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Sequestration of Blue Land: An Urbanization Conflict in Case of Janakpur Dham Sub-Metropolitan City, Nepal

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Abstract
Janakpurdham is known as the 'city of ponds,' yet its glory is diminishing due to haphazard urbanization. The sequestration of blue land is transforming this once vibrant city into a lethargic one. Religious, cultural, and socio-economic hubs are now facing obstacles such as waste dumping, greywater drainage, and pond encroachment. Key informant interviews (KIIs) and focus group discussions (FGDs) with local communities and related organizations are being used to intervene before and after assessing the condition and functions of the ponds. This paper aims to shed light on the tangible and intangible conflicts caused by urbanization and the sequestration of blue land from its users. There are 32 religious and historical ponds within the Parikrama Sadak (ring road), out of which four have entirely vanished, while 28 ponds have succumbed to encroachments. The encroachment of ponds within 30 years amounts to 3.85% of the area enclosed by the Parikrama Sadak, indicating an urgent need for the locals to awaken to the city's rejuvenation. Plans and policies should aim to harmonize blue land with urbanization to foster a positive perception and maintain the city's vibrancy.

Keywords
Sequestration, Blue land, urbanization, conflict, encroachment

1. Introduction

Currently, more than 50% of the world's population resides in urban areas, and this figure is projected to reach 68% by 2050.The trend of urbanization in Nepal has been accelerating rapidly with a growth rate of 2.9% from 1990 to 2018. Moreover, it is anticipated to continue as one of the fastest urbanizing countries through 2050, with a projected urban growth rate of 2 percent [1]. According to the 2021 census, the population density of Nepal is 198 people per sq km. In Madhesh province,this figure rise to 633 people per sq km, while in Janakpur sub-metropolitan city, it reaches 2115 people per sq km [2] With a population density of about 6741 people per sq Km with in Parikrama sadak, Janakpurdham emerges as one of the most densely populated cities, underscoring the critical need to preserve its water bodies. Wetlands, comprising ponds, lakes, and tanks, offer a plethora of benefits, serving as vital ecosystem that support diverse life forms, including migratory birds. Additionally, they play a crucial role in environmental functions such as bioremediation, flood control, and clean water provision. Due to their rich biodiversity and multifaceted benefits, wetland serves as valuable wildlife sanctuaries and educational hubs, often likened referred to the "kidneys of the landscape." [3]. Much like the lungs of the city, the pond serves as a vital source of oxygen, providing majority of the air needed by the inhabitants. Seperating pond from its user is akin to seperating skin from bone. Janakpur Dham, known as the 'City of Ponds,' encapsulates the evolution of settlements intertwined with the significance of its ponds, which now stand at the forefront of a profound urbanization conflict: the sequestration of its invaluable Blue Land resources from its users. These historical, religious, and cultural ponds face imminent threats due to the rapid pace of urbanization. Such challenges are prevalent in underdeveloped and developing countries, as seen in Lucknow, where the new building of the Lucknow High Court is accused of encroaching on ponds [4]. In Nepal, the 'Rani Pokhari Reconstruction and Conflict Settlement' initiative addresses not only the state of the ponds but also the conflicts surrounding them.[5]. The physical changes in ponds are intertwined with societal shifts, reflecting power dynamics and cultural influences. These shifts encompass the values and vision of an improved pond landscape, a concept captured by the term 'environmental imaginaries.' This term encapsulates both the values attached to existing ponds and visions of a 'better' pond landscape[6].

At the global level, we have committed to international agreements such as the Paris Agreement, Sustainable Development Goals (SDGs), and the Sendai Framework for disaster risk reduction. However, at the national and local levels, religious and cultural ponds are being separated from their users. This separation has led to a decline in their splendor and has caused various issues, including flooding, waterlogging, water scarcity, groundwater depletion, deteriorating drinking water quality, rising temperatures, and impacts of climate change. Research conducted in Janakpur has revealed a significant 2°C reduction in summer temperatures for these water bodies when compared to those located farther away [7].

2. Research Objectives

The main objective of this research is to rejuvenate Janakpur Dham as a "city of the pond". The sub-objectives are:

- To study the diminishing glory of Blue Lands over periods of time and its surrounding settlement pattern.

- To outline the drivers leading to the degeneration of the pond and its surrounding areas.
- To reestablish the significance and values of the pond in today's context.

3. Scope and Limitation

The research primarily focuses on the physical and social concerns surrounding the sequestration of the pond, with little consideration given to its ecological aspects.

4. Literature Review

Sequestration is removal or separation; banishment or exile [8]. The term "pond" comes from "pound," meaning a confined water body. Various definitions of ponds exist based on factors like wave action, rooted macrophytes, or light penetration. However, a universally accepted definition is lacking due to measurement complexities. In essence, ponds are still, relatively small bodies of surface water, whether natural or artificial, smaller than lakes[9]. Historical ponds worldwide hold significant cultural, ecological, and socio-economic value, yet they remain understudied. Neglect from communities and authorities has led to their disappearance, with some on the verge of vanishing. Urgent conservation measures are needed [10]. Urbanization is considered as one of the indicators of development in the modern world. The process of spreading of urban bodies in space and time is called as urbanization. As cities expand, they often encroach upon natural habitats, including ponds and other bodies of water. Depletion of ponds has put a lot of adverse impacts on the water supply, groundwater development and local climate. Having said that the present trend of urbanization cannot be abruptly stopped, it is highly required to structure and implement effective management principles to protect and promote the water bodies in urban localities [11]. Criteria used for characterizing the level of urbanization around a pond. [12].

The term "conflict" is a widely used concept that signifies contradictions and clashes of opinions, whether involving violence or not. The emergence of conflicts in a specific context and timeframe hinges on actions undertaken by authorities that are contentious or contrary to public viewpoints[5]. Ponds play a vital role in human civilization, serving as essential water sources for domestic, agricultural, and industrial needs, and providing sustenance through food resources. Unfortunately, these freshwater ecosystems are under threat due to numerous human-induced disturbances. these challenges are crucial to preserve the ecological integrity and essential services provided by ponds in the landscape. Human-induced developmental activities can deteriorate pond water quality due to the accumulation of toxic chemicals (for example, pesticides from agricultural runoff) and sedimentation, rendering the use of ponds ineffective and risky. Ponds are suffering loss from two accounts, namely, a decrease in number and an increase in pollution load [9]. Encroachment is the term for when man-made development encroaches on natural areas, such as ponds, floodplains, and wetlands, negatively impacting the ecological functions and values of these areas through actions like filling, clearing vegetation, and changing the landscape. The habitats, natural processes, and water quality are all impacted by this intrusion. In addition to activities like land filling, vegetation removal, and landscape modifications that contribute to ecological harm like hampered processes, habitat loss, and deteriorating water quality, it also includes the extension of human-built infrastructure into areas like floodplains, wetlands, and ponds [13].

5. Methodology

This research is guided by the pragmatism paradigm, which synthesizes post-positivist and interpretive approaches, given the dual nature of the research topic involving both quantitative data from institutions and qualitative insights from individual users' socially constructed realities. Ontologically, the research posits that urbanization primarily diminishes the prestige of ponds in core urban areas rather than on the periphery. Epistemologically, satellite imagery, aerial maps, and GIS mapping serve as reliable sources of knowledge for assessing changes in the extent of blue land over time.

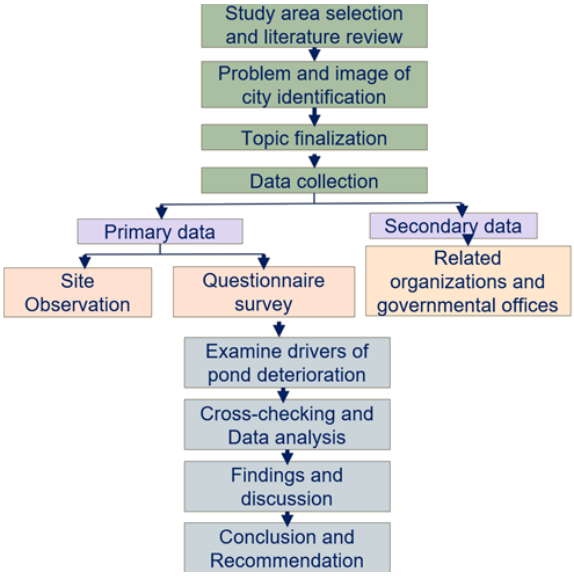

Figure 1: conceptual framework

6. Study Area

Janakpur is the headquarters of the Dhanusha district of Nepal, located about 84 miles (135 km) from Kathmandu. It is also known as Janakpur Dham, with "Dham" in Nepali meaning a sacred region.[14].Janakpur, known as the "City of ponds," is one of the oldest municipalities in Nepal, established in 1962 A.D. It is an ancient, historic, and religious town overseeing 72 ponds (excluding fish/private ponds), managed by the Ram Mandir (temple) and the Janaki Mandir Guthi. The Guthi serves as an institution responsible for overseeing socio-cultural activities and managing properties and functions associated with temples. Despite ongoing challenges, such as ponds disappearing or shrinking due to rising population density, Janakpur continues to maintain 3.8 percent of its total jurisdiction area designated for blue land

Table 1: criteria for level of urbanization around pond

Type of urbanization metric	Measure	Spatial scale of the measure	Example of studies
Presence of buildings	Percentage of built-up area, that is, percentage of area covered by buildings	50 m – 3.2 km radii	Gianuca et al. (2018)
	Percentage built-up area, that is, surface area occupied by buildings, houses, and industrial infrastructure, with roads and parking lots excluded	3.2 km radius	Brans et al. (2017)
	Percentage built-up area, that is, surface area occupied by buildings	200, 500, 800 m radii	Blicharska et al. (2017)
	Built-up area	500 m radius	Holtmann et al. (2017)
	Areas with buildings (low + high rise buildings)	200 m radius	Heino et al. (2017)
	Percentage of buildings: commercial, residential, and parking lots	1 and 2 km radii	Zhang et al. (2016)
	Areas of low, medium, and high urban residential density (six per class), based on city classification	Surrounding landscape	Mimouni et al. (2015)
Presence of roads	Road length within buffer area	10, 100 m, and 1 km	Villasenor et al. (2017)
	Road density in a buffer area	300 m to 10 km	Marsh (2017)
	Road density and urban infrastructure	500 m radius	Roe et al. (2011)
Impervious surfaces	Impervious surfaces	50, 100, 250, 500 m, 1 km, and 2.5 km	Thornhill et al. (2017)
	Impervious surface cover in a buffer area	300 m to 10 km	Marsh (2017)
	% covered in impervious surfaces	catchment	Mackintosh et al. (2017)
	Percentage of impervious surfaces: pavement, driveways, footpaths, and other human-building sites.	1 km and 2 km radii	Zhang et al. (2016)
	Cover of impervious surfaces (buildings and roads)	500 m, 2 km, 5 km radii	Straka et al. (2016)
	Impervious cover (Ontario Geospatial Data)	0.2 km to 2.6 km radii, at 0.2-km intervals	Patenaude et al. (2015)
	Percentage of surface covered by artificial surfaces (FAO GLC-SHARE)	watershed	Castilla et al. (2015)
	Percentage of impervious surface	sub-watershed	Vincent and Kirkwood (2014)
Urban land use	Proportion of urban land use in a buffer	100 m, 200 m, 400 m, 800 m, 1.6 km radii	Le Gall et al. (2018)
	Proportion of urban land use in a buffer	1 km buffer	Hill et al. (2017)
	Type "Urban," from merged types from the Land cover Florida Natural Areas Inventory	2 km buffer	Faller and McCleery (2017)
	Proportion of urban land (Land Cover Circa 2000 dataset) in a buffer	1 km buffer	Hassall and Anderson (2015)
	Land cover (urban industrial, urban residential (including gardens)) from the South African National Land Cover dataset (NLCD)	100 m, 400 m, 1 km radii	Calder et al. (2015)
Distance to city center	Distance to city center	no limit	Pawlikiewicz and Jurasz (2017)
Human population	Number of residents living around ponds	200, 500, 800 m radii	Blicharska et al. (2017)
	Human population density in a buffer area	1 km radius	Hamer and Parris (2011)
Development	Development in a buffer area	300 m to 10 km	Marsh (2017)

use. This unique context positions Janakpur as an excellent case study to explore the implications of blue land use within an urban setting. .[7]. Janakpurdham, also known as "babaan kutti bihattar kund," translates to 52 ancient temples and 72 religious and historical ponds. The majority of these historical and religious ponds are located within the Parikrama Sadak. Therefore, the overall level of encroachment is analyzed within this ring road, with a detailed study conducted on three ponds and their surroundings.

To generalize the dynamics and the state of the ponds, we select ponds in varying stages to broadly represent their condition over time.

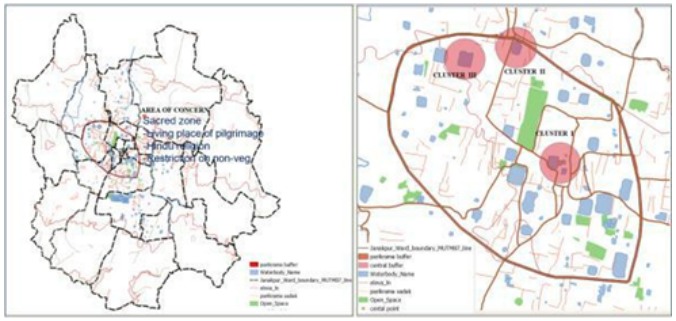

Figure 2: site area

Table 2: Case area selection

Case Area	Ward	Area
Angaraj Sagar and nearby ponds (Telha and Marha pond)	10	Core area
Paadprakchaalaan Gordhoi	9	Inner fringe area
Ratna Satar	8	Outer fringe area

In case of Angraj Sagar Janaki Mandir is situated to the north of this pond. Key Informant Interviews (KII) and Focus Group Discussions (FGD) with elders in this area revealed that Goddess Sita bathed in this pond using 'uptaan,' which is thought to heal skin-related ailments with a single sacred dip. The Nepal Telecom office and road construction are the main causes of this pond's encroachment. By way of the Mahanta and Guthi Sanstha, however, private ownership has encroached upon the Telha Marha pond.

Figure 3: Angraj sagar

In case of gordhoi pokhari Based on local community insights and discussions, it's revealed that this pond is used to wash the feet of lord Ram so it is called as Paadprakchaalaan in Sanskrit and Gordhoi in Maithali language. Before 50 to 60 years the bank area is used for agriculture and also used by washerman("dhobi") to wash clothes, particularly for affluent families, so it is also called as "Dhobhiyahi" locally.

Figure 4: Paadprachalaan

In case of Ratna Sagar This pond, which is in better condition than the other two ponds, served as King Janak's royal bank because of its unusual location—it is connected to a tertiary road in an outer fringe area.

Figure 5: Ratna Sagar

7. Data collection

During the site observation, Google map is used for reference then 87 FGD, KII is done out of which 26% of government offices, 17% with Elected officers and former mayors, local community offices, and tourist guides and 57% with Local residents (mainly elderly residents). A qualitative and quantitative method is used to determine the sequestration of the blue land. A semi-structured questionnaire in (Maithili, Hindi, Nepal, and English) language is followed to analyze before and after intervention situations with elderly groups of a community that have been familiar with this pond for more than 50 years. A snowballing method is used to find out the elder local group. Transit walk is used to observe the existing conditions and pond users is determine by visiting pond at different timings as in the early morning from 5qm to 7am, in morning from 8am to 11am and in the late afternoon and evening from 4pm to 7am in today's context. For a detailed study of ponds a 200m radius is made to analyze the before and existing conditions of urbanization. GIS map from the survey department of 2042 and Google Earth maps are utilize to examine urbanization in 40 years. The missing pond identified is again cross-checked with the KII and FGD with local elders interviews, local NGOs, tourist guides, governmental offices, and elected members (politicians and former mayors and existing and ward chairpersons).

8. Finding and analysis

The level of urbanization in the case as illustrated in literature with different urbanization indications is identified and tabulated as mentioned in Table 3.

Table 3: Criteria used for characterizing the level of urbanisation around a pond

Type of urbanization metric	Measures	Spatial scale	Angraj Sagar	Gordhoi Pokhari	Ratna Sagar
Presence of building	Area with building (low and high rise buildings)	Within 200m	Medium rise due to bylaws constraint	High rise	Low rise
Presence of roads	Raod with in buffer area	100m	Presence of metallic road	Presence of metallic road	Gravelled road
Impervious surface	Impervious surface	50m	RCC Ghats in whole perimeter	RCC Ghats from road side or half of the perimeter	Brick Ghat are in some part
Distance to city center	Distance to city center	No limit	Within a city	1km far	1.2 km far
Human population	Number of residents living around pond	200m	0	15	7
Urban land use	Proportion of urban land use	200m	Commercial	Mixed use	Residential

8.1 Examining the physical factors

8.1.1 Urbanization and Encroachment

Since Google Maps of Janakpur is only available from 2010, older ponds are not displayed, and some pond names are missing. Some ponds appear as land, while others are not shown on the map. However, through Key Informant Interviews (KII) and Focus Group Discussions (FGD) with the local community and local organizations, we have identified the number of ponds, their positions, and their significance, as illustrated in the map below.

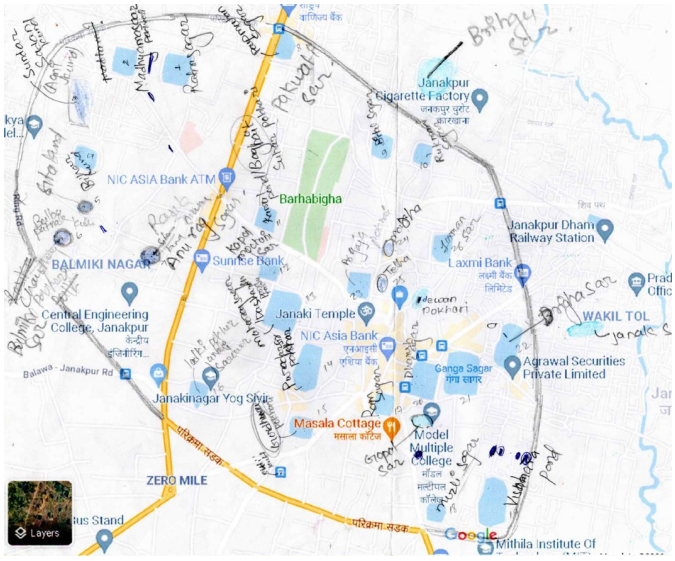

Figure 6: finding the numbers and significance of pond

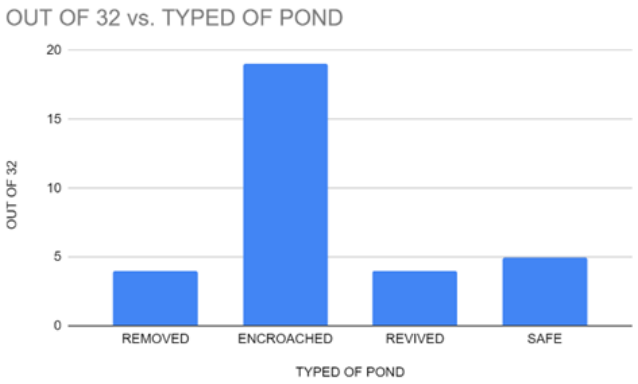

Figure 7: chart of pond condition

There are 32 religious and historical within the Parikrama Sadak out of which 4 ponds are removed while 28 ponds are in the following conditions as shown in below chart and map.

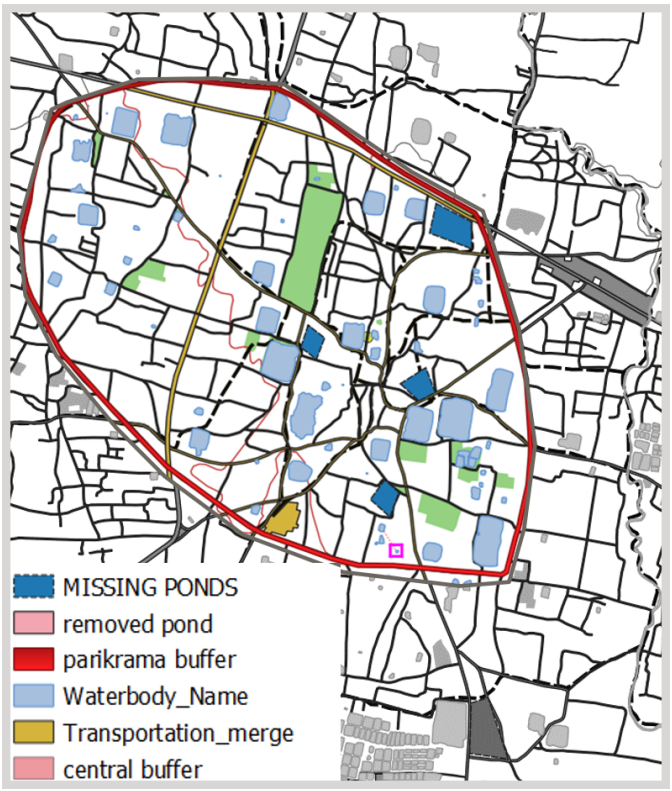

Figure 8: Removed ponds map

The percentage of enchroachment after excluding the four missing pond is 3.85% of the area encircled in Parikrama Sadak in a 30 years. The data of different period of time is shown in below pie chart

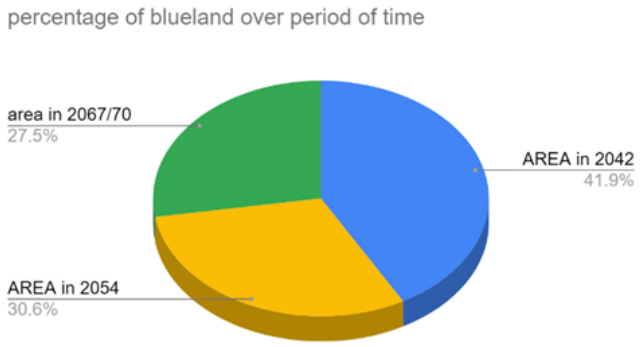

Figure 9: Blue land area over period of time

The encroachment in Angraj Sagar and surrounding ponds, Gordhoi pokhari and in Ratna Sagar from 2042 to 2080 is shown below chart.

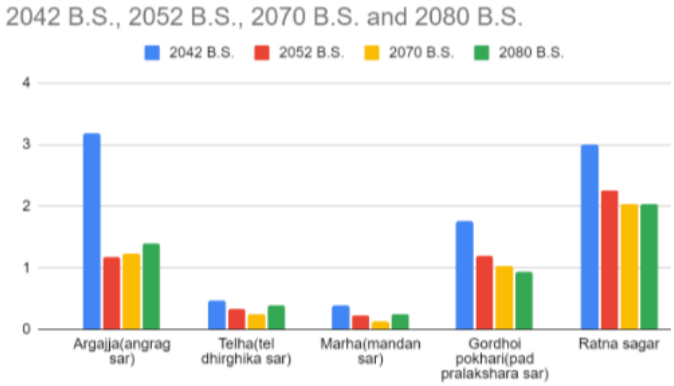

Figure 10: Condition of pond in 2080

8.1.2 Land tenure dynamics

This mechanism serves to illuminate the evolution of encroachment in both core and fringe areas as per bid rent theory even in a religious city because of migration from a business background. The escalating land prices and the process of gentrification within settlements stand as indicators of the encroachment progression over a span of time. The varying rental costs further delineate this trend: within the core area, exemplified by Angaraj Sagar, the figure exceeds Rs 50,000, while the inner fringe hovers around Rs 20,000, and the outer fringe records an approximate value of Rs 5000. These rental disparities underscore the influence of economic forces on the degree of encroachment on these blue land spaces.

8.2 Examining the social factors

8.2.1 Socio-ecological transformation

Ponds that once served religious purposes, such as for holy baths, have now been displaced by household chores among low-income groups, leading to waste dumping and detaching these sacred blue lands from their traditional users. These activities have resulted in the isolation of these ponds, distancing them from their original religious and cultural functions. As a consequence of these activities, the number of pond users has significantly dwindled, with only ten percent of the population now utilizing Angraj and Ratna Sagar, while the other three ponds have been abandoned.

8.2.2 Socio-Economic Factors

Numerous ponds have reached a state of degradation where they are now filled with waste, posing significant challenges and costs for their revitalization. The financial outlay for the restoration of a single pond, like Telha, which necessitates 3 crore rupees for renovation and an additional 30 lakh rupees for waste removal, could potentially fund the construction of more than three entirely new ponds, excluding land costs. This situation highlights the substantial economic burden and intricacies associated with the restoration of severely deteriorated ponds.

8.3 Environmental imaginaries

The concept of 'Shifting Perceptions: Modernization, Land Prices, and Environmental Imaginaries' is elaborated upon in the following points:

8.3.1 Residence perspective on the pond

During the local residence survey, it was found that 63% of respondents viewed encroachment as beneficial, as it often leads to public service improvements like infrastructure development and public buildings. In contrast, 36.4% of locals expressed concern, seeing encroachment as detrimental to their religious and cultural gathering spaces. From the residents' standpoint, a significant 84.2% expressed dissatisfaction, noting that during the pond's revival process, waste removal is inadequate, designs are unpleasing, and water quality remains subpar. However, 15.8% expressed some level of contentment, noting that even an initial effort to revive the area is preferable to no action at all. Regarding responsibility for pond deterioration, 50% of respondents held Guthi Sansthan accountable, while 29.9% attributed it to the Janakpur Sub-Metropolitan City, 13.2% to governmental offices, and the remaining 7.9% to local entities.

8.3.2 Policymaker perspective on pond

From a policy maker's perspective, 75% of them express satisfaction with the ongoing reconstruction of ponds, while the remaining 25% are dissatisfied. Additionally, 60% of policymakers reject the acceptance of encroachments, perceiving it as indicative of policy shortcomings, as illustrated in the graph below.

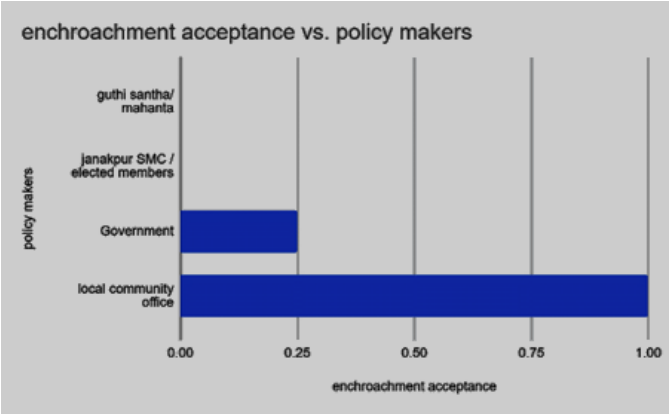

Figure 11: Encroachment acceptance

9. Conclusion and Recommendation

A participatory approach is employed for planning and policy development, involving collaborative efforts among local communities, government agencies, and related organizations, with the provision of incentives to the local community. These incentives include financial support, recognition and rewards, tourism and economic opportunities, capacity building, and the organization of cultural and social events aimed at rejuvenating their local water bodies with religious concerns.

- conservation should adhere to established guidelines, involving local communities and government authorities to accurately determine the size, shape, and area of ponds.
- Reviving the significance of ponds can be achieved through awareness programs within the local community, emphasizing the socio-economic significance of these blue landscapes.
- Enhancing connectivity between ponds and temple complexes can integrate cultural and spiritual elements into climate change adaptation strategies, fostering a harmonious link between the environment and religious recreation, disaster resilience, and sustainability.
- Reconfigure the drainage system to serve multiple purposes, including stormwater drainage, groundwater recharge, disaster resilience, and sustainable water management, thereby addressing challenges related to disaster resilience and climate change adaptation.
- The mandatory use of pond guidelines is crucial for ensuring the sustainable development of these blue landscapes and the preservation of the city of ponds.

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