

From Structuring System to Backyards: Transformation of Bengaluru's Water Network.

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Abstract—Cities like living organisms are in perpetual evolution. Human settlements are made of many interconnected interdependent systems and water network is one such system. Urbanisation alters connectivity of these systems. In case of Bengaluru, urbanisation had robbed the glory of the intricate water network traversing through the city with the tanks as the pause points. The hydrology landscape that evolved from the geography structured the settlements while functioning as provisioning system sustaining the rural settlements. There are many factors contributing to the transformation of the water network, ranging from indiscriminate disposal of waste into the tanks to diverting tanks for infrastructure projects; massive encroachments and severed network contributing to the degradation leading to current state of the water network. Urbanisation in Bengaluru occurs by lateral growth transforming rural maps into urban maps. Transformation of rural maps to urban maps is governed by the process of urbanisation regulated by formal urban planning law. This makes urbanisation the primary factor impacting the water network, calling for the need to review the process of urbanisation that has transformed the water network. The Local Municipal Government has currently taken up the project to reclaim the water network in the lines of Cheonggyecheon, Seoul, South Korea and redevelop it in the lines of Sabarmati river front development. The paper reviews the formal urban planning processes that govern the transformation of rural maps into urban maps in today's Bengaluru City, focusing on the water network system and its transformation in the process of urbanisation from being the structuring system to backyards. The paper maps the consequences and manifestation while addressing the process leading to the transformation.

Index Terms— Urban Land Management, Bengaluru, Formal Process, Transformation, Urbanisation, Urban Planning, Urban Systems, Water Network.

1 INTRODUCTION

Before the City, there was land [1] before the city there were settlements. In her profound wisdom, Hindi poet Mahadevi Verma stated: [2].

“it is not possible for any human being to take a step forward without putting one foot firmly on the ground”.

In context of traditional systems, the relevance of the statement is evident when the human settlements are trying to move ahead without keeping itself rooted in its traditions. Sir Patrick Geddes put forward the need for the formal urban planning process to understand the historical evolution of cities and recognise the sustainable and resilient systems that make human settlements [3]. Historically, human settlements were often established in relation to water sources and waterways; water source as a provider of settlements' water demands and water transport corridors [4]. With the change in the transportation system and water supply mechanisms, the association between water resource and settlements is altered.

Indian urbanisation predominantly occurs by the lateral growth of cities absorbing the rural settlements into the urban jurisdiction. The transformation of rural maps into urban maps in the process of urbanisation alters the resources and infrastructure associated with the settlements. The contribution

of lateral spread of urban settlements to increase in urban population during 1991-2001 is substantial [5]. Urban settlements can either be planned or organic; planning is regulated and governed by the codified urban planning law that transforming rural maps into urban maps. Urban settlement form like any human settlement is determined by both natural and human made systems which are individually and cohesively are integral to the functioning and sustenance of the urban settlements.

By 2050, the world's urban population is expected to nearly double, making urbanization one of the twenty-first century's most transformative trends [6], posing challenges to urban living. Bengaluru like any other city is plagued by urban concerns such as housing shortage, long traffic hours, waste management, polluted water bodies, urban floods, encroachments, governance etc. A significant urban concern along with many others that the city faces is urban floods. 2016 urban floods triggered the demolition drive aimed at reclaiming the water network and removal of encroachment [7], [8]. The demolition drive [9], in 2016 post floods was a wake-up call for the city to review the planning process. According to experts, this urban floods occur as the authorities have worked against Bengaluru's water network system built 468 years ago by founding father Kempegowda, and consolidated later by the British with a drainage system. In the wake of this phase of human settlements which is dominated by urbanisation, the paper advocates the necessity to recognise and include the historic roots and geographic realities in the process of transformation of rural maps into urban maps.

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The entire ecosystem of the settlements was structures along the geography of the land. The wetlands as a part of the ecosystem cleaned the water before it enters the large tanks and were used for banana plantation and acted as containers when the tanks swells during monsoon offering scope for accommodating disruption, extreme pressures or surges in demand.

Before contemporary urbanisation, over 1000 tanks of varying capacity existed within the administrative boundary of today's Bengaluru giving the title "the land of thousand tanks". The water network functioned as an ecology resource with the tanks, rajakaluveys and the wetlands. Wetlands are helpful in controlling floods, replenishing groundwater, protecting biodiversity and providing livelihoods of local population. The indigenous tank system with rajakaluveys channelising the water and the tanks containing the water for subsequent use, coupled with the scope for underground penetration of rain water prevented any possibility of flood. Tanks operated as water resource in the monsoon and soil resource when dried up; additionally the vast tank bends when dried up transformed into hybrid space for housing village festivals. The settlements depended on the system as a provisioning resource for domestic, economy, cultural and many other needs while the system by itself served as an ecology resource. The provisioning services ranged from replenishing ground water, irrigation, drinking water, washing clothes, bathing, feeding and bathing livestock immersion of deities during festivals, collecting fodder, collecting soil to be used as manure as well as brick manufacturing etc. The entire ecosystem of the settlements was structures along the geography of the land. The wetlands as a part of the ecosystem cleaned the water before it enters the large tanks and were used for banana plantation and acted as containers when the tanks swells during monsoon offering scope for accommodating disruption, extreme pressures or surges in demand.

The diagram represents the association between the settlements and the water network in context of rural and urban context. The transition zone between the water and land in the agrarian zone offered scope for redundancy which is lost in the process of urbanisation, manifesting in the flooding of the city during rains. Wetlands intercept surface run-off from land filtering nutrients, wastes and sediments before the water reaches the tanks for storage [19]. The formal urban planning process needs to recognise the use value of the water network as an ecology resource and its provisioning services, as the planning process reinterprets the water network in the ever transforming urban context.

Urbanisation has not altered the relevance of wetland; the use value of wetlands is however altered. This has contributed to the disuse of the hydrology ecosystem. The use value of land in the rural context as determined by the agrarian economy is heterogeneous and has many layers, where soil, nutrients, water and terrain are the attributes of land. Urbanisation has taken settlements physically closer to the water bodies in a bid to increase the availability of land for the settlements. The use value of urban land is land homogenous; the attributes of land like soil type, soil fertility and proximity to water source or the terrain do not determine the use value of the land. The exchange (market) value of urban land varies with the land use category, connectivity, amenities, services and other factors. Given the significance of the water network in the evolution of the pre urban settlements of what we see as Bengaluru today the formal urban planning process need build frameworks for enabling the functioning of the sustainable and resilient system. The transformation of agrarian settlement into urban settlements offers opportunities to reinterpret and recontextualise the water network as an ecology resource and its provisioning services. The recognition of the use value of the water network by the urban planning process is critical in reinterpreting and recontextualise for the urban settlements. The next section studies current state of the water network to identify the manifestation of the formal planning process on water network.

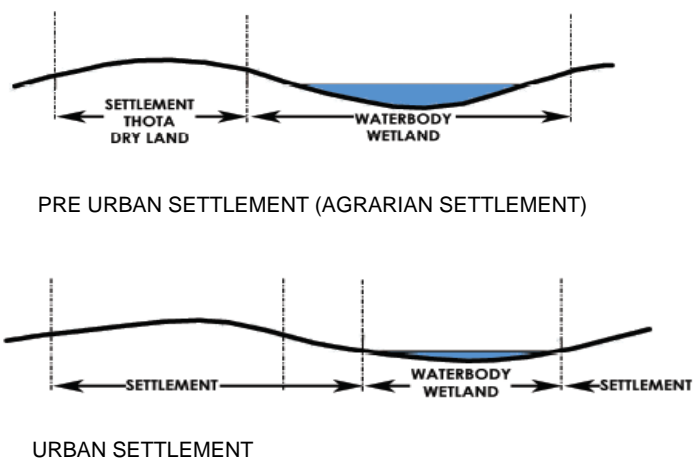


DIAGRAM 2: SETTLEMENT PATTERN: LAND WATER INTERFACE.
SOURCE: Produced by the author from field study and interaction from residents in the Bellendur urban village.

3 THE WATER NETWORK SYSTEM IN ITS CURRENT STATE:

The city as it expanded found alternative source in the form of reservoirs for the supply of water; the Hesaraghatta reservoir, was constructed in the 1890s and the Thippagondanahalli reservoir in the 1930s. The reservoirs became insufficient and the city reached out to Cauvery River approximately 100 km away and 300 mts uphill. With the dependency on the water network severed, the city turned its back to this system. The change in land use from agriculture to urban land use removed the dependency on the water network for irrigation. In studying the transformation of the water network the paper identifies 3 themes; Disuse, Lost and altered. Each of the three themes is explored in this section.

The government of Karnataka by taking into consideration

the problems related to conservation, preservation, rejuvenation, administration and management of water bodies issued order no. PWD 82 IMB 85 Bengaluru, dated: 26th July 1985 to constitute an expert committee headed by Sri Lakshman Rao [20] to study the condition of tanks. The committee looked into the allotment of tank beds made by BDA/government to various agencies/private entrepreneurs, deterioration of the environment water aesthetics and quality to improve underground aquifer, encroachment into the feeder channels and water crisis in the city. The committee had identified 127 tanks in conurbation limits and about 262 tanks were identified/ indicated in the then Green Belt area by the Committee. They are summarized taluk wise as:

- Bengaluru North-61
- Bengaluru South-98
- Hoskote-23
- Anekal-44
- Magadi-11
- Nelamangala-13
- Devanahalli-12

Of the 127 tanks identified in the conurbation area, 81 tanks were found to be live tanks; retained or reclaimed. Kaikondarahalli tank, Madiwala tank and Sanky tank is a case of reclamation. While part of the interconnected water network is retained or reclaimed, a major part is transformed. A total of 46 tanks have been identified by Sri Lakshman Rao committee to be transformed with no water.

STATE OF DISUSE: Defilement of the tank ecosystem is a major contributor to the disuse of the tanks. AT Ramaswamy committee observed that all the tanks are polluted due to impounding the sewage water. The Hon'ble Justice NK Patil Committee Report [21] recommended that the sewage entry into the tanks should be restricted, the sewage water should be treated and with this water the lakes water table should be maintained. The feeding channels follow a natural path and run along the topography of the catchment area and the sewage network follows the same path. The overlap of the water network and the sewage network is leading to spillover of sewage into the rajakaluveys. Additionally, the unregulated dumping of domestic and untreated industrial waste into the rajakaluve is carried into the tank. Many small tanks are polluted; however the case of Bellendur tank and Varthur tank is a glaring example. Located downstream and owing to the scale of the tanks, the polluted tanks pose a complex challenge to the city. Bellendur is known as a tank that catches fire. Various studies by Indian Institute of Science (IISc), Bengaluru, establish the state of disuse of tanks as triggered by pollution. One of the farmers in Varthur shared his experience of using the polluted water for growing vegetables to be sold in city's markets stated "the city polluted our water network robbing us of our resource, and we are left with polluted water to cultivate the vegetables". This indicates a collective loss of water network as a resource and the impact is felt beyond the immediate surroundings. The loss of

services is perceived by the farmers downstream and is contributed by urbanisation.

LOST: The tanks are lost due to formal processes and unregulated encroachment of water network due to urbanisation. The Malaria Eradication Program undertaken by the local government led to the breach of tanks. Water was drained off resulting in dry tank beds which were converted into land resource for various purposes; Subhash Nagar tank bed, Miller tank bed, Sinivagilu tank bed, Akkithimmanahalli tank bed, Kurubarahalli tank bed etc.[22]. In the case of Sinivagilu tank bed and Jakkasandra tank bed, BDA was in the process of formation of layouts when the Lakshman Rao committee objected the formation of the layout and wrote to the government to direct BDA not to take up layout formation. The recommendations were not considered by the planning authority and the formation of these layouts has become the cause for flooding of the area during the rainy season. As per the Lakshman Rao Committee report, 10 of the 46 transformed tanks are lost to development and are being utilised by the Horticulture department, Bengaluru City Corporation, BDA or allotted to institutions. The pattern is recurring in the conurbation area with many tanks making way for urban infrastructure and institutional projects; Kempe Gowda Transport Hub (Dharmanbudhi Tank), Sri Kanteerava Indoor Stadium (Sampangi tank), Hockey Stadium (Akkathimmanahalli tank), National Dairy Research Institute (Koramangala tank) etc. Some have made way for recreational facilities; Karnataka Golf Association (Challaghatta lake), Regional park-JP park (Mathikere tank) etc., while some made way for housing; Labour colony (Karanji tank), BDA Residential layout (Domlur lake), BDA Residential layout (Sinivaigalu lake) etc.

Encroachment of tanks is another pattern observed in the study of lost tanks. Vijanapura Tank, Kavadenahalli Tank, Krishnarajapura Tank, Gangadhara Tank etc. in the existing conditions is encroached for residential use. With the inlets in to the tank blocked, the tank dries up and the process of encroachment takes over to shrink the tanks. Sri AT Ramaswamy, Joint Legislative Committee [23] observed the rampant allotments of dry tank beds by BDA without exercising due diligence to check if the land/tank bed is a part of encroachment. Sri KB Koliwad committee was constituted by the state government in 2014 to enquire into the encroachments in the lakes/water bodies. The implantation of the report however is found wanting.

The tanks in the core are lost to infrastructure and housing projects while in the new development zone, the tanks are lost to encroachment. The infrastructure projects were conceived for common good at the loss of the intricate interconnected ecosystem. The unchecked encroachments however evidenced the lacuna in monitoring mechanisms to protect tanks which the primary reasons for the destruction of the lake ecosystem in Bengaluru city.

ALTERED: The water network system is an interconnected intricate system with tanks and rajakaluveys evolves along the valley system informed by the catchment area. The rajakaluveys form an important part of the water network system acting as connectors, channelising the water to the tanks. This interconnected system is altered either as a response to the context or to accommodate urban needs. While the tanks are either lost or in a state of disuse, the rajakaluveys are altered and disconnected. This is observed in the core of the city where most tanks are lost. With the tanks lost, the role of rajakaluveys as connectors for tanks is severed and altered. The Agara-Bellendur wetland Violation was reported by IISc in 2017 [24]. Alterations in topography and wetlands lead to flooding of regions leading to loss of property and human life, property and affecting health.

The non-recognition of the use value of tanks led to the transformation of the tanks into housing layouts in this case. The paper proceeds with the preposition that the recognition of the water network by the formal urban planning process manifests in the inclusion of the water network. Having learnt the consequences of urbanisation on the water network, the next section reviews the formal process that has led to the transformation of the water network into the backyard of the city.

4 FORMAL URBAN PLANNING PROCESS AND WATER NETWORK

Urban planning largely is governed by the Town and Country Planning Act which provides for making master plan for the cities by the local planning authority. The formal urban planning for Bengaluru is regulated by the Karnataka Town and Country Planning (KTCP) Act 1961. The objective of the Act is to create conditions favorable for planning and replanning of urban and rural areas on the state of Karnataka, stop uncontrolled development of land, preserve and improve existing recreational facilities and direct the future growth of the populated areas of the state. Section 9 of the KTCP Act 1961 provides for making master plan for any Local Planning Area (LPA) and section 13 D provides for periodic revision of master plan. The master plan regulates and governs the land use planning of the city.

The land use plans for Bengaluru are reviewed in context of inclusion of water network; water network being an attribute of geography. Comparative study of the land use classification of the master plans for Bengaluru indicates no change in the typology and classification of the land use for Bengaluru city. The typology for residential, commercial, industrial, public and semi-public, open spaces, agriculture land and unclassified/defense is recognised by the 3 master plans, while public utilities as a typology was recognised by Revised Master Plan 2015 (RMP 2015). The RMP 2015 however has a range of sub classification, evidencing the recognition of geography; water network, valleys and the forest being

attributes of geography.

TABLE 1: The regulations are documented in the table below:

PLANS	WATER NETWORK
ODP 1972 [25]	The land use category has no mention of water network ¹ .
CDP 1995 [26]	The land use category has no mention of water network ² .
RCDP 2001 [27]	The land use category has no mention of water network.
RMP 2015 [28]	The land use category ³ has water network mentioned as a sub-category under Park and open space land use category ⁴ .

¹ ODP 1972 ANNEXURE I: Land use classification and occupancies (or use) permitted:.

1.1 CDP 1995 Classification of land sue into various use zones:

- a) Residential
- b) Commercial (retail and whole sale business)
- c) Industrial (Light and service industries, medium industries and heavy industries)
- d) Open spaces, parks, playgrounds and recreational areas.
- e) Public and Semi- public use
- f) Transportation and Communication
- g) Agriculture land (Green Belt)
- h) Defence land (Unclassified)

² RCDP 2001 ANNEXURE II: Classification of land use and the uses of development that is permissible.

Classification of land sue into various use zones

- a) Residential
- b) Commercial (retail and whole sale business)
- c) Industrial (Light and service industries, medium industries and heavy industries)
- d) Public and Semi public
- e) Utilities and Services.
- f) Parks & Open spaces and playgrounds(Including public recreational areas)
- g) Transportation and Communication
- h) Agriculture land, water sheet (Green Belt)

³ RMP 2015 1.2 (B) Classification of land use zones:

- a) Residential (R)
- b) Commercial (C)
- c) Industrial (I)
- d) Public and Semi-public (P&SP)
- e) Traffic and Transportation (T&T)
- f) Public Utilities (PU)
- g) Parks & Open spaces (P)
- h) Unclassified (UC)
- i) Agriculture land (AG)

⁴ RMP 2015 4.1.2 PARK AND OPEN SPACE (P)

B) Valley/ drain

Within the demarcated buffer for the valley the following uses are allowed:

- i. Sewerage Treatment Plants and Water treatment plants
- ii. Roads, pathways, formation of drains, culverts, bridges, etc which will not obstruct the water course, run offs, channels.
- iii. In case of water bodies a 30.0 m buffer of 'no development zone' is to be maintained around the lake (as per revenue records)

The planning authority has revised the master plan for Bengaluru periodically. The paper classifies the master plans into 2 categories for analysis:

Previous master plans

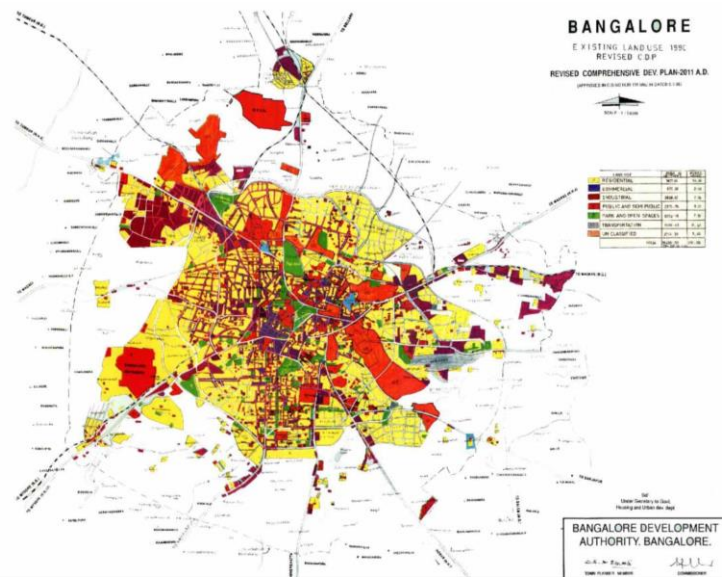
- Outline Development Plan 1972 (ODP 1972).
- Comprehensive Development Plan 1995 (CDP 1995).
- Revised Comprehensive Development Plan 2001. (RCDP 2001).

Current master plan

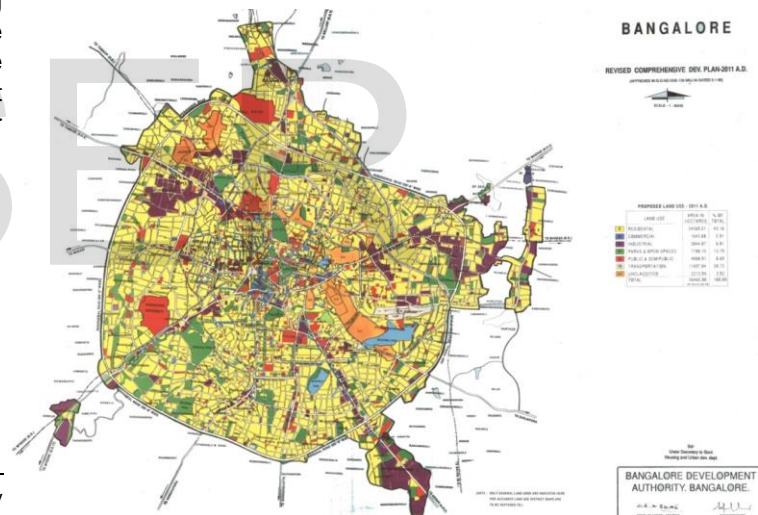
- Revised Master Plan 2015 (RMP 2015).

PREVIOUS MASTER PLANS

The ODP 1972, CDP 1995 and RCDP 2001, along with the land use zoning and land use regulations formulated the added regulations for density controls and building bylaws. As for recognition of geography, there is no mention of the landform, topography or the water network in the three previous plans. While the ODP did not recognise the water network, the CDP recognised the water bodies as green amenities or land, transforming water bodies into parks. RCDP 2011 proposed green zone for most lakes within the planning jurisdiction. The RCDP 2011 limited the recognition to the use value of tanks to land while not recognising the ecology value of the tanks. Additionally tank as a source of water was not recognised owing to the lack of dependence on tanks as water resource.



MAP 3 EXISTING LAND USE MAP OF RCDP 2011: NO CLASSIFICATION OF WATER NETWORK. SOURCE: Bengaluru Development Authority.



MAP 4 PROPOSED LAND USE MAP OF RCDP 2011: - WATER NETWORK AS PARKS AND GREEN ZONES. SOURCE: Bengaluru Development Authority.

CURRENT MASTER PLAN

Revised Master Plan 2015 (RMP 2015) was published in 2007. The LPA as defined by the RMP 2015 consists of 387 villages, 7 City Municipal Councils (CMC) and 1 Town Municipal Council (TMC). RMP 2015 recognises and classifies the valley zone as “sensitive zone” with a non-buildable green buffer zone⁵. The forest land is also classified under open spaces and declared protected zone. The RMP 2015 for the

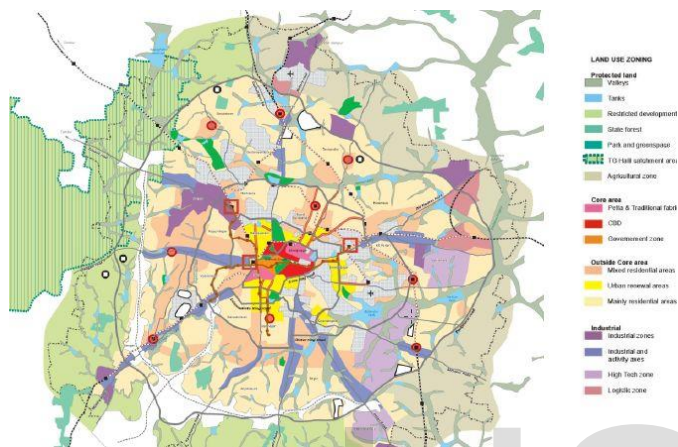
with exception of activities associated with lake and this buffer may be taken into account for reservation of park while sanctioning plans.
iv. If the valley portion is a part of the layout/ development plan, then that part of the valley zone could be taken into account for reservation of parks and open spaces both in development plan and under subdivision regulations subject to fulfilling section 17 of KTCP Act, 1961 and sec 32 of BDA Act, 1976.
v. Any land falling within the valley for which permission has been accorded either by the Authority or Government, and then such permission shall be valid irrespective of the land use classification in the RMP 2015. Fresh permissions for developments shall not be accorded in valley zone.

NOTE:

Drains: the RMP 2015. In case the buffer has not been marked due to cartographical error for any of the above types of drains, then based on the revenue records buffer shall be insisted in all such cases without referring the land use plan while according approval for building/development/ layout plan. Permissions in sensitive areas earmarked on the land use plan shall be considered only by the planning Authority. The drains have been categorized into 3 types namely primary, secondary and tertiary. These drains will have a buffer of 50, 25 and 15m (measured from the centre of the drain) respectively on either side. These classifications have been used for the drains newly identified while finalizing

⁵ According to Sri Nanje Gowda Ex-Joint Director in BDA's Town Planning section, 'Sensitive' is a classification for areas housing drains that connect tanks.

first time recognised the water network and classified the rajakaluveys⁶ as primary, secondary and tertiary, specifying a non-buildable green buffer zone from the edge of the tanks and rajakaluveys⁷. The recognition of valleys and water network is evidenced by identification, classification as sensitive zone and prescription of a non-buildable buffer space to protect the sensitive zone. The planning authority for the first time recognised the need to address critical issues of ecology and environment in addition to preserving and managing natural hydraulic balance.



MAP 5 REVISED MASTER PLAN 2015 - IDENTIFICATION OF VALLEYS AND SENSITIVE ZONES. SOURCE: Bengaluru Development Authority.

The regulation however is not supported by a map showing the classification of the primary, secondary and tertiary nala. Also, there is no reference for the edge of the nalas. The nalas are identified from the revenue map where the edge of the water network is not clearly marked. This leaves the demarcation of the non-buildable unclear. The buffer space regulation is one of the most contested legal frame works in the domain of urban planning in Bengaluru, as evident from the NGT's approach [29] and the demolition drive [9]. The lack of differential strategy for core, developed zone and to be developed zone has led to failure in implementation of the regulation for buffer space. The planning authority has no strategy to reclaim the buffer space that is already built up. The built-up could be for various reasons as listed:

- The layouts developed by BDA or private developers prior to the commencement of the 2015 RMP,
- Unchecked encroachment of the tanks and nalas.
- Layouts developed in violation of the regulations for buffer space as prescribed by RMP 2015.

While the land use classification recognises the water network

⁶ Note: Rajakaluveys, nalas and storm water drain are used interchangeably.

⁷ Buffer zone regulation defining the extent of the non-buildable zone: Tanks- 30 mts; Primary nalas- 50 mts; Secondary nalas – 35 mts; Tertiary nalas- 25 mts.

as a no-development zone while classifying the valleys as sensitive zone, no guidelines are formulated for the development in the “sensitive zone”. Permission in sensitive areas earmarked on the land use plan shall be considered only by the planning authority with no attached regulation and guiding principle laid out for the decision making, leaving the regulation to the discretion of the planning authority and the interpretation of the stack holders.

As for the valley and the forest, it is classified as protected zone. For any development in valley zone, a part of the valley zone could be taken into account for reservation of parks and open spaces both in development plan and under subdivision regulations, subject to fulfilling section 178 of KTCP Act, 1961 and Sec 329 of BDA Act 1976. The land use regulation however does not differentiate a valley zone which any other from a zone with the same land use classification. For example, a major percentage of land is residential and Hi-tech in the PLU Map 3.16 Varthur map (a), which is a part of the Koramangala Challaghatta valley. A part of the residential as well as hi-tech zone has been earmarked as sensitive zone. The zoning regulations and density control tools however are uniform for the entire zone with no differentiation of the sensitive zone. The only difference when developing the land in the valley being the part of the valley zone ‘could’ be taken into account for reservation of parks and open spaces, leaving room for speculation

The recognition of the water network as ecology system by the RMP 2015 has manifested in the formulation of regulation to protect the water network, evidencing the recognition of the geography of the land. The recognition however is limited its functional value manifesting in the formulation of regulations that are narrow in scope.

5 CONCLUSION

Do we have solution to an urban concern of this degree of complexity? The water network system which once structured the settlements has transformed to backyard of the city as a manifestation of urban planning and urban governance. The transformation has a negative impact on the ecology value and the provisioning services of the water network. There is a need to reclaim the water network that is in a state of disuse, lost or altered. The authorities and the policies are addressing the negative impact of the transformed water network (urban floods) as an aftermath and clearly not guided by a vision to work with the system. For example, providing compensation to the affected during urban floods will give temporary relief, only as the city waits to sink in the next rain. For the city to be resilient to urban floods and have self-sustaining water source, the water network need to be reclaimed and revived.

⁸ Section 17 of KTCP Act 1961. - Sanction for sub-division of plot or layout of private street.-

⁹ Section 32 of KTCP Act 1961. - Contents of draft scheme.-

The reclaiming and reconnecting the water network is a bold step that clearly needs the legal framework to recognise the inherent value of the water network and the association of water network system with the settlement. The need to shift the strategies for sourcing water for the city cannot be understated in the wake of discussions on resilience and sustainability. The dependence on Cauvery as the sole source supplying water to the city is not sustainable. There is a need to revive the water network system as a water resource. The live tanks can recharge ground water reducing the dependency on Cauvery.

What is urban planning to offer to resolve this conflict? Reclaiming the water network is for common good. Recognising the use value of water network as land is where the conflict is. While in the urban core many tanks have made way for public infrastructure and housing projects, the downstream witnessed encroachment by private players. The complex governance process in the management of tanks has is a concern at one level, and the urban planning law being narrow in scope in recognising the water network is another concern. The paper established the role of urban planning law in the transformation of the water network as seen in the three themes of transformation; disuse, lost and altered.

REFERENCES

- [1] Cronon, W. (1991). *Nature's metropolis: Chicago and the Great West*. New York, London Pg 23. W Norton.
- [2] Agarwall A, & Sunita N, (Ed.). (1976). *Dying Wisdom: Rise fall and potential of India's traditional water harvesting systems*. Centre for science and Environment, Pg no iv.
- [3] Munshi, I. (2000). Patrick Geddes: Sociologist, environmentalist and town planner. *Economic and Political weekly*, 35(6), 485-491.
- [4] Bai, X. e. (2005). *Urban Systems, In: Ecosystems and Human Well-being: Current State and Trends (Vols. Volume 1, Chapter 27)*. Millennium Ecosystem Assessment (MA), Pg 795-825.
- [5] Kundu, A., Pradhan, B., & Subramanian A. (2003, July 19). *Urbanisation and Urban Governance: Search for a Perspective beyond Neo-liberalism*. *Economic and Political Weekly*, 30, pp. 79-87.
- [6] *New Urban Agenda: Habitat III*. (2016). Housing and Sustainable Urban Development. United Nations. United Nations Conference.
- [7] Prasad, N. N., & Narayanan, P. (2016). *Vulnerability assessment of flood-affected locations of Bangalore by using multi-criteria evaluation*. 22:2, 151-162.
- [8] Ramachandra T V, Vinay S, & Aithal, B. H. (2016). *Frequent Floods in Bangalore: Causes and Remedial Measures*. ENVIS Technical Report, 123.
- [9] Chandran, et al. (2016). *Bangaluru demolition drive: A lesson for how to govern land in India*. Retrieved 05/05/2020, from <https://www.livemint.com/Politics/YYcre6DZBtdWJI7wabPzM/Bangaluru-demolition-drive-A-lesson-for-how-to-govern-land.html>.
- [10] Case Study: Cheonggyecheon; Seoul, Korea. (n.d.). Retrieved 5 6, 2021, from <https://globaldesigningcities.org/publication/global-street-design-guide/streets/special-conditions/elevated-structure-removal/case-study-cheonggyecheon-seoul-korea/>
- [11] Chada. (2017, 5 17). *London's River Thames: From Filthy, Foul-Smelling Drain To One Of The World's Cleanest Rivers*. Retrieved 5 6, 2021, from <https://thelogicalindian.com/environment/river-thames/>
- [12] *Daylighting Streams: Breathing Life into Urban Streams and Communities*. (2016). Retrieved 5 6, 2021, from *Daylighting Streams: Breathing Life into Urban Streams and Communities* https://www.americanrivers.org/wp-content/uploads/2016/05/AmericanRivers_daylighting-streams-report.pdf
- [13] Ramachandra, T.V, Asulabha, K.S, Sincy, V, & Bhat. (2016). *Wetlands: Treasures of Bangalore: Abused, polluted, encroached, and vanishing*. ENVIS Technical Report 101.
- [14] Sundaresan, J. (2011). *Planning as commoning: transformation of a Bangalore lake*. *Economic and Political Weekly*, 46 (50), 71-79.
- [15] Unnikrishnan H, M. S. (2017). *Making water flow in Bengaluru: planning for the resilience of water supply in a semi-arid city*. *Journal of Sustainable Urbanization, Planning and Progress*, Vol.2 (1), 1-11.
- [16] D'Souza, R, & Nagendra. (2011). *Changes in public commons as a consequence of urbanization: The Agara lake in Bangalore, India*. *Environmental Management*, 47(5), 840-850.
- [17] Nair, J. (2005). *The Promise of the Metropolis: Bangalore's Twentieth Century*. New Delhi: Oxford University Press.
- [18] Kavitha, Somashekar R, & Nagaraja B. (2015). *Urban expansion and loss of Agriculture land - A case of Bengaluru city*. *International Journal of Geomatics and Geosciences*, 5(3).
- [19] *Status of Wetlands in Bangalore*. (n.d.). Retrieved 7/07/2020, from "Status of Wetlands in Bengaluru" <http://wgbis.ces.iisc.ernet.in/energy/TR86/intro.html>
- [20] Sri N. Lakshman Rao, IAS (Retd) Committee. (1988), the report of the committee on lakes of Sri N. Lakshman Rao, IAS (Retd), 1988 submitted to the State Government of Karnataka. Bengaluru.
- [21] Justice N.K. Patil Committee. (2011), the report of the committee of Justice N.K. Patil dated 26.02.2011 submitted to the state government of Karnataka and high court of Karnataka. Bengaluru.
- [22] DHNS. (2015). *BDA says it has developed 14 layouts in lake areas*. Retrieved 6/06/2020, from <https://www.deccanherald.com/content/475932/bda-says-has-developed-14.html>
- [23] Sri A.T. Ramaswamy committee. (2007). *The report of the committee of Sri A.T. Ramaswamy, Member of Legislative Assembly, February 2007 and second interim report on 26.07.2007 submitted to the State Government of Karnataka*.
- [24] Ramachandra T V, Vinay Shivamurthy, Dr. Bharath H Aithal., (2018). *Need to Preserve the Buffer Zone Integrity of water Bodies*. ETR 152.
- [25] "Outline Development Plan 1972" (ODP 1972), for Bengaluru, Bengaluru Development Authority. Bengaluru. (n.d.).
- [26] "Comprehensive Development Plan 1995" (CDP 1995), for Bengaluru, Bengaluru Development Authority. Bengaluru. (n.d.).
- [27] "Revised Comprehensive Development Plan 2001" (CDP 2001) for Bengaluru, Bengaluru Development Authority. Bengaluru. (n.d.).
- [28] "Revised Master Plan 2015" (RMP 2015), for Bengaluru, Bengaluru Development Authority. Bengaluru. (n.d.).
- [29] Hon'ble Justice Sri N. Santhosh Hegde. (2019). *Compliance report for the orders of the Hon'ble NGT during its hearing on 21.10.2019 in respect of OA No. 125/2017 in line with the report of NGT Committee headed by Hon'ble Justice Sri N. Santhosh Hegde Dated 20.09.2019*.