

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 use --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.

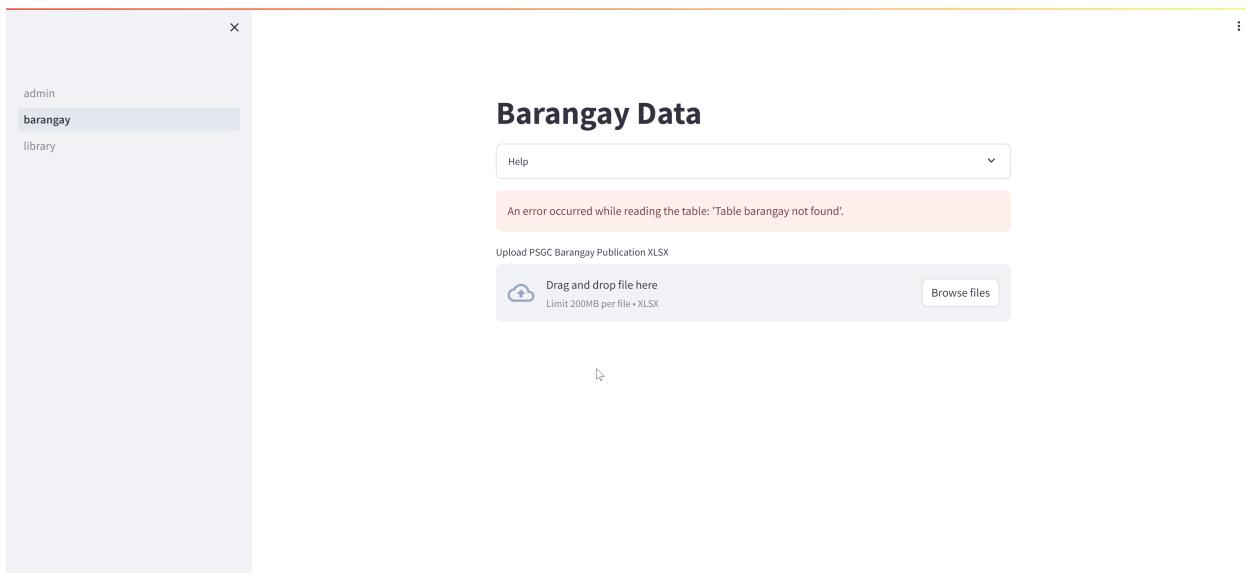


Figure 5.1: Admin inteface barangay page

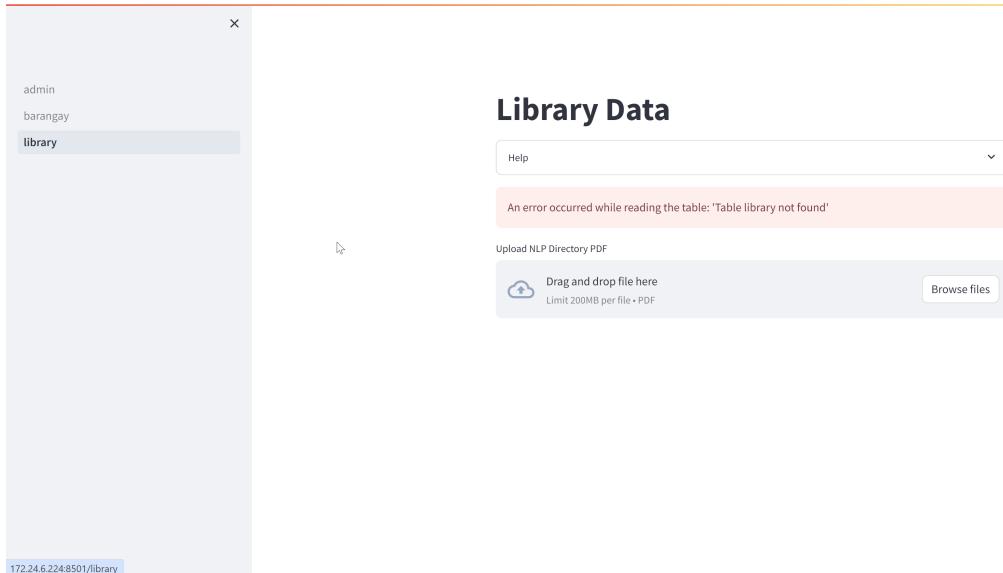


Figure 5.2: Admin interface library page

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.

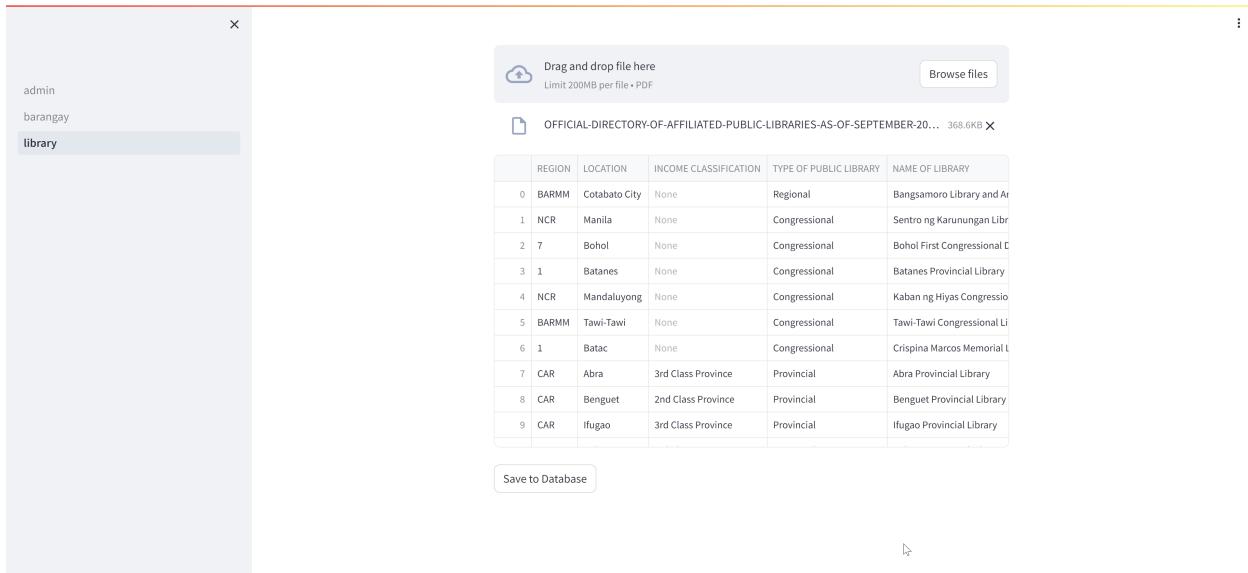


Figure 5.3: Library upload interface

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 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.

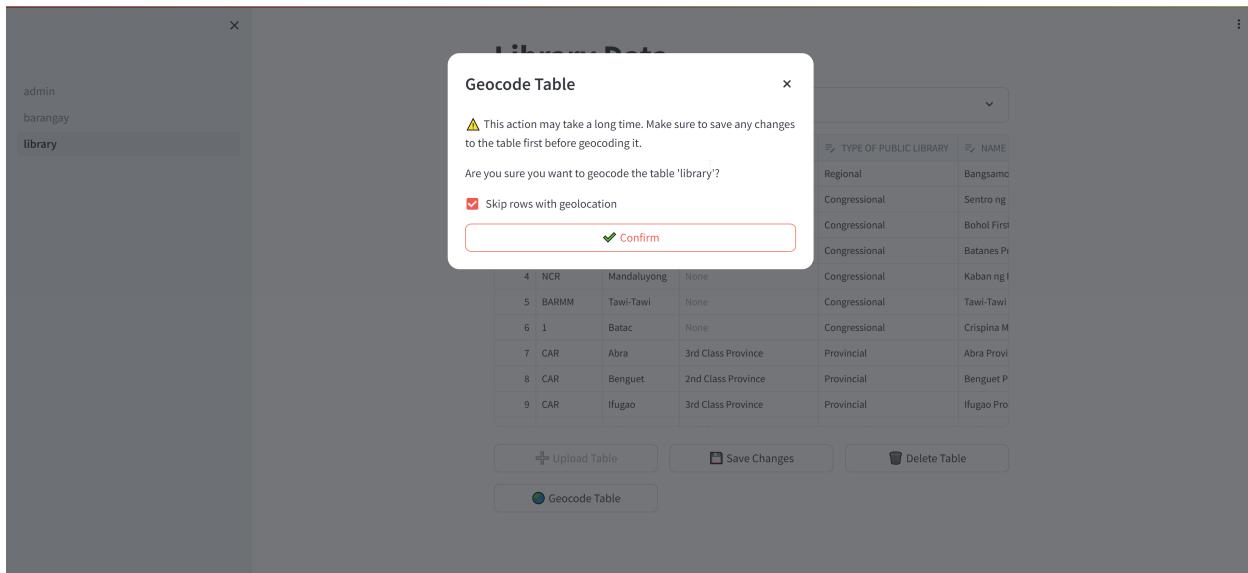


Figure 5.4: Library geocoding

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.

The screenshot shows the PLAN interface with a navigation bar at the top. The main content area displays a table of PSGC publications for barangays, followed by two side panels: 'Download PSGC Publications' and 'Infographics'.

PSGC Publications Table:

Barangay	ID	Name	Type	Population
Barangay 8	1380100008	137501008	Urban	23,399
Barangay 9	1380100009	137501009	Urban	1,866
Barangay 10	1380100010	137501010	Urban	1,485
Barangay 11	1380100011	137501011	Urban	1,230
Barangay 12	1380100012	137501012	Urban	34,309
Barangay 13	1380100013	137501013	Urban	1,074
Barangay 14	1380100014	137501014	Urban	21,906
Barangay 15	1380100015	137501015	Urban	1,424
Barangay 16	1380100016	137501016	Urban	3,550
Barangay 17	1380100017	137501017	Urban	3,419
Barangay 18	1380100018	137501018	Urban	10,932
Barangay 19	1380100019	137501019	Urban	3,655
Barangay 20	1380100020	137501020	Urban	7,892

Download PSGC Publications: Philippine Standard Geographic Code as of 30 April 2023

Latest Release: Publication

Infographics: Facts and Figures (Philippine Standard Geographic Code - as of 30 June 2021)

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.

The screenshot shows the 'Barangay Data' management interface. It features a table of barangay records with columns for ID, 10-digit PSGC, Name, Correspondence Code, Geography Level, Old names, City Class, Income Classification, and Urban / Rural status. Below the table are buttons for 'Upload Table', 'Delete Table', 'Save Changes', and 'Geocode Table'.

id	10-digit PSGC	Name	Correspondence Code	Geography Level	Old names	City Class	Income Classification	Urban / Rural (based on 2020 CP)
0	0102801001	Adams	012801001	Bgy	None	None	None	R
1	0102802001	Bani	012802001	Bgy	None	None	None	R
2	0102802002	Buyon	012802002	Bgy	None	None	None	R
3	0102802003	Cabaruán	012802003	Bgy	None	None	None	R
4	0102802004	Cabulalaan	012802004	Bgy	None	None	None	R
5	0102802005	Cabusigan	012802005	Bgy	None	None	None	R
6	0102802006	Cadaratan	012802006	Bgy	None	None	None	R
7	0102802007	Calioet-Libong	012802007	Bgy	None	None	None	R
8	0102802008	Casilan	012802008	Bgy	None	None	None	R
9	0102802009	Corocor	012802009	Bgy	None	None	None	R

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

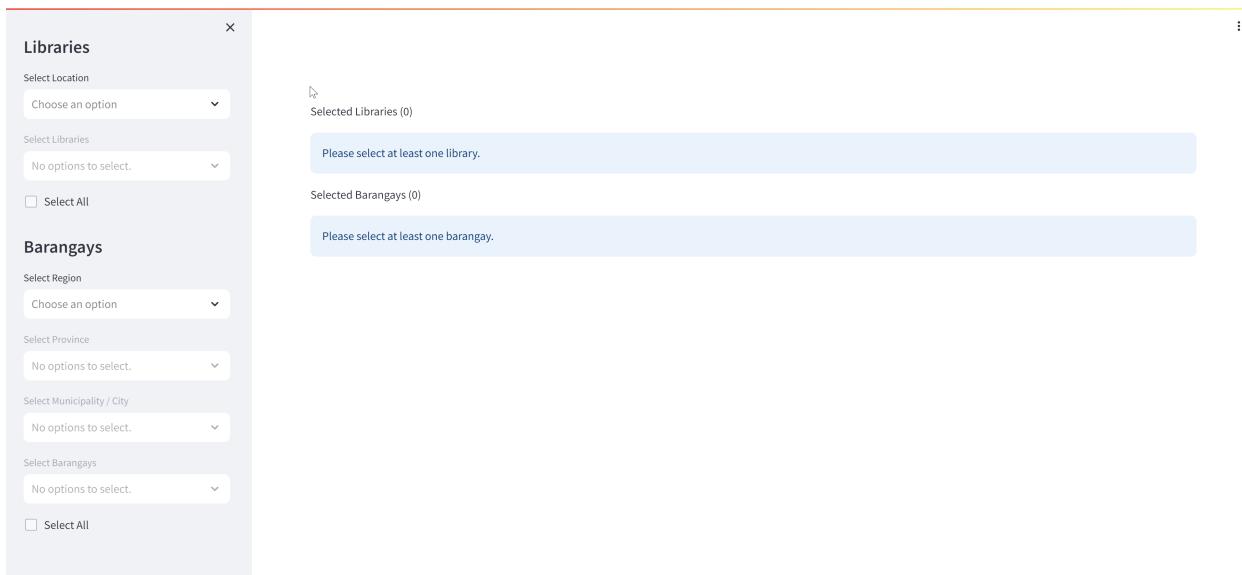


Figure 6.1: PLAN user interface

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

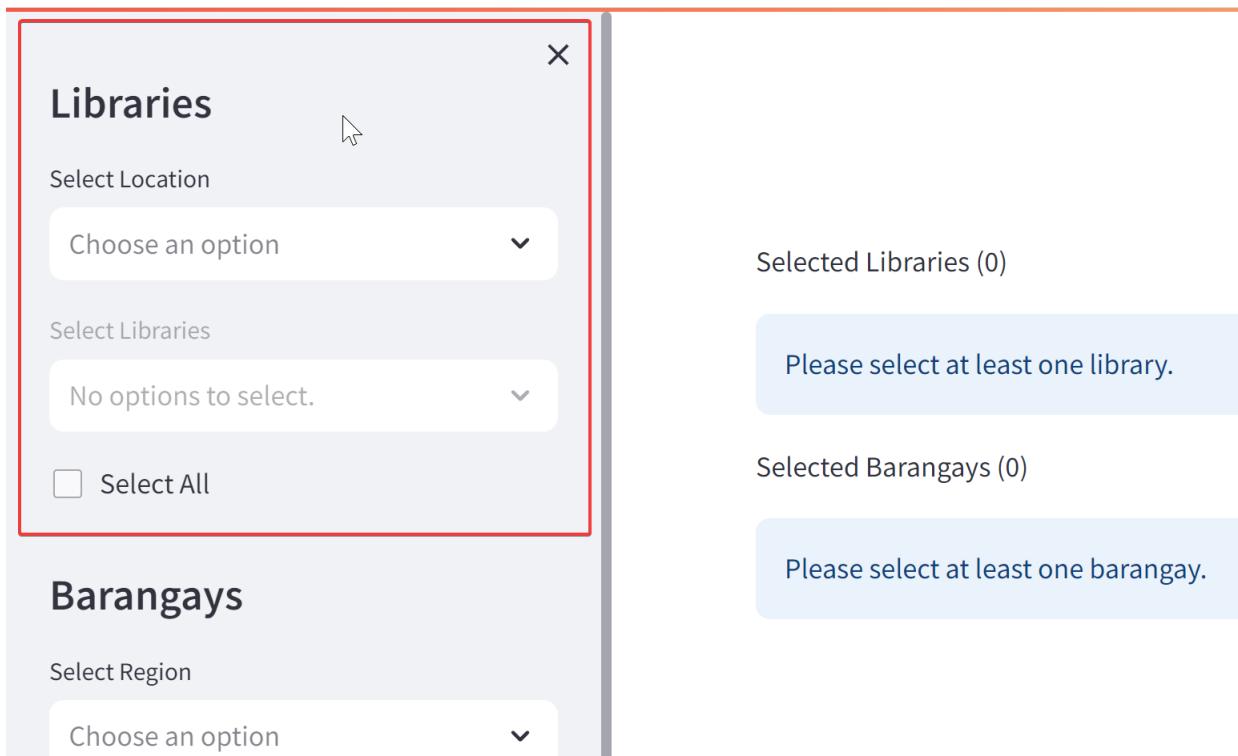


Figure 6.2: Library selection

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).

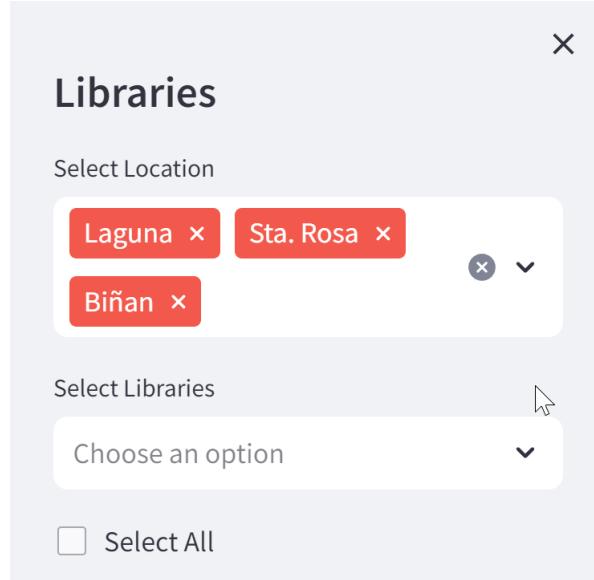


Figure 6.3: Library location selection example

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.

ID	NAME OF LIBRARY	Google Maps Name	place_id	latitude	longitude	library_service
27	Laguna Provincial Library	Laguna Provincial Library	ChiJjfzOqmjzlzMRgf50dy6X4al	14.2772	121.4166	0
102	Biñan City Studies Center	Sentrang Pangkultura ng Biñan	ChiJfzxLl_zzIMReOW1WN0F_N4	14.3388	121.0843	0
111	City of Sta. Rosa Library	Sta. Rosa City Library	ChiJkahmeLzLzMRh-558jcjOE	14.3176	121.1107	0
375	Bay Municipal Library	SWA LIBRARY - HOMEBASED BUSINESS	ChiJyfDzK1lzMRX-WX261-Mw	14.6418	120.9573	0
376	Cavinti Municipal Library	Cavinti Municipal Library	ChiJ90MhUKH-lzMRthSggwvfqjDE	14.2649	121.542	0
377	Famy Municipal Library	Siniloan Municipal Library & Museum	ChiJ0z2xQinvzlMrmnwYEJZGmTk	14.4215	121.4457	0
378	Liliw Municipal Library	Liliw Municipal Library	ChiJhzZdmPIzVtMRbBqpsCxtbgk	14.1358	121.4367	0
379	Lumban Municipal Library	Lumban Municipal Library	ChiJfz-8mVn7zMRQ6uPqozZog	14.297	121.4592	0
380	Magdalena Municipal Library	Magdalena Municipal Library	ChiJr9ssSRBVvTMRouxnKmQY	14.2028	121.4318	0
381	Paete Municipal Library	Paete Municipal Library	ChiJ_8bGtp6lzMRo-LNolqXYtE	14.363	121.4794	0

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.

The screenshot shows the PLAN application's search interface. On the left, there are two main sections: 'Libraries' and 'Barangays'. Under 'Libraries', a 'Select Location' dropdown is set to 'Quezon City'. Below it, a list of libraries is shown with several items selected, indicated by a red border: 'QCPL-Bag... x', 'QCPL- Bag... x', 'QCPL-Bali... x', 'Bagumbay... x', and '(810, 'QCPL-Cub... x'. A 'Select All' checkbox is also present. Under 'Barangays', a 'Select Region' dropdown is set to 'National Capital ... x'. Below it, a 'Select Province' dropdown is set to 'National Capital ... x'. A 'Select Municipality / City' dropdown is set to 'Quezon City x'. A 'Selected Barangays (142)' table is shown with three rows: 36,290 Sauyo (population 76289), 36,291 Sienna (population 2072), and 36,180 Alicia (population 6119). The table has columns for id, Name, 2020 Population, latitude, and longitude.

Selected Libraries (24)						
id	NAME OF LIBRARY	Google Maps Name	place_id	latitude	longitude	library_service
806	QCPL-Bagong Pag-aso Library (District 1)	Quezon City Public Library - Bagong Pag-aso Branch	ChiJSXWe1B-3lzMrgguib2RESVE	14.6626	121.0339	0
807	QCPL- Bagong Silangan Branch (District 2)	Quezon City Public Library - Bagong Silangan Branch	ChiJbZRjlG7lzMrrAFXdtBIL_Q	14.6974	121.1107	0
808	QCPL-Balingasa Library (District 1)	Quezon City Public Library - Balingasa Branch	ChiJaP7Soi2lzMrt-SeyxDDj0	14.6505	121.0018	0
809	Bagumbayan Barangay Library	Bagumbayan Barangay Library	ChiJq_w0xy4lzMRMj_RTVe3Ls	14.6084	121.0825	0
810	QCPL-Cubao Library (District 4)	Quezon City Public Library	ChiJH4PFsx2lzMRY18wsJzSj-A	14.6475	121.0507	0
811	QCPL-Escopa 3 Library (District 3)	Quezon City Public Library - Escopa 3 Branch	ChiJ8a9W4-3lzM4anYlZ7-QuM	14.6277	121.0722	0
812	QCPL-Escopa 2 Library (District 3)	Quezon City Public Library - Escopa 2 Branch	ChiJG3RMdP23lzMPrv2naJDFnil	14.6251	121.074	0
813	QCPL-Krus na Ligas Library (District 4)	Quezon City Public Library - Krus na Ligas Branch	ChiJu3txa3lzMRNjN8x8t5xQ	14.6442	121.064	0
814	QCPL-Lagro Library (District 5)	Quezon City Public Library - Lagro Branch	ChiJ1egQWQWz2lzMRR-nScRHekj0	14.7263	121.0666	0
815	Loyola Barangay Library	Rizal Library	ChiJ6CLIBX-3lzMRh18hHW7_ykA	14.64	121.0761	0

Selected Barangays (142)				
id	Name	2020 Population	latitude	longitude
36,290	Sauyo	76289	14.6895	121.0336
36,291	Sienna	2072	14.6382	121.0055
36,180	Alicia	6119	14.6601	121.0258

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.

The screenshot shows the PLAN interface with two main sections: 'Selected Libraries (25)' and 'Selected Barangays (142)'. Both sections are tables with columns for ID, NAME OF LIBRARY/NAME, Google Maps Name, place_id, latitude, longitude, and library_service.

Selected Libraries (25)

ID	NAME OF LIBRARY / NAME	Google Maps Name	place_id	latitude	longitude	library_service
75	Quezon City Public Library	Quezon City Public Library	ChiJH4PFsx2lzMRY18wsJzSj-A	14.6475	121.0507	0
806	QCPL-Bagong Pag-asa Library (District 1)	Quezon City Public Library - Bagong Pag-asa Branch	ChiJSXWe1B-3lzMRggub2RESVE	14.6626	121.0339	0
807	QCPL-Bagong Silangan Branch (District 2)	Quezon City Public Library - Bagong Silangan Branch	ChiJbzRjbLG7lzMRrAFYdtBIL_Q	14.6974	121.1107	0
808	QCPL-Balingasa Library (District 1)	Quezon City Public Library - Balingasa Branch	ChiIjaP7So2lzmRt-SeyxDDj0	14.6505	121.0018	0
809	Bagumbayan Barangay Library	Bagumbayan Barangay Library	ChiJqL-w9xy4lzMRMj_RTVee3Ls	14.6084	121.0825	0
810	QCPL-Cubao Library (District 4)	Quezon City Public Library	ChiJH4PFsx2lzMRY18wsJzSj-A	14.6475	121.0507	0
811	QCPL-Escopa 3 Library (District 3)	Quezon City Public Library - Escopa 3 Branch	ChiJ8a9W4-3lzMR4anYZl7-QuM	14.6277	121.0722	0
812	QCPL-Escopa 2 Library (District 3)	Quezon City Public Library - Escopa 2 Branch	ChiJG3RMdp23lzMRYy2naJDfRil	14.6251	121.074	0
813	QCPL-Krus na Ligas Library (District 4)	Quezon City Public Library - Krus Na Ligas Branch	ChiJu3ttxA3lzMRNjnNx8jsQ	14.6442	121.064	0
814	QCPL-Lagro Library (District 5)	Quezon City Public Library - Lagro Branch	ChiJ1exgQWowlzMRM-nScRHek0	14.7263	121.0666	0

Selected Barangays (142)

ID	Name	2020 Population	latitude	longitude
36,290	Sauyo	76289	14.6895	121.0336
36,291	Sienna	2072	14.6382	121.0055
36,180	Alicia	6119	14.6601	121.0258

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.

The screenshot shows the PLAN application's interface. On the left, there is a sidebar with dropdown menus for selecting regions, provinces, municipalities/cities, and barangays. Below these are checkboxes for 'Select All' and 'Select Barangays'. The main area displays two tables. The top table, titled 'Selected Libraries (142)', has columns for ID, Name, 2020 Population, latitude, and longitude. It contains several rows with NaN values in the population and coordinate columns. The bottom table, titled 'Selected Barangays (142)', has columns for id, Name, 2020 Population, latitude, and longitude. It lists various barangays with their respective coordinates. A note at the bottom states: 'The following libraries have no location data: [QCPL-Novaliches Library (District 5), QCPL-Payatas Landfill Library (District 2)]'. At the bottom right, there is a small map of the San Jose del Monte area.

ID	Name	2020 Population	latitude	longitude
817	QCPL-Novaliches Library (District 5)	Nan	Nan	None
818	Pansol Barangay Library	North Bay Boulevard South Barangay Library	ChiJb4gZ-Lq1lzMRF8qq3MRSgwg	14.6435
819	QCPL-Pasong Tamo Library (District 6)	Quezon City Public Library - Pasong Tamo Branch	ChiJgX-QFa2wlzMRru5BmYUkpBA	14.682
				120.956
				0
				0

ID	Name	2020 Population	latitude	longitude
36,290	Sauyo	76289	14.6895	121.0336
36,291	Sienna	2072	14.6382	121.0055
36,180	Alicia	6119	14.6601	121.0258
36,181	Amihan	3513	14.6338	121.0666
36,182	Apolonio Samson	33629	14.6553	121.0116
36,183	Aurora	4221	14.6158	121.0087
36,184	Baes	55328	14.6746	121.0134
36,185	Bagbag	64653	14.6965	121.0308
36,186	Bagumbuhay	6681	14.6242	121.0648
36,187	Bagong Lipunan Ng Crame	13630	14.6138	121.0505

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.

The screenshot shows the PLAN interface with several dropdown menus and a table.

- Top Left:** A list of selected libraries: (826, 'QCPL-San ...'), (827, 'QCPL-Saga...'), (828, 'QCPL-Tagu...'), and (829, 'QCPL-Talip...'). Below it is a checkbox for 'Select All'.
- Barangays Section:** Sub-sections for 'Select Region' (National Capital ...), 'Select Province' (National Capital ...), and 'Select Municipality / City' (Quezon City). Below these are dropdowns for 'Selected Barangays' containing: (36180, 'Alicia') x, (36181, 'Amihan') x, (36182, 'Apoloni...'), (36183, 'Aurora') x, and (36184, 'Baesa') x. A 'Select All' checkbox is also present.
- Table:** A table titled 'Selected Libraries (142)' with columns: id, NAME OF LIBRARY, Google Maps Name, place_id, latitude, longitude, and library_service. It lists 814 entries, such as Quezon City Public Library (id 75) and QCPL-Bagong Pag-asa Library (District 1) (id 806).
- Table:** A table titled 'Selected Barangays (142)' with columns: id, Name, 2020 Population, latitude, and longitude. It lists 142 barangays, including Blue Ridge A (id 36194) and Blue Ridge B (id 36195).

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.

The screenshot shows the PLAN interface with a map visualization.

- Top Left:** Same library selection list as Figure 6.8.
- Barangays Section:** Same selection dropdowns as Figure 6.8.
- Map:** A map of the Manila area showing the locations of selected libraries and barangays. Red dots represent libraries, and blue dots represent barangays. A callout box indicates: "The following libraries have no location data: ['Loyola Barangay Library', 'QCPL-Novaliches Library (District 5)', 'QCPL-Payatas Landfill Library (District 2)']".

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.

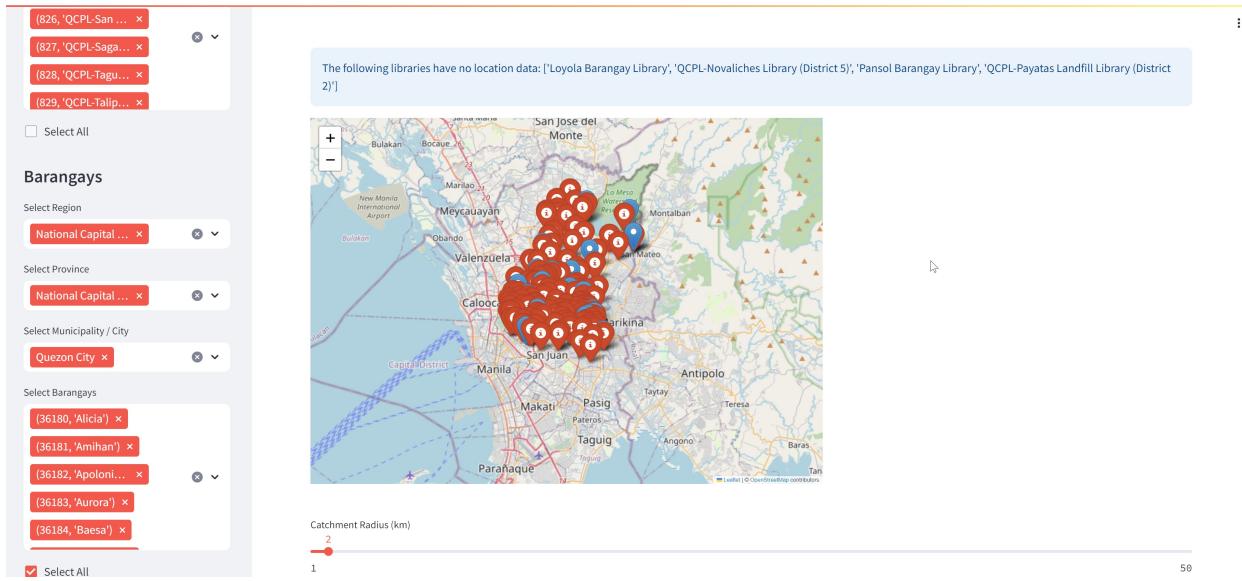


Figure 6.10: Updated map of selected libraries and barangays

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.

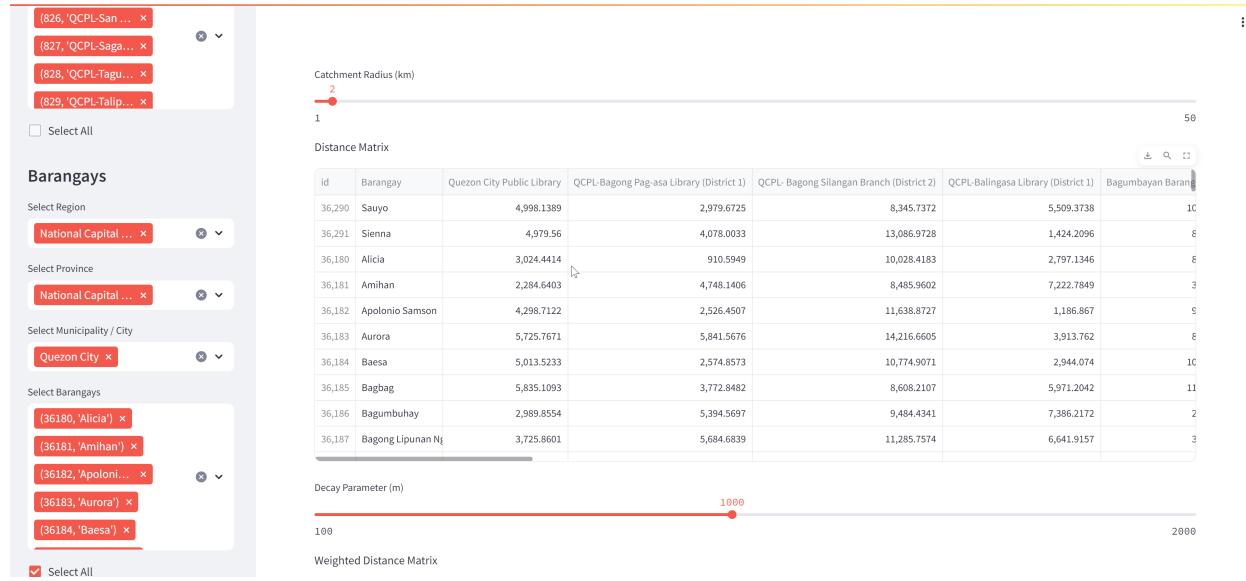


Figure 6.11: Setting catchment radius

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.

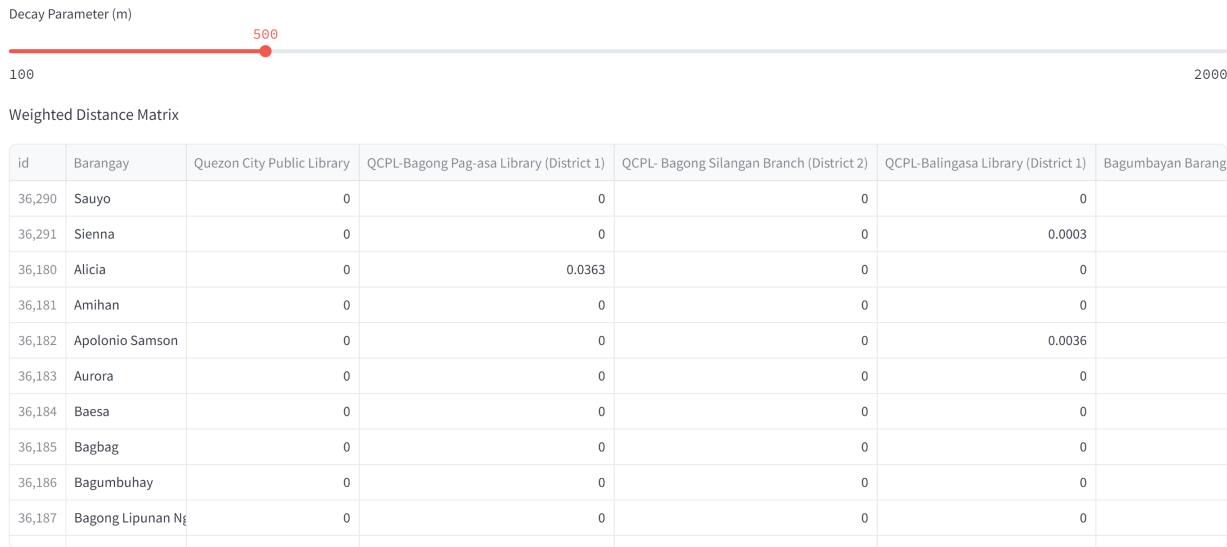


Figure 6.12: Setting decay parameter

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

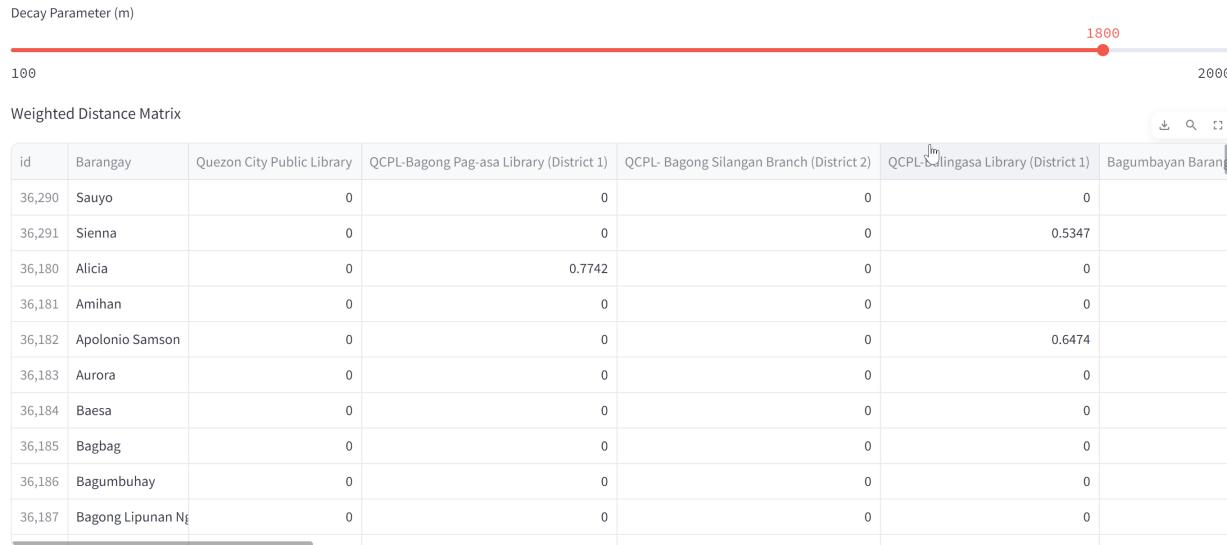


Figure 6.13: Weighted distance matrix

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 East,19332
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,106887
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 East,19332
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 Claro,3885
814	QCPL-Lagro Library (District 5)	4,000	107,873	34,370.261	0.1164	Pasong Putik Proper,39896 Greater,39897

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)', 0.0002)
36,192	Balingasa	19260	0.205	('QCPL-Balingasa Library (District 1)', 0.205) ('QCPL-Masambong Library (District 1)', 0.0002)
36,193	Bayanihan	613	0.0128	('Bagumbayan Barangay Library', 0.0) ('QCPL-Escopa 3 Library (District 3)', 0.0) ('QCPL-Escopa 2 Library (District 3)', 0.0)
36,194	Blue Ridge A	1534	0.1236	('Bagumbayan Barangay Library', 0.0) ('QCPL-Escopa 3 Library (District 3)', 0.0203) ('QCPL-Escopa 2 Library (District 3)', 0.0)
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-Escopa 3 Library (District 3)', 0.0)
36,197	Bungad	7014	0.0704	('QCPL-Bagong Pag-asa Library (District 1)', 0.0) ('QCPL-Masambong Library (District 1)', 0.0)
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 constraints, 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/randyzwitcch/streamlit-folium>

13. tabula-py

- License: MIT License
- URL: <https://github.com/chezou/tabula-py>