) is a powerful tool designed to help you analyze the accessibility of libraries across various barangays in the Philippines using the Enhanced Two-Step Floating Catchment Area (E2SFCA) method. This manual will provide you with comprehensive instructions and guidance on how to make the most of this tool.

1.2 Sections

1. **Introduction**: An overview of the PLAN project, its purpose, and the intended audience.
2. **Installation**: Detailed steps for installing PLAN and setting up the necessary environment.
3. **Configuration**: Instructions for configuring PLAN, including setting up environment variables.
4. **Admin**: How to set up PLAN as a developer or administrator.
5. **User**: How to run the application, navigate the interface, and interpret results.
6. **Contributing**: Guidelines for contributing to the project.
7. **Appendices**: Additional resources, acknowledgments, and license information.

Chapter 2

Introduction

2.1 Project Description

Philippine Library Accessibility Navigator (PLAN) allows researchers to analyze the accessibility of libraries across various barangays in the Philippines using the Enhanced Two-Step Floating Catchment Area (E2SFCA) method.

PLAN assists users in identifying areas with low library accessibility and highlighting potential gaps in library services.

Unlike traditional GIS tools, **PLAN** provides a streamlined, web-based interface for performing spatial accessibility analysis without requiring extensive GIS expertise. The application is built using Streamlit, which allows for quick and interactive web application development. This ensures that users can easily navigate through the tool, upload data, adjust parameters, and visualize results without needing to install complex GIS software.

2.2 Purpose of the Manual

This manual provides detailed instructions on how to install, configure, and use PLAN.

2.3 Audience

This manual is intended for researchers, urban planners, and policymakers.

Chapter 3

Installing PLAN

1. Clone the repository:

```
git clone https://github.com/OpenLISPh/PLAN.git
cd PLAN
```

2. Create and activate a virtual environment, and install the required Python packages using Make:

```
make venv
make dev
```

```
● luke@DESKTOP-L1SDDAL ~/PLAN (main)> make venv
  `which python3` -m venv venv
  venv/bin/pip install -U pip pip-tools wheel --no-cache-dir
  Requirement already satisfied: pip in ./venv/lib/python3.10/site-packages (22.0.2)
  Collecting pip
    Downloading pip-24.0-py3-none-any.whl (2.1 MB)
       ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 2.1/2.1 MB 12.5 MB/s eta 0:00:00
  Collecting pip-tools
    Downloading pip_tools-7.4.1-py3-none-any.whl (61 kB)
       ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 61.2/61.2 KB 422.5 MB/s eta 0:00:00
  Collecting wheel
    Downloading wheel-0.43.0-py3-none-any.whl (65 kB)
       ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 65.8/65.8 KB 339.5 MB/s eta 0:00:00
  Collecting build>=1.0.0
    Downloading build-1.2.1-py3-none-any.whl (21 kB)
  Collecting pyproject-hooks
    Downloading pyproject_hooks-1.1.0-py3-none-any.whl (9.2 kB)
  Requirement already satisfied: setuptools in ./venv/lib/python3.10/site-packages (from pip-tools) (59.6.0)
  Collecting tomli
    Downloading tomli-2.0.1-py3-none-any.whl (12 kB)
  Collecting click>=8
    Downloading click-8.1.7-py3-none-any.whl (97 kB)
       ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 97.9/97.9 KB 475.1 MB/s eta 0:00:00
  Collecting packaging>=19.1
    Downloading packaging-24.1-py3-none-any.whl (53 kB)
       ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 54.0/54.0 KB 376.4 MB/s eta 0:00:00
  Installing collected packages: wheel, tomli, pyproject-hooks, pip, packaging, click, build, pip-tools
    Attempting uninstall: pip
      Found existing installation: pip 22.0.2
      Uninstalling pip-22.0.2:
        Successfully uninstalled pip-22.0.2
  Successfully installed build-1.2.1 click-8.1.7 packaging-24.1 pip-24.0 pip-tools-7.4.1 pyproject-hooks-1.1.0 tomli-2.0.1 wheel-0.43.0
```

Figure 3.1: make venv

```
luke@DESKTOP-L1SDDAL ~/PLAN (main)> make dev
venv/bin/pip-compile -o requirements.txt --upgrade requirements.in
WARNING: --strip-extras is becoming the default in version 8.0.0. To silence this warning, either use --strip-extras to opt into the new default or us
e --no-strip-extras to retain the existing behavior.
#
# This file is autogenerated by pip-compile with Python 3.10
# by the following command:
#
#    pip-compile --output-file=requirements.txt requirements.in
#
altair==5.3.0
    # via streamlit
```

Figure 3.2: make dev

3. Start the PostgreSQL server with Docker:

```
make db
```

```
luke@DESKTOP-L1SDDAL ~/PLAN (main)> make db
docker run -d --rm \
-p 5432:5432 \
--name postgres \
-e POSTGRES_USER=devUser \
-e POSTGRES_PASSWORD=devPassword \
-e POSTGRES_DB=library_db \
-e TZ=Asia/Manila \
-v /home/luke/PLAN/data:/var/lib/postgresql/data \
postgres:16.3-alpine3.19
69e7bf7bd707823e15a7ff6b4513a2f0c9c49b2521d3c91701c17e66d5dd13ea
```

Figure 3.3: make db

Chapter 4

Configuring Plan

1. Obtain a Google Maps API key from the Google Cloud Platform.
2. Copy `.env.example` to `.env` and fill in the values.

```
cp env.example .env
```

Chapter 5

Running PLAN as an Administrator

1. If you are a developer running your own instance of PLAN, start here. Otherwise, skip this step and proceed to user.

- You will need to ingest data first using the admin interface.

5.1 Navigating the Admin Interface

When accessing the admin interface for the first time, you will see an error `An error occurred while reading the table: 'Table library not found'`. This is normal as your database is not yet populated.

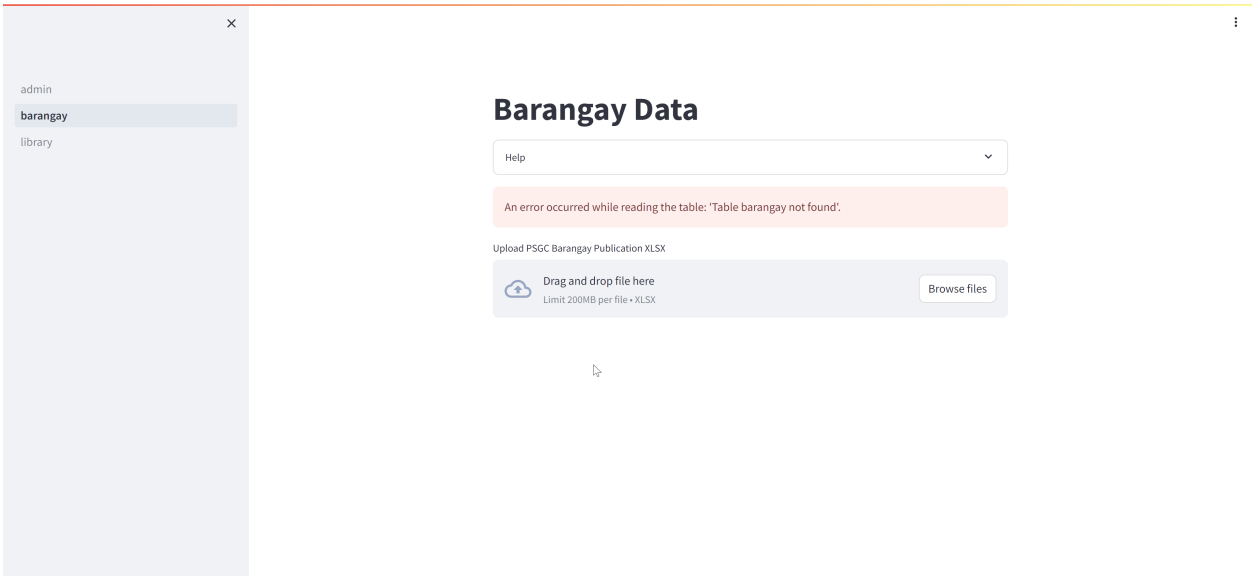


Figure 5.1: Admin inteface barangay page

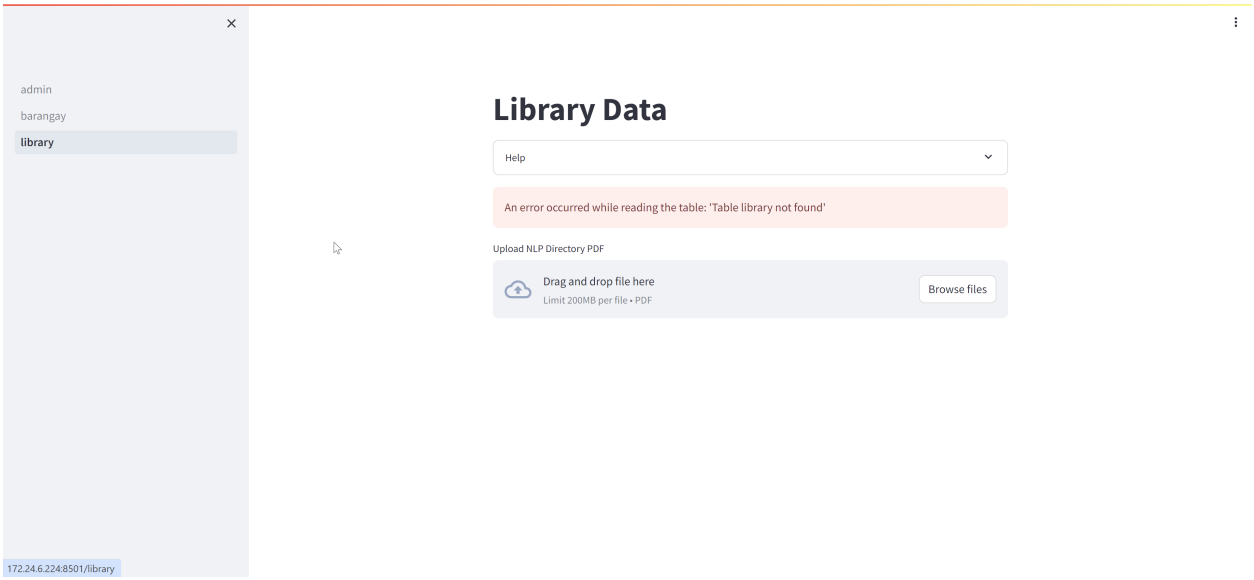


Figure 5.2: Admin inteface library page

5.1.1 Ingesting Library Data

You can obtain the Directory of Public Libraries from the National Library of the Philippines (NLP) website. This is a PDF document that contains information on all public libraries affiliated with the NLP. We will use this information to populate the library table in the database.

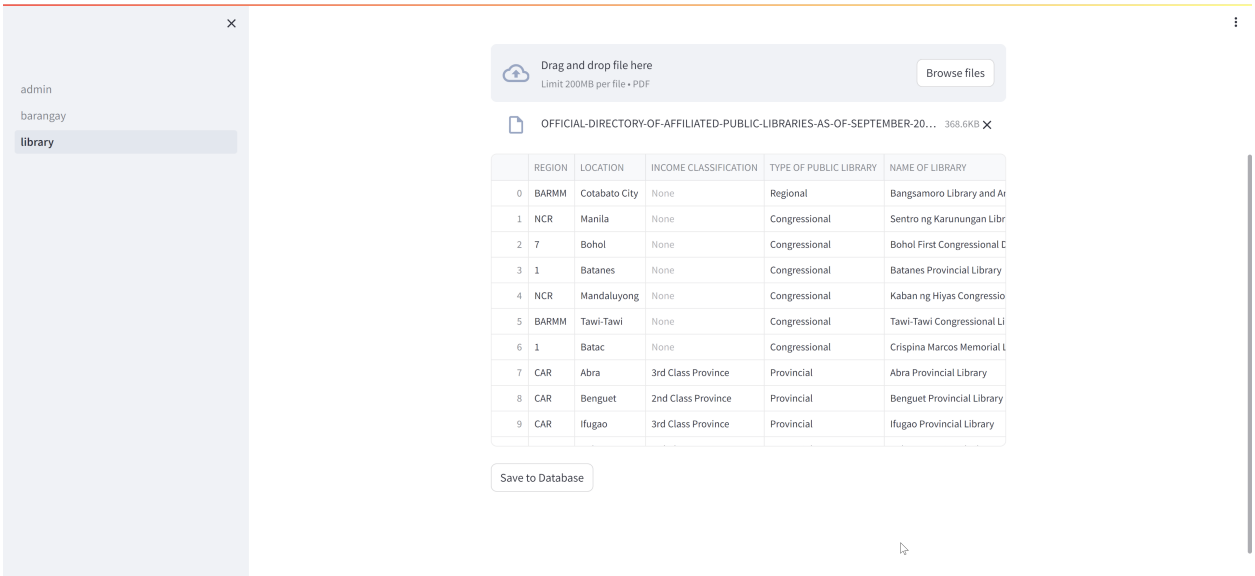


Figure 5.3: Library upload interface

The database will be saved upon hitting `Save to Database` and is ready for geocoding. Geocoding is the process of converting addresses to geographic coordinates. However, in this case we are using the “NAME OF LIBRARY” column from NLP and using the Google Maps API to

search for the Google Maps place, address, and coordinates that correspond closest to the name of the library. This is useful automatically processing the large number of libraries and barangays, but it can make mistakes, especially for locations not in Google Maps or are named differently from the NLP directory.

Pressing `Geocode Table` brings up a modal to confirm that you'd like to geocode the table. This can be can be a long process and require large amounts of calls to the Google Maps API. As of publication, there are over 1,400 libraries in the database. Do not process anything after starting the geocoding process. If this process is interrupted, it can continue geocoding only libraries that do not have geolocations yet.

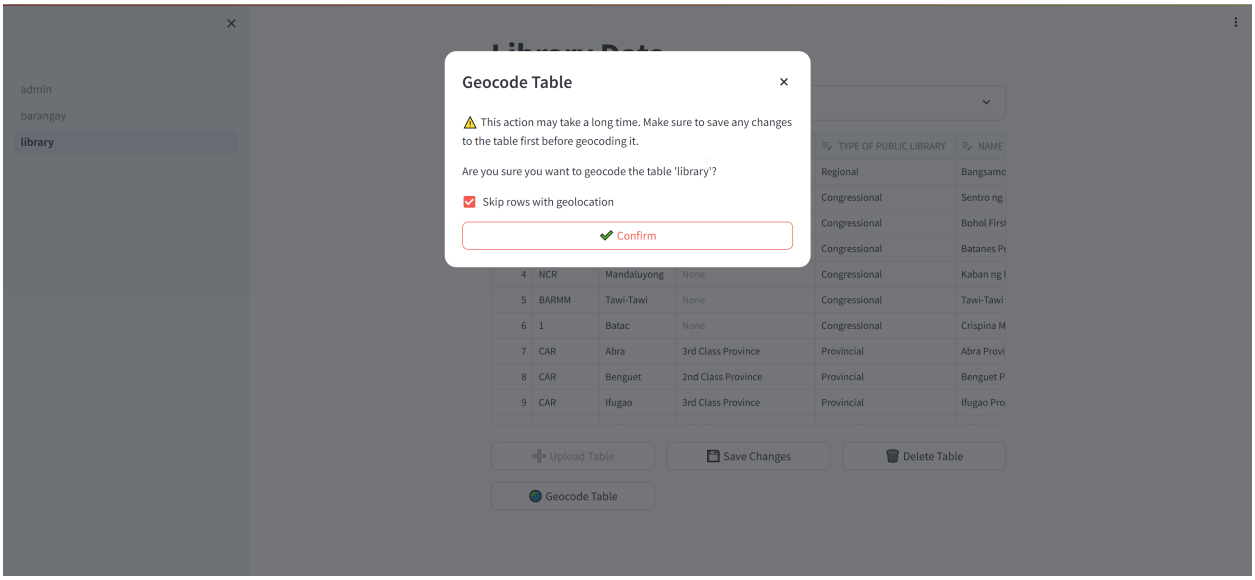


Figure 5.4: Library geocoding

In this page, you can also update any fields in the table if you find the need to do so. Make sure to hit "Save Changes" and confirming the changes in the table before moving on.

5.1.2 Ingesting Barangay Data

You can repeat the same process for barangays table. The barangay data is published by PSA as a PSGC Publications excel (.xlsx) file. You can obtain the PSGC Publications xlsx file from the PSA website.

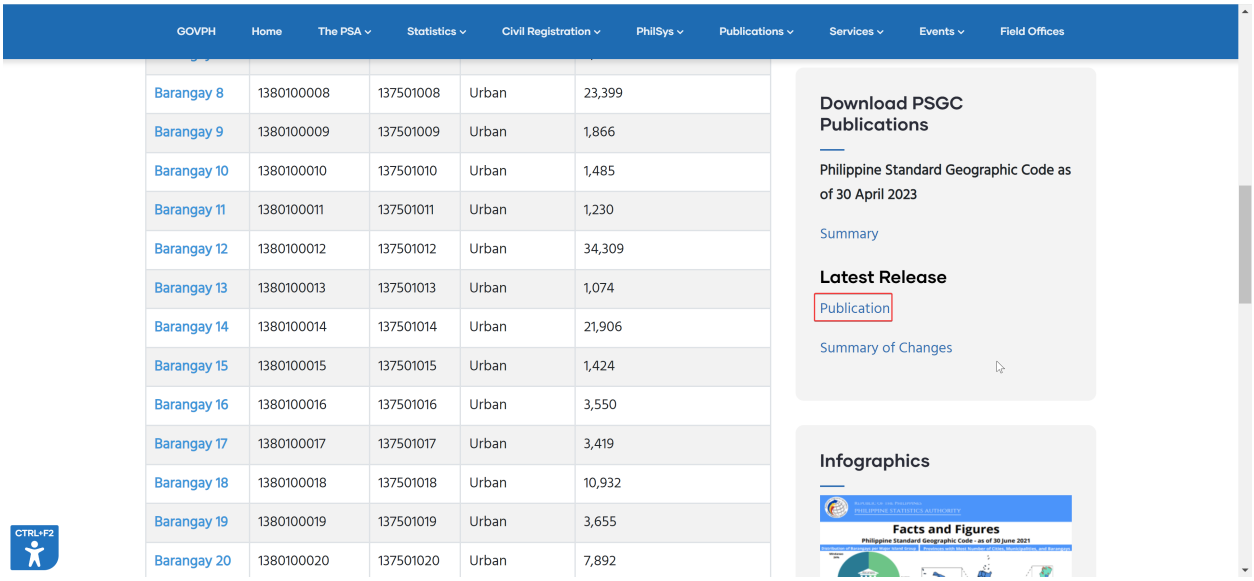


Figure 5.5: PSGC Publications

The same steps are done for geocoding the barangay table. There are however over 42,000 barangays in the database. This may be expensive to geocode via the Google Maps API. Caution is advised.

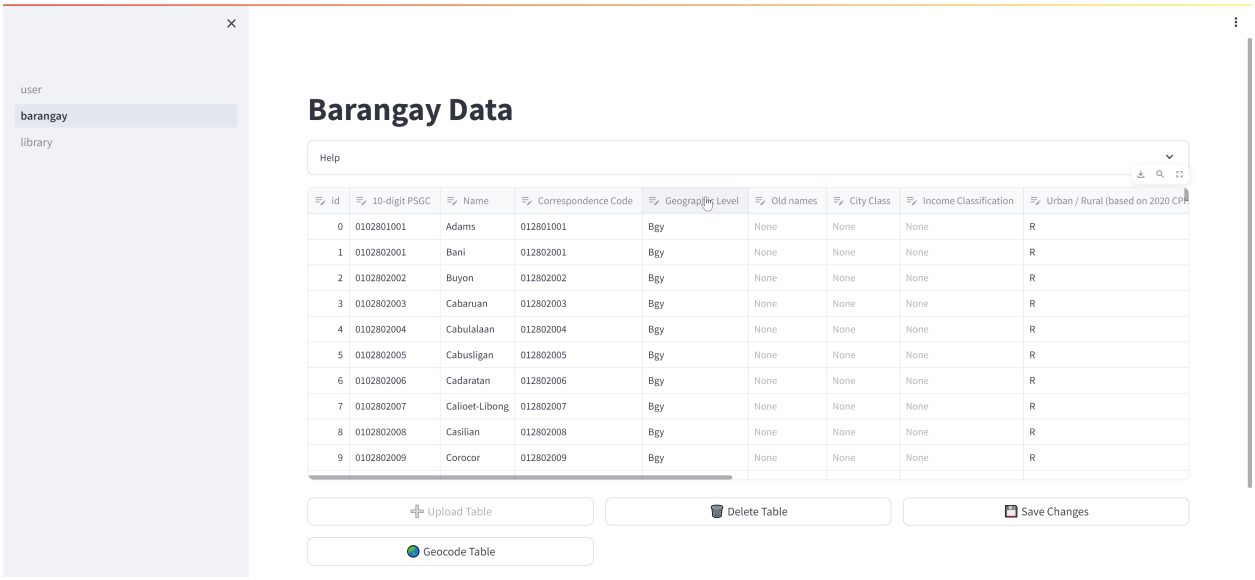


Figure 5.6: Barangay geocoding

Chapter 6

Running PLAN as a user

1. If you are a regular user of PLAN, start here.

- If you are a user of PLAN using the hosted version, you can simply access PLAN by entering the URL in your browser.
- If you are using an instance of PLAN that is managed by your organization, refer to your administrator for the URL.
- If you are a developer or administrator who has completed the installation steps, you can run PLAN and set its root URL to the user page by running:

```
make run
```

6.1 Navigating the User Interface

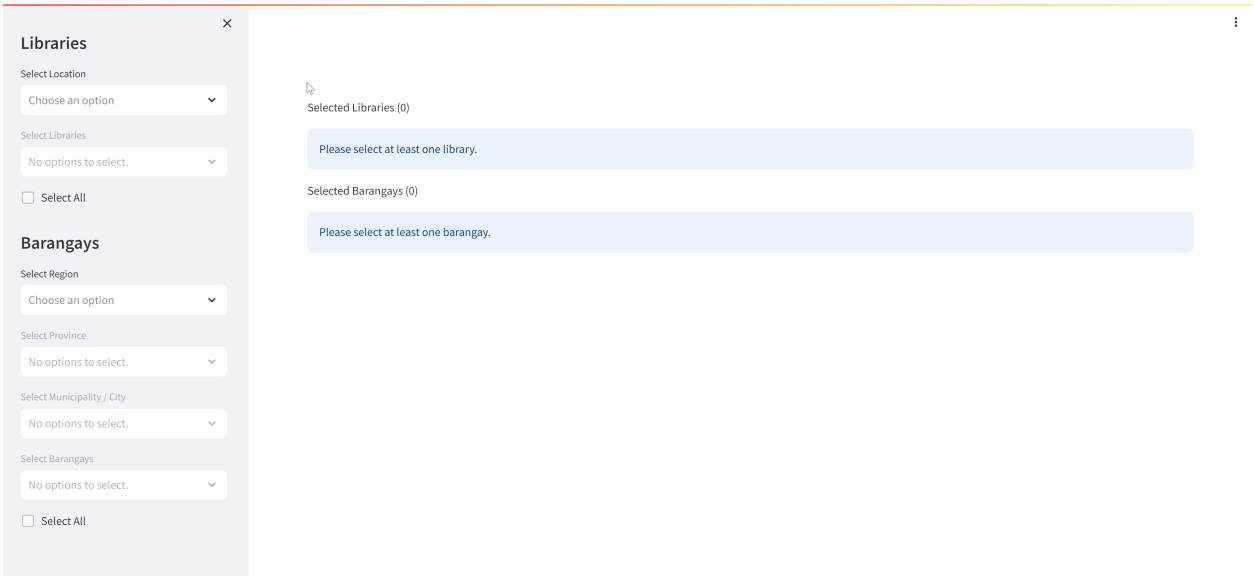


Figure 6.1: PLAN user inteface

PLAN is designed as a single-page application that enables users to select any set of libraries and barangays to measure library accessibility using the Enhanced Two-Step Floating Catchment Area (E2SFCA) method. The interface features a sidebar for selecting libraries and barangays and a main page for entering library services, visualizing calculations, and interpreting results.

While it can be daunting for first time users, PLAN can be imagined as a slightly complicated spreadsheet that already contains library and barangay data, as well as the formulas used to calculate the accessibility. In fact, data and results in this sheet can be copied and pasted into Google Sheets or Microsoft Excel. Any further charts, visualizations, or calculations can be continued in any spreadsheet software.

6.2 E2SFCA Overview

The E2SFCA method evaluates the ratio of different library services to the population they serve. A brief overview of the E2SFCA method is provided below, with a more detailed explanation available in the accompanying thesis.

The accessibility of each library is determined using the following key steps: First, the total population of barangays whose barangay halls fall within a library's catchment area is measured. The barangay hall serves as a proxy for the population centroid, based on the assumption that it is strategically located to best serve the community. If a barangay hall is within the radius around a library, the barangay is considered serviceable by that library. A gravity model is employed to estimate how accessibility decreases with increasing distance, indicating that portions of the barangay are less likely to patronize the library due to access difficulties. Finally, the ratio of the inputted service is divided by the newly weighted population of the barangay.

Similar steps are taken for each barangay: the previously calculated service-to-population ratio of each library within its catchment is multiplied by the decay parameter and then summed to obtain the total accessibility of the library. This represents the total number of services available to the barangay.

6.3 Selecting Libraries

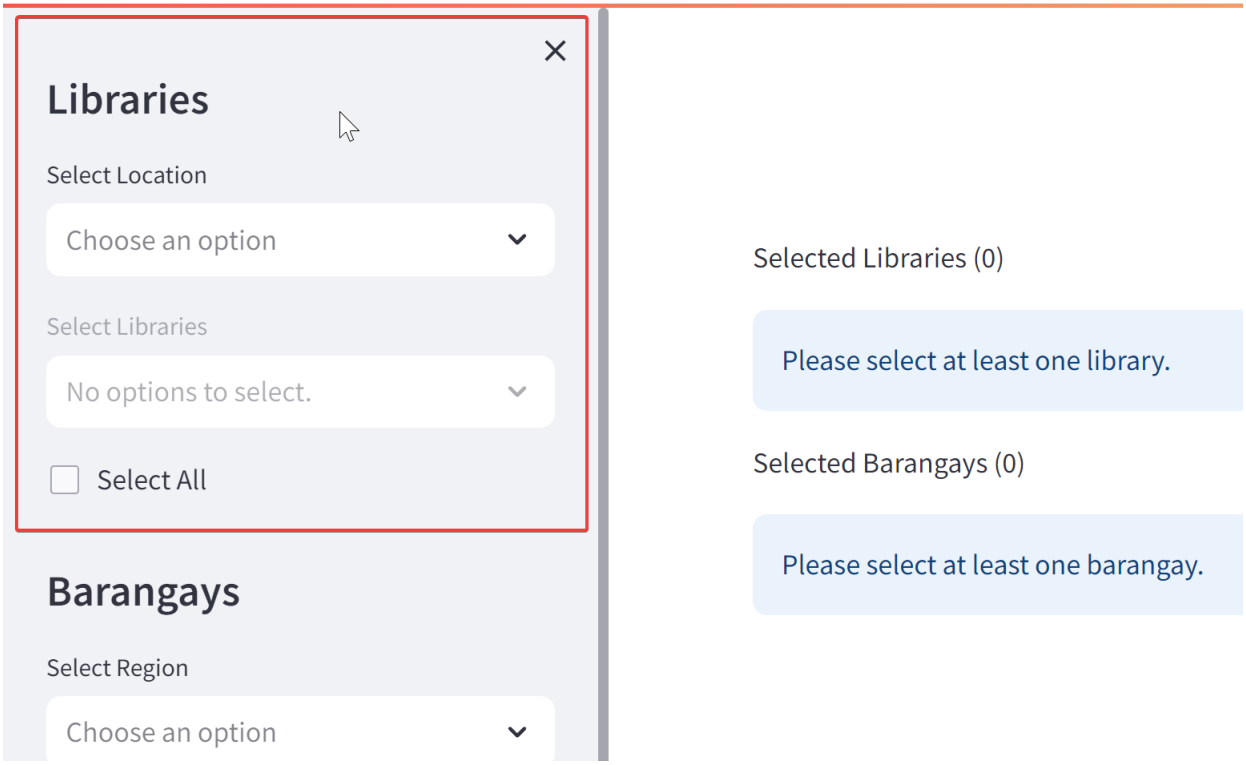


Figure 6.2: Library selection

The first step is to select the libraries for which you want to measure accessibility. This is done by choosing one or more locations from the first multiselect bar labeled “Select Location.” Here, location refers to the library’s location according to the NLP directory. You may need to select multiple items to encompass an entire region (e.g., Laguna, Sta. Rosa, Biñan).

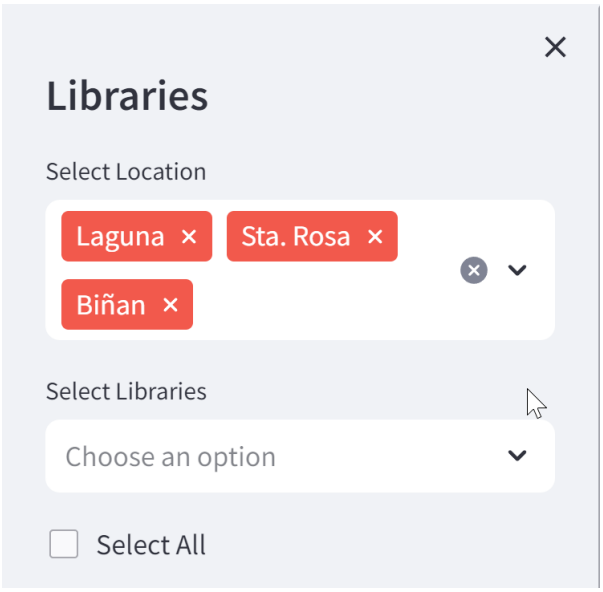


Figure 6.3: Library location selection example

The next multiselect will list all libraries from the selected locations. A “Select All” checkbox can be used to select all libraries from these locations. Libraries can still be added or removed at any point.

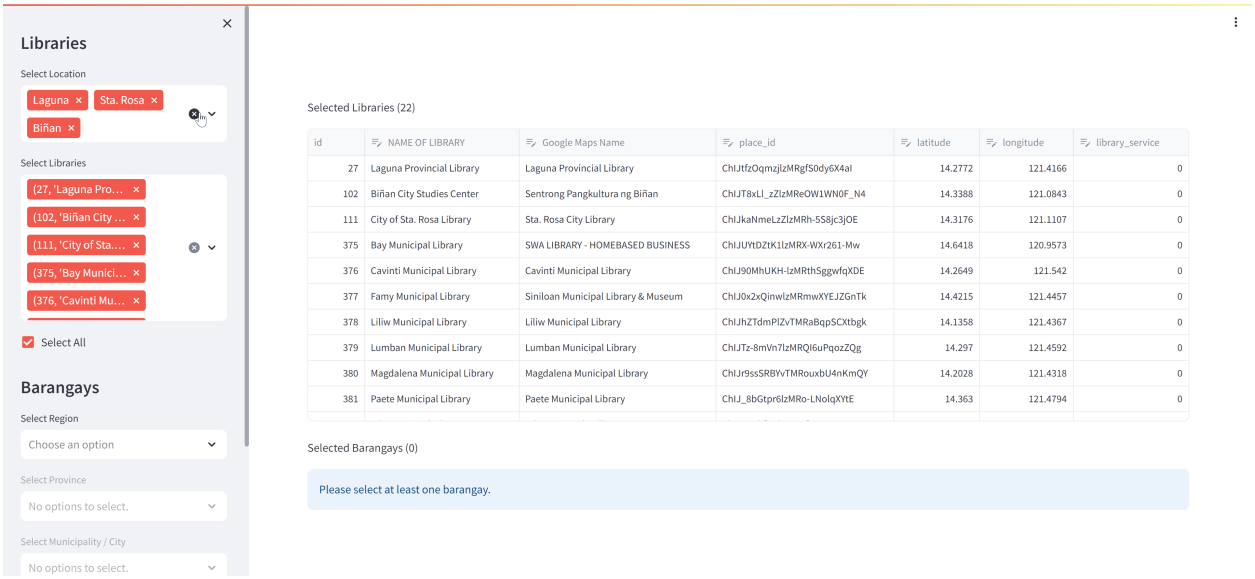


Figure 6.4: Library selection results

6.4 Selecting Barangays

Next, select barangays from the same region as the chosen libraries. Barangay data is organized according to PSA’s PSGC classification of administrative units in the Philippines, which can differ

significantly from the NLP directory. Filter barangays by selecting one or more regions, provinces, and municipalities/cities.

Some municipalities are not part of a province but belong to a certain region. For instance, cities in NCR all belong to the NCR region but do not belong to any province. For these cities and municipalities, you will need to select the region again in the province multiselect to locate the city/municipality.

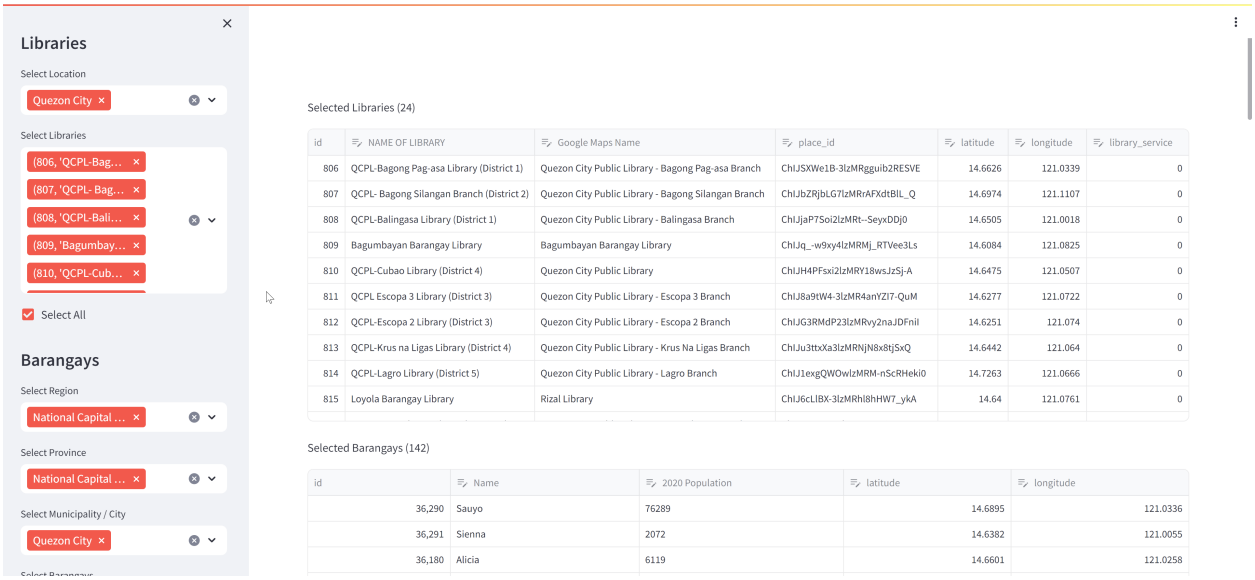


Figure 6.5: Library and barangay selection

After selecting all the libraries and barangays, you may notice that some main branches, especially in Metro Manila, are missing. This is because in the NLP database, main branches are classified not under their respective cities (e.g., “Quezon City”) but as “Quezon.” In such cases, select both “Quezon” and “Quezon City” or “Pasig” and “Pasig City.” Be cautious, as “Quezon” also refers to “Quezon Province.” This issue stems from the original NLP directory and not in PLAN.

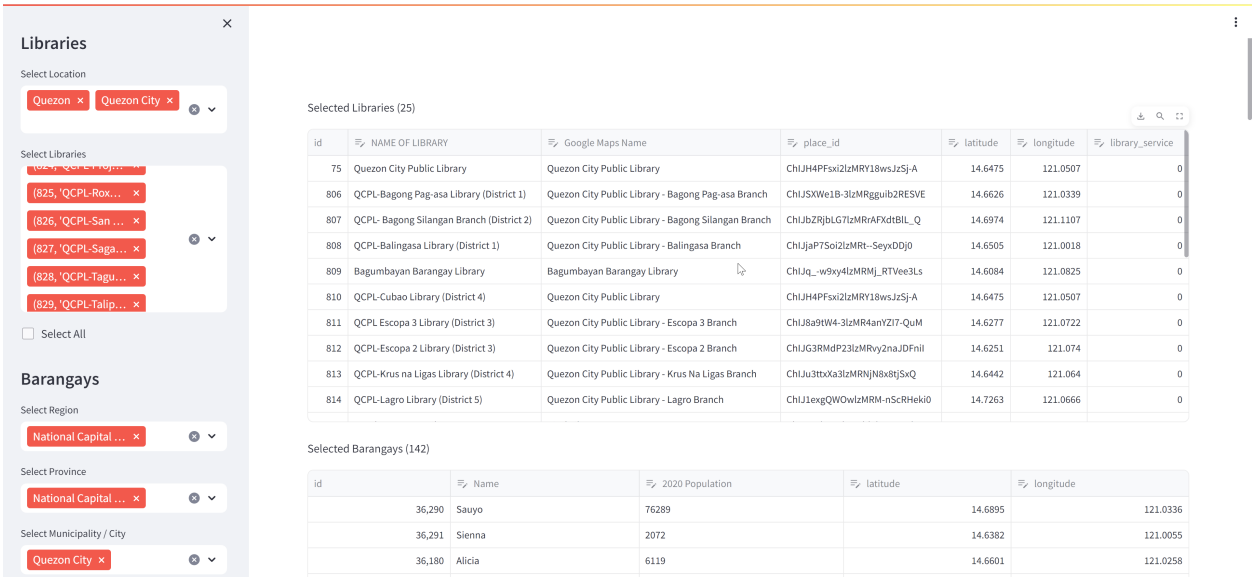


Figure 6.6: Complete library and barangay selection

Now that you have selected all the libraries and barangays, you can move on to the next step.

6.5 Inspecting Selected Libraries and Barangays

In the main body of the page, you will find the selected libraries dataframe or simply the selected libraries sheet. This sheet contains the selected libraries and their relevant fields. The “NAME OF LIBRARY” column lists the library names according to the NLP directory, while “Google Maps Name” refers to the library geocoded by the Google Maps API. If these do not refer to the same library, are missing values, or contain NaN, you may want to manually update the rows with the correct name and GPS coordinates.

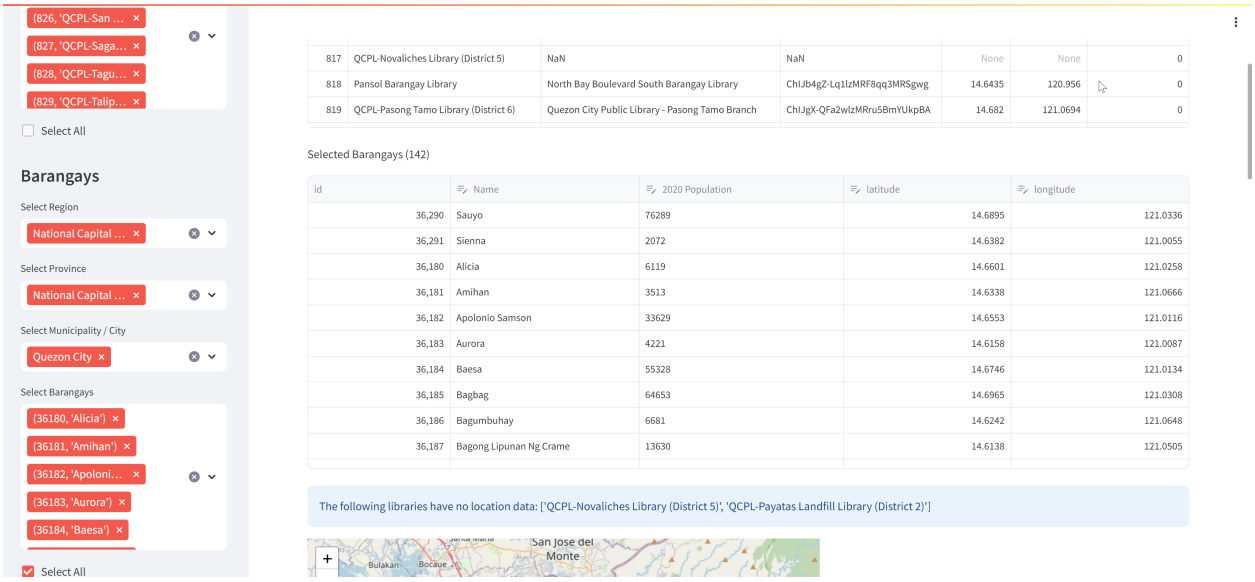


Figure 6.7: Library sheet containing selected libraries with NaN values

You can search for your library on Google Maps and right-click its place marker to find its GPS coordinates. Fill in these values in the selected libraries sheet, and it will be included in the results. Alternatively, you may leave it blank, and libraries and barangays without valid GPS coordinates will be excluded from the results. You can edit this at any point, even during the subsequent steps, and the calculations will automatically update to reflect your changes.

Follow the same steps for the selected barangays and proceed to the next steps once you are satisfied.

6.6 Entering Services

You are now ready to enter the services you want to measure. Services refer to the different aspects of the library system you wish to evaluate. Recommended services include collection size, digital collection size, floor area, service hours per week, staff size, seating capacity, and computer stations.

Only one type of service can be entered at a time. If you wish to measure multiple services, you will need to repeat the process for each. In this example, we will enter collection size as the service.

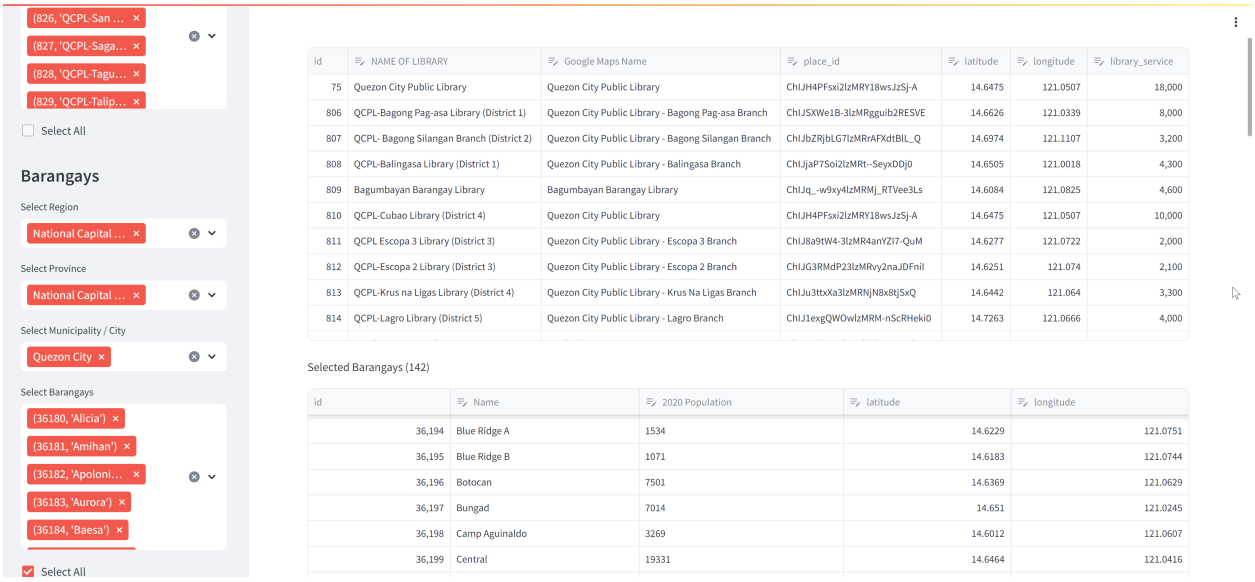


Figure 6.8: Entering mock values for Quezon City Library System

In this example, we enter a possible collection size for the Quezon City Library System. Libraries that are closed or under renovation are assigned a collection size of zero. This is a judgment call for the librarian or administrator. We noticed that "Loyola Barangay Library" referred to the "Rizal Library" in our sheet and could not find it on Google Maps, so the values for Rizal Library and its coordinates were removed from the results.

Scroll down on the page to see your selected libraries and barangays on a map. This visualization helps identify barangays without libraries or libraries/barangays that are geocoded incorrectly. In our example, Pansol Barangay Library is placed in the middle of Caloocan.

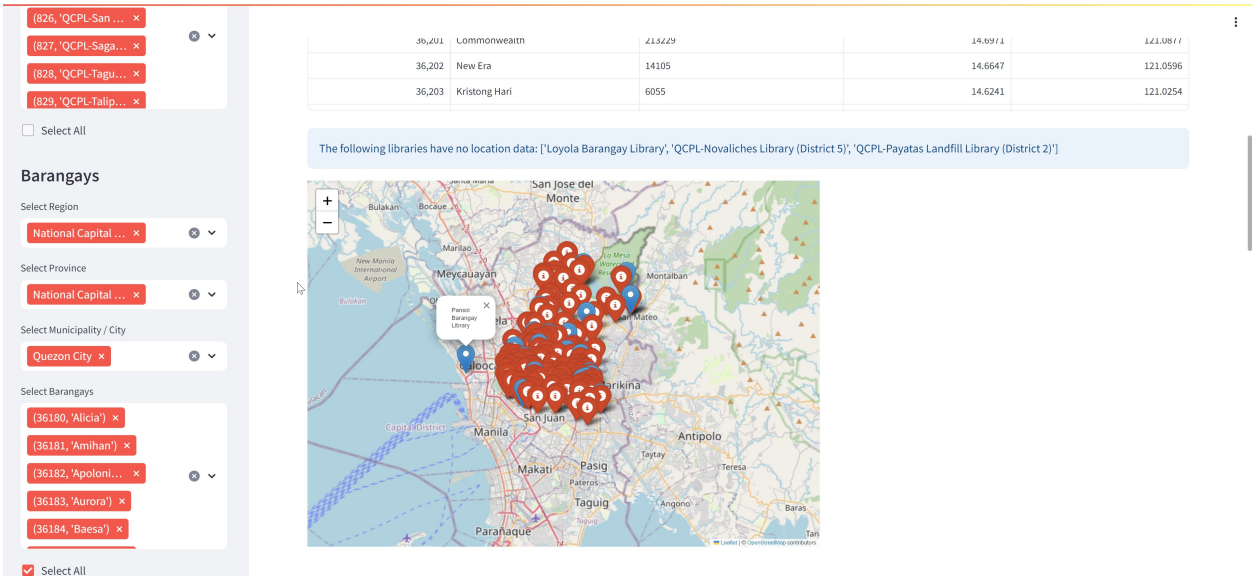


Figure 6.9: Map of selected libraries and barangays

No results were found for the library in Pansol, Diliman. We will exclude this library from the results by returning to the sheet and removing its location values.

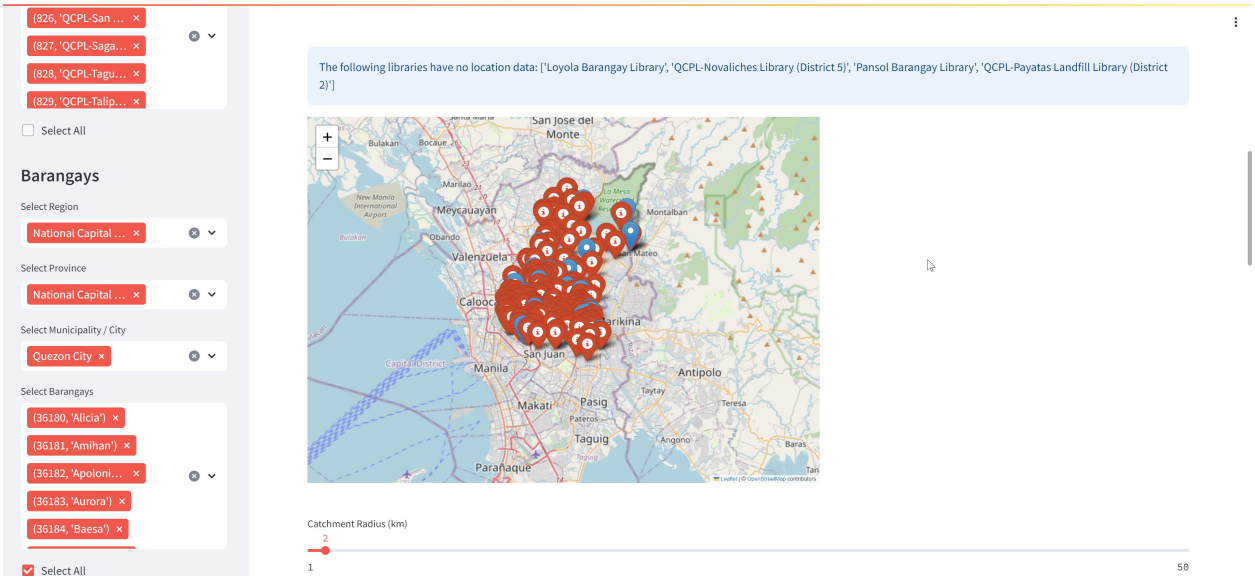


Figure 6.10: Updated map of selected libraries and barangays

The map is automatically updated to reflect our changes.

6.7 Setting Parameters

6.7.1 Catchment Radius

Next, set the “Catchment Radius (km)” parameter. This radius around the library determines the serviceable area. A default value of 2 km is set based on academic research, but you may adjust this value based on your specific needs. Rural areas may require a larger radius due to fewer libraries.

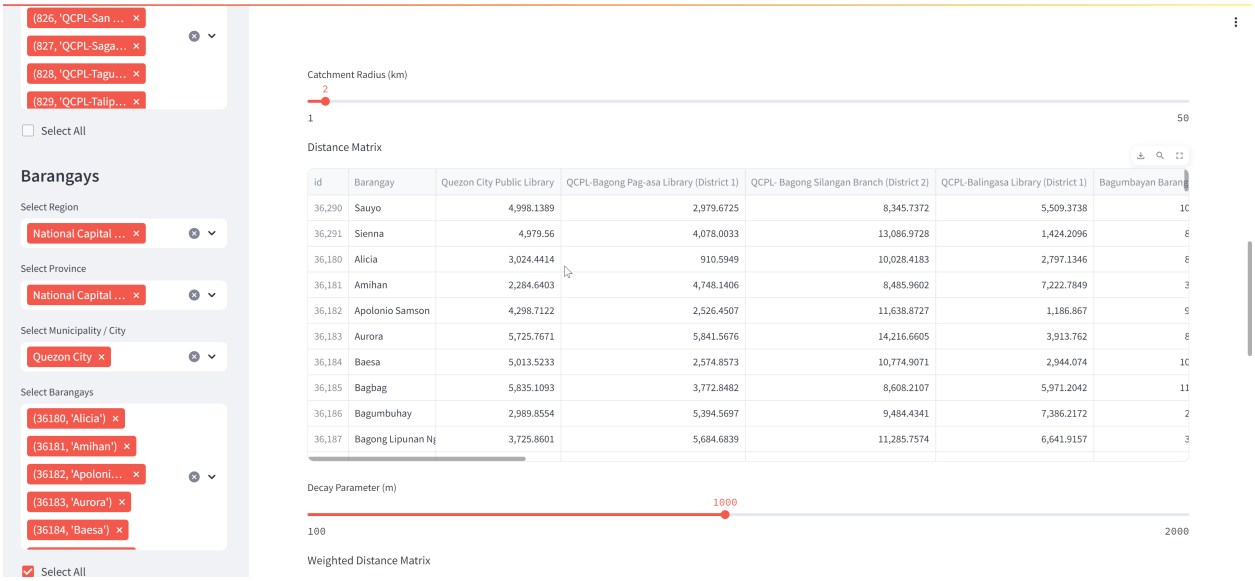


Figure 6.11: Setting catchment radius

Below this, you will find the Distance Matrix, representing the geodesic distances between all selected libraries and barangays. The geodesic distance is the distance when drawing the shortest line between two points on the earth's surface.

6.7.2 Decay Parameter

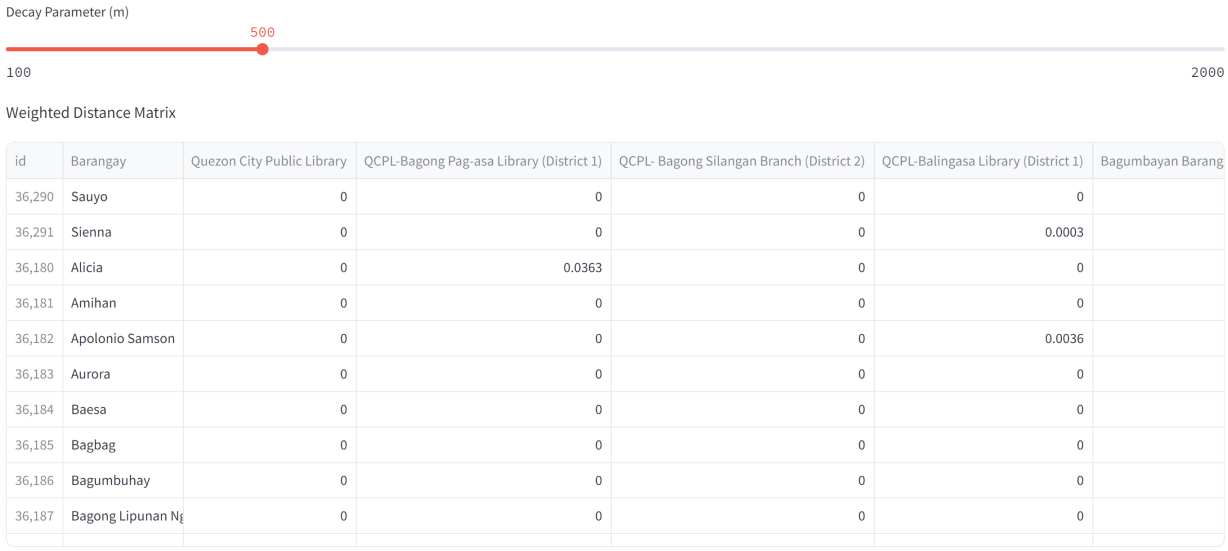
The "Decay Parameter (m)" slider allows you to adjust how accessibility decreases with distance using a Gaussian function:

$$w(d) = e^{-\frac{d^2}{2\sigma^2}}$$

where:

- $w(d)$ is the weight based on distance d,
- σ is the decay parameter controlling the rate of decay.

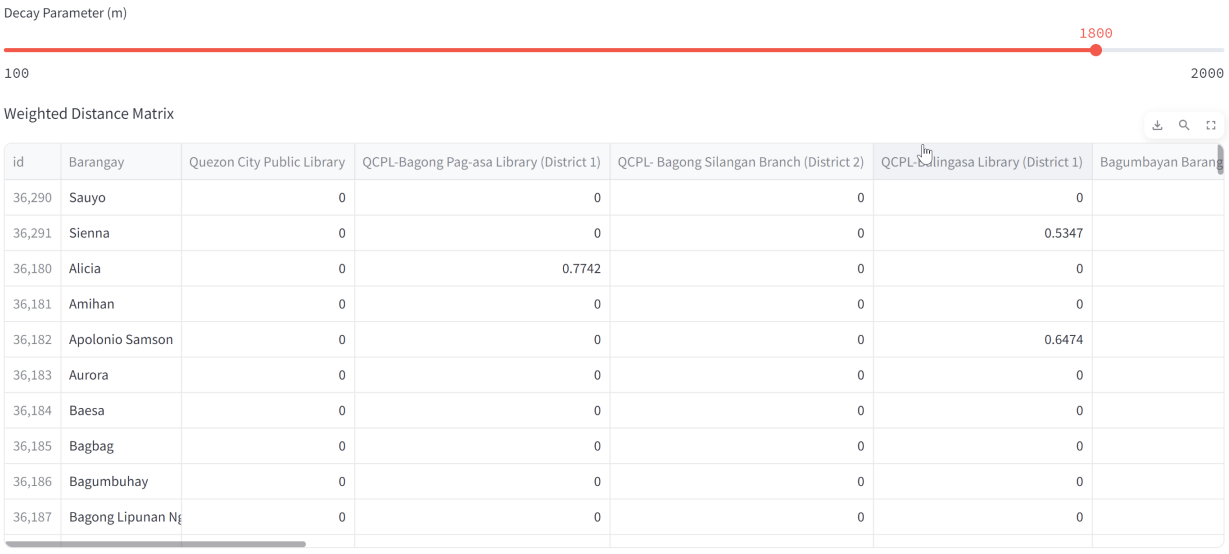
The decay parameter models how far people are willing to travel within the catchment radius. A higher decay parameter means accessibility decreases more slowly with distance, while a lower decay parameter means accessibility decreases more rapidly. Adjust the decay parameter between 100 m and the catchment radius; distances beyond the catchment radius are considered inaccessible.



id	Barangay	Quezon City Public Library	QCPL-Bagong Pag-asa Library (District 1)	QCPL- Bagong Silangan Branch (District 2)	QCPL-Balingasa Library (District 1)	Bagumbayan Barang
36,290	Sauyo	0	0	0	0	
36,291	Sienna	0	0	0	0.0003	
36,180	Alicia	0	0.0363	0	0	
36,181	Amihan	0	0	0	0	
36,182	Apolonio Samson	0	0	0	0.0036	
36,183	Aurora	0	0	0	0	
36,184	Baesa	0	0	0	0	
36,185	Bagbag	0	0	0	0	
36,186	Bagumbuhay	0	0	0	0	
36,187	Bagong Lipunan Ng	0	0	0	0	

Figure 6.12: Setting decay parameter

The weighted distance matrix applies the decay parameter to the distance values, showing weights from 0 to 1 within the catchment radius.



id	Barangay	Quezon City Public Library	QCPL-Bagong Pag-asa Library (District 1)	QCPL- Bagong Silangan Branch (District 2)	QCPL-Balingasa Library (District 1)	Bagumbayan Barang
36,290	Sauyo	0	0	0	0	
36,291	Sienna	0	0	0	0.5347	
36,180	Alicia	0	0.7742	0	0	
36,181	Amihan	0	0	0	0	
36,182	Apolonio Samson	0	0	0	0.6474	
36,183	Aurora	0	0	0	0	
36,184	Baesa	0	0	0	0	
36,185	Bagbag	0	0	0	0	
36,186	Bagumbuhay	0	0	0	0	
36,187	Bagong Lipunan Ng	0	0	0	0	

Figure 6.13: Weighted distance matrix

6.8 Library FCA

The Library FCA table contains the service-to-population ratio of each library. It includes columns for raw catchment population, weighted population within the catchment, and the weighted service-to-population ratio. This ratio reflects the number of books per person in the catchment area, adjusted for distance decay.

In this case, the weighted service-to-population ratio represents the number of books per person in the catchment area, adjusted for the distance decay effect. The intuition behind this is that populations farther from the library are less likely to avail of its services, hence the adjustment based on the decay parameter.

Library FCA

id	NAME OF LIBRARY	library_service	Raw Catchment Population	Weighted Catchment Population	Service to Population Ratio	Catchment Barangays
75	Quezon City Public Library	18,000	166,951	1,841.7744	9.7732	Botocan,7501 Central,19331 Ea
806	QCPL-Bagong Pag-asa Library (District 1)	8,000	242,572	37,803.4286	0.2116	Alicia,6119 Bagong Pag-asa,29389
807	QCPL- Bagong Silangan Branch (District 2)	3,200	278,289	110,538.6815	0.0289	Bagong Silangan,106886 Silangan,
808	QCPL-Balingasa Library (District 1)	4,300	169,420	20,676.4226	0.208	Sienna,2072 Apolonio Samson,336
809	Bagumbayan Barangay Library	4,600	50,703	22,202.6222	0.2072	Bagumbayan,22147 Bayanihan,61
810	QCPL-Cubao Library (District 4)	10,000	166,951	1,841.7744	5.4295	Botocan,7501 Central,19331 Ea
811	QCPL Escopa 3 Library (District 3)	2,000	207,995	21,683.6365	0.0922	Amihan,3513 Bagumbuhay,6681
812	QCPL-Escopa 2 Library (District 3)	2,100	160,619	18,662.9382	0.1125	Amihan,3513 Bagumbuhay,6681
813	QCPL-Krus na Ligas Library (District 4)	3,300	193,116	41,832.5501	0.0789	Amihan,3513 Botocan,7501 Cla
814	QCPL-Lagro Library (District 5)	4,000	107,873	34,370.261	0.1164	Pasong Putik Proper,39896 Greate

Figure 6.14: Library FCA table

This table also lists the barangays within each library's catchment area.

6.9 Barangay FCA

The Barangay FCA table provides cumulative service-to-population scores from each library within its catchment, weighted by distance decay. These scores reflect overall accessibility to library services within each barangay, with closer libraries contributing more significantly. This table helps identify which barangays have limited access to library services.

Barangay FCA

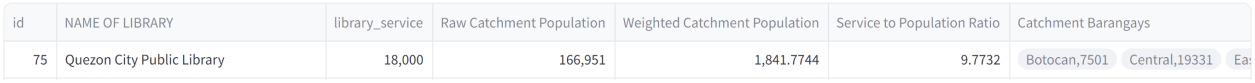
id	Name	2020 Population	Catchment Library Accessibility Weighted Ratio	Catchment Libraries
36,191	Bahay Toro	59639	0.0465	('QCPL-Bagong Pag-asa Library (District 1)', 0.0002) ('QCPL-Project 8 Library (District 1
36,192	Balingasa	19260	0.205	('QCPL-Balingasa Library (District 1)', 0.205) ('QCPL-Masambong Library (District 1)', 0.
36,193	Bayanihan	613	0.0128	('Bagumbayan Barangay Library', 0.0) ('QCPL Escopa 3 Library (District 3)', 0.0) ('QC
36,194	Blue Ridge A	1534	0.1236	('Bagumbayan Barangay Library', 0.0) ('QCPL Escopa 3 Library (District 3)', 0.0203)
36,195	Blue Ridge B	1071	0.0232	('Bagumbayan Barangay Library', 0.0001) ('QCPL Escopa 3 Library (District 3)', 0.001)
36,196	Botocan	7501	0.0055	('Quezon City Public Library', 0.0) ('QCPL-Cubao Library (District 4)', 0.0) ('QCPL Esc
36,197	Bungad	7014	0.0704	('QCPL-Bagong Pag-asa Library (District 1)', 0.0) ('QCPL-Masambong Library (District 1
36,198	Camp Aguinaldo	3269	0	
36,199	Central	19331	0.3008	('Quezon City Public Library', 0.1934) ('QCPL-Bagong Pag-asa Library (District 1)', 0.0)
36,200	Claro	3885	0.0049	('QCPL Escopa 3 Library (District 3)', 0.003) ('QCPL-Escopa 2 Library (District 3)', 0.0002

Figure 6.15: Barangay FCA table

This table also presents the libraries accessible to each barangay, which helps identify which barangays have the least access to library services.

6.10 Interpreting Results

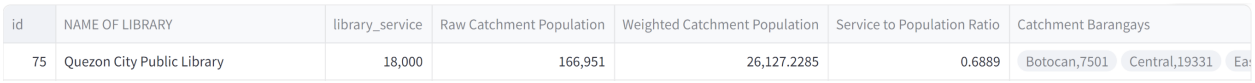
Interpretation of results is highly personal to each library. In the example above, where we assumed that accessibility decays quickly after 500 meters, and that users outside of the 2km catchment are not likely to patronize the library, we find that the raw catchment population of 166,951 yields a weighted catchment population of only 1,841.7744 or just above 1%. This means that the collection size of 18,000 of the Quezon City Main Library has a service-to-population ratio of 9.7732, or almost 10 books per person.



id	NAME OF LIBRARY	library_service	Raw Catchment Population	Weighted Catchment Population	Service to Population Ratio	Catchment Barangays
75	Quezon City Public Library	18,000	166,951	1,841.7744	9.7732	Botocan,7501 Central,19331 Ea

Figure 6.16: Library FCA score of Quezon City Main Library at 500m

However a distance decay parameter set at 1000m yields a weighted catchment population of 26,127.2285, giving us 0.688 books per person.



id	NAME OF LIBRARY	library_service	Raw Catchment Population	Weighted Catchment Population	Service to Population Ratio	Catchment Barangays
75	Quezon City Public Library	18,000	166,951	26,127.2285	0.6889	Botocan,7501 Central,19331 Ea

Figure 6.17: Library FCA score of Quezon City Main Library at 1000m

Rural libraries, or libraries in different terrain, population distributions, budget contraints, etc are likely to have vastly different parameters. A set of libraries in a large, sparsely populated province may want to set a higher catchment of 3, 5, or 10km. They may also have to set a higher decay parameter if their population is known to be very willing to travel a large distance to reach the library. They may want to set a lower decay parameter during the rainy season where people are unwilling to travel far away from their homes.

The primary goal of PLAN is to provide insights into the distribution of library services within a library system, not to deliver absolute accessibility scores. Here are some ways to interpret the results:

6.10.1 Identifying Disparities

One of the key benefits of using PLAN is the ability to identify disparities in library accessibility within the system. By analyzing the service-to-population ratios, users can pinpoint which libraries offer high accessibility and which ones fall short.

Libraries with low accessibility ratios may indicate a need for additional resources, improved infrastructure, or strategic relocation to better serve the community. Conversely, libraries with high

accessibility may serve as models for best practices in resource allocation and community engagement.

6.10.2 Visualizing Results

PLAN provides powerful visualization tools to help users understand the spatial distribution of library services across different areas. By mapping the selected libraries and barangays, users can easily see which regions are well-served and which are underserved. This geographic representation aids in identifying clusters of high or low accessibility and can highlight potential gaps in service coverage. Visualizing results in this way helps to communicate findings more effectively to stakeholders and can support strategic planning efforts to enhance library access.

6.10.3 Scenario Analysis

PLAN allows users to conduct scenario analysis by adjusting various parameters, such as catchment radii and decay parameters. This flexibility enables users to explore how changes in these parameters impact library accessibility. For instance, increasing the catchment radius may show how accessibility improves in rural areas where libraries are sparse. Conversely, adjusting the decay parameter can simulate different levels of population willingness to travel, providing insights into how accessibility fluctuates under various conditions.

Chapter 7

Contributing

7.1 Contributions are Welcome!

PLAN is not yet ready for contributions, but we appreciate your interest in contributing. We hope to open the project to contributions in the near future!

7.1.1 Stay Tuned

Please stay tuned for updates on how you can contribute to PLAN. In the meantime, feel free to explore the project and get familiar with its features. Your interest and future contributions are greatly appreciated!

Chapter 8

Appendix

8.1 Licenses of Third-Party Software

This project includes the following third-party software:

1. **pandas**
   - License: BSD 3-Clause License
   - URL: https://github.com/pandas-dev/pandas
2. **Streamlit**
   - License: Apache License 2.0
   - URL: https://github.com/streamlit/streamlit
3. **pre-commit**
   - License: MIT License
   - URL: https://github.com/pre-commit/pre-commit
4. **geopy**
   - License: MIT License
   - URL: https://github.com/geopy/geopy
5. **googlemaps**
   - License: Apache License 2.0
   - URL: https://github.com/googlemaps/google-maps-services-python
6. **openpyxl**
   - License: MIT License
   - URL: https://foss.heptapod.net/openpyxl/openpyxl
7. **python-dotenv**
   - License: BSD 3-Clause “New” or “Revised” License
   - URL: https://github.com/theskumar/python-dotenv
8. **psycopg2-binary**
   - License: LGPL 3.0
   - URL: https://github.com/psycopg/psycopg2
9. **sqlalchemy**
   - License: MIT License

- URL: https://github.com/sqlalchemy/sqlalchemy

10. **stqdm**
    - License: Apache License 2.0
    - URL: https://github.com/Wirg/stqdm
11. **streamlit-extras**
    - License: Apache License 2.0
    - URL: https://github.com/arnaudmiribel/streamlit-extras
12. **streamlit_folium**
    - License: MIT License
    - URL: https://github.com/randyzwitch/streamlit-folium
13. **tabula-py**
    - License: MIT License
    - URL: https://github.com/chezou/tabula-py