SUITABILITY ANALYSIS FOR URBAN BICYCLE TOURISM OF ILOILO CITY USING GIS

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ABSTRACT:

Urban bicycle tourism refers to the recreational and enjoyable use of bicycles in navigating urban cities like Iloilo City. The city has already established an 11-kilometer cycling infrastructure within its boundaries. It is imperative to maximize its use to combat the negative impacts of rapid urbanization and promote safe and sustainable transportation. This paper shows the use of Geographic Information Systems (GIS) to assess the bike lanes network's suitability and accessibility for building a bike-sharing system that also caters to drop-off and ride-on points at each station. Deletion of duplicates and cleaning of road network data and tourist attraction point data was performed prior to any analysis. Service areas were generated to determine the number of tourist attractions catered by each potential bike share station – defined by main road intersections. Point distance analysis was performed to reduce the number of road intersections to just thirty-nine (39). Bicycle route maps and itineraries were produced to visualize the optimal routes tourists can use for exploring the city based on preferred sites category. From here, Route Analysis was conducted to create four (4) itineraries based on tourism categories: Top 10 Most Rated Tourist Attractions, Food and Dining, Museums and Churches, and Shopping and Leisure. The output maps and itineraries can be presented to the City Tourism Office of Iloilo City as a decision support tool for its programs and policies regarding bike lanes.

1. INTRODUCTION

Iloilo City is one of the country's prime and top tourist destinations, attracting local and foreign tourists through its rich culture, history, urban lifestyle, and festivals like the Dinagyang Festival (Explore Iloilo, n.d; Yulu & Kapan, 2020). As part of the efforts of the local government unit or LGU of Iloilo City to ease transportation for their citizens and visitors, the LGU has improved and continuously improves their already usable 11-kilometer cycling infrastructure or bike lanes through the years; four (4) kilometers of these lanes are protected lanes (Golez, 2021). The existing city bikeways stretch out from Ninoy Aquino Avenue, also known as Diversion Road – the central business district of the city, to selected city roads including the downtown area (Lena, 2022). The LGU has also planned to expand its bikeways to 43 kilometers through its Bike Lanes Network Project Plan in the coming years. The effective use and promotion of the bike network give Iloilo City the title "Bike Capital of the Philippines" and one of the "most bike-friendly cities in the country" (Lena, 2022; GMA Regional TV, 2023). In 2014, the city launched the first Iloilo Bike Festival - a three-day annual event aiming to promote Iloilo City as a bikeable and walkable city (Taclino, 2021). Iloilo City, being a two-time Gold Awardee for the Most Bicycle-Friendly City, hosted the National Bike Day in 2023 attracting around 3000 bike enthusiasts (Castor, 2023).

Urban Bicycle Tourism is a current trend in highly developed countries and its key major cities, like Tokyo, Japan; Auckland, New Zealand; and London, United Kingdom (Nilsson, 2018; Kanpai, n.d). Path Less Pedaled defines urban bicycle tourism as "a travel-related activity for pleasure which incorporates the use of a bicycle." (Bicycle Tourism 101, n.d). The mentioned cities also have a bicycle-sharing system as part of their public transportation that locals and tourists use for commuting and casual touring.

Rapid urbanization challenges cities to come up with technology-driven solutions – in this case, transportation (Sta. Ana et al, 2021; Shahidehpour et al, 2018, Billones et al, 2021). The City Tourism of Iloilo has prepared suggested travel itineraries for the following themes: Heritage and Culture, Downtown Iloilo City Walking Tour, Mysterious Iloilo City Tour, Art Gallery Tour, Educational Tour, and Industrial Tour (City Government of Iloilo, 2020). Most of the suggested tour itineraries take up the whole day (with the exception of the Downtown Walking Tour) – visiting a minimum of ten (10) stops per tour. With Iloilo City's established bikeways, the LGU can further promote the infrastructure to tourists as means of clean and sustainable transportation to tour around the city. Identifying efficient routes depends on the tourist-preferred experience categories such as food and dining, recreational sites, and historical settings.

This paper aims to (1) assess the usability and accessibility of the bike lanes to the location of the tourist attractions and essential establishments in the city; (2) determine the most optimal locations to put bike-share stations (drop off/ride on points); and (3) create a proposed itinerary for bicycle tours based on different site categories and prioritizations. With the success of the study, the city can provide opportunities for investors to help develop the city and fully promote urban

bicycle tourism as a key activity for green and sustainable tourism.

2. METHODS

2.1 Study Site

Iloilo City is the capital of Iloilo Province in the Western Visayas region of the Philippines. It has a land area of 78.34 sq. km and a population density of 5,719 per sq. km (Philippine Statistics Authority, 2015). Iloilo City is a highly urbanized city and is titled the "Bike Capital of the Philippines", making it a prime pilot area for this study (Lena, 2022).

Figure 1. Study Site - Iloilo City

2.2 Project Design

A general methodology was formulated for the conduct of this study. It is shown as follows:

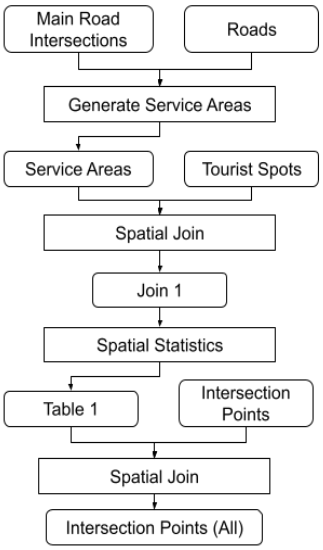

Figure 2. General Methodology (Phase 1)

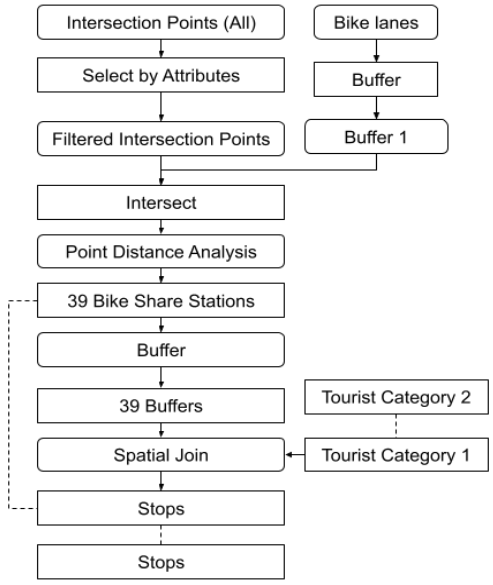

Figure 3. General Methodology (Phase 2)

2.3 Data Acquisition

All datasets were sourced from Project LUNGSOD and the Local Government of Iloilo City. These are the following:

- Existing Bike Lane Routes
- Road Network Data
- Barangay Administrative Boundaries
- District Administrative Boundaries
- Tourist Attractions in Iloilo City

2.4 Data Screening and Cleaning

2.4.1 Network Topology

A topological network was built to clean the road network data and to perform error validation with rules to check dangling lines and intersection points not covered by lines. A total of 2,229 errors were initially found after combining two road datasets (main roads and LGU-provided road inventory). Errors were then corrected through manual editing using ArcGIS Desktop readily available functions within the Error Inspector window. From here, a total of 1,391 intersection points between the roads were identified.

2.4.2 Removal of Duplicates

Points of interest (POIs) were collated, validated, and removed for duplicates after consolidating to maintain the integrity of the samples to be used in the study. These data include three (3) listings of Points-of-Interest. These are a) Churches, b) Heritage Sites, and c) Iloilo City Tourism Attractions. Each feature consisted of its spatial location (latitude and longitude), type, and tourism category. A total of two hundred and seventy-nine (279) tourist attractions were identified.

2.5 Data Analyses

For data processing and analyses, ArcGIS Desktop applications such as ArcGIS Pro v2.8.0 and ArcMap Desktop v10.8.1 were used. Both software has advanced licenses and spatial analyst extensions. Out-of-the-box geoprocessing tools within the application were then used and utilized.

To start with the process, each of the 279 tourist attractions was given a score based on their priority for tourists to visit based on different literature. The following scoring system is as follows:

Score	Tourist Attraction Categories (# of POIs)
5	TripAdvisor most rated POIs, Notable Museums, Nature, Notable Parks and Plazas, Leisure, Hospitals, Shopping Centers (36)
4	Other Parks and Plazas, Other Known Restaurants, Other Leisure, Other Museums, Other Nature Parks, Other University Campus (36)
3	Event Centers, Port, City Hall, Remaining Restaurants, Cafes, Delicacies, Food Strips, Other Churches, Other Nature Beach, Primary and Secondary Schools (46)
2	Architecture (6)
1	Monument, Other Buildings, Other Historical Residences, Bridges (155)

Table 1. Scoring System for Tourist Attractions

Afterward, service areas (polygons) were then generated for each intersection point. A distance of four-hundred (400) meters was set as cut-offs away from the Facilities, in this case, the intersection points.

The Spatial Join tool was used to get all tourist spots that intersect or were within each service area's catchment area. The team summarized the table generated from the previous tool by getting the summation of the PRIORITY field for each FacilityID; a new field was added to indicate the OBJECTID of the original intersection point. The summarized table was joined to the intersection point feature class and the Field Calculator was used to populate the SCORE field of the sum value. All intersection points with null or 0 score values were eliminated. This was an indication that these points do not have any accessible tourist spots.

The bike lane network only has minimal coverage of the main road network; hence, a 20-meter buffer was created in bike lanes. These created polygons helped eliminate further intersection points that were not suitable, as this study aims to have bike share stations that are accessible within walking distance from the main road and in the existing bike lanes. The Intersect tool was used to get all intersection points within the buffers created. Four hundred sixty-two (462) points were selected, and after running the Delete Identical tool to check duplicate data based on the SHAPE attribute, one hundred sixty-one (161) unique intersection points were identified.

As the software lacked a geoprocessing tool to do Point Data Analysis, the team had to develop a Python script that analyzed the remaining 161 points. The point with the highest SCORE served as the initial point for the script analysis. A snippet of the said script is shown in Figure 4.

```
# Remove all points of lower priority and are within specified distance
of existing point in station list
    station_list = []
    for i in range(1, len(content)):
        current_line = content[i].split(',')
        point = (float(current_line[8]), float(current_line[9]))
        quit = False
        for station in station_list:
            if haversine(point[0], point[1], float(station[8]), float(station[9])) <
0.001: # specified distance
                quit = True
                break
        if quit:
            continue
        else:
            station_list.append(current_line)
```

Figure 4. Python Script to identify bike share stations

3. RESULTS

3.1 Proposed Bike Share Stations

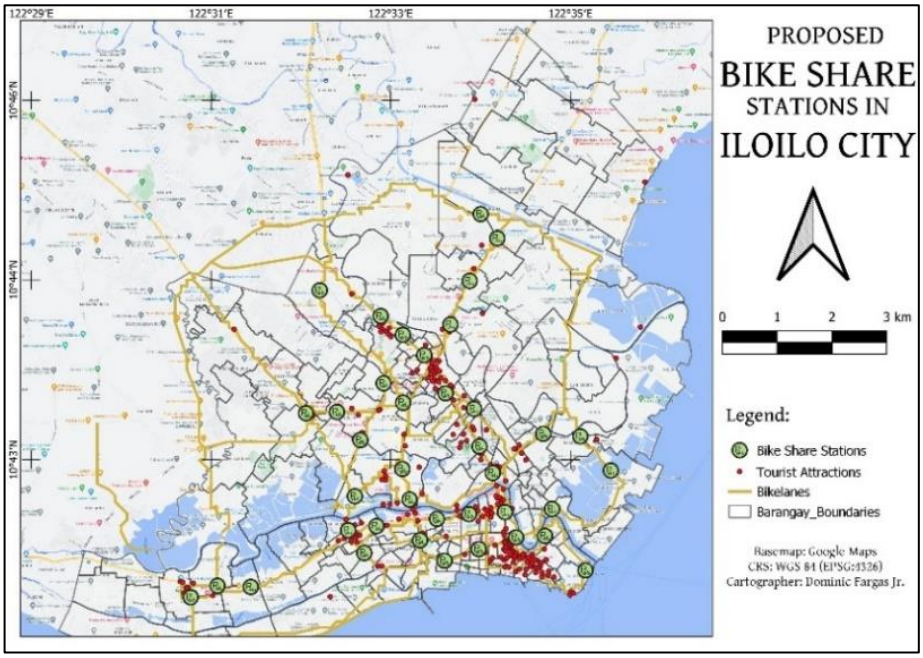

Figure 5. Location of Proposed Bike Share Stations

Figure 5 shows the location of the proposed bike share stations in Iloilo City using GIS. A total of thirty-nine (39) bike-share stations have been identified using the Point Distance Analysis. Each bike share station is at least 500 meters away from another bike share station - equivalent to biking at the global average speed of 12 km/hr for 3 minutes.

As seen in the figure, the bulk of the bike-share stations is located in the Iloilo City Proper District, the center of economic activity in the city and the location for most of the tourist attractions. A few bike-share stations can be found in the districts of Mandurriao and La Paz - residential districts in the city also with few bike lane routes.

3.2 Route Analysis

Four (4) itineraries were created based on tourism categories: Top 10 Most Rated Tourist Attractions, Food and Dining, Museums and Churches, and Shopping and Leisure.

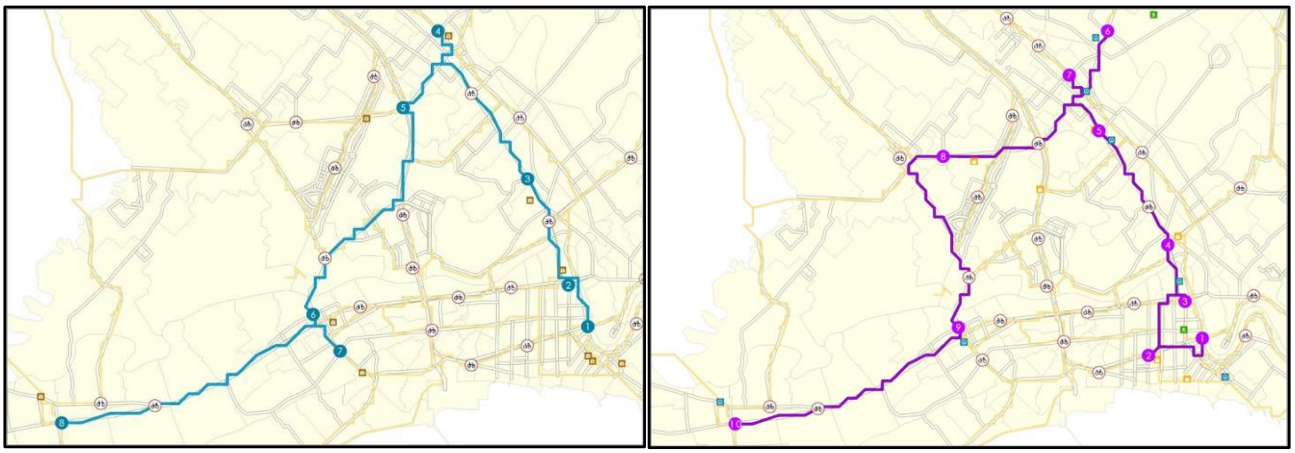

Figure 6. Generated Bicycle Itineraries (from top to bottom, left to right): Itinerary A - Top 10 Most Rated Tourist Attractions; Itinerary B - Food and Dining; Itinerary C – Museums and Churches; Itinerary D - Shopping and Leisure

3.2.1 Top 10 Most Rated Tourist Attractions

Itinerary A spans a stretch of approximately 17.66 kilometers and takes about forty-two (42) minutes to traverse one way. Along the said route are ten (10) stops that one would be able to visit:

1. Calle Real
2. Museo Iloilo
3. Nelly Garden
4. Casa Mariquit
5. Central Philippine University
6. Iloilo Museum of Contemporary Art
7. SM City Iloilo
8. Molo Mansion
9. Jaro Cathedral
10. Camiña Balay na Bato

3.2.2 Food and Dining

Itinerary B spans a stretch of approximately 14.03 kilometers and takes about thirty-three (33) minutes to traverse one way. Along the said route are seven (7) stops that one would be able to visit:

1. Roberto's Iloilo
2. Deco's La Paz Batchoy/ Madge Café La Paz/ Ted's La Paz Batchoy
3. Biscocho Haus/ De Ocampos Barquillos
4. Kap Ising Molo/ Netong's La Paz Batchoy Atria
5. Punot
6. Panaderia de Molo
7. Glory's Café Arevalo/ Breakthrough's Restaurant/ Tatoy's Manokan and Seafoods

3.2.3 Museums and Churches

Itinerary C spans a stretch of approximately 13.80 kilometers and takes about thirty-three (33) minutes to traverse one way. Along the said route are seven (7) stops that one would be able to visit:

1. Calle Real/ Museum of Philippine Economic History/ Casa Real de Iloilo
2. Museo Iloilo
3. Saint Clement's Church
4. Casa Mariquit
5. Iloilo Museum of Contemporary Art
6. Jaro Cathedral
7. Rosendo Mejica Landmark and Museum
8. Camiña Balay na Batotourist spots.

3.2.4 Shopping and Leisure

Itinerary D spans a stretch of approximately 17.62 kilometers and takes about forty-three (43) minutes to traverse one way. Along the said route are seven (7) stops that one would be able to visit:

1. Plaza Libertad/ Casino Filipino Iloilo
2. Iloilo Central Market/ Robinsons Iloilo
3. Iloilo Provincial Capitol Grounds
4. La Paz Market
5. Sanson-Montinola Ancestral-Antillean House/ Robinsons Jaro
6. Waterworld Iloilo/ Lizares Mansion
7. Old Jaro Municipal Hall
8. Festive Walk Iloilo
9. Molo Mansion / Yusay Consing Mansion
10. Sinamay House

4. DISCUSSION AND CONCLUSIONS

Thirty-nine (39) proposed bike share stations were identified within the study area of Iloilo City based on their existing bike lane routes, road network, and list of tourist attractions. Four (4) tourism itineraries were also made as a guide for tourists when visiting the city depending on specific themes: Top 10 Most Rated Tourist Attractions, Food and Dining, Museums and Churches, and Shopping and Leisure. Each of these tours contains a map of the said attractions, the length of the bike tour (in kilometers), and the duration of the bike trip (in minutes). Of the four (4) tourism itineraries, the longest is the Top 10 Most Rated Tourist Attractions also being that with the greatest number of stops. The Shopping and Leisure tour, though narrowly shorter, takes more time to traverse at forty-three (43)

minutes. It must be noted, however, that it is not required for the user to strictly perform the itinerary from start to finish – they may start and end at any stop.

To further improve the study, recommendations include exploring variable distances between bike share stations, buffers for each service area, and other tourism categories to generate other routes/itineraries for the users. Whenever possible, the road network, existing bike lanes, and list of tourist attractions must be updated while performing the methodology again to improve its output.

The results of the study can be presented to the City Tourism office of the local government of Iloilo City as a suggestive guide for its programs and policies regarding bike lanes. This may also be compared with the 2020-2022 Iloilo City Tourism Development Plan as recommendations for the upcoming years to come. It may also be presented to a private entity that may take interest in creating a business solution while promoting urban bicycle tourism. As always, the methodology of the study could be explored to see its applicability and usability in other study sites that may want to promote urban bicycle tourism in their area.

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