

Water Imprints: The Process of Contemporary Urbanization for [Re]-Structuring Rural to Urban Transect of Dhaka City

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Abstract - Continuous losing of natural imprints in the contemporary city and territory is now a deficiency of ecological core problem. The reality is that the natural resources are enormously consumed and transformed by the action of energy dependency, economic growth of risk, and unsustainable development. Preservation of nature in the present contemporary period is being challenged with the fundamental spatial ingredients for restructuring and reconnecting the city to the territorial life of biodiversity. The ideology of environmental core derives from the environmental and settlement crisis of the contemporary cities, whereas grabbing territory and natural imprints aggregates faster growth beyond the border of cities dimension with gray splinters of the urban core. Cities dimension are getting larger where white (open space) and fluid (water) structures are physically separated from the core resources of nature and stimulated by concrete masses. Moreover, the lack of relationship in-between urban and environmental core is dried up by the water-related crisis and complexity of ground. This research paper will focus on the relation between theory and practice, which is revealed thru the environmental core value for restructuring the spatial dimension of the urban core system. The abstract gradient analysis of the case study could explore the spatial position of environmental flow in the contemporary context of a complex built environment. Inclusively it will depict that the water is the sustainable structural elements for the future growth of the city and regenerating the diverse spatial relationship between urban to peri-urban human settlements.

Key Words: Water, Ecology, Core

1. INTRODUCTION

At the end of the twentieth century, when globalization accelerated the local markets and the global economy, then many cities in developing countries are transformed to adapt to the reality of an emerging economy. This significant flow of the economy vibrates the cities spatial system directly by giving to the centrality of urban development. And this process of urban development declines the waterfront site instead of an opportunity for creating and reinventing images of the city and its urban iconography [1]. Indeed, "Processes of industrial restructuring, mass rural-urban migration in the developing world, and the gathering impetus of economic globalization since the early 1970s, shattered the assumptions and relationships which

underpinned the integrated urban ideal that had developed during the first half of the twentieth century. The "megacities" of the global South now reveal some of the sharpest dilemmas and contradictions posed by the urban infrastructure crisis with widening disparities emerging in access to (...) water" [2]. While the traces of waterfront transformation became a frontage of global and local interest, then at the same time it reveals the unseen fractal images of the identity of the city and its territory. Constant suffering thru the industrial sprawl and economic demand of growth on the interface of city and territory are rupture continuously without any spatial definition. Reclaiming water in the process of spatial development is a potential contemporary instrument for reducing the urban gap in-between two different space of landscapes. And giving back to the biodiversity through the spatial intervention of ecological imprints could reconnect urban centers and territorial capitals, where the spatial ecological resources are declining in this contemporary period of time. But in reality, cities boundaries are eroded with the urban mood of deregulation, inflexible, and irrational implementation, without paying any spatial ecological values in the integration process of urban transformation. The flow of water and space (without any boundary) which are linked each other with significant and conceivable ecological values in the urban to the territorial ground; but they are now damaging and fragmenting with a result of sprawl. Mackillop and Boudreau [3], stress on links between networks, urban sprawl, and urban fragmentation, by characterizing water as a paradox in a socio-political and spatial point of view; where these strategic elements are disintegrated from the social dimension of urban life. On the other hand, studies shows [4-8] fractal dimension of urban form and urban growth generate three types of urban fractal dimension, which are depended on the range of spatial values and based on city size, shape, and scale. But those studies are disregard in the environmental dimension of spatial values. Besides, both positive and negative repercussions of urban development, cities are necessary to load ecological values [9], through the process of urban metabolism analysis (UMA). Conversely, the fundamentalism and idealism are now being transformed into the flow of capitalism, where this idea of fluidity is melting and facing up the dilemmas of water and human settlements in the cutting-edge of the environmental aspect.

1.1 Transect and regionalism

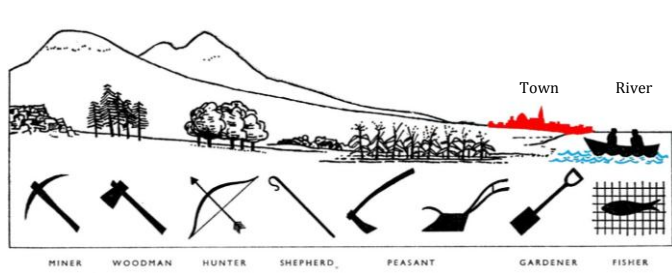


Fig -1: Geddes' Valley section with basic occupations (1909).

The planning vision of regionalism is based on spatial segregation of zoning and numerical planning analysis, where it is clearly ignored to reveal a potential sequence of spaces. Then modern planning concept appeared as an empirical evaluation and rationalized the segregated zoning, where both are dominated by numerical perception and statistical norms of the outcome. On the other hand, from the eye of environmentalism extending only green could not create a livable city, while green adversely brings an impulse of low-density suburbia by reinforcing the longevity of sprawl. Consequently, green aestheticized is not the only way of living unless it does not functionally link with our living pattern. However, the standing of current embedded environmental proposition and technique of zoning could be reform and revitalized by a better understanding of the natural law of the ground; where 'structure of nature is a strategy for design' [10]. The idea of environmentalism is not equipped initially to build urbanism with green, where its propensity is to only green transformation — living with a green in the theory of transect representing human settlement under the binding of the natural order, where it explicitly conceptualized the formulation and present need for contemporary urbanism in the way of sustainable alternative thought. In the nineteenth and early twentieth-century transect was conceived by Sir Patrick Geddes [11] in his valley section where it was diagrammed from upland to river area. The mode of planning was constructed on primary human needs. And the approach of planning intervention was engaged in productive and traditional process rather than the heroic tradition of the gridiron plan. It also articulated a series of images from highlands to tradesman along the shore area, where it addressed the ordering potentiality in the regional planning aspect. But this model had failed to demonstrate the model of the industrial city when in that revolution age, nature was not conceived as a protagonist. Half a century later, Scottish landscape architect Ian McHarg [12] embodied this methodology in design with a natural system. But that model was opposite to Geddes where it was not focused on social and habitats patterns. Similarly, it did not make any proposition designed for how the residential areas to be urbanized. Therefore, it led only environmentally responsible communities where green was adopted

esthetically and transformed the landscape into an identical sprawl [13] in consequence of the socio-economic landscape. However, the lack of urban amalgamation converted this proposition of regionalism into an extremely segmented bonding diagram of a society where suburban communities were not naturally connected with the characterization of settlement patterns and the land gradation system. Another proposition on transect after two decades by Christopher Alexander [14] was implemented in the design with nature as a pattern language. And this pattern was implied in a series of numerical digits, where all together were framed in transect patterns. But it was persisted among other patterns with precise knowledge of the language and less independent of reconciling the pattern of urbanism and environmentalism. However, the current transect [15] is the consequence of a compilation of the lexicon for new urbanism. Integrating the ecological imprints of water and green with other spatial imprints such as form and accessibility, in urbanism, they are basic ingredients to make the city and its territory more livable. Therefore, the terminology of transect could be better understood through its functional elements and their authentic relationship. In some extent, it allied with true environmentalism through the natural order with the taxonomy of urban elements in the realm of urbanism.

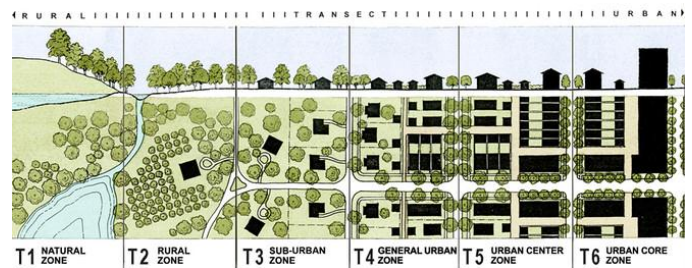


Fig -2: Rural to urban transect. By Andres Duany.

They are then correlating their different spatial elements, always rebuilding and rediscovering the importance of transect. Hence, [Re] emergence of transect extensively requires to maintain a natural ordering system with a geographical gradient to range the sequence of habitats. This concept had been substantiated to encompass human habitats with significant components of urbanism by finding spaces within rural to urban gradients. But this potential strategy in the new urbanism for designing and understanding the contemporary facts of the fast-growing cities are more complex and in their different spatial elements. Since, the complexity of human settlements is diversely involved with the contemporary issues of urban population growth, water, and green infrastructure in the process of urbanization; then theories fall down into deferent challenges rather than looking at a segmented view of urban transect. Finding the beauty from the complexity where ecological imprints become a frontline issue, could be a contemporary spatial tool with its different structural imprints through the integration of environmental core.

However, the resonant of water and green imprints are structuring and shaping the ground of human settlements. Hence, the spatial movement through the wave of the transition of space and the intersection of natural resources could diminish the character of sprawl. Rediscovering the index section of natural biodiversity in our settlement pattern thru the transition of space and revealing the territorial landscape rather than focusing only on a particular zoning system. Synthesis of environmental core from the transect theory and instigating through the process of contemporary urban transformation requires spatial intervention in the interfaces of fragmented urban and natural imprints.

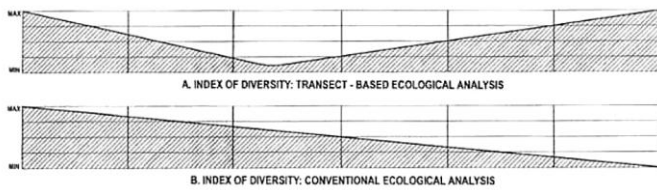


Fig -3: Based and conventional index of Ecological Diversity. By Andres Duany.

It is also prerequisite to corresponding with the growth of the urban core system, where cities and towns are perceived as the source of economic wealth and the core of social and cultural activities [16]. So the new contemporary intervention and the potentiality of transect theory could reveal the spatial dimension of the territory and city by means of an integration opportunity for restructuring our human settlement pattern with diverse spatial imprints of water and green landscape. There are many models of urbanism, some of which emphasize the risks and vulnerabilities of urban living, and others which highlight the benefits. New urbanism [17], green urbanism [18], sustainable urbanism [19], ecological urbanism [20] and landscape urbanism [21] etcetera all are models of urbanism in the current movement of ways to improve life in cities and suburbs. Those benefits extending human quality of life and lowering environmental impacts but to some extent, those visions are segmented into rural and urban lands transition, where spatial and ecological imprints are replaced as a fragmented way into human settlements. On the other hand, Social and economic equity are also concerns to contemporary models of urbanism. Urban-rural gradients (natural, social, economic, and structural) of transects in space and abstract comparisons are based on quantitative and qualitative differences. Therefore, it could be developed as a persistent tool of integrity in contemporary metropolitan areas for research in urban to rural spatial ecological order.

1.2 Environmental core

Sustainable development agenda has been taken as a 'core concept' in the 'Rio earth summit' since 1992 and later Sustainable Development Goals (SDGs) in Rio+20 where water gave a central focus, for transforming our built

environment in the perspective of sustainability. As a consequence, physical and social structures in fast-growing cities are fallen in an enormous crisis of biodiversity in the built environment. Water imprints in the watershed converted and disconnected thru concrete development where green is not commingle and complementary with water bodies in the present spatial movement. And those natural imprints are becoming isolated and disappearing thru the expansion of the city. The scenarios of territory are deferent, where sprawling of grey matter appears in agriculture land with new industrial footprint. Lack of balance integrity with core resources, both groups of natural and manmade imprints is spatially suffering as a character of splinter effect. Both characters are individually sprawling without spatial dimension and integrity within them. Similarly, the effect of climate change, transforming space rapidly into a grey texture of the unmoving landscape. As a consequence, it is a question of spatial nexus between the city and its territory, then, is it a problem of the spatial dimension of interfaces of two different landscapes? [OR] How both relationships could be better understood from their own singularity thru the spatial transition of space to space? [OR] What is the reality of water courses for decoding the fundamental function as a spatial opportunity rather than a word 'openness'? Such questions could be traced as a backbone of an imperative structure with the functional essence of the spaces in-between of the city and the territory.

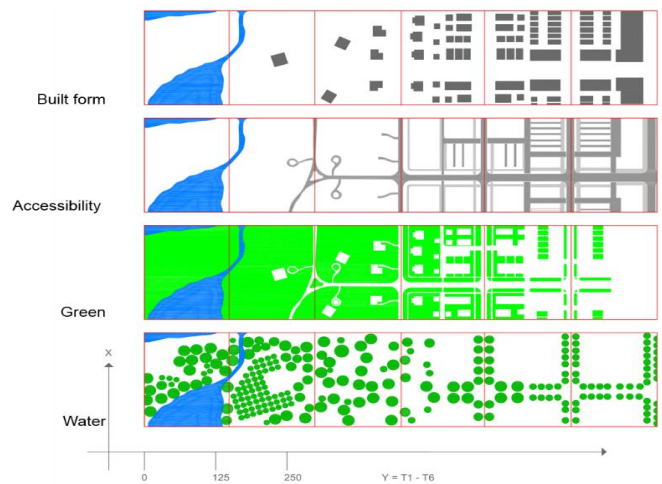


Fig -4: Spatial Composition of the transect.

Table -1: Geometric composition of transect.

T1	T2	T3	T4	T5	T6
0%	2%	6%	18%	29%	39%
0%	5%	13%	28%	44%	53%
61%	90%	61%	54%	27%	8%
39%	3%	0%	0%	0%	0%

Hypothetical synthesis of the index diversity of transect has two utmost facts of space where natural diversity preserved in the natural zone and social diversity gradually higher in the urban zone. And in the lowest fact is defined as peri-urban areas with a higher ratio of green open spaces are interpreted with an inadvertent eccentricity of sprawl. However, the transition of space between two facts is fluctuating with two clusters of natural and physical imprints. The cluster of accessibility and urban form are more dominant rather than a cluster of water and green in the natural zone.

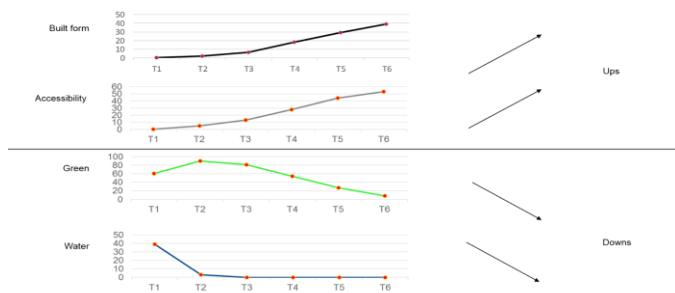


Chart -1: Spatial interval of imprints in the transect.

The synthesis diagram of transect urbanism shows the diverse density of imprints and their waves of movement in the traverse direction. In this hypothetical diagram, the density of grey matters of spaces is an upward direction to the urban core. On the other hand, white and fluid matters are the upward direction towards the rural natural zone. Plotting those two groups of matters and their transitions of space-wave generate three distinct facts of space. And in the theoretical experiment diagram p1 represent environmental core with fluid structure, p2 represents urban core in less of white matters and absent of fluid matters where p3 represent the intersection facts of the white and grey matters. And this intersection point represents the lowest density of different imprints and the highest density of sprawl, where the interface of the city and territory is not theoretically defined. In some extent, this new urbanism failed to establish the strategic position of environmental core in the transition of space, when the contemporary cities are growing beyond the border of territorial regions. On the other hand, restructuring the environmental core is becoming a fundamental spatial intervention for human settlement in the theoretical and practical point of view. So, it could build a strong relationship between the contemporary conflicts of urbanism and environmentalism.



Fig -5: Grey and white matter composition.

Table -2: Composition of Grey, White, and Fluid matters in the transect.

Compo-sition	T1	T2	T3	T4	T5	T6
Grey	0%	7%	19%	46%	73%	92%
White	61%	90%	81%	54%	27%	8%
Fluid	39%	3%	0%	0%	0%	0%

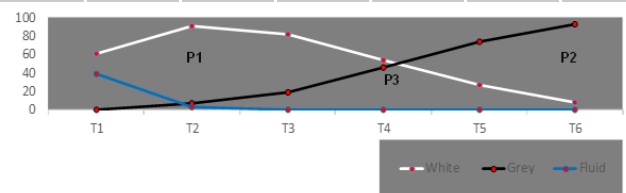


Chart -2: Graph of the transition of space in Transect.

However, in this case, the transect theory is becoming paralyzed to explain and to rebuild the biodiversity in the contemporary context, but on the other hand, it theoretically supports to reveal the environmental core from the wave of the transition of space gradients. In this sense, the new spatial intervention of environmental core can support both city and territory thru the network of biodiversity corridors. In the end, natural imprints could be spatially stronger by physically connected to this net intervention with a balanced relationship of the urban core system.

2. Method for integrity

Water and its spatial relationship integrate city and territory as a coherence of a living environment. "Most approaches towards solving urban problems and water stress have (...) failed because rural, peri-urban and urban issues were treated in isolation. There is now an urgent need to view urban, peri-urban, and rural segments of the region as part of a single but integrated livelihood and ecosystem" [22]. Transformation thru spatial imprints in a set of scales, evidently reveal the gradients of space. However, in this section, the findings of four diverse spatial imprints under the Transect theory of new urbanism are relatively investigated with the case study of Dhaka city according to the role of water. The aim of this method is to examine the contemporary city for restructuring biodiversity focusing on natural spatial imprints. The strategy for this method is developed to integrate urban and peri-urban fabrics of diverse segments. The project implementation is grounded under the consecutive of four key objectives. First, the project background is morphologically explained following the two groups of spatial imprints in the particular context of the case study, where the transition of space is focusing on six different strategic zones in one direction of trajectory

from the urban core to the territory of the city Dhaka. Each zone is composed of those four morphological spatial imprints which are separated in an imperative way to their spatial position and volumetric percentage under confined parameters. Second, spatial gradients are signifying the wave of space, where individual segmented zones are conceptualized in one united depth of the film. It visualizes the transition of different individual imprints in gradients from one transect to another transect. After that comparing the individual experimental verdicts are adept with the analytical framework of transect theory. Third spatial imprints are abstracted into grey, white, and fluid matters for retrieving the configuration of the city. Position of fluid matters reclaim the appeal of territory and integrate surrounding with grey to white matter. It contrasts the urban development process of the existing fluid environment and translates the territorial parameters to comprehend the basic composition of the ground layout.

Finally, the simulation of parameters is drawn four strategic points in the transition of matters concerning with fluid structure. Then comparing those strategic points of matters in transect and experimental case is plotted to evaluate the future development of fluid with the implementation of the environmental core. However, the comparison result is then demonstrated through the section of the experimental ground to instate the ecological center as an intervention of environmental core for the contemporary city.

2.1 Spatial imprints

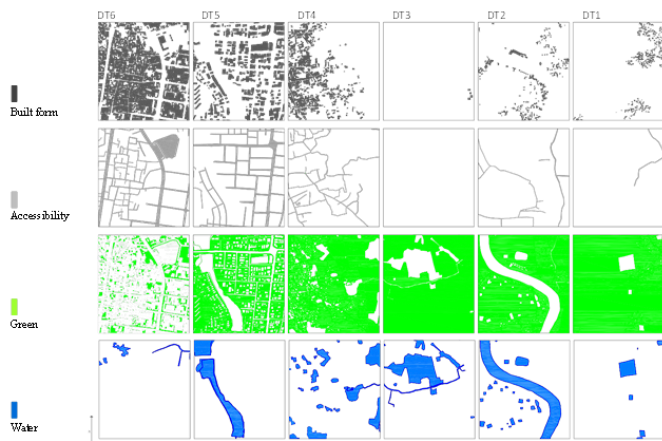


Fig -6: Spatial composition of diverse imprints of Dhaka city.

The taxonomy of urban to the peri-urban landscape of Dhaka city is allocated into six sections of the framework. This experiment is measured in the eastern direction of the city and separated each section. Vertically [x-axis] in four diverse spatial imprints regarding built form, accessibility, green, and water. The depth of investigating frame is measured here in one square kilometer. The density of the built-up area in DT6 is impenetrable with the mixed-use land pattern. Geometrically this zone is a combination of formal and

informal shape in-ground layout, where built forms are occupied 48 percent. The building footprints in the formal area are engaged with commercial and industrial functions. But informal layouts are mixed with commercial and residential activities. On the other hand, 44 percent of accessibility of this zone is explicitly defined by formal and informal layout. The formal geometric layout is subdivided into the primary and secondary street system, and the informal layouts are plugged in with formal grid system, where its cul-de-sac layout pattern system is holding the different shape of geometrical with comparatively narrow streets. 7 percent green imprints are scattered in tiny pieces, where those imprints exist in the setback of plot boundaries and are belongs to private space. Less than one percent of water bodies are found in this zone into two different shapes. One is pond shape in the informal area, and another one is canal shape in the formal area. However, natural imprints are totally fragmented in this zone. Zone DT5 are less dense and occupy 26 percent land of building footprints with large block size, where each block are subdivided into a gridiron pattern. The geometric layout of the accessibility of DT5 is occupied 36 percent, which indicates that this zone is more accessible. And this pattern consists of primary and secondary streets. The intersection of two primary streets create one of the strategic urban centers in the city structure and transform the residential built form into commercial activity along these two streets. Perforated 25 percent green imprints are integrated discrete built forms as a private green space. And

Table -3: Geometric composition of transect in Dhaka.

Composition	DT6	DT5	DT4	DT3	DT2	DT1
Built form	48%	26%	15%	0.7%	9%	6%
Accessibility	44%	36%	35%	0.3%	18%	15%
Green	7%	25%	40%	83%	53%	75%
Water	1%	13%	10%	16%	20%	5%

the secondary streets are ended to the lake shape water bodies like a character of a cul-de-sac pattern, where this lake is occupied 13 percent area with no urban access and green vegetation. In the DT4 built forms are defined as a private residential area at the periphery of Dhaka city. Typically, it is an informal settlement and sprawling on wetlands. This low rise and high density built forms are occupied 15 percent of the land where 35 percent of informal accessibilities are spontaneously growing under the pressure of contemporary development. Those patterns are more organic and develop with the linear shape of the network with narrow cul-de-sacs which are ended to the

group of built forms in a community. Natural imprints are constituted with 40 percent green and 10 percent water in a sprawling form in the settlement area. The shape of water bodies is typically ponds, which are all integrated into the community with private access. And rests of the green patterns are investigated in this zone as wetlands with water bodies. The zone DT3 is a strategic zone for the ecological center. And this zone was devoid of accessibility and built form. It consists of 83 percent gree, which is representing wetlands with 16 percent water bodies. This area is seasonally transformed into a different color regarding agriculture and fishing activities. In the rainy season, this total area of space is used as a floodplain area. The water bodies are structured and connected by rivers and canals. And in dry season lakes are used as a natural retention pond for supporting the groundwater level of the city. The zone DT2 is a territorial section which is shaped by the cluster of built form in a linear curve around the river edges. In this river dominated settlement, villagers are directly engaged with water in their everyday activities. Other types of built forms are clustered around the water ponds, where ponds are used as a source of water in their community. In addition, the river is used in this territory as a primary transportation route. On the other hand, linear rural accessibilities are connecting neighbor villages and agriculture lands. The curvilinear accessibility is developed by following the river bank. With, 53 percent green of the total area is representing here agriculture field where 20 percent is water bodies. Therefore, this territorial zone is based on agriculture and fishing activities. Water ponds in the villages are mounted by substantial vegetation. In a sense, the life pattern and ground layout of this zone are shaped by the water. Finally, the territorial zone DT1 consists of 6 percent built forms in cluster shape around the ponds water and made their settlement in a higher elevation than agriculture land. However, those villages are formed in a group of the cluster and linked each other with long linear rural elevated access. Green areas in this zone are agriculture land. And villages and water ponds are surrounded by green vegetation.

2.2 Urban-rural gradients

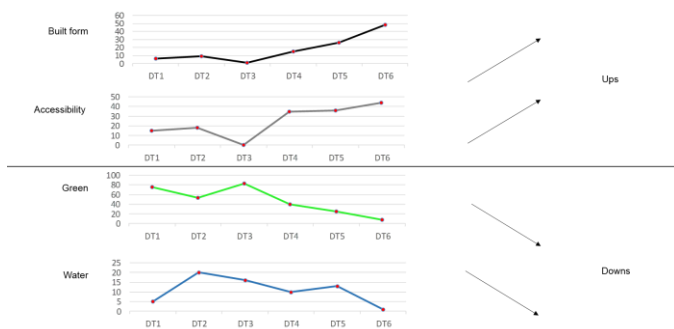


Chart -3: Spatial interval of imprints in the transect.

Above spatial imprints of Dhaka city are horizontally plotted in 'Y-axis' to make a scenario of rural to urban gradients. In the graph, dependent variables are plotted to the y-direction in the percentage of spatial imprints, and independent variables are measured in a square meter of each depth of the film. The spatial gradients of built forms are gradually increasing density from DT1 to DT6 with a breakpoint in DT3. But in the accessibility, the fall is drastic in the DT3. After that, it gradually increases towards DT6. Urban imprints of built form and accessibility are both spatially upward direction to the urban core, but in this transition of space, both are collapsed in the section of DT3. On the other hand, natural imprints of green and water are totally in reverse direction where both gradually decline towards the urban core area. And spatial gradients of green increase dramatically in DT3. Though water imprints are gradually declining from DT2 to DT4, it decreases both the strategic points of DT1 and DT6 again. However, the gradients of urban spatial imprints are upwards to the urban zones and downwards to the rural zones. Conversely, natural gradients are upwards to the rural zone and downward to the urban zones. And, this similar attitudes of urban and natural imprints are observed in the synthesis of transect analysis (see chart-1). Therefore, a relative comparison of each spatial gradients is drawn in the below charts, where the spatial gradients of space in the experimental case (DT) are examined with the spatial gradients of Transect (T) philosophy of theory. From the comparison of spatial gradients of Transect and Dhaka city in chart 4(a) shows

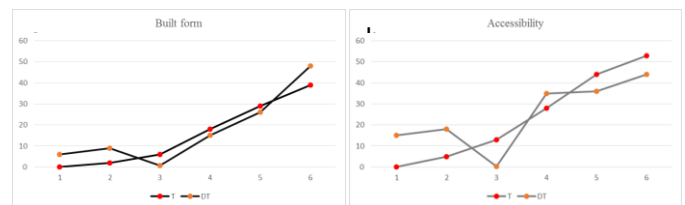


Chart -4: Relative spatial interval of gradients a) Built form b) Accessibility.

evidently that the spatial gradation of built form in DT is decreased in the zones 3, 4 and 5 where zones 1, 2 and 6 are comparatively utmost, in chart 4(b) the spatial gradation of accessibility is dramatically cut in zone 3 and decline again in zones 5 and 6, but it intensified in zones 1, 2 and 4 comparatively.

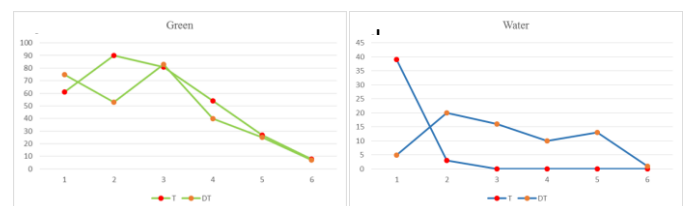


Chart -5: Relative spatial interval of gradients c) Green d) Water.

The other hand, spatial gradients of green imprints in chart 5(c) are declined in zones 2 and 4 where zone 5 and 6 are comparable. But a slight increase is observable in zone 1. However, in chart 5(d) indicates the spatial gradation of water imprints of DT 2, 3, 4 and 5 is exist comparatively in advanced fraction, where there is no existence of water imprints in the zone T 3, 4, 5 and 6 . But relatively it is declined in the experimental zone DT 1 and 6.

The inclusive of the theoretical and experimental analysis of the above comparison are pragmatically visualizing the transition of space, and diverse spatial imprints are active to balance for smooth spatial growth of the structural movement.

3. Waterscapes

Urban and territorial water shortage, floods or water pollutions in the developed or developing countries evidently indicates enormous loss of water courses and water flow areas. And eventually, cities are transformed into major factors of climate changes. Similarly, encroaching the topography of natural landscape of water and dislocating its lifeline connectivity with a biodiversity of nature, causes devastating environmental changes in the urban to periurban fringes. Consequently, plummeting biodiversity of cities are flattering to resistance with the dimensions of spatial water capitals. Revitalizing waterfront, biodiversity corridors, groundwater recharge, and retention ponds, living pattern with natural territorial settings of resources, irrigation of agricultural lands, farming, and water purification system through wetlands, water channels, flood plain areas and so forth all natural dynamic characters are a climatically complex change in the contemporary urban process. Although they are directly or indirectly supporting our urban and territorial life cycle of biodiversity, now they are being collapsed and flooded thru manmade disasters. Depending more on the ground water either ignoring the resource of surface water which grafted by the natural flow of water system or increases the unconsciousness of land use of water are all contaminating repeatedly the quality of water. Currently, the normal lives of developing countries are animated with the crisis of water. City and the role of water historically coexist with the life of the human settlement. Agglomeration of water sources with living pattern which are topographically embedded with invisible eco-functions for healthy living being and cycling of life style, have been misplacing with it's all kind of ecological values; due to the rapid urbanization of last two decades; whether the natural reservation of water, natural flow of water for recycling and fertilizing the agricultural lands are required to describe the land as a way of creating flow of vigorous life. But disturbing this lifeline natural streams of lands are transforming into the concrete mass without paying any attentions to its existing natural capitals in the contemporary process of urbanization. On the other hand, this distress increases the reproduction of spatial values and

statically decreases all natural values of the surrounding reciprocal spaces of the city. In the contemporary period of time rapid growth of spatial expansion on the peripheral land, are continuously encroaching water bodies and vacant low lands for industrial and objectionable unsettling housing activities. And those new industrial developments are sealing the catchment areas of water. On the other hand, it is polluting water, which is interlinked with different water channels. And it's turned into a result of an unwanted seasonal flash flood in the territory of the agricultural land and seized seasonal aesthetic variations. Therefore, this manmade disaster transformed space hastily by depressing space with fake different spatial values. For interweaving manmade city and nature made territory needs a spatial intervention in-between of these two ongoing urban paradigms, where the spatial development of fluid structure could generate and link with the green diversity of life through upgrading spatial imprints of the ecological approach under land mutation process, for the future development of this dual character of contemporary cities. As the climate is undergoing major complex changes and triggering ecological urbanism, then water sensitive landscape could be a contemporary response to the complex dynamics of hydrology and topography as major structuring foundations of landscape form. Therefore, a large scale landscape strategy is needed to develop built infrastructure, topographical conditions, ecological functions, aesthetic design, and public space development [22]. So that, city and its territory could reclaim biodiversity of nature with the integration of all scale of watercourses.

3.1 Grey and white matters



Fig -7: Water and transect in urban to rural space of Dhaka city.

Grey and white matters are components of the space by means of a city floor. And the transition of space is directly or indirectly fluctuated by those matters of configuration. The difference between grey and white matters in the built environment -is what they are consist of? In this experiment, grey matters are considered the composition of built forms and accessibility. And white matters are considered as a ground of green fabric in open spaces — those two layers of the city structure representing concrete and spongy floor of space. Grey matter in the contemporary city like Dhaka is transforming into a concrete floor in such a way where white matters are being isolated and decayed without any

coherent relationship. However, the communications between grey and white matters are escalating contemporary cities with different parameters of fluid structures from urban to periurban evolution. But the intelligence of both grey and white matters could be observed hypothetically from the perviousness and imperviousness character of a surface by considering the notable components of fluid matters in the built environment. The attributes of those three matters are the spatial resolution of integration which proportions are improve and balance the environment of human settlement. In this context, white matters are unified with its diverse arteries in the grey matter. But the disorder of grey and white matter comprises dissimilar convoluted polarization, which is the consequence of climate change by affecting the fluid matters in the contemporary cities.

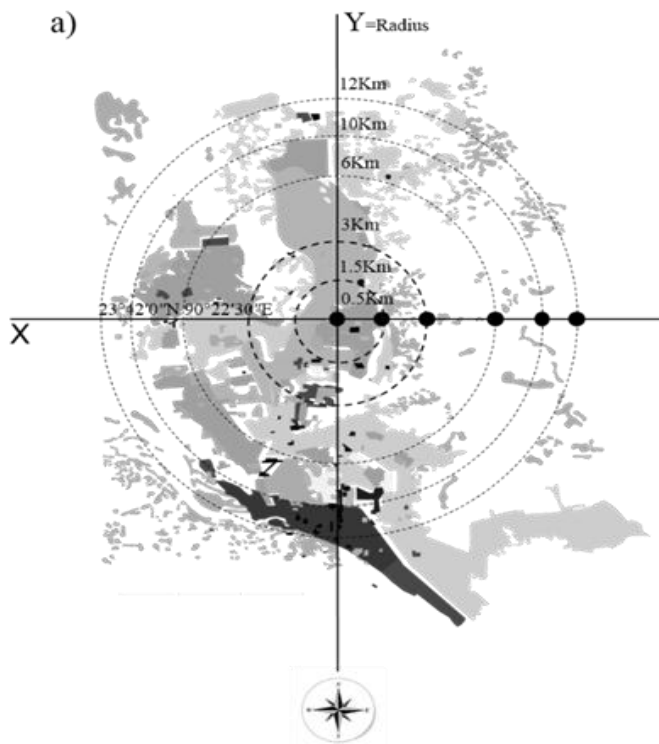


Fig -8: Grey and white matter of Dhaka city, a) Locations of study spaces.

Table -2: Grey and white matter of Dhaka city, Constitution of grey, white, and fluid matters.

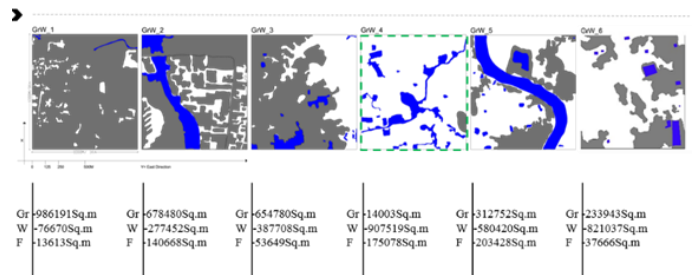
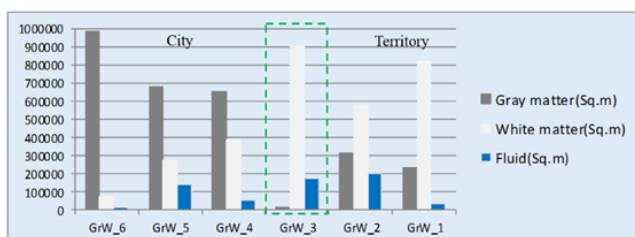


Fig -9: Grey and white matter of Dhaka city, Composition of grey, white, and fluid matters.

The grey matter of Dhaka city is getting higher with the rapid expansion of concrete floor beyond the city border. And this effect of a concrete floor is also gradually intensifying with the result of sprawl in the territory. But dramatically in between of city and territory there is a huge gap of space (GrW_3) where there are almost no grey matters. The structure of this space is topographically transformed by means of white and fluid matters. And this defined segmented zone consists of a higher flexible ratio of white and fluid matter which response seasonally. Spatially invisible and due to lack of grey matters, this zone spatially separated city and territory. As grey matters are dominated in the city over white and fluid matters; therefore, the spatial relationship is deteriorating with natural resources in the above-separated zone. And the scenarios of the territory are in reverse character where white and fluid matters are dominating on the grey imprints.

The compositions of grey and white matter in the territory are depended on the network of fluid matter. However, at the discontinued residual space of the segmented zones are prerequisite for spatially and functionally to integrate with city and territory for restructuring the spatial dimension of Dhaka city and its future development of biodiversity.

3.2 Environmental core experiment

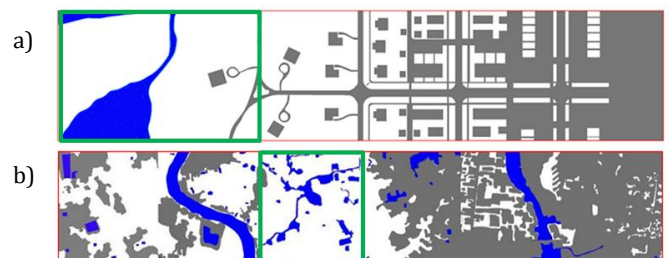


Fig - 10: Grey, white and fluid matter, a) Stoichiometric depth of film in Transect, b) Experimental depth of film in Dhaka city.

In this part, grey, white, and fluid matters are unified in two depth of films for comparatively examine the stoichiometric ratio in transect theory and the experimental ratio of Dhaka city. Theoretically sections T1 and T2 are

Table -4: Composition of grey, white and fluid matter, a)Stoichiometric ratio b) experimental ratio.

a)		Composition	T1	T2	T3	T4	T5	T6
Stoichiometric ratio	Grey		0%	7%	19%	46%	73%	92%
	White		61%	90%	81%	54%	27%	8%
	Fluid		39%	3%	0%	0%	0%	0%
b)		Composition	GrW1	GrW2	GrW3	GrW4	GrW5	GrW6
Experimental ratio	Grey		21%	29%	1%	60%	62%	92%
	White		75%	53%	83%	35%	25%	7%
	Fluid		4%	18%	16%	5%	13%	1%

defined randomly as natural and rural zone, and the ratio of deferent components of these two sections is close to the ratio of GrW3 in the depth of the experimental film. And the percentage of grey matters of T1 and Grw3 are in scale, which indicates those zones are non-accessible or no man zone. And in theory, it was described as a naturally preserved zone which is consist of only white and fluid matters. But in the experimental section, the ratio of components in GrW3 consist of 1 percent grey, 83 percent white with 16 percent fluid matter, which is much similar in compositional attributes compare to the T1 section. Apparently, there is no similarity of T1 and T2 section with the section of GrW1 and GrW2. But in the pragmatic analysis, it shows that grey matters are rapidly increased in the zone GrW1 and GrW2 comparatively with T1 and T2. In this case, the regular relationship from GrW1 to GrW6 is collapsed in GrW3. And this isolated space is physically separate the city and territory into two deferent parts. But theoretically, the relationship between T1 to T6 is integrated physically and rationally from natural zone to the urban core.

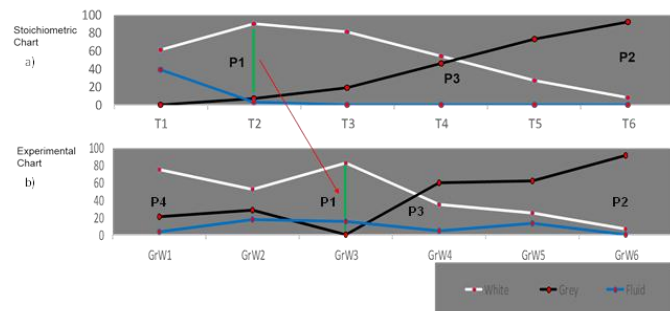
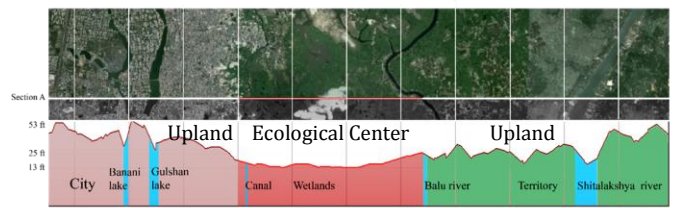


Chart -6: Environmental core experiment, a) stoichiometric chart of the natural zone, b) experimental chart of the natural zone.

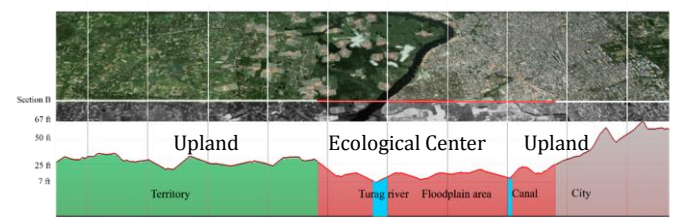
In the stoichiometric line chart of transect model procreate two strategic points and one intersection point. They are symbolized in chart 6(a) urban core as p2 and environmental core as P1, where in-betweens P3 is representing the general urban zone. However, the strategic point P2 is without fluid matters, and P1 is with the fluid matter but gradually diminish grey matter towards the natural zone T1. Therefore, the strategic position of environmental core theoretically established at P1 = (T1+T2), which gradually exist at the end of the transition of space. But on the other hand, comparing these findings with

the experimental chart 6(b) discover space that contemporary city Dhaka is extending beyond this theoretical strategic position P1=GrW3, and the new strategic position P4 is identified with the attributes of territory. And the outcome shows that the order of the environmental core is shifted from a theoretical position to the contemporary context. As a result, the theoretical core is rediscovered in-between of city and territory in the context of the rapid growth of Dhaka city with the correlation of maximum white and fluid matters. However, other strategic point P3 and P2 are remaining in the same position.



Section -A: Index of based diversity at the eastern part of Dhaka city.

The ground elevation of diversity in the above section explaining the topography of the above experimental area; where the strategic position of P2 is marked as in red color. And this zone is investigated as a low land area which is physically signifying the environmental core position and the ecological center for the surviving built environment by considering the slope of the ground for adapting the natural system of the watershed.



Section -B: Index of based diversity at the western part of Dhaka city.

However, a similar investigation at the western part of the city has also discovered the existence of low land elevation in-between of city floor and territory.

Therefore, the function of the low land area is topographically characterized here to flow of fluid matters, which are transmitted by the natural order in the system of the watershed. But in reality, both sections 'A' and 'B' are spatially separated and disconnected from the city and territory, wherein the eastern and the western part of sections are rapidly filling up with sand filling on wetlands (eastern part) and flood plain (western part) area. Those lowland areas are clutched by the sprawl of grey matters of

new unplanned satellite towns, factories, and brick industries.

4. CONCLUSION

The spatial intervention of environmental core in the contemporary city like Dhaka should reasonably retrofit the lowland areas with the existing network of spatial imprints by preserving wetlands and floodplain area. [Re] structuring those potential spaces are spatially needed to be transformed as a strategic environmental center. So that it could provide an opportunity to the city and territory for reshuffling their existing spatial dimension thru water urbanism, on the other hand, it could develop the ecological center with the web of existing ecological imprints in the upland area to keep flowing biodiversity in all dimension of our human settlement from rural to urban spaces. Theoretically, the natural zone is prescribed with the relationship of the urban strategic core value. Then practically, the investigation of the case study shows that the ecological center is existed in the transition of space but not spatially defined either the relationship of the urban core or the territory. As a result, both are spatially and ecologically deprived of the benefit of reciprocal structure. However, strategically established the environmental core in the contemporarily built environment could transform the space by giving the new vision for sustainable growth of deferent spatial imprints, which could integrate the two paradigms of city and territory. Contemporary cities are fall in the crisis of environmental degradation, which adversely causes climate change in our built environment.

REFERENCES

- [1] Dovey, Kim. *Fluid City: Transforming Melbourne's Urban Waterfront*. New York : Routledge, 2013.
- [2] Rethinking urban metabolism: water, space and the modern city. Gandy, Matthew . 3, 2004, *City: analysis of urban trends, culture, theory, policy, action*, Vol. VIII, pp. 363-379.
- [3] Water and power networks and urban fragmentation in Los Angeles: Rethinking assumed mechanisms. MacKillop, Fionn and Boudreau, Julie-Anne . 6, 2008, *Geoforum*, Vol. XXXIX, pp. 1833-1842.
- [4] Urban shapes as fractals . Batty, Michael and Longley, Paul A . 3, 1987a, *Area*, Vol. XIX, pp. 215-221 .
- [5] Fractal-based description of urban form. Batty, M and Longley, P A . 1987b, *Environment and Planning B: Planning and Design*, Vol. XIV, pp. 123-134.
- [6] Batty, M and Longley, Paul. *Fractal Cities: A Geometry of Form and Function*. London : Academic Press, 1994.
- [7] Preliminary evidence for a theory of the fractal city. Batty, M and Xie, Y . 10, 1996, *Environment and Planning A*, Vol. XXVIII, pp. 1745 - 1762.
- [8] Fractal dimension and fractal growth of urbanized areas. Shen, Guoqiang. 5, 2002, *geographical information science*, Vol. XVI, pp. 419-437.
- [9] An urban metabolism and ecological footprint assessment of Metro Vancouver. Moore, Jennie, Kissinger, Meidad and Rees, William E. . 2013, *Journal of Environmental Management*, Vol. 124, pp. 51-61.
- [10] Pearce, Peter . *Structure in Nature Is a Strategy for Design*. Massachusetts : MIT Press, 1990.
- [11] Geddes, Patrick . *Cities in Evolution: An introduction to the town planning movement and to the study of civics*. London : Williams & Norgate, 1915.
- [12] McHarg, Ian L. *Design With Nature*. New York : Doubleday, 1965.
- [13] Calthorpe, Peter and Fulton, William . *The Regional City: Planning for the end of sprawl*. New York : Island Press, 2001.
- [14] Alexander, Christopher , Ishikawa, Sara and Silverstein, Murray . *A Pattern Language: Towns, Buildings, Construction*. New York : Oxford University Press, 1977.
- [15] Introduction to the Special Issue: The Transect. Duany, Andrés . 3, 2002, *Journal of Urban Design*, Vol. VII, pp. 251-260.
- [16] Jacobs, Jane . *Cities and the Wealth of Nations: Principles of Economic Life*. New York : Vintage Books, 1984.
- [17] Helbrecht, Ilse and Dirksmeier, Peter . *New Urbanism: Life, Work, and Space in the New Downtown*. England : Ashgate Publishing, Ltd., 2012.
- [18] Lehmann, Steffen . *The Principles of Green Urbanism: Transforming the City for Sustainability*. Canada : Earthscan , 2010.
- [19] Farr, Douglas . *Sustainable Urbanism: Urban Design With Nature*. New Jersey : John Wiley & Sons, 2008.
- [20] Mostafavi, Mohsen . *Ecological urbanism*. [ed.] Mohsen Mostafavi and Gareth Doherty. USA : Lars Müller Publishers, 2010.
- [21] Waldheim, Charles , [ed.]. *The Landscape Urbanism Reader*. New York : Princeton Architectural Press, 2006.
- [22] Water sensitive urban landscape design: 'Scales of Nature': IFLA World Congress. Werner, J. . Zurich : Grün Stadt Zürich, 2011.