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Challenges in Sustainability of Suburban Ecology of Bengaluru Metropolitan: A Study of Interfaces in Socio-Ecological Transformation

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ABSTRACT: This study explores the social-ecological dynamics of suburban landscapes of Bengaluru, jeopardised by recent developments. Previous to the present state of landforms it had support of agrarian function of landscape suddenly turned to habitat, risking its multifunction. For the past three to four decades the growth as a choice of habitation transformed by fragmentation of estate legacy. The changes in land cover remarkably impacted the stakeholder of natives as well the settlers. Here in this study we use the state of suburban Bengaluru North and North West transformations to demonstrate the people's perception as well the ecological scenario. It tries to realize the patterns of fragmentation of agrarian landscape to multiple ownerships that allows the neglect of possible multifunction of the landscape in general. It wishes to establish the dichotomy of individualization of modern development and claims for sustainable ecosystem functions. Also, the kinds of crises evolving through changing land functions lead to shifts in overall perception of ecology altogether.

Keywords: Landscape, Functions of Land, Suburban Ecology, Urbanisation.

INTRODUCTION

Urban settlements have always been influenced by the landforms that determine the ecology of the habitat. However, Bengaluru, has been the attraction of many throughout the country majorly for its weather as well as its geographic location. The ecological patterns governed by various functions have been the interest of research since the late 1950s. Studies have documented the ecological structure of Bengaluru, with a major concern for its growth and an interesting comparison with Western cities (Gist, 1957). The characteristics of ecological patterns follow a central high-income resident, and move away with ecological engagements suits to income groups. The peripheral locale essentially dominates with low-income, but forms a major work force of the urban to move with their development. These populations are the most vulnerable to environmental hazards, apart from being poor and play a major as well direct role in maintaining the biological diversity of the landscapes of Bengaluru (Sudhira and Nagendra 2013).

Several studies in understanding the ecosystem functions of a variety of corners of urban areas. Amrita Sen *et al.* (2020) have examined the historical waterscapes of Bengaluru against their dynamic status with the development of the city over decades. This is reported as the system has since been fragmented due to urbanization and changes in land cover, impacting local institutions and livelihoods dependent on the water sources. The development of the city of Bengaluru has been very well inquired with its patterns of changes by monitoring the surface urban cool island (SUCI) insights (Sarif *et al.,* 2022). Studies have identified the network of citizen groups engaged in environmental issues of Bangalore city, the place that experiences rapid urbanization with the pressures on conventional ecosystem management practices (Johan Enqvist *et al.,* 2014). It reported the trust of most people who live and experience urban growth as expected to find the suitable benefits of the habitat.

Bengaluru, being one of the largest Information Technology (IT) hubs in India and also a place host to other industries, offers a tremendous job opportunity and a considerable good standard of living makes it attractive as well as an inevitable habitat. This leads to the growth of habitat acquiring the landscapes that served the conventional functions. The attractive place for being converted into habitat experiences multicultural, multi-social and unexpected ecological interfaces. Keeping this in mind, the present research has been carried out to study the dynamics of sustainable challenges of suburban ecology of Bengaluru. Sudhira *et al*. (2007) outlines the challenges in planning to ensure better delivery of basic services across the city.

MATERIAL AND METHODS

A. The Study Area

The study area Bengaluru is the capital city of Karnataka, a southern state of India. It is one of the largest megacities in India, with several attractions for settlement. It has developed into one of the most

wanted habitats of India, largely due to its environment as well the geographic location. Bengaluru city is located geographically between 12°09′N and 13°09′N latitude and 80°12′E and 80°19′E longitude, with a mean elevation of 873.97 m. The city landscape has an undulating variation ranging between 696 and 1,031 m. The city has a considerable number of lakes and small and medium sized water bodies, as a result the city experiences wet and dry climate (Matloob *et al.,* 2021). Bengaluru experiences a daily average minimum temperature of 19.2 and maximum of 29.6^0C. It receives a mean total rainfall of 986.9 mm, with a mean number of rainy days as 58.1 (IMD, 2010). The suburb is essentially the once adjacent rural landscape to urban area and geographically the core area. The surrounding, once rural, has now been under metropolitan, due to the demand of urban habitants. These people who experience and as well the stakeholders of suburban ecology along with the primary habitants of the area.

B. Ecological functionaries of Suburban Bengaluru

Bengaluru, being the one of the foremost developing cities in India as well the state capital attracts many cosmopolitan occupants. However, the ecological niche has an advantage over the rest of the cities of India, being the elevated geographical location. It provides the most attractive settings for the habitants, with pleasant weather and climate. The green coverage associated with reflection for the land and climate support forms a prime function of the suburban landscapes. The long-time agrarian landscapes, being converted to habitats, leaves a neglect of prime function of soil, the food production. Hence, the conventional pollinators and agro-ecological supporters make a partnership with the changed scenario. The blend of socio-ecological conditions formed due to association with neo-metropolitan interfaced conditions will also interfere with the overall ecology of suburbs. Increased exhausts, solid wastes, water stress and food mileage make it a different ecological functionary that the previously experienced conditions. Therefore, the population dynamics and associated landscape change frames the ecological niche. The challenge is will it be framed to be sustainable as previous or what are the vulnerable complexities that take part in building yet another situation. Keeping this in mind this study was framed with the population dynamics and landscape perception of habitants. The ecological insights supported by various studies (Sarif *et al.,* 2022; Govind and Ramesh 2019; Sudhira *et al*., 2007).

C. Data Collection and Analysis

A basic study was carried out to understand the patterns of landscape functions and their changes over time by the inhabitants of communities in north-western part of suburban Bengaluru. Hundred and twelve residents representing mixed groups by age, education, time of their association to community were randomly selected and interviewed personally using a structurally designed case method with open discussion. Sufficient time was offered to enumerate the perception of landscape function as socio-ecological transformation of their community. Individual perceptions were pooled for drawing a more comprehensive perception and challenges of the habitat ecology.

RESULTS AND DISCUSSION

Our findings on the suburban landscape transformations and the related reflection on perception of habitants through socio-ecological interfaces had some crucial insights. These perceptions were cumulated over a comparative match of seven decades population dynamics and perception of an over mixed age group of the population, with a considerable match of diverse socio-cultural representation. It used these to document the understood patterns of interfaces.

A. Overall Population Dynamics of Bengaluru

The population dynamics of Bengaluru were analysed with the data provided by the world population review document, to understand the changes in every five years. It is depicted clearly in Table 1 for the changes for the last fifty years.

Table 1: Change in population for every five years during the past 75 years.

Sr. No.	Year	Population*	Percent Increase in Population over 5 Years
1.	1950	7,46,000	—
2.	1955	9,39,000	25.88
3.	1960	11,66,000	24.18
4.	1965	13,77,000	18.1
5.	1970	16,15,000	17.28
6.	1975	21,11,000	30.21
7.	1980	28,12,000	33.21
8.	1985	33,97,000	20.8
9.	1990	40,43,000	19.02
10.	1995	47,54,000	17.58
11.	2000	55,81,000	17.39
12.	2005	67,86,000	21.59
13.	2010	82,96,000	22.25
14.	2015	1,01,41,000	22.24
15.	2020	1,23,27,000	21.56
16.	2024	1,40,08,000	13.64

(*Source of population data: https://worldpopulationreview.com/)

The percent change for every five years was recorded and understood. The changes between 1970 to 1980 recorded the maximum increase in population. And further after 2000 it increased. These decades realize the most migration happened to the city. The annual growth rate of the population ranged between 3.15 to 5.92 percent. During the years between 1972 to 1981 the growth rate has crossed 5%. 1975 being the maximum 2023 the minimum. The decade wise increase in population is as follows. The 1950s the growth was between 4 and 5 %, the 1960s growth was between 3 and 4%, 1970s growth was between 4 and 5%, the 1980s and 1990s less than 4% after 2000 it again increased with more than 4 %.

It is evident that the city attracts more migration, demanding more habitat and leads to disruption in the conventional landscape functions. Essentially the offer that city could be made in the suburbs which had the otherwise agrarian type of landscapes that gradually converted to layouts with the estate developments. Similar results were supported with other studies too (Sarif *et al.,* 2022; Govind and Ramesh 2019).

B. Habitants' Perceptions of Socio-Ecological Transformations

Our findings were further explored with the community residents on interview and mixed methods. The demographic representation of the population studied are depicted in Table 2 that explain their diversity and interests, especially on their socio-ecological relationships in the community. Their connections with Bengaluru city, that too their stay in suburbs of the city were matching the consideration to cover the broader interests of the socio-ecological functions of the Bengaluru.

A greater population representing typically over 90 percent had the experience of over ten years of stay. Only a small population of 8.92 % had recently arrived in the city. The occupation matched to find their experience, typically to move around the locale area. The business class of the area, who has more movements for transport etc, the educated class, whose intellectual pursuits to understand perception matched. As the considerable population say over 25 % had regular interaction with the community helped to record the perception of the community.

Table 2 : Collective Representative Data for Interviewees (n=112).

Particulars	Type	Individuals	Percentage
Gender Distribution	Female	42	37.50
	Male	70	62.50
Connection to Bengaluru	Since Birth	34	30.35
	In Bengalore for long (10+ years)	40	35.71
	Since 5 – 10 Years	28	25.00
	Recently arrived (< 5 Years)	10	08.92
Age Group	20-30	32	28.57
	31-60	56	50.00
	61-80	24	21.43
Education	High School	12	10.72
	Graduation	44	39.28
	Post-graduation	56	50.00
Occupation	Home making	12	10.71
	Business	26	23.21
	Education/Research	34	30.36
	IT/Engineering	16	14.29
	Law/Corporate	10	08.93
	Media	06	05.36
	Health	08	07.14
Relationship with Socio-ecological life	Considerable (Some Regularity)	24	21.42
	Medium (Occasional)	36	32.14
	Negligible (Rare event)	28	25.00
	Passive	24	21.42

C. Members' perceptions on overall ecology and roles

In Table 3 that presents an overview of the interview findings. Inter- viewed members are quite diverse in terms of age, gender, profession, background and level of involvement, although there is some predominance of males, people younger than 40, and those who have stayed in Bangalore 10 years or more. Considerable interviewees also consider themselves Inactive or Passive, resulting from common insights of just a livelihood, than the long-time opportunities for them. All interviewees spoke good, with excellent English and most had occupations associated with Some level of higher education, indicating lower diversity in terms of social class. Many respondents explicitly shared their perception of their interfaces.

Table 3: Perception on Landscape malfunctions in relation to identified utility.

Sr. No.	Malfunctions	Impact from public perception
1.	Narrow transits	**Heterogeneity** : No uniform road/connecting paths that could add the beauty of the networked landscape
2.	Waste disposal	**Disturbed practice:** Non regulated distribution of handling waste generated in habitats
3.	Approach to habitation	**Closure:** Interest of land developers, No common basis, Realised with time
4.	Shade tree preferences/Green amenities	**Beauty and Requirement:** People's interest as beautification as well the required environmental safety

In their perception the major concern shared to their connectivity and transits for general purposes. It was their striking point in the heterogeneity of networked connectivity. It represented the perception of their sense of beauty as well the usability. The disruption in their opinion was that irregular, highly personal plans of estate developments rather than community insights.

Similarly, material handling in the suburbs was a misleading usage which directly affected the socio-ecology of the landscapes. Particularly the waste recycling and segregation had been a highly neglected phenomenon, although some recent interventions have been made. The general practice of the community has been highly disturbing. General habitation approaches were closure, but that made the major transits narrow. The community has a very good perception of the natural support for the vegetation and their cultural support. It was of everybody's choice to benefit from the beauty and environmental requirements. Amrita Sen *et al.* (2020) had highlighted similar instances of knowledge and perceptions regarding water management through lakes of the city.

D. Major Insights of Discussion Among the individuals

It is a very insightful understanding of the common dialogues with the stakeholders of the community, that the landscape malfunction has been the direct reflection of socio-ecological interfaces. At least 50% of the population has some relevance of their contact with community ecology. This could be through layout functionaries, or routine walk thoughts. Everybody was convinced about the material handling, however the practice is. They could connect the dots through networked transits, vehicular movements and community coexisted relevance of the issues. Table 4 explains the major titles as the issues of individuals' exploration on suburban ecosystem management.

Table 4: Major themes during the discourse with individuals.

Sr. No.	Theme	Type of discussion/consensus/
1.	Personal and involvement in community perception/life	Name, Occupation, Place etc What is community life? Why working with community? What are reasons being in community?
2.	Landscape issues/knowledge Landscape issues/knowledge	Level of perception on landscapes
3.	Issues with Waste disposal	Practices, Observed and Practiced Major issues concerned with
4.	Sanitation/Drainage	What are the development patterns? Why are these a botheration?
5.	Parking/ Traffic sense	How often the problem sensed? Community concern and harmony
6.	Community Coexistence/ Neighbourhood support	Why is it important and how? Community concern and harmony
7.	Open Choice	Freedom of choice

As early as in 2005, green life, a reaction against encroachment on urban greenery in Bangalore had been initiated to combat the changes undergone among the fastest growing cities (Sudhira *et al.* 2007). It was brought to the notice of many while on discussion. However the situation has not been a satisfactory change as the perception of the community members revealed. The noticeable challenge observed was the overall ecosystem management that is now a fragmented phenomenon. Reassuring the reverted feel of coexistence through neighbourhood support by bringing the responsible roles in the community habitants.

CONCLUSIONS

This study of suburban ecological stewardship in a city of having rapid developments sheds some light on challenges to take care. It perfectly isolates the sustainable landscape management through understanding of coexistence livelihood safety. It tried to identify the landscape malfunction through narrow transits, mishandling of materials and closure approaches of habitation. It reflects the interfaces of socio-ecological narratives based on the community interests to further explore for the overall benefits.

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