URBANIZATION AND WETLAND ECOSYSTEMS – A CASE STUDY AT SRI JAYAWARDENAPURA KOTTE AND SUBURBS

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ABSTRACT: The landuse/ landcover of watersheds are facing frequent changes due to rapid increase of population. Land is converted to settlements or urban lands to fulfill the requirements of increasing population. Though it is an unavoidable phenomenon, the threat is the changes are not in a systematic way to put up with the side effects of such changes. In other words, the developments happen without proper planning and design guidelines. Generally, when land cover changes without proper plans, it affects the hydrology of watersheds, such as distortions of natural waterways, infiltration blocking and increase of runoff. It causes to have frequent flooding in catchments. Further it vanishes the natural flora and fauna from the landscape causing imbalances of the landscape. The main aim of this study was to find out the effect of urbanization on the wetland ecosystems and to show the importance of linking isolated wetlands to have a favorable balance between natural ecosystems and the urbanized landscape. For this study, Sri Jayawardenapura area and suburbs which face frequent flooding during recent years were selected. Aerial photographs and high resolution satellite images were selected for the demarcation of wetland ecosystems of the study area during 1956, 1972, 1999, 2007 and 2016 years. Rapid urbanization without understanding the ecological pattern of the landscape has fragmented the whole wetland network into smaller, scattered wetland patches and it caused to change the natural stream network during the study period. An attempt was taken to show the most feasible way of connecting isolated wetland patches to minimize the flooding events and to have ecological balance to the study area.

1. INTRODUCTION

A wetland is generally an area which has soil that is saturated with moisture, such as a swamp or marsh. The importance of wetlands was not identified by most of Sri Lankans thus the wetlands were used as drains, construction spaces and as garbage dumping sites. The interaction between soil, water, plants and animals in the wetlands enable many functions which are useful to the entire eco-system. In addition, these perform a range of functions which are extremely important. Marshes play a vital role in the mitigation of floods, purification of water and as a carbon sink. Tanks also help to mitigate floods. Mangroves, marshes and sea-grass beds become extremely important in the eco-system as breeding habitats for a wide variety of fish. Mangroves and coral reefs provide protection from storms and erosion. The biodiversity of wetlands, which supports a range of animal and plant species, is very significant.

There must be landscapes in urban fabric where living beings can walk or run in safety, play and have their niches in safe places. Also waste should be used to fertilizing the city landscapes, water bodies, river edges. Wetlands should be conserved for the animal habitat with the harmony of human aesthetical perceptions.

However, due to rapid increase of population, the natural ecosystems had to face number of difficulties. With high population fluxes environmental degradation happen in a number of ways such as deforestation, land infill, air pollution, land insecurity and excessive solid waste materials. Filling and fragmentation from the constructions and infrastructure developments is one of main reasons for the degradation of wetlands. Also Alteration of river flows by making dams, destructively changes ecological distributions associated with water flows and Abstraction of water for agriculture, industrial, and domestic purposes affect harmfully to the wetland ecosystems. The aftermath is the fragmentation of natural ecosystems into isolated patches. This phenomenon is significant in Colombo since it is a metropolitan region which has a quarter of the nation's population Since Colombo has significant amount of lowlands, they are the subjects to infill in urbanization process.

Change of lowland into settlements or industrial areas is very prominent in Sri jayawardenapura, Kotte and suburbs. Therefore for this study Sri jayawardenapura, Kotte and suburbs were selected. Urbanization without proper plans caused to remove and fragment the wetlands of the study area. The main aim of this study is to show the changes of wetlands over the time due to urbanization and to propose some feasible locations to connect wetlands to maintain smooth flow of wetland ecosystems to remedy the ecosystem balance which was destroyed by the urbanization.

1.1 Objectives

1. To map the changes of wetland ecosystems and to display the fragmentation of wetlands over the time
2. To show the possible connecting places for the isolated wetland patches to have a smooth flow of flora and fauna, water and energy among remaining wetland patches.

2.METHODOLOGY

2.1 Study area

Study area covers some parts from Sri Jayawardenapura and kaduwela District Secretariat divisions.
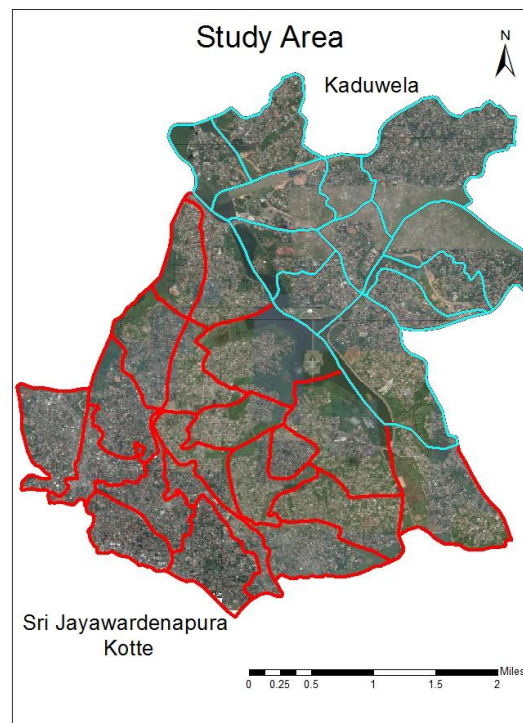

Figure 1: Study Area

Sri Jayawardenapura, Kotte is the official capital of Sri Lanka. Kaduwela is one of the neighboring DS divisions of Sri Jayawardenapura, Kotte. Since larger amount of lowlands belong to these DS divisions, they were selected for the study. The village of Darugama lay at the confluence of two streams, the Diyawanna Oya and the Kolonnawa Oya. As Darugama was a naturally secure place, it was not easy for enemies to enter it. Here, in the 13th century, a chieftain named Nissanka Alagakkonara built a fortress called Kotte. Kotte was a *jala durgha* (water fortress), in the shape of a triangle, with the Diyawanna Oya and Kolonnawa Oya marshes forming two long sides; along the shorter third (land) side a large moat (the 'inner moat') was dug. The fortress was nearly 2.5 km² (1 sq. mile) in area, fortified with ramparts of *kabook* or laterite rock, 2.5 m high and 10.7 m in breadth (http://www.ds.gov.lk). Thus, Sri Jayewardenepura area was surrounded by marshes and lakes since ancient times. The city developed around wetlands and still depends on the same wetlands. According to the Metro Colombo wetland management plans, a 20km2 area of land in Colombo is still a wetland. The wetlands in the west and north-west of the CMR, such Kimbula Ela, Thalapthpitiya are extensively degraded. Towards the east and south-east of the CMR a lot of working and abandoned paddy lands and open water areas, like the ones around Thalangama, deliver a lot of supporting services and provide

various provisions. The hydrological character or the CMR gets altered because of the dredging, widening and the construction of canals. The locks built to control the outflow of the Kelani River have altered the wetlands, especially around the Madiwala area. This results in a reverse flow of water when the water level of the Kelani River is high.
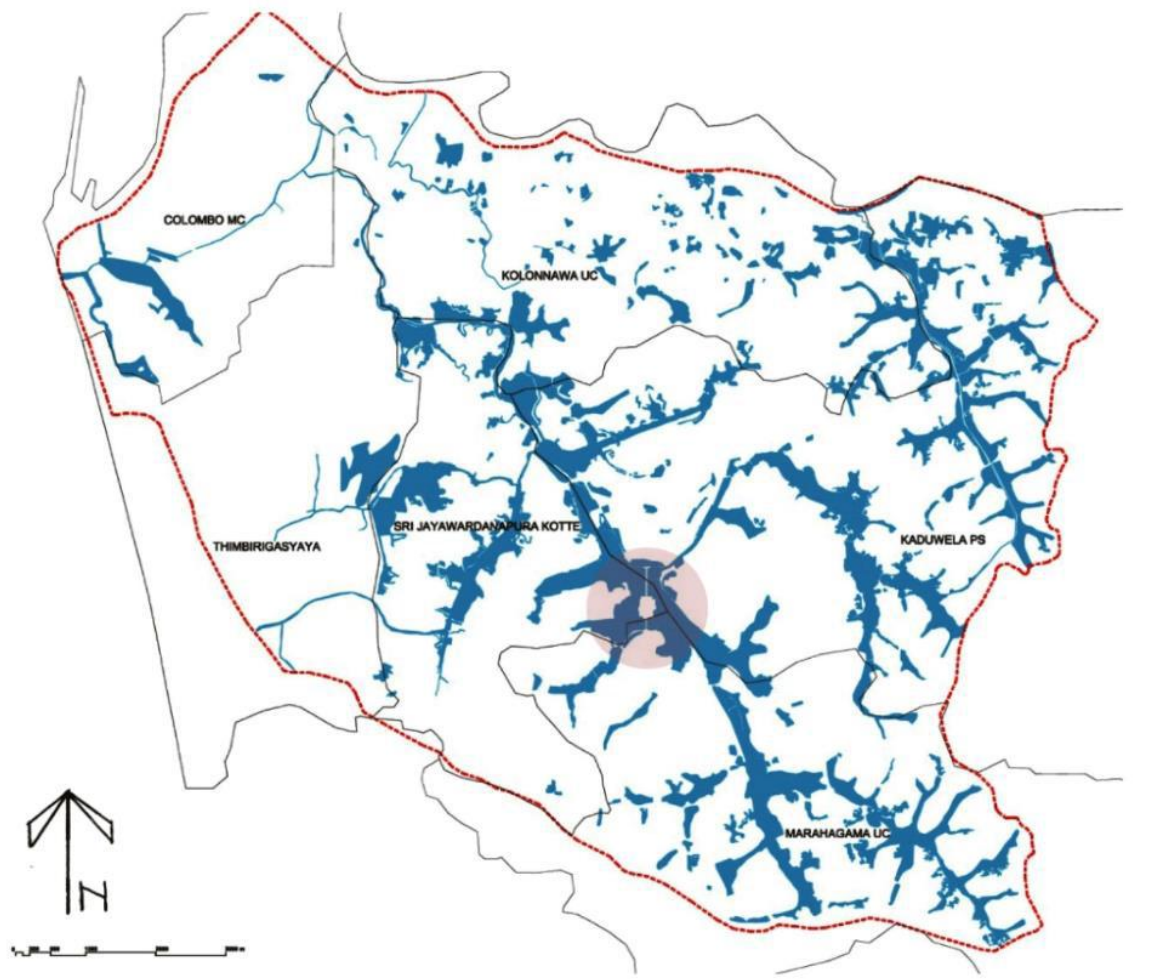

Figure 2: Wetlands of Colombo
**Source: Metro Colombo Urban Development Project**

2.2 Method

The study was carried out to achieve two objectives. To achieve the first objective, the wetland ecosystem changes over the time were needed to measure. For that, aerial photographs were selected representing 1956, 1972, 1999, 2007 and 2016 years. Using ENVI and ArcGIS software the wetlands for each year was demarcated and the areas were calculated. Then the decrease of wetlands over the time and the fragmentation of wetland ecosystem over time was analyzed.

To achieve the second objective, some connectivity theories were studied and the most suitable connectivity theory for the study area was selected. Then the possible areas to regain the connectivity among isolated wetlands were proposed.

The theories studied to find out the possible connectivity method are; functional connectivity; 'The functional relationship among habitat patches due to their spatial distribution and the movement of organisms in response to landscape structure'' (Burel, 2008), structural connectivity; physical relationship among habitat patches and ecological restoration; an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to the environment health, integrity and sustainability.

3. RESULTS AND DISCUSSION

The first objective was to demarcate the reduction of wetland ecosystems in the study area over the time and displaying the process of fragmentation of wetland ecosystem over the time causing isolated wetland patches. In this perspective, aerial photographs were digitized and wetlands were demarcated for 1956, 1972, 1999, 2007 and 206 years. Figures 03 displays the wetland ecosystems in each year respectively.
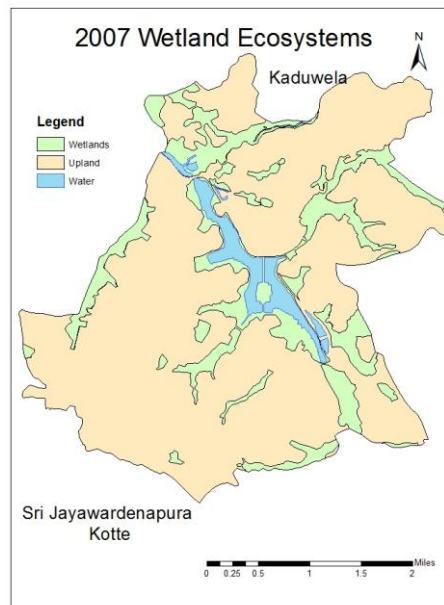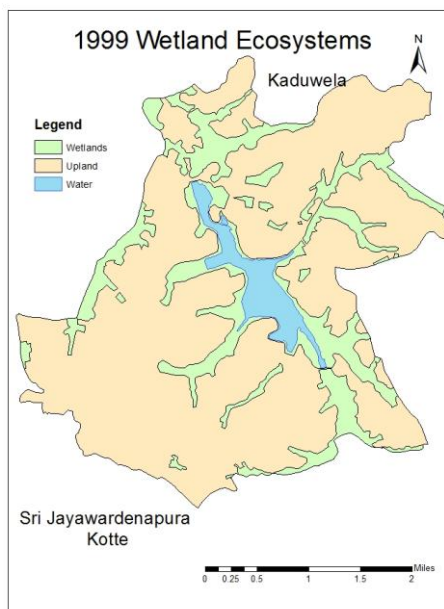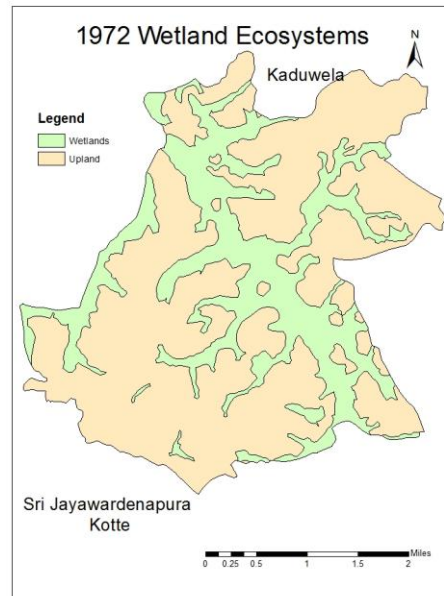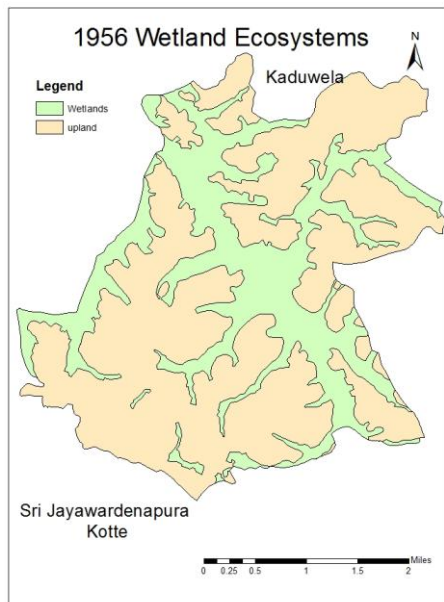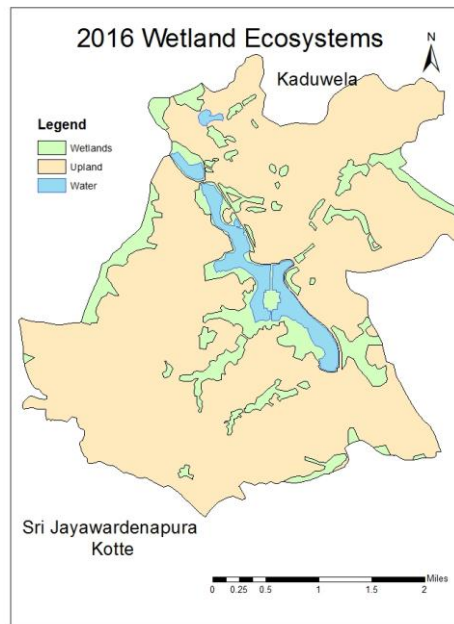
Figure 3: Wetland Ecosystems in Sri Jayawardenapura and Kaduwela

During 1956 and 1972 period the wetlands were covered with flourished paddy cultivation. Within 1972 to 1999 the paddy cultivation started to decrease in the study area. Map of 1999 displayed a water body inside the main part of wetland ecosystem. During this period the wetland fragmentation has been started. From there onwards the rapid urbanization caused the shrinkage of wetland ecosystems and the isolation of some patches all over the study area. It is significantly obvious in the aerial photographs. Large amount of wetland ecosystems disappeared from the South Western part of the study area. The main section of wetland has been converted into a water body to satisfy the human feelings. When the impermeable surface ratio increases with rapid urbanization, the infiltration becomes lower causing increase of runoff. To give a solution to the runoff, the main body of the wetland was converted to water body to store runoff water.

Then the wetland ecosystem reduction was calculated and table 0 displays the area under wetlands in each year.

Table 1: Wetland area in Each Study period

Year	Area (m2)
1956	8805188
1972	8210412
1999	6339851
2007	5548696
2016	4664412

The wetland area of the study area has significantly reduced over the time. From 1956 to 2016 the total wetland have reduce around 50%. It is a dramatic effect for the flora and fauna lived in the wetlands.

It is obvious that the vanish of wetlands due to urbanization process of the study area.

The second objective was to propose most reasonable connectivity method to the remaining wetland patches to protect flora and fauna in the study area. Figure 04 displays the possible connections that responsible authorities should carryout to regain the functionality of wetland ecosystem of the study area.
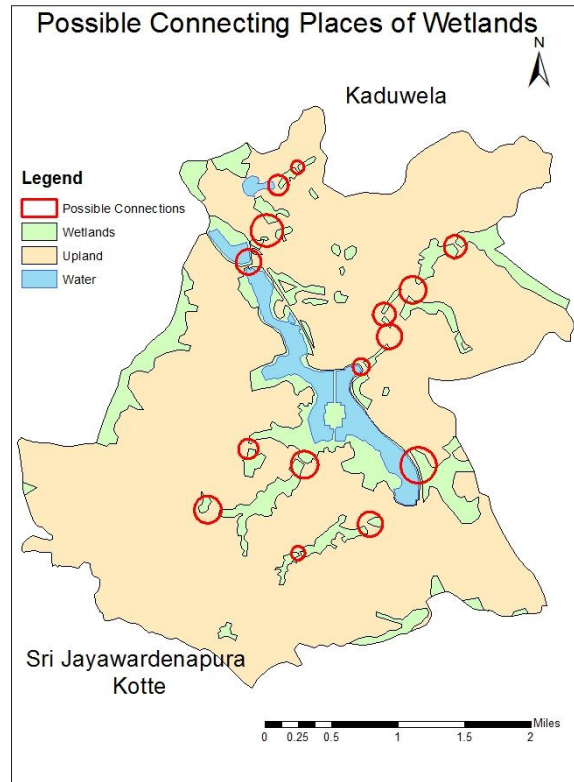
Figure 4: Possible Places to Connect Isolated Wetlands

Restoration is the most suitable solution for the remnant damaged wetland patches identified and mentioned in figure 3. The areas to restore are given in the figure 4 with circles. The landuses in these areas can be transformed to wetlands again, since these are newly built settlements. The people in these areas can be relocated to another suitable living places and the land can be restored as wetlands again to have connectivity among isolated wetland patches at present. Further it is important to hold social awareness programs to aware the residents in this area about the importance of wetlands to have a good living space for them in the study area. It is important to give knowledge about the untold importance of the wetlands for the betterment of the living beings to minimize further damages to the wetlands. In addition to that the responsible authorities should take steps to introduce the already vanished flora and fauna from the study area due to urbanization to the wetlands again to have a good ecological balance to the study area.

4. CONCLUSIONS

Urbanization without proper plans for the ecological aspects is changing the landscape with the land use, people, their occupations and behaviors. With the rapid urbanization in Sri Jayewardenepura Kotte and suburbs in the last six decades, the value of wetland environmental services for human well-being has been neglected. Wetlands now have only a construction value of the land.

The study clearly displayed the significant reduction of wetland ecosystems from the study area during past 60 years period. The reduction is almost 50% from the beginning amount. It is totally due to selfishness of humans, they only think about the well being of them at present. They do not have an understanding or purposely they neglect the bad effects they caused to the environment. However, finally humans are the who will have to suffer a lot with their activities in future.

The reduction of wetlands caused to isolate some wetland patches in the study area and it caused to totally remove some flora and fauna from the study area. It is a timely requirement to think about the gravity of this issue and take

quick remedial solutions to overcome bad effects of wetland reduction in the study area. Already the study area is facing frequent flooding events due to lack of infiltration of storm water. Therefore it is a must to stop further reduction of wetlands in the name of urbanization.

Urbanization and population increase should handle with proper knowledge about the subject. Due to lack of proper plans to handle these issues, the environment has to face lots of difficulties. If this phenomenon continues all living beings will be in real danger of extinction from this world.

Therefore it is a requirement to develop proper plans to mitigate all the issues which area discussed in this study.

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