Green Spaces Management Strategy Using Suitability Evaluation and Proximity Method: Case of Satara City

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Abstract: - To ensure equitable and sustainable urban development, a thorough city-level green space management policy must be developed. In order to highlight present green space management practises, difficulties, and chances for improvement, this article focuses on the instance of Satara city. Reviewing best practises in managing green spaces from other Indian and international cities, the study will look at how they may be applied to Satara city. The research will also investigate and quantify the financial, social, and environmental advantages of investing in green spaces. The project will make better use of technology, including GIS and remote sensing, to manage the green spaces in Satara city. The report will also look at the best methods for managing green spaces and how community participation and engagement can be improved. The study will also make sure that Satara city's broader development objectives, such as lowering carbon emissions, improving air quality, and promoting public health and wellbeing, are in line with the management strategy for green areas. The results of this study will be helpful for Satara city and other cities with comparable problems in developing a comprehensive city-level green space management policy. The study is mostly dependent on secondary data, opinion surveys and personal observations. Though the study deals with open spaces both existing and future ones, and suggests a model to create new open areas where there is deficit, but due to shortage in time and non-availability of data the proposals are presented at a policy level.

Key Words: — ***Green public spaces; suitability; spatial planning; thematic map; GIS; urbanization; parameters.***

I. INTRODUCTION

The global urbanization is rapidly increasing, particularly in emerging countries like India. By 2030, urban regions will house over 60% of the world's population. Asia and Africa are urbanizing faster than any other area, with rates of 56% and 64%, respectively, expected by 2050. The rise in urban population is likely to be rapid in India, China, and Nigeria, which are expected to account for 35% of global urban population growth between 2018 and 2050.

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The development has been happening at such a rapid pace due to economic activities and increased investments, especially in less developed countries such as India, that it led to an infrastructure crunch. Over the years, the Indian Government had initiated various development projects, but the focus on green infrastructure was comparatively lesser than grey infrastructure. The shrinkage in green cover in urban India is a significant concern. Therefore, there is a need to investigate the possibilities of open spaces at the municipal level because it appears that the city may lose this equilibrium because it is developing, and conditions could worsen in the near future. To assess the Green Infrastructure components of a city and assess the Potential for Enhancement of Urban Green Infrastructure, it is important to understand what Green Infrastructure is, its components, and its significance in the urban context in Indian cities. The challenges faced by UGS are many and include land availability, quantity, quality, distribution, accessibility, lack of intended purpose, and stakeholder involvement. UGS are being

deteriorated substantially due to booming urbanization in developing countries such as India. The poor and irregular watering of many existing UGS is one of the major challenges associated with the management and maintenance of UGS. Effective wastewater treatment and a non-potable reuse system are potential remedies for improved UGS prospects. The Indian government needs to focus on planning UGS to ensure their adequate provision and maintenance in cities.

II. Literature Review

Urban green spaces (UGS) are crucial for sustainable and ecologically friendly urbanization, but the rapid urbanization in emerging nations like India is significantly deteriorating UGS. The challenges faced by UGS include land availability, quantity, quality, distribution, accessibility, lack of intended purpose, and stakeholder involvement. The poor and irregular watering of many existing UGS is one of the major challenges associated with the management and maintenance of UGS. Effective wastewater treatment and a non-potable reuse system are potential remedies for improved UGS prospects. In addition, exploring the role of UGS in 'smartening' cities in India and identifying plausible strategies for inclusion in urban planning framework can help in creating and maintaining UGS. The transformation of Indian cities requires policies and practices that promote the greening of urban areas and the conservation of green spaces. Studies have shown that UGS are important for sustainable urban development due to their ecological, health, economic, and social benefits.

There are three main perspectives on green infrastructure according to these.

- Ecosystem services approach
- The natural cycles which operate globally, can also be retained, restored and maintained within cities
- Sustainable development and urban ecology (Spirn, 1984; Hough, 2004).
- 'green' frame- work
- Green space linking approach
- retaining and linking green spaces, nature corridors and drainage cities to ecosystem.
- the network of Green Infrastructure is seen as an equivalent to the network of general engineering infrastructure
- Green engineering approach
- normal approach of engineering is replaced by structure with green elements which enables it to per-form various ecosystem services
- e.g.: building energy efficiency.(American River, n.d.; Benton-Short, n.d.; Voghera & Giudice, 2019)

2.1 Four core principles:

- *Green-blue integration* – combining green and grey infrastructure UGI planning seeks the integration and coordination of urban green spaces with other infrastructure, water bodies and natural outlets, etc
- *Connectivity* – creating green space networks UGI planning for connectivity involves creating and restoring connections to support and protect processes, functions and benefits that individual green spaces cannot provide alone.
- *Multifunctionality* – delivering and enhancing multiple functions and services UGI planning aims at combining different functions to enhance the capacity of urban green space to deliver multiple benefits – creating synergies, while reducing conflicts and trade-offs.
- *Social inclusion* – collaborative and participatory planning UGI planning aims for collaborative, socially inclusive processes. This means that planning processes are open to all and incorporate the knowledge and needs of diverse parties.(Ebary, n.d.; Vigar, 2014).

III. Research Methodology

This study's research methodology employs a methodical approach to addressing the research objectives and the research gap. It employs the KOBO survey format to determine the preferences of Satara residents. To gain thorough insights from the respondents, the survey questions were prepared by referring to previous toolkits, publications, and expert comments. The questionnaire includes background questions concerning existing open spaces as well as questions about reporting current state. The survey data collected will be analyzed to gain important insights into the respondents' preferences and perceptions of metro transit. This study will entail identifying patterns and trends in the responses in order to understand spatial trends and citizens' perspectives in order to create maps. To compute the sample size required for a reliable and representative survey, the Cochran's formula is often employed. It takes into account variables such as the required level of confidence, margin of error, and population size. The reconnaissance study was intended to collect data in photographic format identifying difficulties and providing support for changing land uses, if necessary, as well as for

activity mapping and questionnaire surveys to learn about users' perceptions, socioeconomic status, purpose, and frequency.

Computation of Suitable locations for Urban Green Space development.

To create a suitability map for urban green space (UGS) development, each criterion addressed in the study requires unique ratings or separate weights. The determination of each class's weight is the most important stage in the integrated analysis, as the result is heavily reliant on the assignment of proper weights. The weighted sum overlay approach in Arc Map Spatial Analyst is modified for the integration of input data layers, in which the data layers are multiplied by their respective weights derived from the comparison matrix and then summed to produce the suitability map. The entire research area is classified into four zones of suitability based on the total scores computed for all characteristics by assigning appropriate ranges of the aggregate score to each suitability zone. The output is then provided in the form of a suitability map for green space development, with four zones representing the zones that are very suitable, moderately suitable, less suitable, and not suitable, respectively. The geospatial assessment of urban green space using multi-criteria decision analysis is a common method used to evaluate the suitability of UGS development in different cities. The Analytic Hierarchy Process (AHP) method is recognized as a traditional technique to identify the weight of the UGS suitability evaluation.

3.1 Need of Open Spaces

Calculating Green urban spaces sustainable indices and general integrative indicator.

The mentioned data was gathered from municipal sources, maps, and surveys of the distribution of urban UGS in order to evaluate public green spaces that can be included into a continuous network of public landscaped spaces that contribute to the sustainability of the city.

The second group— UGS parameters—represents a set of selected key indicators which describe the sustainable performance of UGS on the city level. Qualitative attributes of UGS such as comfort, beauty, safety or security were considered as significant contributors to social value of the final project. Open public space without greening but with potential possibly for landscape restoration as well as greened places without any additional economy or society related function were also considered as the elements of the city UGS network and objected to evaluation. The accessibility of UGS is considered at the neighborhood scale as the ability of the pedestrians to reach the UGS nearest to their location. This conception refers to the walkable accessibility and is measured by time and/or distance. The integrative indicator accounts for the total set of the incoming parameters. The radial line graph helps to present the results clearly by mapping a list of parameters, from the minimum to the maximum of the extent of the diagram, wrapped around a circle.

3.2 Land suitability

The UGS suitability classification consists of 5 levels and these levels have the numerical values 5, 4, 3, 2 or 1, which represent high-suitability, higher-suitability, medium-suitability, lower-suitability, and low-suitability, respectively.

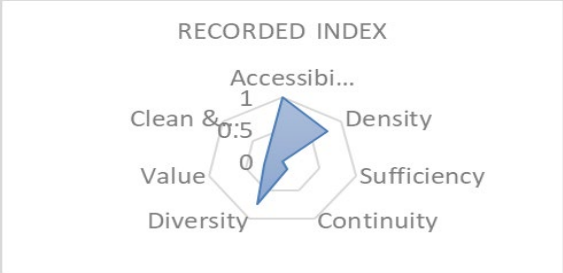
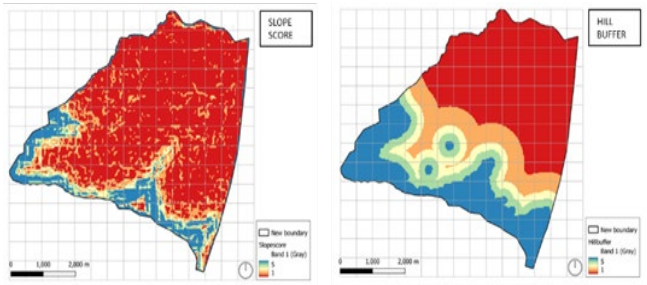
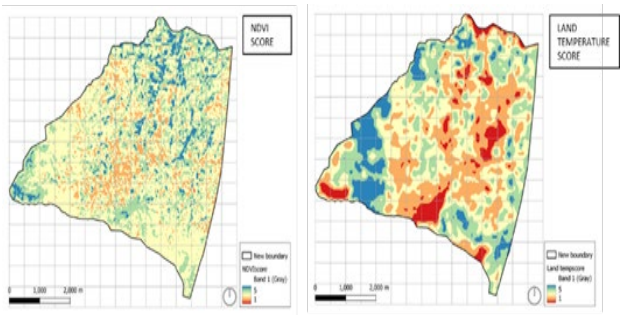


Table.1. land suitability

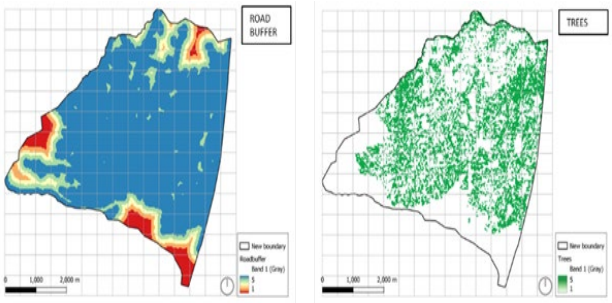
CRITER+A1:G10IA	DESCRIPTION	LAND CLASSIFICATION				
		5	4	3	2	1
Land use	Existing land use	forest,water	green space	agricultural land		construction land
slope	Reflects the degree of impact on vegetation distribution	>20◦	15–20◦	10–15◦	5–10◦	<5◦
water area	Factors that reflect the conditions of regional water resources and maintenance of the ecological balance	Water	< 100 m	100–300	300–500	>500 m
ecological patches	Reflects the degree of biological diversity	Ecological p	>300 m	300–500	500–1000	>1000 m
NDVI	Reflects the growth of green vegetation	NDVI > 0.3	0.2 < NDV	0.1 < NDV	0 < NDVI	NDVI < 0
tree cover	concentration of trees and preservation					
Land surface temperature	Reflects the influence of regional temperature differences on vegetation	based on natural breaks -divided into 5 classes				
Roads	connectivity	< 100 m	100–300	300–500	>500 m	>800 m



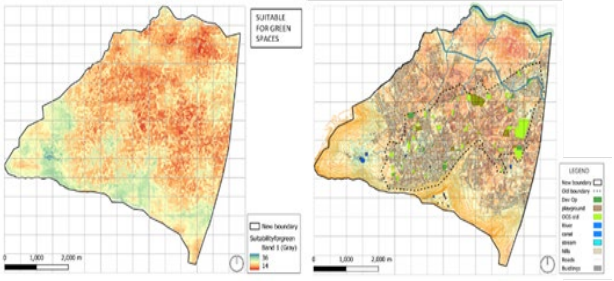
Map 1 Satara City-Slope Score & Hill Buffer



Satara city-NDVI Score & Land Temperature Score



Satara city-Road Buffer & Trees



Satara city-Suitable for Green Spaces

The physical characteristics of the green space system were used to develop the new UGS suitability evaluation index system. The results suggest that the high-suitability evaluation areas are mostly concentrated in the city's northern and central districts. As a result, local governments should increase UGS planning and construction, as well as their collaboration with the urban master plan. The following detailed spatial layout suggestions for green space system planning were made: (1) protect water resource conservation and biodiversity in the southern mountainous regions, (2) consolidate landscape construction of the central city and fringe areas, (3) strengthen landscape construction on both sides of the water corridors, and (4) establish a UGS ecological network.

3.3 Proximity

In every geographical inquiry, the importance of closeness is always there. Green spaces must be accessible to settlement areas in urban zones due to their numerous ecological, social, and economic benefits. claimed that a significant distance between settlement areas and green spaces has a negative impact on customers, and reported that the playgrounds, parks, and sports fields closest to settlement areas are the most popular green spaces. As a result, it is critical to consider how close or far away green spaces are from the settlement area. In this study, the proximity of the settlement area was considered. As a result, locations within 500 metres of the settlement area have been judged quite acceptable by employing Euclidian distances, and the area between 500 metres and 1000 metres has also been deemed suitable. Furthermore, the creation of urban green spaces has been rated fairly acceptable, poorly suited, and unsuitable for areas 1000 m to 2000 m, 2000 m to 3000 m, and greater than 3000 m from a populated area.

IV. RESULTS AND DISCUSSIONS

4.1 Proposals

Proposals are made at several levels based on site area, service area, accessibility, suitability, and adjoining land uses. Although most open areas will allow a variety of activities, when assigning the character and activity type to open spaces Priority was given to user preferences in spaces. Broad ideas are based on the peculiarities of the neighborhood. The improvement status of open space availability and green cover increment has been considered based on the open space proposal.

4.2 UGS ecological network

In order to improve the quality of the living environment, a “green heart” should be given more weight in the central urban area. We need to accelerate the construction of comprehensive urban parks, special parks, community parks, ribbon parks, street-side gardens, various types of affiliated green spaces,

protective green spaces, and other UGS, while expanding the scale of the greening of the surrounding towns and cities.

- Two community level sites are proposed for dense forestation and Organised Green Parks acting as lungs of the city.
- One 33 sites are proposed are proposed for Plazas, Nurseries and gardens, Multipurpose Ground and Cash crop/Gardening Centres.
- Open spaces of this level should be developed through PPP.

4.3 Green corridors

Create a UGS ecological network- A green space network is formed by connecting various types of ecological patches along a linear corridor, which can effectively improve the quality of the urban ecological environment, establish a virtuous cycle of the urban ecosystem, and promote the coordinated development of nature and city.

There are nallahs, or open drains, in many Indian cities. They are, however, often seen as an irritation and a health risk. The plan is to turn the nallahs into urban parks that may be used for recreation. This is not a novel concept; similar proposals have been made in cities such as Pune. The pause points are meant to span the entire length of nallah. Other ideas for the park include a tree park and a scent garden and a food court These concepts demonstrate how nallahs can be turned into attractive and practical communal areas. Cities may transform underutilized places into beautiful and functional spaces that help the community in a variety of ways by converting nallahs into parks.

4.4 Satara City-Green Corridors

4.4.1 Conservation of biodiversity

Once established, the Biodiversity Park will protect native biodiversity, raise public awareness of the diverse natural heritage, and provide a high quality of life for its people. The city will be impacted by the proposed Biodiversity Park in the following ways:

- When completed, the Biodiversity Park will function as a mini-ecosystem capable of providing all ecological functions.
- It will serve as a green lung for Pune and will have a good impact on the local climatic conditions.
- Because Satara is close to the Western Ghats (50 kilometres), the proposed parks will provide room for all essential plant communities, ensuring the protection of vital species.
- It will serve as an appropriate teaching facility for individuals and organisations interested in environmental restoration and conservation activities.
- The Biodiversity Park will be planned as a community project.
- The Biodiversity Park will be an excellent community participation programme, allowing the local people to get involved and gain a greater awareness of the importance of biodiversity and its conservation. Ecotourism and recreational centre destination.

The development of forest land will be helpful to the urban area by:

- Ground water recharge
- Soil conservation
- Biodiversity conservation
- Regulation in climate
- Carbon sequestering (Pollution Control)

SMC has planned many development projects on the forest land in Yavteshwar and its surroundings. These projects' proposed activities include the construction of boundary walls for protection, soil and water conservation structures, the formation of water bodies with restricted entry zones for public plantation of suitable plant species, and water delivery. For the project's implementation, a joint forest management committee could be recommended.

Satara Municipal Council (SMC) can build Bio-diversity Parks to restore local flora and fauna and connect them through the city's natural and planned aspects to produce carbon sinks and raise awareness about nature discourse. Satara will establish a 'People's Biodiversity Register,' from which a Biodiversity Committee will be constituted. The Biodiversity Park has been suggested for development in the following sites.

4.4.2 Fundings

The sources of funding for development of Biodiversity Parks include: (i) Smart City Funds; (ii) Municipal Corporation; (iii) Village Panchayat; (iv) State Irrigation Department; (v) State Tourism Department; (vi) State Pollution Control Board; (vii) CSIR grants from PSUs and Public Sector Banks; (viii) Public and Private Sector Corporations; (x) donations from individuals/ charitable trusts; (xi) International Agencies; (xii) Ministry of Housing and Urban Affairs, Government of India; (xiii) Departments of Urban Planning of State Governments;

and (xiv) Ministry of Jal Shakti, Government of India, and charitable foundations in water body rejuvenation and maintenance may be encouraged.

V. Conclusion

Natural assets and human communities are inextricably linked, and the health and vibrancy of one effect the other, necessitating the equitable allocation of open space. Individuals living in society must actively collaborate to create viable and unbiased ventures. Data exchange at all levels boosts the effectiveness and adaptability of City agencies, associations, and organizations.

With the exception of cases when it is impossible due to vital considerations, open space planning is a long-term strategy that is uniform across space. When utilized, the technique will result in practical and sustainable city growth. It is a way of supplying, ensuring, and increasing environmental quality while also meeting the demands of the population for social and recreational activities and providing environmental and economic benefits to the city.

The purpose of this project is to plan organized open spaces at various levels in places where there is a need. The city's environment can be improved if recommendations at the spatial level are implemented. The study finishes with the development of a model for open space planning and a set of recommendations to make UGS more sustainable.

- Strengthen current coalitions and partnerships with environmental groups and NGOs, as well as urban forestry operations, for the application of environmentally friendly technology and proper natural resource management, as well as environmental awareness and education. Ensure that grass-roots organizations, technical aid providers, land managers, and policymakers are actively involved.
- Increase public engagement opportunities.
- Raise public understanding of the benefits of well-designed, organized, maintained, and utilized open space to quality of life. Launch a public awareness and education campaign. Make vacant lots and neighborhood open space a public priority.

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