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Nesting in the City: Urban Environment That Invites Wildlife

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Abstract

This study explores how important it is to keep the ecosystem in balance, maintaining healthy biodiversity in urban areas. It also seeks ways in which a growing metropolitan like Dhaka can be friendly for wildlife. Modern cities are becoming more and more hostile to fauna which eventually affects humans also. The damage done over decades cannot be rectified overnight. The approach will be in different phases that address ecological succession. The paper suggests ways urban design can aid biodiversity. A minor consideration as the introduction of nectar-producing plants may increase the honeybee population. The urban landscape should be such that it favors insects or birds. To achieve this, complementary plants should be selected that can nurture an ecosystem.

This research looks for options that can be applied in Dhaka's context. The symbiosis between native wildlife and humans is studied. Exemplary design solutions for urban built areas as flyovers, bus stops or road medians are proposed.

Keywords

urban ecosystem; biodiversity; ecological succession; urban design; urban landscape; ecological corridor

1. Introduction

No matter how much we indulge ourselves in the countless digital screens around us, it seems that it is embedded in our genes to be amidst a clean and green natural environment. Frederick Law Olmsted states, "...it is evident that in our daily lives nature must be thought of not as a luxury to be made available if possible, but as part of our inherent indispensable biological need" (Dramstad et al., 1996).

Imagining human life amidst a natural setting may sound like a dream if we consider Dhaka's realities. The capital city of Bangladesh is one of the major megacities in the world and the 9th largest city as per World Bank (World Bank, 2010). With 9,317,043 urban population in 2011, greater Dhaka has an area of 1,463.60 sq. km.; 8,229 people per sq. km. (BBS, 2015). The Chief Town Planner of Dhaka City Corporation mentions that the city has only 8% green coverage, although theoretically, it should have a minimum of 20% greenery to sustain a healthy urban environment (Byomkesh & Nakagoshi, 2012). Moreover, 90% of Dhaka's wetlands and low-lying areas got filled up in the past 12 years. With the decrease in bio-capacity and the increase in transport sector emission, the city's ecology will face more deterioration (Labib et al. 2013). The Structure Plan of 1995-2015 recognizes the importance of greenery in urban areas and advocates the introduction of new ones. It also proposes to preserve the existing green spaces (Byomkesh & Nakagoshi, 2012).

Leaving too little space for green not only deteriorates the city's charms but the regular loss of urban green spaces is steering towards the loss of biodiversity and key species, resulting in the appearance of contagious maladies and

growing environmental pollution. These phenomena have adverse effects on both the urban ecosystem and the human population (Byomkesh & Nakagoshi, 2012).

If we look into the bird population, Dhaka was once a home for waterfowls, pheasants, partridges, bustards, cranes, storks, eagles, hawks, falcons, owls, herons, egrets, etc. except the present-day city-birds. The city still accommodates two hundred bird species in its concrete jungle, giving us hope for the betterment of today's condition (Akash et al., 2013).

2. Background

2.1. Importance of connectivity

Ecological corridors serve as the connections or continuation among the patches. Connectivity is interpreted as "the degree to which the landscape facilitates or impedes movement among resource patches" at the landscape scale (Taylor et al., 1993). Corridors serve five major functions: Habitat, Conduit, Filter, Source and Sink. These functions are primarily controlled by Width and Connectivity (Dramstad et al., 1996). An efficacious habitat corridor makes an entirely or partially undisturbed habitat link that is congenial through an uncongenial context. Such links are known as 'wildlife corridors', 'dispersal corridors' or 'movement corridors' and they are to be used for animal passage (Bennet, 1998, 2003).

Dhaka still has a few remaining habitat patches (fig. 1) which can be enriched if we can manage connectivity. These connections work as a continuation of the patches and help a species populate a previously unpopulated area. Bennet (1998, 2003) has justified that "recolonization will be greater in remnants that are connected to source areas by corridors than in unconnected remnants". Identifying the key habitat patches is essential in this respect. Hillary et al. (2002) mentioned a hierarchy of habitat nodes for their habitat connectivity analysis. The nodes are defined as Mother Nodes and Satellite Nodes; Mother Nodes are the larger green areas with greater biodiversity and Satellite nodes serve as stepping stones through an inhospitable environment. The first type has a greater influence on the latter type. Corridors in the urban matrix greatly affect the arthropod garden metacommunities that are essential for a healthy urban ecosystem. Alan et al. (2011) observed: "taxonomic and functional compositions of carabids, staphylinids and spiders communities of connected gardens were closer to those of the corridors and the sources than the communities of disconnected gardens."

These connectors are beneficial not only for flora and fauna but for the people also. As per Fuller et al. (2007), there is a positive connection between the diversity of species in urban green areas and the health of the people visiting those areas. Furthermore, a variation in green space type increases human well-being as it permits them to choose and access the spaces where they get the most benefit. Bolund & Hunhammar (1999) suggested that urban landscape provides numerous services as air filtration, microclimate regulation, depletion of sound pollution, rainwater management and adding recreational values to a space. Moreover, effective connections across ecosystems can serve as a supplement to sewer and water services. They can also define zoning edges and restrict development (Nassauer, 1997).

2.2. The Landscape where Dhaka fits in

It is strongly emphasized to follow native topography and vegetation if we want to enrich the nature of the city. It is also vital to support the ecosystem with a built environment as it is a very efficient way to make it self-sustainable. The principles of Landscape Ecology are to be followed here. Ecology is generally defined as the study of the interconnections among life forms and their environment and Landscape Ecology is merely the ecology of landscapes (Dramstad et al., 1996). While considering a natural ecosystem, discreet habitat patches are more likely to fail. In the case of developed landscapes today, the necessity of ecological linkages is acknowledged as an elementary concept in land-use planning and land management (Bennet, 1998, 2003).

Dhaka falls under Madhupur Tract physiographic region. It is a region of complex relief and soils developed over the Madhupur Clay. It consists of three main kinds of relief: broad level uplands dissected by broad valleys, closely dissected uplands dissected by many shallow, sloping valleys and a few undissected level upland areas (Brammer,

2016). The uplands intertwined by low-lying areas have been prominent in this region's topography before being interrupted by landfills. The difference in elevation complements each other; the low areas accommodate seasonal flooding while the higher areas support the upland inhabitants. Until the beginning of the 20th century, this region was part of a continuous deciduous Sal forest belt from Comilla in Bangladesh to Darjeeling in India (Alam et al. 2008). Very little is left today of this continuous forest because of urbanization and population growth. Moreover, forestation with foreign tree species has caused dramatic changes and damages to the environment. The rubber plantations or the manmade gardens with limited species diversity do not have many birds as peacock and python anymore (Gain, 2005). The Jahangirnagar University campus is in the Dhaka district, not far from the central urban area. A remarkable number of bird species has been spotted here. During a study conducted by Jahan et al. in 2018, not even a single bird's nest was spotted in *Eucalyptus* sp. on this campus. A small number of nests were found in *Acacia moniliformes*. It is to be noted here that both are exotic tree species in the local context. There should be no denial of the fact that if we want to restore a degraded natural environment, it is best to go with the native flora that is well accepted by the native fauna.

2.3. The remaining green

Dhaka city has an area of about 360 square km. Around 21.57% or 7765 hectares of its territory is allotted to open space. This open area consists of 12.12% cultivated land, 0.9% garden, 0.036% burial ground, 0.15% lake, 5% unoccupied area, 0.9% park, 0.39% playfield, 0.25% pond, 1.82% swamp, 0.02% urban green etc. (Uddin, 2006).

It has been mentioned by Byomkesh and Nakagoshi (2012) that the major or noticeable green patches (fig. 1) in Dhaka are the Botanical garden, Suhrawardy Uddyan, Ramna Park, National Parliament building, Chandrima Uddyan, Bahadur Shah Park and the national zoo. To add to this list, there are Dhaka University area, Azimpur and Wari graveyards, Hatirjheel, lakes in Dhanmondi, Gulshan and Banani, the city parks, playfields and so on.

Ramna Park has an area of 68.50 acres now. Fifty bird species from 11 orders and 28 families were found in total by Rajia et al. in 2015. Among these, the percentage of permanent residents is 84% and the rest 16% were recognized as migratory, counting both winter migrants and summer migrants. Half of the observed birds were passerines. The high species diversity in December is suggested to be an outcome of the migratory birds appearing for food, suitable foraging and breeding sites. On the contrary, extreme heat, scarcity of food and shorter-range migration of birds to surrounding cultivated lands may reduce the species diversity in the month of July (Maheswaran et al., 2001). We can derive from this study that if the proper habitat is provided nearby, the amount of local migration will be reduced.

The Dhaka university area (established on 600 acres of land) is home to many of Dhaka's remaining bird communities with its abundance of green space. Here the highest number of birds (5879) was recorded in winter as it was the time for wintering and passage migrants. However, 5400 birds were sighted in the monsoon (Banu et al., 2016). Studies by Akash et al. (2013) on the birds of Dhaka University Curzon hall area show an abundance of 50 species. Shrubs and bushes adjacent to water bodies are preferred by species as Clamorous Reed Warbler, Great Tit and Indian Silverbill. House Swift, Common Kingfisher, Green Bee-eater and White-breasted Kingfisher were found in close proximity to water bodies. Coppersmith Barbet was recorded to nest in Cape Lilac tree. Ficus and Parrot trees attract birds as Chestnut-tailed Starling and Rufous Treepie.

This area serves not just the avian community; Akter et al. (2019) identified eleven bee species from three different areas- Curzon Hall, Ramna Park and Sher-E-Bangla Agricultural University. The dominant species was *Apis dorsata*, a species of honeybee.

The surprisingly high number of fauna in Ramna Park and Dhaka University campus indicates that it may still be possible to induce rich biodiversity in other less green areas. The interconnectivity here is very crucial. A well-connected number of patches gives the inhabitants not just more area to live but also more freedom of movement.

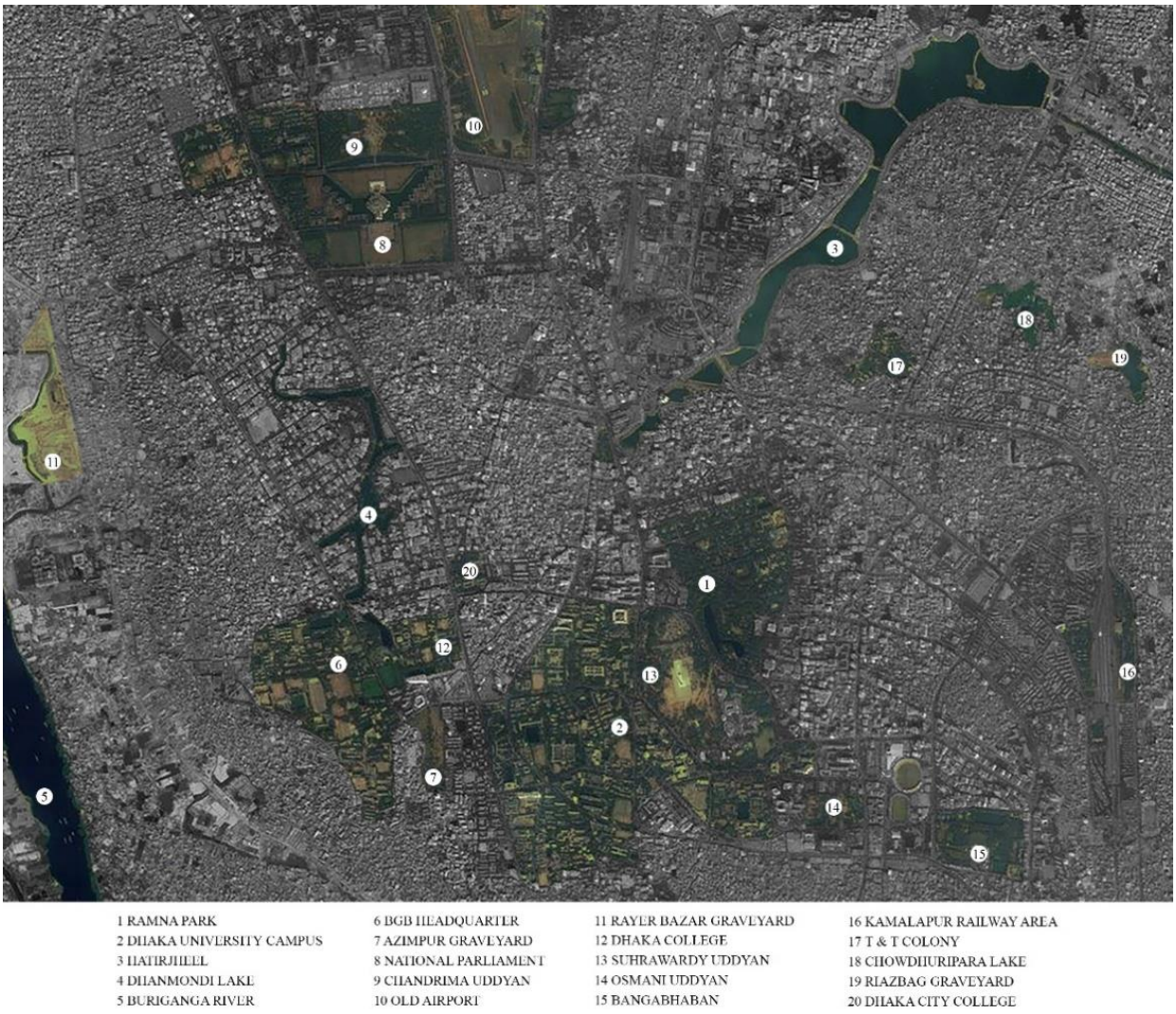

Figure 1: A few of the green areas in Dhaka. Even without considering how healthy the ecosystem is there, the small quantity of isolated green areas in comparison with the grey ones is highly noticeable. Image source: Bing Maps

3. Findings and Recommendations

3.1. Succession & Grassland Patch

The corridor can be seen as linear connectors with a microclimate that resembles the native forest. For Dhaka, it should consist of vegetation that appears naturally in the Sal forest. Though it has many other co-dominant species, Shorea robusta constitutes 70% of Sal forest (Gain, 2005) . Growing large native trees will take years. That is where an approach in phases comes in. The natural succession of a Sal forest can be followed here.

Any riverain area is first populated by grass as *Saccharum munja*. The first trees to appear are usually the ones that are fast-growing and can thrive in soil with low humus content, e.g., *Dalbergia sissoo*. In the next phase, the plant community is taken over by species as *Bombax* spp., *Heloptelia* spp., *Albizia* spp. and eventually develops into a Sal forest (Alam et al., 2008).

The initial habitat accommodates the grassland birds. Also, in areas where a tall visual obstruction is not desired, a grassland patch should be kept permanently, e.g., the central median of a node. A node median is usually not accessible for people and hence suitable for a microhabitat patch. It even works better if accompanied by a water body. It has been observed that the microhabitats containing both a creek and dense, tall grass hold the highest number of grassland specialists. The preferred habitat for grassland birds can consist of Ravenna Grass (*Saccharum ravennae*) that can be the dominant species. The co-dominant layer is to be of Cogon Grass (*Imperata cylindrical*). These, accompanied by dense *Clerodendrum infortunatum* (a native and widely available perennial shrub), form enough coverage for foraging (Akash et al., 2018).

3.2. Roadside linkages

Dhaka is infamous for traffic congestion, poor quality of public transport, insufficient safety and comfort measures for the wayfarers and increasing contamination of air (World Bank, 2009). The percentage of people in Dhaka walking to their destinations or taking non-motorized vehicles is over 55%. Another study reveals that 14% of Dhaka dwellers opt for walking (Labib et al., 2013).

Figure 2: New modes of transport being added in Dhaka. The photo shows the ongoing construction work of elevated MRT at the Karwan Bajar node. Image courtesy: Dhaka Tribune

The importance of well-designed pedestrian circulation is beyond doubt here. If we can nudge in a wider buffer (fig. 3 & 4) between the footpath and vehicular circulation, it benefits both the pedestrians and the biodiversity. These buffers or bio-swales need to be "soakable" areas where stormwater soaks in as much as possible and surface run-off water amount is reduced. Apart from providing extensive ecological services as microclimate regulation, wildlife habitat and biodiversity, they also serve the purpose of educating people and enhancing the aesthetic value. (Lovell et al., 2009).

Plantation with native water edge plants for the bioswales ensures the filtering of hazardous elements from water. These areas can hold, permeate and manage a part of surface runoff water which results in decreasing the adverse effects of built areas on aquatic ecosystems (Lovell et al., 2009). As buffers are able to decelerate the course of water and escalate the water permeation into the ground, they can lessen the extremity of flooding (Schultz et al., 1997).

If suitable habitat nodes (fig. 3) are integrated into a link, they can expand its efficacy with their additional habitat areas. They can act as shelters or foraging grounds while passing through a long route. "Habitat nodes may also maintain larger breeding populations within the linkage, thus introducing more dispersers into the system" (Bennet, 1998, 2003). These nodes can take the form of rain gardens at intervals connected with the roadside bioswales.

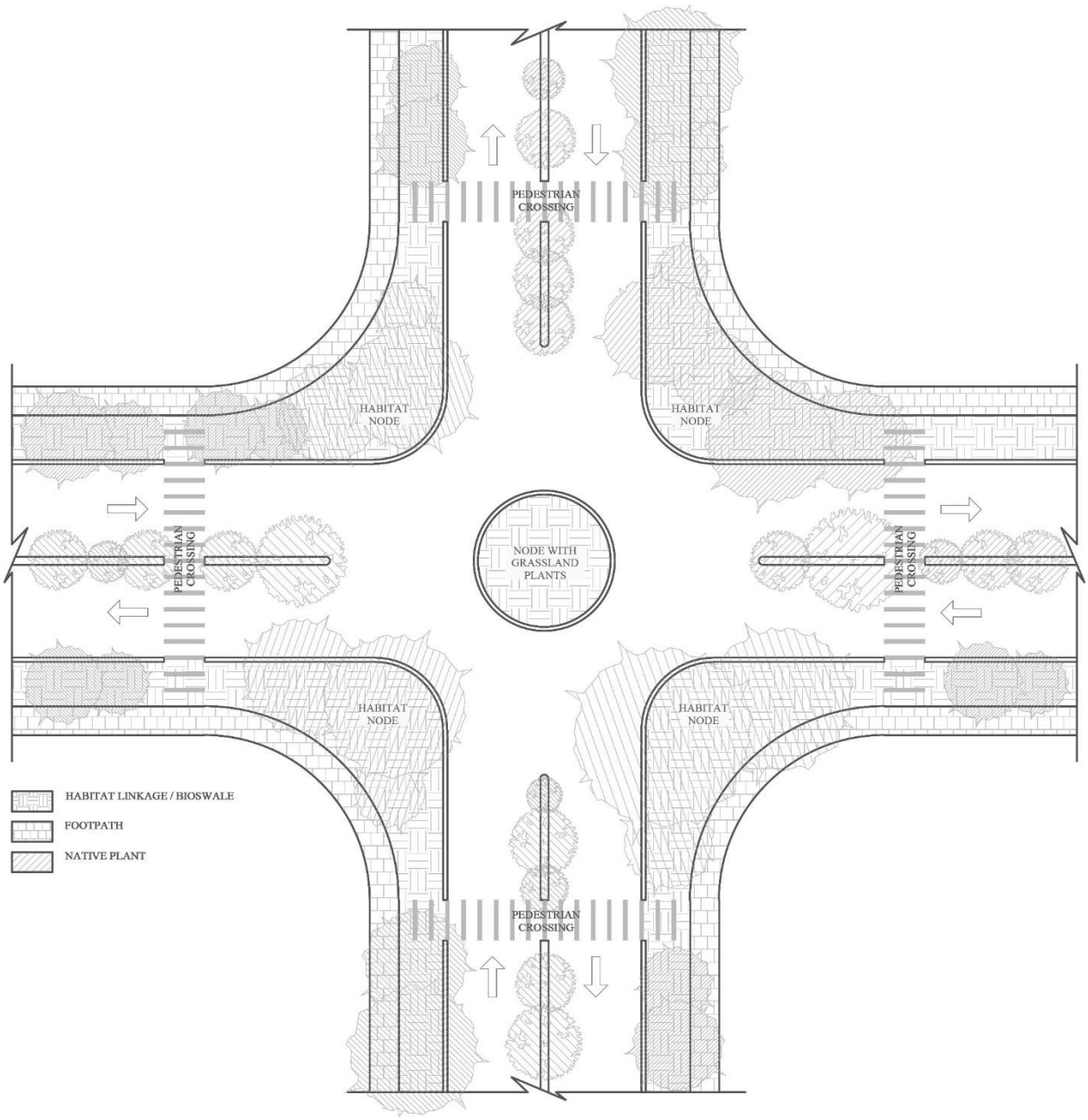

Figure 3: Proposed road intersection plan showing roadside habitat linkages and habitat intermediate nodes.

The road medians can be planted with trees that prefer drier areas, while the roadside linkages can have riparian plants e.g., *Operculina turpethum* (Turpeth), *Tamarindus indica* (Tamarind), *Crataeva magna* (Three leaved caper), *Albizia lebbeck* (Siris), *Bombax ceiba* (Shimul), *Barringtonia acutangula* (Indian oak), *Ficus racemosa* (Cluster fig) (Rahman et al., 2013). These are well accompanied by *Neolamarckia cadamba* (Burflower tree), *Lagerstroemia speciosa* (Queen crepe myrtle) and *Holarrhena antidysenterica* (Kurchi). The habitat nodes may take the form of a rain garden with water-loving plants. Or can have mild slopes going up from the road level with larger and drier soil preferring trees as *Shorea robusta* (Sal), *Alstonia scholaris* (Devil's tree), *Artocarpus heterophyllus* (Jackfruit), *Artocarpus lacucha* (Monkey Jack), *Schleichera oleosa* (Ceylon Oak) or *Nyctanthes arbortristis* (Coral Jasmine).

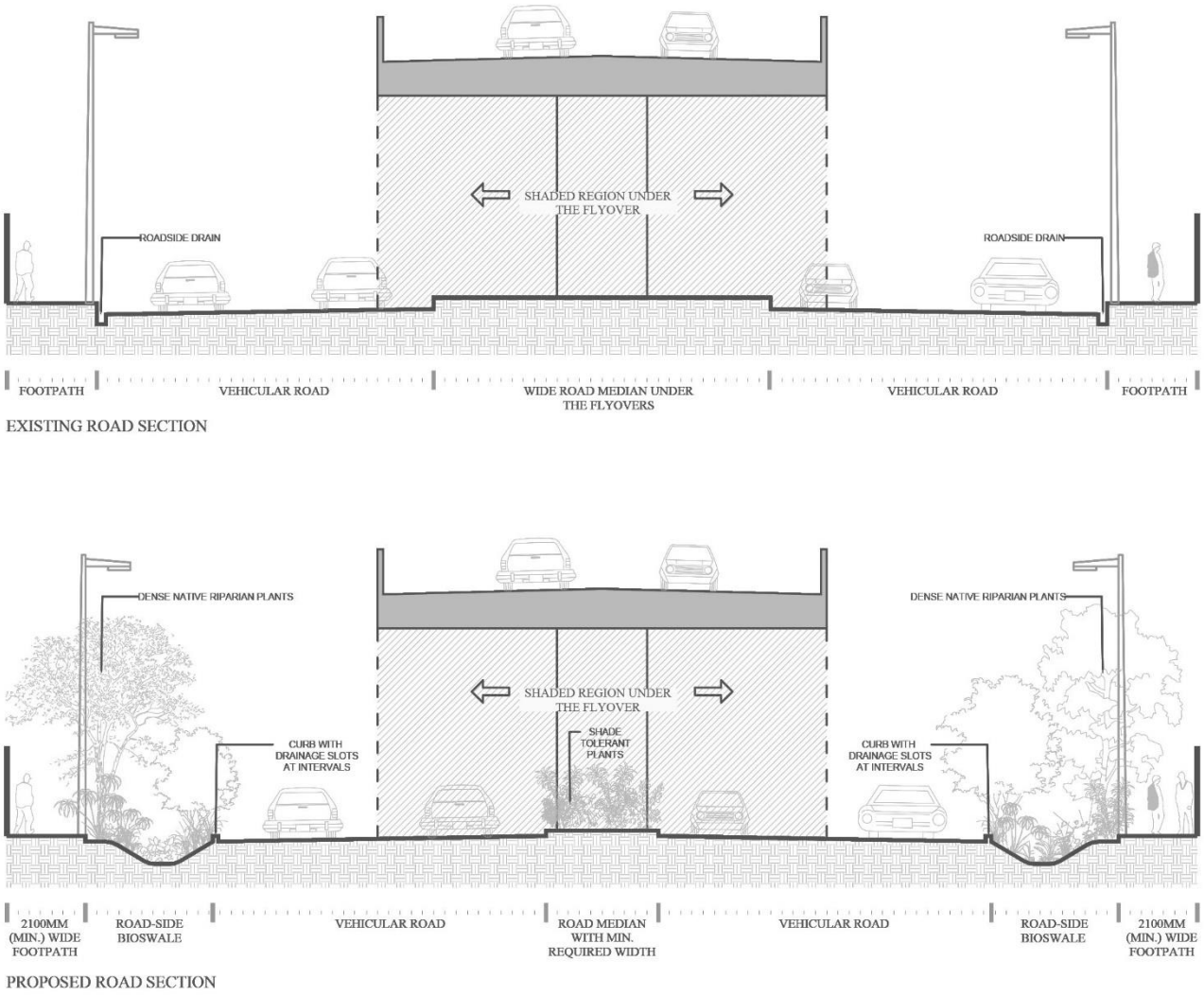

Figure 4: Roadside Bioswale Linkages

The roadside bioswale (fig. 4) doesn't only work as habitat corridors but also performs as green buffers separating the vehicular traffic from the pedestrian circulation, creates a pleasing environment for the people walking by.

3.3. Riparian buffer

The edge treatment of a water body plays a vital role in the health of both the water and its surrounding area. Riparian ecosystems are unique ones that sustain adjacent aquatic flora and fauna. The riparian buffers consist of a more diverse and populated flora species communities than the nearby habitats. This phenomenon can accommodate a wider variety of foraging grounds and microhabitats, resulting in a more diverse fauna species community. Dhaka has a few months of relatively drier season when habitats in proximity to water can stretch the growing season. Therefore, it increases the plethora, dependability and continuance of food for inhabitants (Bennet, 1998, 2003). "A number of reptiles and waterfowl rely upon natural wetlands as permanent habitat or migration corridors" (Lovell et al., 2009). As observed by Doyle (1990), considering small mammals, riparian zones held both greater species richness and a larger total number of individuals than the surrounding upland areas. These areas generally have coarser and more friable soil, which makes burrowing easier for small mammals. The higher number of insects here attracts a high number of insectivores. Bennet (1998, 2003) has seen the more productive and stable riparian zones as probable source habitats in the future. Individuals can disperse into surrounding areas from these sources. Hence it is important to not cover

water edges with hardscape. Native plant species can help to keep the water clean, prevent erosion by holding soil with rooting and create habitat for fauna.

3.4. Making the birds feel at home

It is important to use a mix of deciduous and evergreen species as a mixed evergreen environment supports a wider range of bird species. Jahan et al. (2018) spotted more bird nests in summer than winter at the Jahangirnagar University campus. They suggested that insectivores pick the dry winter season for breeding and build nests when the insects are abundant before the onset of monsoon; parents need insects to feed nestlings. The non-insectivore birds usually build nests during the drier months of winter. Examples of such birds are the Kingfishers and the Indian Pond Herons.

Jahan et al. (2018) also discovered that one-third of the birds chose to make holes for nests in trees, built spaces, soil mounds and electric posts. The rest two-third preferred places as tree branches. There are birds that make nests both in holes and built areas, e.g. Common Myna, Rose-ringed Parakeet, Jungle Myna, Oriental Magpie Robin and Asian Pied Starling. Woody trees as *Shorea robusta*, *Alstonia scholaris* and *Albizia procera* are excellent hosts for birds that prefer nesting in holes (Jahan et al., 2018).

Bennet (1998, 2003) suggests, "Roadsides with broad strips of suitable habitat have a valuable conservation role for invertebrates". Birds were found to prefer large roadside trees in the Jahangirnagar University campus to build nests though these areas have a high amount of human movement and nests are easily detectable (Jahan et al., 2018). Along with large trees, as suggested by Gates & Gysel (1978) for forest edges, dense shrubby vegetation creates habitat niches amidst urban areas by providing increased foraging and nesting sites for understory birds.

3.5. Utilizing the transport route

Dhaka is growing fast with numerous new elements being incorporated into the city's transportation lattice (fig. 2). The routes for bus and metro rail can be seen as a network where small habitat patches can be created at intervals by introducing green roofs for the stations and incorporating plants in road median design. Green roofs can hold and filter rainwater, reducing surface run-off, regulate microclimate, contribute to food production by urban farming and add to the recreational value of built space. They also reduce the heat island effect by providing shade and evapotranspiration. It lessens the air conditioning cost of the building (Oberndorfer et al., 2007).

These habitat patches can serve the urban bee population if the plants are selected wisely. Bees are attracted to yellow and blue flowering plants in general but are mostly attracted to the yellow ones during foraging. Akter et al. (2019) observed bees on flowering plants as *Corchorus capsularis* (White Jute), *Solanum nigrum* (Eggplant), *Abelmoschus esculentus* (Okra), *Mesua ferrea* (Indian Rose Chestnut), *Vigna radiata* (Green Gram) and *Brassica nigra* (Mustard). Bees play a vital role in pollination both in natural and managed ecosystems. They are also effective agents to control pest insects (Akter et al., 2019).

3.6. The networking policy

According to Dhaka Imarat Nirman Bidhimala 2008 (Dhaka Building Construction Act), depending on the building type and site area, it is mandatory to keep at least 16.25%-25% area as "true ground". In other words, nothing can be built on, over or under this area. Moreover, it has to be completely unpaved. This piece of land can be utilized by developing policies as:

- connecting this true ground directly with the roadside green linkages without any interruption, e.g., a vehicular road. There should be a minimum length of connection that will be proportional to the site area.

- generating a list of native plants (that play a significant role in regulating microclimate and creating habitat) and make it compulsory to plant at least one species in the mandatory "true ground" area.

The link (fig 5) between the roadside bioswale and the mandatory true ground inside a property area creates a continuous habitat for small species, e.g., earthworms, insects and mollusks. The inclusion of native plant species

enriches the ecosystem and complements the surrounding connected habitat patch. This connection helps with the site drainage too.

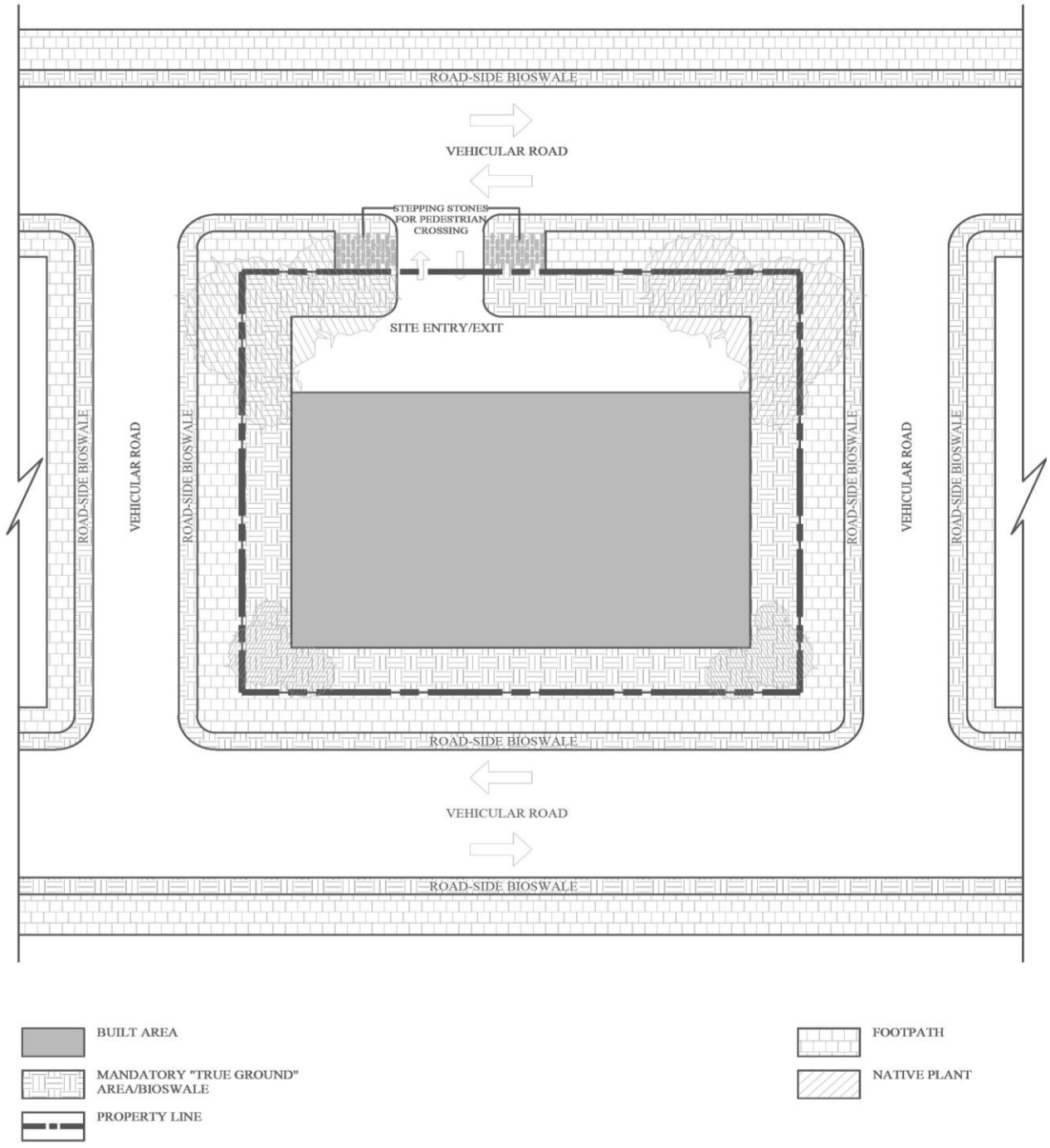

Figure 5: A conceptual diagram showing how the mandatory soakable true ground can be connected with the roadside bioswale.

4. Conclusion

While conducting this study, it has been strongly felt that there are very little research data available on Dhaka's native biodiversity and how urbanization impacts the natural ecosystem. There is an urgent need for more studies being conducted on these topics for making more efficient planning and design decisions.

It is understood that a metropolitan with a growing economic boom has many other concerns than making the city wildlife-friendly. But it should not be forgotten that before introducing any new element to any area, the characteristics of that area should be thoroughly understood and the impacts of this introduction should be known. Poorly coordinated new developments as making stories upon stories of elevated transport routes without improving

the efficiency of the existing transport system and filling up wetlands may bring localized and short-sighted benefits but destroying a well-established natural system on the way will not be good in the long run. Our hostile behavior towards nature is bound to come back to us. The more we fill up the wetlands, cover up the remaining pieces of ground with impervious surfaces or cut down trees thoughtlessly, the farther we push ourselves away from nature, from being humans. Nature has always prioritized balance and every single life here is a much-needed part of an intricate system. Toppling this balance will commence dire consequences. The sooner we understand this and act accordingly, the better for us.

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