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A GIS Analysis for Identifying Suitable Locations Establishing for New Urban Green Space in Colombo Municipal Council, Sri Lanka

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ABSTRACT

Urban green spaces are vital for enhancing the quality of life in densely populated areas by offering recreational opportunities, improving air quality, and mitigating urban heat island effects. This research focuses on identifying suitable locations for new urban green spaces within the Colombo Municipal Council (CMC), Sri Lanka, using a Global Position System (GIS)-based Multi-Criteria Evaluation (MCE) approach. The rapid urbanisation and increasing population in Colombo have made it essential to evaluate potential sites for green space development. The study utilises the Analytical Hierarchy Process (AHP) to assign weights to factors that influence land suitability, including population density, proximity to water sources, settlements, roads, Normalised Difference Vegetation Index (NDVI), land use, elevation, and slope as environmental and physical factors. By integrating these criteria into a GIS framework, the research provides a comprehensive spatial analysis to highlight optimal areas for green space development. The study identified several potential sites for new urban green spaces through the suitability map, with the southern part of Colombo, including areas near the Port City and Beira Lake, emerging as the most suitable due to favourable environmental conditions such as proximity to water bodies and higher population densities. The research not only contributes to sustainable urban planning but also aims to improve environmental quality and public health in Colombo. It offers a replicable model for other rapidly urbanising cities seeking to optimise green space allocation. The findings recommend that urban planners prioritise new green spaces in highly suitable areas like the southern parts of Colombo, and that existing green spaces be expanded, particularly in underserved areas. Integrating green space development into Colombo's broader urban strategies is crucial for building resilience against urbanisation challenges like pollution and heat islands. Continuous GIS-based monitoring will ensure the adaptive management of green spaces, helping safeguard Colombo’s long-term sustainability and enhance residents' well-being.

Keywords: Urban Green Space, GIS-based Suitability Analysis, Multi-Criteria Evaluation (MCE), Analytical Hierarchy Process (AHP), Colombo Municipal Council (CMC)

INTRODUCTION

Urban green spaces (UGS) are important components of sustainable urban development as they improve environmental quality, urban attractiveness, and residents’ quality of life. These spaces include parks, forests, gardens, green roofs, and blue-green areas such as rivers and canals, providing benefits such as biodiversity conservation, temperature regulation, flood reduction, recreation, social interaction, and improved mental well-being (Lui et al., 2023; Zhang et al., 2023; M'Ikiugu et al., 2012; Apud et al., 2020; Coroian et al., 2021). They also contribute to better air quality, reduced noise pollution, and healthier urban environments, with the World Health Organisation (WHO) recommending a minimum of 9.5 m^2 of green space per person for healthy urban living (Li et al., 2022).

Globally, green space planning has become a priority in urban development, with developed countries implementing successful strategies through urban parks, green infrastructure, and tree-planting programs (Kwon et al., 2021; Lui et al., 2022). However, many developing countries face challenges due to rapid urbanisation, limited resources, and inadequate planning frameworks, although countries such as India, Ethiopia, and Nepal have recently increased their focus on green space development (Sharma et al., 2022; Abebe & Megento, 2016). Urban expansion, land use changes, and population growth have contributed to environmental degradation and reduced green space availability, highlighting the need for effective planning strategies (Tzoulas et al., 2007; Byomkesh et al., 2012).

In Sri Lanka, particularly in Colombo, rapid urbanisation and infrastructure development have increased pressure on land resources and reduced available green spaces. Therefore, effective approaches are required to identify suitable locations for future green space development and maintain ecological balance (Senanayake et al., 2013). GIS and remote sensing technologies are important tools for identifying and evaluating suitable areas for urban green space development by providing accurate spatial information and supporting comprehensive spatial analysis. Remote sensing enables the monitoring of vegetation conditions, land cover changes, and environmental characteristics, while GIS facilitates the integration and analysis of multiple factors such as land use, population density, accessibility, topography, and hydrological conditions (Santhasiri et al., 2025; Santhasiri et al., 2026). These technologies support the assessment of existing green spaces, identification of areas lacking vegetation, and prioritisation of potential locations for future green infrastructure development (Faryadi & Taheri, 2009). Furthermore, GIS-based Multi-Criteria Analysis (MCA) and the Analytic Hierarchy Process (AHP) allow the combination of environmental and socio-economic factors to improve suitability analysis and support evidence-based urban planning decisions (Gelan, 2021; Moisa et al., 2023). In Sri Lanka, GIS and remote sensing applications have contributed to assessing green space availability, monitoring land use changes, analysing vegetation distribution, and identifying areas requiring additional green infrastructure, providing an effective framework for sustainable urban development (Senanayake et al., 2013).

Study Area

The CMC, located in the Western Province of Sri Lanka between approximately 79°50′–79°53′ East longitude and 6°54′–6°57′ North latitude, covers approximately 37 km² and is one of the country's most densely populated urban areas, with a population exceeding 0.5 million and a density of over 13,000 people/km². Although the area contains important green spaces such as Viharamahadevi Park, the available green space per capita remains below the recommended standard due to rapid urbanisation, land use changes, and infrastructure expansion. With low-lying terrain, a tropical climate, and limited space for green development (Figure 01).

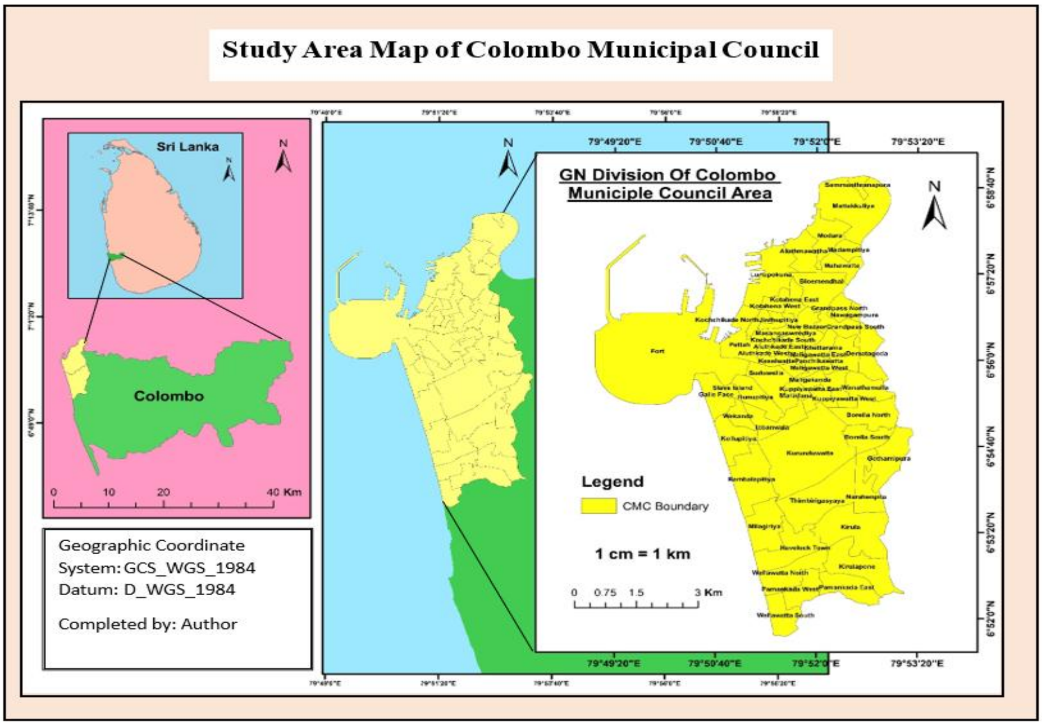

Figure 01: Study area of Colombo Municipal Council (CMC).

METHODOLOGY

The following steps have been utilised for this study, there are;

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Population, Sample and Sampling; This study uses GIS and Multi-Criteria Decision Analysis (MCDA) to identify suitable locations for new urban green spaces across the entire Colombo Municipal Council (CMC) area. Since no sampling techniques are applied, the study provides a complete spatial assessment based on factors such as land use, water bodies, infrastructure, urbanisation, and population density.

Methods of Data Collection: The study utilised primary data from field observations and photographs, along with secondary data from UDA, the Department of Census and Statistics, municipal records, and planning reports to assess UGS distribution in the CMC. These datasets were integrated into GIS analysis to identify green space deficiencies, evaluate suitable areas for future development, and improve accessibility.

Methods of Data Analysis: The study applied GIS technology integrated with a Multi-Criteria Evaluation (MCE) approach to analyse environmental, social, and infrastructural factors influencing urban green space suitability. This method supports the identification of appropriate locations for new green spaces within the CMC, contributing to improved quality of life, ecological balance, urban sustainability, and accessibility.

Determination of Efficient Criteria and Factors: The eight key criteria were selected based on physical and environmental factors. These include population density, proximity to water bodies, proximity to settlements, NDVI, existing land use, proximity to roads, elevation, and slope. These criteria were integrated using GIS-based weighted overlay analysis to evaluate community demand, ecological conditions, accessibility, land availability, and terrain suitability for identifying potential urban green space development areas.

Describe the Analytical Method: ArcMap 10.8 and its tools, including Spatial Analyst, Analysis tools, and Model Builder, were used for geoprocessing, spatial analysis, and raster-based evaluation. The study applied Euclidean Distance, Slope analysis, raster reclassification, and AHP-based weighting to standardise and integrate multiple criteria through the Weighted Overlay method, generating the final urban green space suitability map. The identified suitable areas were calculated using field calculations and exported as KML files for visualisation and field verification in Google Earth Pro.

Area and Percentage Distributions Equation Given Below: The percentage contribution of each identified potential green space area was calculated using the following formula,

$$\text{Percentage of CMC Area (\%)} = \frac{\text{Identified Green Space Area (km}^2\text{)}}{\text{Total CMC Area (km}^2\text{)}} \times 100$$

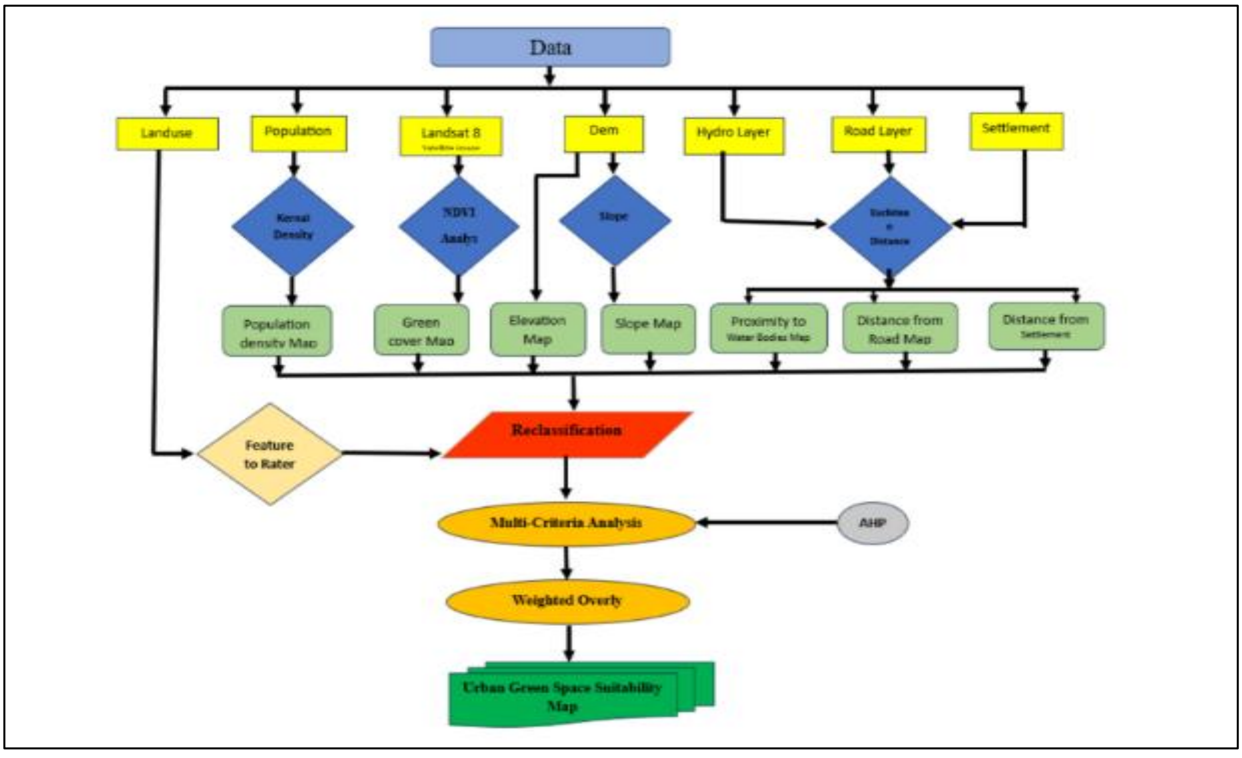

Figure 02: The Analytical Hierarchy

RESULTS AND DISCUSSION

Identified Existing Green Spaces and Assessed

The analysis assessed the existing distribution and gaps of urban green spaces (UGS) within the Colombo Municipal Council (CMC) area. Although major green spaces such as Viharamahadevi Park, Galle Face Green, and Independence Square exist, they are insufficient to meet the increasing demand caused by urbanisation and population growth. Green spaces are unevenly distributed, with larger areas concentrated in the eastern and southeastern parts, while central and western areas have limited and fragmented green spaces. According to the World Health Organisation (WHO)**,** urban residents should have access to public green spaces within a 15-minute walking distance; however, this standard is difficult to achieve in many parts of central Colombo. Therefore, developing new green spaces such as pocket parks, rooftop gardens, and underutilised land conversion is essential to improve accessibility, environmental quality, and urban resilience.

Distribution of Green Areas in CMC Area

(Table 01) presents the major existing green spaces within the Colombo Municipal Council (CMC) area, including their area, location, type, and functions. These green spaces provide ecological, recreational, and social benefits. Viharamahadevi Park is the largest green space (27.5 ha), followed by the Diyawanna Oya surrounding area (10 ha) and Talangama Wetland (8 ha). However, the distribution of green spaces is uneven, with limited access in highly urbanised areas, highlighting the need for strategic planning to improve green space availability and accessibility within the CMC area.

Table 01: Distribution of Existing Green Areas in CMC area.

Green Space Name	Area (hectares)	Location	Type	Notes
Viharamahadevi Park	27.5	Colombo 7	Public Park	Central Park, popular for recreational activities.
Galle Face Green	5	Colombo 1	Urban Park	Coastal Park, used for events and leisure activities.
Colombo Race Course	8	Colombo 7	Sports Complex	Green space used for horse racing and other events.
Victoria Park	1.8	Colombo 2	Public Park	Smaller Park, often used for community events.
Diyawanna Oya (Surrounding Area)	10	Colombo 8	Water Body with Green Space	Lake surrounded by green areas, used for various activities.
Independence Square	2	Colombo 7	Public Square	Includes open green areas for public events and gatherings.
Colombo City Centre Green Space	3	Colombo 3	Urban Park	Recently developed green area within the city center.
Talangama Wetland	8	Colombo 5	Nature Reserve	Wetland area with rich biodiversity, used for education and research.
Borella Cemetery Green	2.5	Colombo 8	Cemetery Grounds	Green space within a historical cemetery, used for quiet reflection.

Analysed the Key Factors

The study analysed eight key factors influencing urban green space suitability using GIS-based spatial analysis and thematic maps with classified legends. **(a) Population density** was considered to represent social demand,

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where highly populated areas indicate greater requirements for accessible green spaces and recreational facilities. **(b) Road network accessibility** was assessed to determine the influence of connectivity, as areas closer to roads provide better public access and greater potential for green space utilisation. **(c) Proximity to water bodies** was evaluated due to its contribution to ecological sustainability, biodiversity support, and integration of blue-green infrastructure. **(d) Land use characteristics** were analysed to identify suitable areas based on existing land availability, development pressure, and potential for land conversion or improvement. **(e) Slope conditions** were assessed to determine the feasibility of green space development, with flatter areas considered more suitable due to lower construction requirements and easier maintenance. **(f) NDVI values** were analysed to represent vegetation conditions and ecological quality, where areas with lower vegetation coverage indicate potential locations for green space enhancement. **(g) Settlement distribution** was evaluated to understand the relationship between residential concentration and green space demand, identifying areas requiring improved access to green facilities. **(h) Elevation** was considered to assess land suitability, flood vulnerability, and climate resilience, as appropriate elevation conditions support safer and more sustainable green space development. The integration of these factor maps and their legends supported the identification of suitable locations for future urban green space development (Figure 03, (a) – (h)).

The integration of these criteria through GIS-based multi-criteria analysis allows the identification and prioritisation of suitable locations for urban green space development within the CMC area.

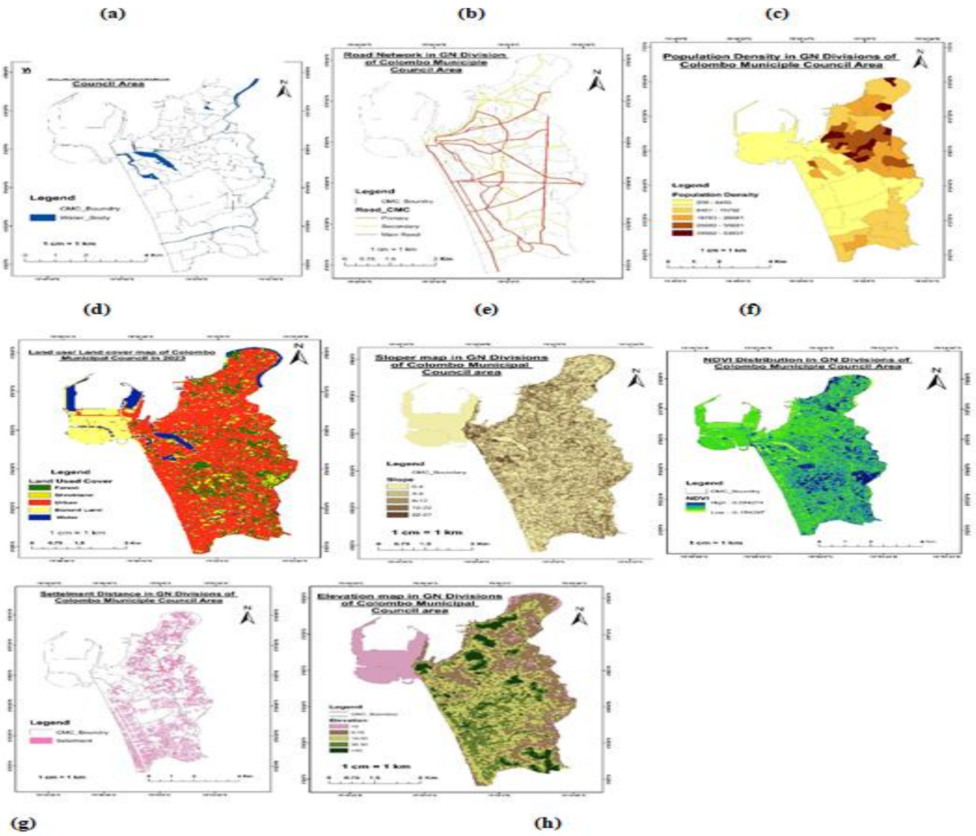

Figure 03, (a) Population density, (b) Road network accessibility, (c) Proximity to water bodies, (d) Land use characteristics, (e) Slope, (f) NDVI, (g) Settlement, (h) Elevation.

Reclassify the Selected Factors

The suitability analysis integrated key environmental, social, and physical criteria to identify potential urban green space locations within the CMC area. Population density identified northern and central CMC as priority areas due to high demand for green spaces, while road accessibility highlighted northern and western corridors with better connectivity. Proximity to water bodies emphasised southwestern and northeastern areas due to ecological benefits, and land use analysis identified northern and northeastern areas near the Kelani River as suitable due to available land. Slope and elevation conditions indicated flatter and lower-risk areas as favourable for development, while NDVI analysis highlighted regions with better vegetation potential. Settlement analysis showed opportunities for larger green spaces in less-developed areas and small-scale green interventions in dense

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urban zones. Overall, the GIS-based suitability analysis integrated these factors to identify optimal locations by balancing urban demand, accessibility, ecological value, land availability, and environmental sustainability (Figure 04 (a) – (h) and Table 02).

Table 02: Reclassify the selected factors with Sub-factor Range / Category.

Criteria	Sub-factor Range / Category	Score (Suitability)
Slope (°)	0–4 (1), 4–8 (2), 8–12 (3), 12–22 (4), 22–70 (5)	VH, H, M, P, U
Elevation (m)	<0 (1), 0–15 (2), 15–30 (3), 30–50 (4), >50 (5)	U, P, M, H, VH
Road Distance (m)	0–300 (1), 300–600 (2), 600–900 (3), 900–1200 (4), >1200 (5)	VH, H, M, P, U
Land Use	Grassland/Forest/Open space (1), Cultivation (2), Water (3), Settlement (4)	VH, H, M, P
NDVI	0.4844–0.9997 (1), 0.336–0.4844 (2), 0.2111–0.336 (3), 0.0862–0.2111 (4), -0.9992–0.0862 (5)	VH, H, M, P, U
Settlement Distance (m)	0–200 (1), 200–500 (2), 500–1000 (3), 1000–1600 (4), 1600–2750 (5)	VH, H, M, P, U
Water Distance (m)	0–217.8 (1), 217.8–435.7 (2), 435.7–653.5 (3), 653.5–871 (4), 871–1089.15 (5)	VH, H, M, P, U
Flood Susceptibility	360–485 (1), 310–360 (2), 260–310 (3), 185–260 (4), 100–185 (5)	VH, H, M, P, U
Population Density	<50 (1), 50–100 (2), 100–200 (3), 200–300 (4), >300 (5)	VH, H, M, P, U

Key Elements: (1)VH = Very Highly Suitable, (2)H = Highly Suitable, (3)M = Moderately Suitable, (4) P = Poorly Suitable, (5) U = Unsuitable.

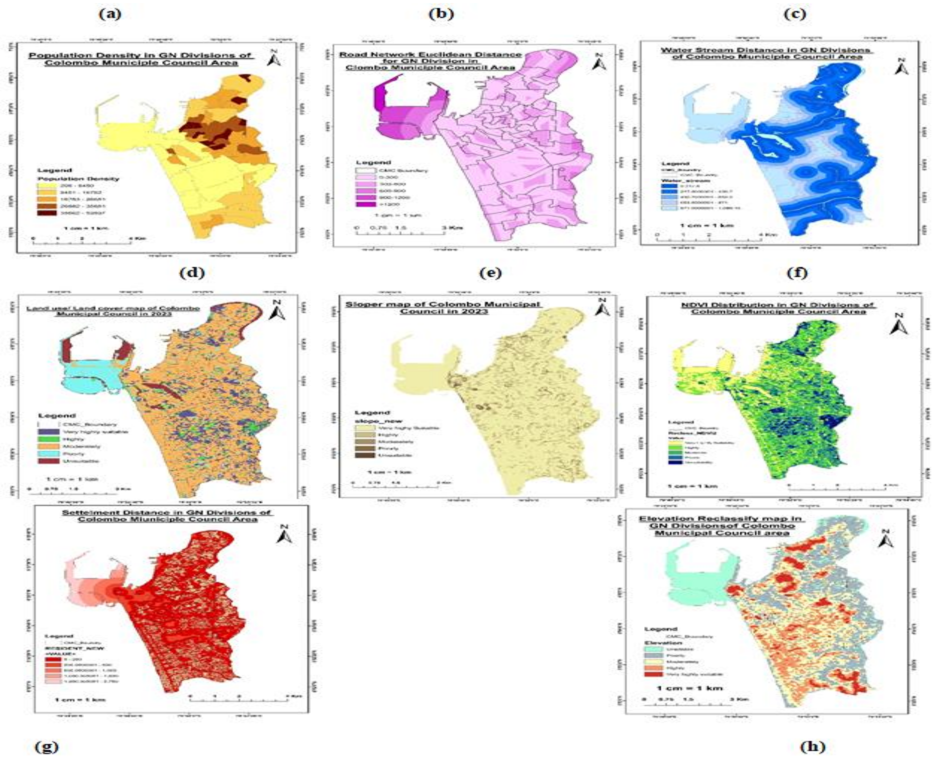

Figure 04, (a) Re-Classified Population density, (b) Re-Classified Road network accessibility, (c) Re-Classified Proximity to water bodies, (d) Re-Classified Land use characteristics, (e) Re-Classified Slope, (f) Re-Classified NDVI, (g) Re-Classified Settlement, (h) Re-Classified Elevation.

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Developed Suitability Maps using GIS to Identify Potential Areas for New Urban Green Spaces

The development of urban green spaces plays a vital role in improving the quality of life in densely populated cities by providing environmental, social, and economic benefits. However, rapid urbanisation and increasing land-use pressures have reduced the availability of suitable areas for green space expansion. Therefore, identifying appropriate locations for UGS development has become an important aspect of sustainable urban planning. GIS provide effective tools for spatial analysis by integrating multiple datasets, including land use, population density, accessibility, and environmental factors, to evaluate spatial suitability and identify potential areas for future green space development.

Table 03: AHP methodology (Analytic Hierarchy Process)

Intensity of importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favour one parameter over another
5	Strong importance	Experience and judgment strongly favour one parameter over another
7	Very strong importance	One parameter is favoured very strongly and is considered superior to another: its dominance is demonstrated in practice.
9	Extreme importance	The evidence favouring one parameter as superior to another is of the highest possible order of affirmation.
2, 4, 6, 8	Intermediate values between the two adjacent judgements	When compromise is needed

Soure, Saaty 1980

Table 04 presents the AHP pairwise comparison matrix used to compare the relative importance of selected criteria. The values show the priority relationship between each criterion for urban green space suitability analysis.

Table 04: Normalised pairwise comparison matrix

Criteria	Roads	Land Use	Population Density	Residences	NDVI	Water Stream
Proximity to Roads	1	1/3	3	1	1/3	3
Land Use Type	3	1	5	3	1	5
Population Density	1/3	1/5	1	1/3	1/5	1
Proximity to Residences	1	1/3	3	1	1/3	3
NDVI	3	1	5	3	1	5
Proximity to Water Stream	1/3	1/5	1	1/3	1/5	1
Column Sums	**9.87**	**3.39**	**18.66**	**9.46**	**4.48**	**19.66**

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Table 05 shows the normalised AHP matrix and the calculated priority weights for each criterion. These weights represent the importance of each factor and were used in the GIS-based suitability analysis.

Table 05: Pair-wise comparison matrix for site selection factors

Criteria	Roads	Land Use	Population Density	Residences	NDVI	Water Stream	Priority Vector
Proximity to Roads	0.125	0.094	0.167	0.125	0.094	0.167	**0.137**
Land Use Type	0.375	0.281	0.278	0.375	0.278	0.278	**0.279**
Population Density	0.042	0.028	0.056	0.042	0.028	0.056	**0.055**
Proximity to Residences	0.125	0.094	0.167	0.125	0.094	0.167	**0.137**
NDVI	0.375	0.281	0.278	0.375	0.278	0.278	**0.279**
Proximity to Water Stream	0.042	0.028	0.056	0.042	0.028	0.056	**0.055**

Assigned Weight for Each Criterion

The assigned weights obtained from the AHP pairwise comparison represent the relative importance of each criterion in identifying suitable locations for urban green space development. Among the selected factors, Population Density received the highest weight (0.462, 46.20%), indicating that population demand has the greatest influence on green space suitability. NDVI was assigned the second-highest weight (0.163, 16.30%), highlighting the importance of vegetation conditions in supporting ecological functions. Proximity to Roads and Proximity to Residences were assigned moderate weights (0.106, 10.60% each) due to their role in improving accessibility and community use. Land Use Type received a weight of 0.103 (10.30%), reflecting its importance in determining land availability and development potential. Proximity to Water Streams obtained the lowest weight (0.082, 8.20%), while still contributing to ecological sustainability and environmental benefits. These weighted criteria were integrated through GIS-based suitability analysis to identify priority areas for urban green space development within the CMC area (Table 06).

Table 06: Assigned Weight for Each Criterion with Influence Percentage

Criteria	Assigned Weight	Influence (%)
Proximity to Roads	0.106	10.60
Land Use Type	0.103	10.30
Population Density	0.462	46.20
Proximity to Residences	0.106	10.60
NDVI	0.163	16.30
Proximity to Water Streams	0.082	8.20

Identified Suitable Area for New Urban Green Spaces

The UGS Suitability Map (Figure 05 (a) & (b)) presents the potential areas for developing new urban green spaces within the CMC area based on the integration of multiple criteria. The analysis identifies the western and central parts of Colombo as highly suitable areas for future green space development due to their high population

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density, limited existing green infrastructure, and greater demand for recreational and environmental services. These densely urbanised areas, including locations such as Pettah, Fort, and Maradana, would benefit significantly from green interventions such as pocket parks, rooftop gardens, and the conversion of underutilised spaces into public green areas. Developing green spaces in these locations can help reduce urban heat effects, improve air quality, enhance biodiversity, and provide better access to recreational facilities for residents. Therefore, prioritising green space development in these suitable areas can contribute to creating a more balanced, sustainable, and resilient urban environment within the CMC area.

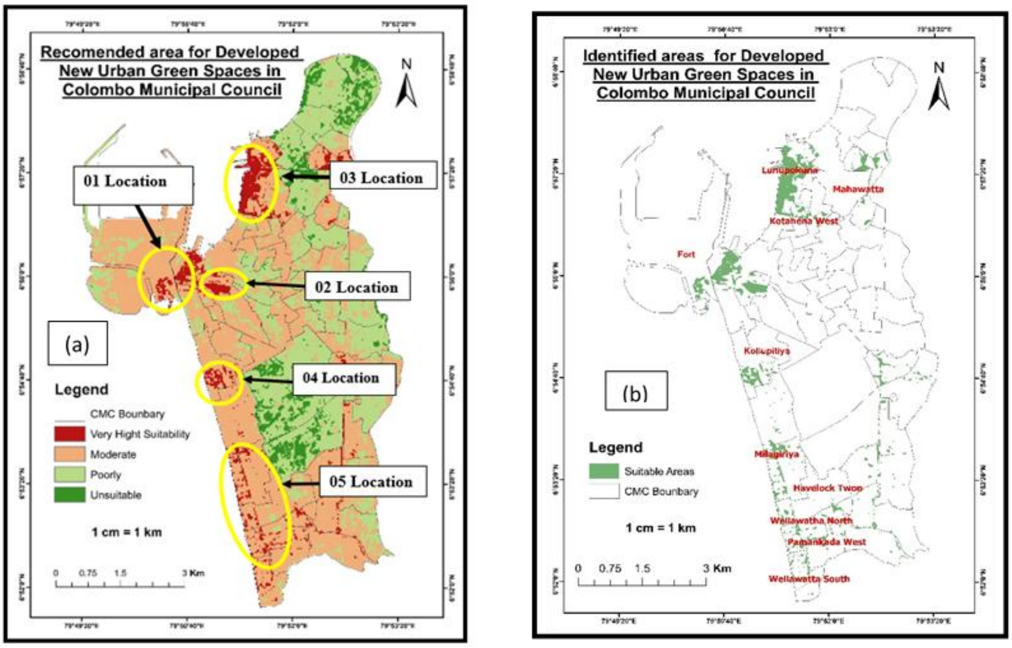

Figure 05; (a) - Recommended Area of Developed New Urban Green Spaces in CMC, (b) – Identified Suitable Area of GN Divisions in CMC.

Identified Potential Urban Green Space Areas and Their Contribution within CMC

The identified potential urban green space locations within the CMC boundary were quantified using GIS-based spatial analysis techniques. The area of each selected location was calculated as square kilometres (km²) to represent their spatial extent accurately (Santhasiri et al., 2025). The analysis identified five major categories of potential green space development opportunities, including port areas, Berelake areas, container yard areas, house scheme and rooftop areas, and railway corridors with both sides of main roads. The combined identified area of these locations is approximately 1,493,690.71 m² (1.494 km²), which accounts for 4.04% of the total CMC area (37 km²). The findings indicate that despite the limited availability of vacant land within the highly urbanised CMC region, underutilised spaces associated with industrial, transportation, waterfront, residential, and built environments provide valuable opportunities for expanding urban green infrastructure. These identified areas can contribute to improving urban environmental quality, enhancing ecological connectivity, and supporting sustainable urban development strategies within Colombo (Table 07).

Table 07: Area Calculation with Percentages for Identifying the Contribution of Potential Green Space Areas

No.	Identified Location Type	Identified Area (km²)	Area (m²)	Contribution to CMC Area (%)
1	Port Area Location	0.094321434	94,321	**0.25**
2	Berelake Area	0.109809000	109,809	**0.30**
3	Container Yard Areas	0.672114759	672,115	**1.82**

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4	House Scheme Areas and Building Rooftop Areas	0.141875256	141,875	**0.38**
5	Railway Corridors and Both Sides of Main Roads	0.475570262	475,570	**1.29**
Total	**All Identified Potential Green Space Areas**	**1.493690711**	**1,493,691**	**4.04**

Field Validation and Identified the Most Suitable Area for Developing New Urban Green Spaces in the Colombo Municipal Council Area

The final suitability analysis map (Figure 07 (a) – (e)) presents the recommended locations for developing new UGS within the CMC area. The map identifies five priority locations based on the integrated GIS-based suitability analysis with 370 areas (Figure 05 (b)). The identified sites represent strategically important areas across coastal, central, and southern parts of Colombo, where new green spaces can enhance public accessibility, reduce urban heat effects, improve ecological connectivity, and provide recreational benefits for surrounding communities. The field validation was conducted to assess the practical suitability of the GIS-identified potential green space locations within the CMC area. The five identified locations showed that, from the total GIS-identified area of 1.4931 km², only 0.3341 km² (22.38%) was confirmed as suitable for urban green space development after field verification.

The highest validation success was observed in the Beira Lake Area, where the entire identified area (100%) was considered suitable due to the availability of existing open-water-edge spaces and potential for recreational green development. The Railway Corridors and Both Sides of Main Roads also showed a relatively higher suitability rate (33.77%) due to the presence of linear open spaces that can support green corridor development. However, locations such as Container Yard Areas (5.60%), House Scheme and Rooftop Areas (7.44%), and the Port Area (16.77%) had lower validation percentages due to several field-level limitations. These limitations included restricted access to private and operational areas, existing industrial activities, security restrictions, built infrastructure, unsuitable physical conditions, and limited availability of continuous open land (Figure 06 and Table 08).

Table 08: Field Validation of Identified Potential Green Space Areas

Location	Producer Accuracy Identified Area (km²)	User Accuracy Area with Field Validation (km²)	Validated Area Percentage (%)
Location 01(Port Area)	0.094321434	0.015820173	16.77
Location 02 (Beira Lake Area	0.109809000	0.109809000	100.00
Location 03 (Railway Corridors and Both Sides of Main Roads)	0.474382589	0.160221516	33.77
Location 04 (House Scheme and Building Rooftop Areas)	0.142480504	0.010605643	7.44
Location 05 (Container Yard Areas)	0.672114759	0.037658201	5.60
Total	**1.493108286**	**0.334114533**	**22.38**

Surrounding of Port Area

Figure 07 (a) highlights the coastal area surrounding the Port of Colombo as a suitable location for new urban green space development. Location **01** (Surrounding Port Area) recorded the lowest field validation percentage (16.77%), with only 0.015820173 km² of the 0.094321434 km² identified by the GIS analysis being confirmed as suitable. This occurred because a large portion of the identified area consists of operational port infrastructure, container storage yards, security-restricted zones, transportation facilities, and paved surfaces. Although these areas satisfied several spatial suitability criteria during the GIS-based analysis, field observations revealed that they are unavailable for urban green space development due to their operational importance, restricted public access, and existing land use. Consequently, only a small portion of the originally identified area was considered practically suitable. This reclaimed or underutilised land near the shoreline provides potential for creating a public green space with waterfront parks, walking paths, and recreational facilities. Developing this area can improve environmental quality by enhancing air quality, reducing urban heat, supporting stormwater management, and strengthening coastal resilience. Furthermore, the proposed green space can improve the city's visual appeal, provide recreational opportunities, and contribute to a more sustainable and livable urban environment.

Around Beira Lake

Figure 07 (b) identifies Beira Lake and its surrounding areas as a suitable location for new urban green space development. Location **02** (Beira Lake Area) recorded the highest field validation percentage (100.00%), with the entire 0.109809000 km² identified through the GIS-based suitability analysis being confirmed as suitable during field verification. This result indicates that the spatial suitability assessment accurately identified areas that are both environmentally and practically feasible for urban green space development. Field observations confirmed that the identified locations consist of accessible open spaces surrounding Beira Lake with existing vegetation, recreational potential, and minimal physical or operational constraints. Furthermore, the area is publicly accessible and compatible with future green space enhancement initiatives. Therefore, no reduction in the identified suitable area was required after field validation, demonstrating the high reliability of the GIS-MCDA results for this location. That located within a densely developed commercial and residential zone, the lake perimeter provides an opportunity to create an urban green corridor with recreational facilities, walking paths, and landscaped areas. Developing green spaces around Beira Lake can enhance its scenic value, improve air quality, support urban biodiversity, manage stormwater, and improve the local microclimate. These green interventions can also promote community recreation, increase visitor attraction, and preserve the ecological and cultural importance of the lake.

Along Roads and Railway Corridors

Figure 07 (c) identifies suitable locations for urban green space development along both sides of major roads and railway corridors within the CMC area. Location **03** (Railway Corridors and Both Sides of Main Roads) recorded a field validation percentage of 33.77%, with 0.160221516 km² of the 0.474382589 km² identified through the GIS-based suitability analysis being confirmed as suitable during field verification. The reduction in suitable area occurred because a considerable portion of the identified land lies within active railway reservations, road rights-of-way, transportation infrastructure, utility corridors, and other restricted or heavily utilised spaces. Although these areas satisfied several spatial suitability criteria in the GIS-based analysis, field observations revealed that many locations are unsuitable for urban green space development due to safety regulations, ongoing transportation functions, limited available space, and maintenance constraints. However, several sections along railway corridors and road verges were confirmed to be practically suitable for roadside greening and linear green space development. Consequently, only one-third of the initially identified area was validated as suitable, emphasising the importance of field verification in distinguishing between theoretically suitable and practically feasible locations for urban green space development. Developing green spaces on both sides of these corridors can maximise the use of limited urban land while creating continuous green networks that improve connectivity, accessibility, and urban aesthetics. These areas can be enhanced through tree planting, roadside vegetation, landscaped strips, and pedestrian-friendly pathways, which help reduce urban heat, air pollution, and noise while supporting biodiversity, improving stormwater management, and creating a healthier urban environment.

House Schemes and Building Rooftops in Kollupitiya and Surrounding Areas

Figure 07 (d) identifies house schemes and building rooftops in Kollupitiya and surrounding areas as suitable locations for urban green space development. Location **04** (House Scheme and Building Rooftop Areas) recorded a field validation percentage of 7.44%, with only 0.010605643 km² of the 0.142480504 km² identified through the GIS-based suitability analysis being confirmed as suitable during field verification. This considerable reduction occurred because most of the identified areas consist of densely developed residential neighbourhoods and building rooftops that are privately owned or structurally unsuitable for green space development. Although these locations met several spatial suitability criteria in the GIS-based analysis, field observations revealed practical constraints such as limited available space, private land ownership, building structural limitations, restricted accessibility, and existing residential land use. Consequently, only a small portion of the originally identified area was considered practically suitable for urban green space development, highlighting the importance of field verification in identifying feasible locations beyond the theoretical suitability predicted by GIS-based analysis. Green roofs, rooftop gardens, and other green infrastructure can increase urban greenery, reduce heat, improve air quality, and create a more sustainable urban environment.

Container Yard and Underutilised Areas

Figure 07 (e) identifies the container yard and surrounding underutilised areas in Bloemendal, Aluthmawatha, Madampitiya**,** and nearby Dockyard General Engineering Services as suitable locations for urban green space development. Location **05** (Container Yard Areas) recorded the lowest field validation percentage (5.60%), with only 0.037658201 km² of the 0.672114759 km² identified through the GIS-based suitability analysis being confirmed as suitable during field verification. This substantial reduction occurred because most of the identified area consists of active container storage yards, logistics facilities, heavy vehicle circulation routes, and other operational infrastructure essential for port activities. Although these areas satisfied several spatial suitability criteria in the GIS-based analysis, field observations revealed that they are unavailable for urban green space development due to intensive industrial use, restricted public access, safety considerations, and operational requirements. Consequently, only a small portion of the originally identified area was considered practically suitable for green space development after field validation, highlighting the importance of integrating field verification with GIS-based suitability assessments. These industrial and vacant lands offer opportunities to introduce green infrastructure through tree plantations, landscaped buffer zones, and vegetated open spaces. Such developments can reduce air pollution, dust, noise, and urban heat while improving stormwater management, enhancing urban biodiversity, and improving the visual quality of industrial landscapes. Integrating green spaces within these areas would create a more sustainable, climate-resilient, and environmentally balanced urban environment while supporting existing industrial activities.

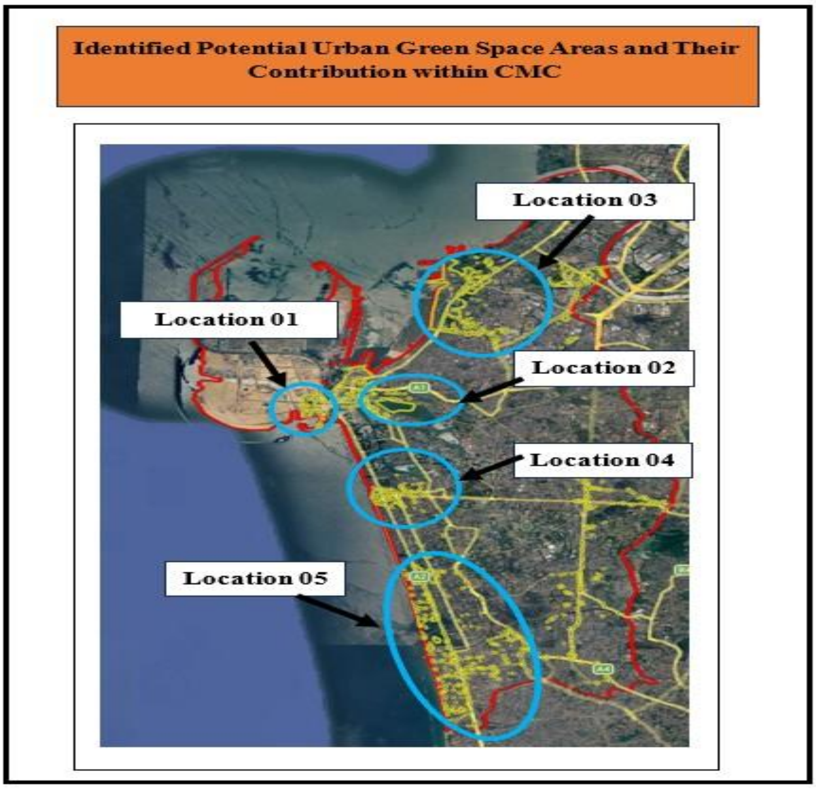

Figure 06: Field Validation of Identified Potential Green Space Areas Map

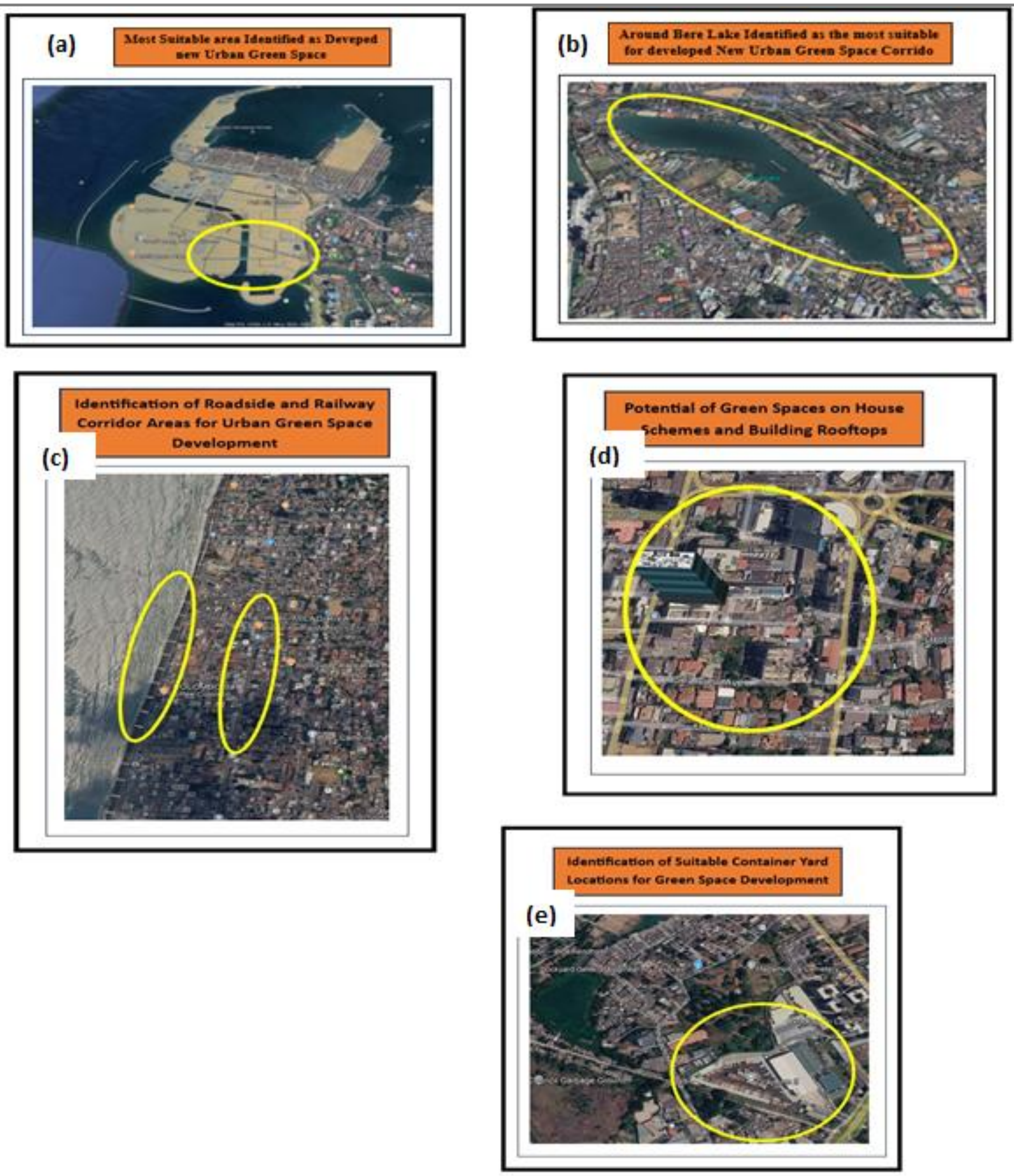

Figure 07; (a) - Most Suitable area identified as Developed new Urban Green Space, (b) - Around Bere Lake Identified as the most suitable for developed New Urban Green Space Corrido, (c) - Identification of Roadside and Railway Corridor Areas For Urban Green Space Developments, (d) - Potential of Green Space on House Schemes and Building Rooftops, (e) - Identification of Suitable container Yard Locations for Green Space Developments.

CONCLUSION

This research applied a GIS-based Multi-Criteria Evaluation (MCE) integrated with AHP to identify suitable locations for urban green space development in the CMC. The study identified high-potential areas such as Borella, Kolonnawa, and Battaramulla, along with five development opportunities including port areas, Beira Lake areas, container yards, rooftops, and railway corridors. These identified areas collectively cover approximately 1,493,690.71 m² (1.494 km²), representing 4.04% of the total CMC area of 37 km². The field validation of the extracxted are presented different conditions. The highest location is location **02**, and that present 0.109809000 km^2 and 100.00% accuracy and the lowest is location **05** and that 0.037658201 km^2 and 5.60%, respectively. The other locations, **01**, **03** and **04,** are shows the 0.015820173, 0.160221516 and 0.010605643 km^2 and 16.77%, 33.77% and 7.44%, respectively. The restricted access to private and operational areas, existing industrial activities, security restrictions, built infrastructure, unsuitable physical conditions, and limited availability of continuous open land conditions and types of land uses have affected the above differentiation. However, the validated area is 0.334114533 km^2, and that is 22.38% of the area suitable for demonstrating the potential of underutilised urban spaces to enhance green infrastructure and support a sustainable urban environment.

Limitation and Future Directions

Due to security, administrative regulations, and financial limitations, certain locations that have been determined to be appropriate for the creation of urban green spaces may not be practical to implement; improved spatial datasets and comparative validation methods can further enhance the accuracy of suitability mapping and support more effective decision-making for sustainable urban green space development. This study mainly focused on physical and environmental factors only. Further research should concentrate on more factors that would help ensure the accuracy and reliability of urban green space suitability assessment. It is also possible to use modern deep learning techniques and comparative field validation methods to achieve higher accuracy of results, thus helping to find high-quality sites for future urban green space development. The integration of additional criteria, including land availability, economic feasibility, accessibility for vulnerable groups, social requirements, and future climate change impacts, would provide a more comprehensive evaluation framework. Moreover, the application of advanced geospatial techniques.

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