

A Suitability Analysis for Community Gardens in Vancouver, British Columbia

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INTRODUCTION

In Canada's current economy, affordability of food is an issue for many citizens, as well as having access to food that is of high quality. The city of Vancouver is just one example in Canada where inflation has caused food prices to rise drastically, with a 10% increase just between 2022 and 2023 (Carrigg, 2023). This issue has affected many individuals and families, leaving people questioning how food unaffordability will impact their livelihoods. To overcome this issue, municipalities should focus on increasing urban agriculture such as community gardens in neighborhoods so citizens can have regular and affordable access to food (Zaki et al., 2023).

Within geographic information systems (GIS), multi criteria evaluation is defined as the transformation of geographic data into criteria containing levels of importance to determine suitability. The combination of GIS and MCE improves decision making processes in spatial analysis (Malczewski, 2015). The objective of this study is to perform a suitability analysis using a GIS-based multi-criteria evaluation (MCE) to find areas in the city of Vancouver where future community garden plots can be developed. In addition to the MCE method, analytical hierarchy process (AHP) and weighted linear combination (WLC) were used to determine criteria weights. Both methods are highly used in GIS works as MCE techniques (Li et al., 2018; Malczewski, 2000).

DATASETS

The datasets used in this study were obtained from the City of Vancouver Open Data Portal. The data layers include city boundary, community gardens and food trees, city-owned properties, zoning districts and labels, non-market housing, parks, and water transmission mains. Data have been rasterized to a 50-meter spatial resolution for the method implementation.

METHODS

For this MCE, five criteria were chosen as factors influencing potential development of community gardens (Table 1). Each criterion's suitability was determined with individual suitability functions. Two criteria not listed below, public streets and community gardens, were labelled as constraints where future plots cannot be developed. The MCE was performed with both equal and AHP derived weights measured as percents. Table 2 shows the AHP matrix of how the weights were calculated. In addition, the WLC method was used for the suitability by combining the weights and suitability functions / scores in Table 3. All analysis were performed using Esri ArcGIS Pro software.

Criteria	Weights (equal)	Weights (AHP)
Proximity to city owned properties	20	13.57
Land use zoning	20	39.31
Proximity to non-market housing	20	13.57
Public parks	20	6.88
Proximity to water transmission mains	20	26.67

Table 1: List of suitability factors and weights used in the MCE.

Criteria	Zoning districts	Prox. to city owned properties	Prox. to non-market housing	Prox. to water transmission mains	Parks
Zoning districts	1	3	3	2	5
Prox. to city owned properties	1/3	1	1	1/2	2
Prox. to non-market housing	1/3	1	1	1/2	2
Prox. to water transmission mains	1/2	2	2	1	4
Parks	1/5	1/2	1/2	1/4	1

Table 2: Analytical hierarchy process weight matrix.

Criteria	Class	Suitability Score (Low suitability = 1, high suitability = 5)	Weights
Zoning districts	Industrial	1	39.31%
	Residential	5	
	Commercial	3	
	Residential Rental	5	
	Comprehensive development	4	
Proximity to city owned properties (meters)	≤ 251.90	1	13.57%
	≤ 580.47	2	
	≤ 1040.46	3	
	≤ 1620.93	4	
	≤ 2792.82	5	
Proximity to non-market housing (meters)	≤ 353.62	1	13.57%
	≤ 748.05	2	
	≤ 1292.08	3	
	≤ 2040.13	4	
	≤ 3469.22	5	
Proximity to water transmission mains (meters)	≤ 348.12	1	26.67%
	≤ 887.70	2	
	≤ 1653.56	3	
	≤ 2593.48	4	
	≤ 4438.51	5	
Parks	Parks	5	6.88%

Table 3: Criteria classes with corresponding suitability scores and weights.

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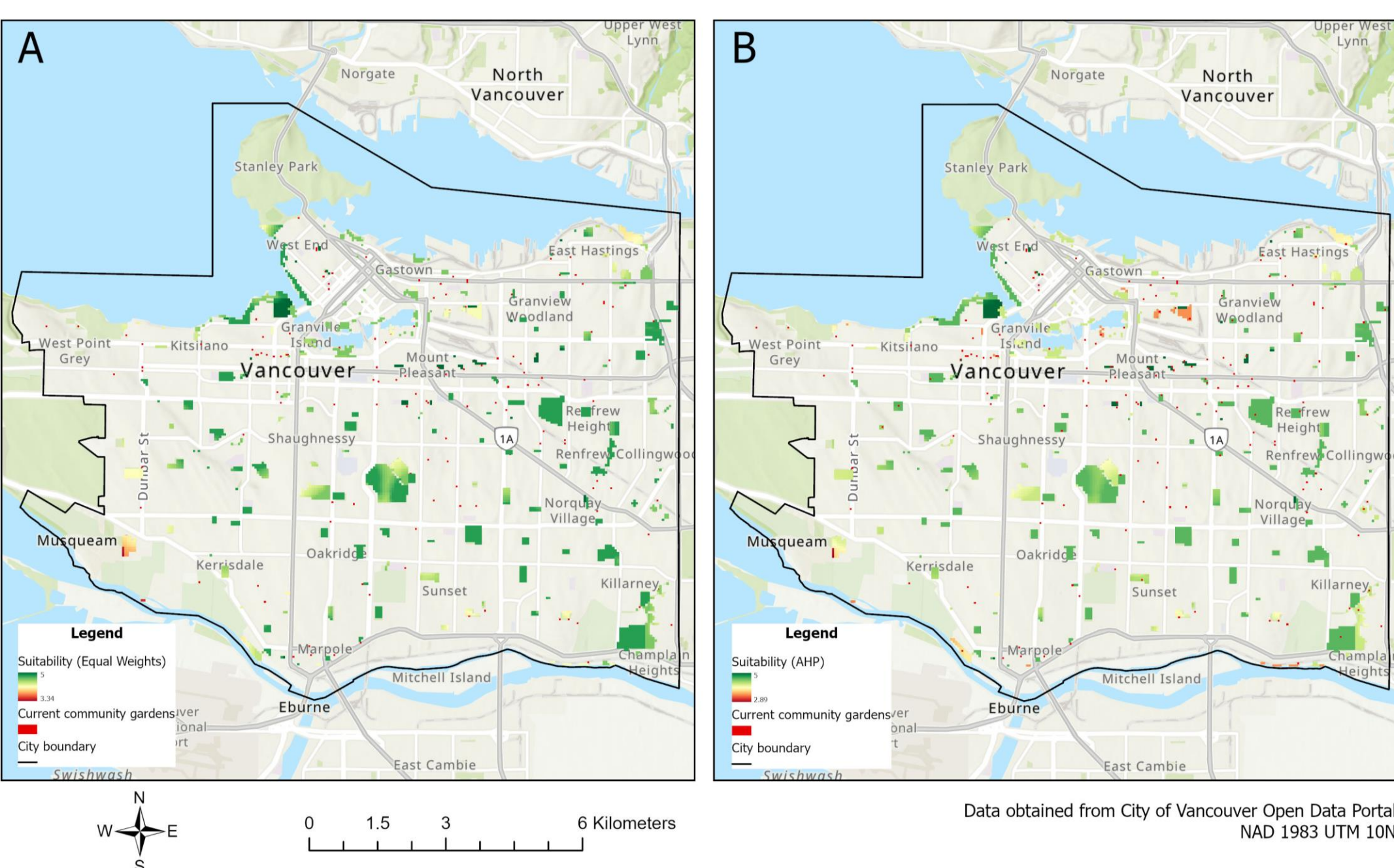


Figure 1: Maps depicting potential community garden plots with equally weighted criteria and weights determined with the AHP method.

RESULTS & DISCUSSION

As a result of the GIS-based MCE, two suitability maps were produced. Map A presents criteria based on equal weights with suitability values ranging from 3.34 to 5, while Map B presents criteria with AHP generated weights and a suitability scale of 2.89 to 5. For this study, 'high suitability' defines locations that are in residential and comprehensive development zones and in close proximity to city-owned properties, non-market housing, parks, and water transmission mains. 'Low suitability' defines locations that are in industrial and commercial zones and far away from the criteria previously mentioned. Even though both maps contain the same suitability locations, the values changed when the criteria were given differing weights.

Some notable areas of high suitability are near Granville Island, Renfrew Heights, and Queen Elizabeth Park. The least suitable areas are in southwest Vancouver near Kerrisdale and near the Downtown Eastside.

For a community garden MCE, there are other factors that can influence suitability analysis such as land cover, elevation, and soil type data that were not included due to data inaccessibility. Additionally, future studies could include population and income to have a better understanding of what specific neighborhoods would benefit the most from community garden plots.

Due to data being low resolution, public streets were not added into the MCE, but are acknowledged as unsuitable criteria.

CONCLUSION

The proposed GIS-MCE method successfully derives numerous suitable areas within the City of Vancouver for new locations of community gardens. These areas include residential and comprehensive development zones, parks, and proximity to city-owned properties, non-market housing, and water transmission mains. With urban agriculture development being a recognized solution to food insecurity, municipalities and city planners have the opportunity to make great change in their cities.

REFERENCES

- Carrigg, D. (2023). B.C. food prices climb almost 10 per cent over the past year. Vancouver Sun. <https://vancouversun.com/news/local-news/bc-food-prices-climb-almost-10-per-cent-over-the-past-year>
- Li, Z., Fan, Z., & Shen, S. (2018). Urban green space suitability evaluation based on the AHP-CV combined weight method: A case study of fuping county, China. *Sustainability*, 10(8), 1-15. <https://doi.org/10.3390/su10082656>
- Malczewski, J. (2000). On the use of weighted linear combination method in GIS: Common and best practice approaches. *Transactions in GIS*, 4(1), 5-22. <https://doi.org/10.1111/1467-9671.00035>
- Malczewski, J., & Rinner, C. (2015). *Multicriteria decision analysis in Geographic Information Science*. Springer.
- Zaki, Z. A., Yusup, M., Che Abdullah, I., Abdullah, Y. A., & Abdul Halim Shah, A. S. (2023). Land suitability analysis for urban gardening using GIS-based multi-criteria decision-making approach. *Planning Malaysia*, 21, 402-413. <https://doi.org/10.21837/pm.v21i29.1379>

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