

A STUDY OF THE EFFECTS OF HUMAN ACTIVITIES ON MUTHURAJAWELA WETLAND SANCTUARY

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Abstract

The Muthurajawela Wetland is a significant eco-system within rapidly developing urban area which is located close to the coastal area in Western Province of Sri Lanka. It has a remarkable and strong historical background which goes back to the period of the Kotte Kingdom and Colonial era. Development of urban areas in cities needs to maintain the balance between biodiversity and urbanization. Biodiversity and ecosystem are essential considerations in sustainable urban development. The Muthurajawela Wetland as a biodiversity hot spot provides numerous aspects of cities such as regulate temperature, improve food and waste security, absorb pollution, and contribute to livelihoods, addressing poverty. Managing natural resources is a crucial part of the urban development.

At present, due to the high level of unplanned development activities and constant human interventions, particularly land reclamation in Muthurajawela Wetland have led to degradation of its rich biodiversity among flora and fauna and resulted rapid changes in the natural wetland ecosystem. This paper intends to highlight the impacts of human activities on Muthurajawela Wetland Sanctuary and the means of mitigating negative effects towards its protection. The research is mainly focused on the central part of the Muthurajawela where the ecosystem is extremely vulnerable. The study is conducted through the direct investigation, questionnaire development and data collection using review of literature.

The study recommends that the initiation of conservation actions to be prioritized in the central part of the sanctuary, and conducting awareness programs among the people around Muthurajawela, formalizing the legal enforcements also by restricting dumping of garbage and land reclamation, along with incorporating nature as a value addition to the socio-economic development, will effectively take part in caring the urban environment while conserving the wetland ecosystem to its greatest possible extent.

Keywords: Muthurajawela wetland sanctuary, biodiversity, human effects, threats

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Introduction

Muthurajawela Wetland located on the west coast between the Negombo lagoon and Kelani river spreading up to the Gampaha district Sri Lanka, 30 km north of Colombo, covering an area of 6,000 hectares (Figure 01). Muthurajawela became a protected wetland under the Flora and Fauna Protection act dated October 31, 1996. The Muthurajawela Wetland is internationally acclaimed wetland which has a remarkable and strong historical background which goes back to the period of Kotte Kingdom and colonial era. During the Dutch period Muthurajawela marsh was used for paddy cultivation. To flush salt water from marshes, they constructed canals such as Dutch canal and Ja- Ela canal. In the British period, the marsh had been continued as a good place for paddy growing as a result of continuing drainage and flushing system. When the Hamilton canal was born, the paddy was not successful. Later it became the area into a waterlogged marsh. In 1990 it was declared for the International Convention for the Conservation of Wetland (the RAMSAR Convention) (Bambaradeniya S. P., 2000).

The marsh has been used by many activities including trade, fishery, shipping and agriculture since historical time (Bambaradeniya, et al., 2002). It is considered as a coastal biodiversity hot spot. A variety of mangroves, flora and fauna including medicinal plants can be found within the marsh and endemism is high among the flora and fauna. Different species of fish, butterflies and birds, some of which are endemic as well as crocodiles, and Sri Lanka's largest snake, the python which are native animals can be found in Muthurajawela Marsh (Tour, 2019). At present, Muthurajawela wetland is an extremely vulnerable ecosystem as results of rapid and inadequately planned development activities in surrounding urban areas (Bambaradeniya, et al., 2002). With the rapid development, people have disregarded caring of natural resources in city's transformation. Therefore, the biodiversity of Muthurajawela has been considerably changed over the period of last 10 years. The objective of this research is to study the effects of human activities which are leading up to degrade the biodiversity of Muthurajawela Wetland. Particularly, it attempts to identify the threats to Muthurajawela, the impact on vegetation and habitat type, and to examine the means of mitigating negative effects of human activities on the Muthurajawela Wetland.

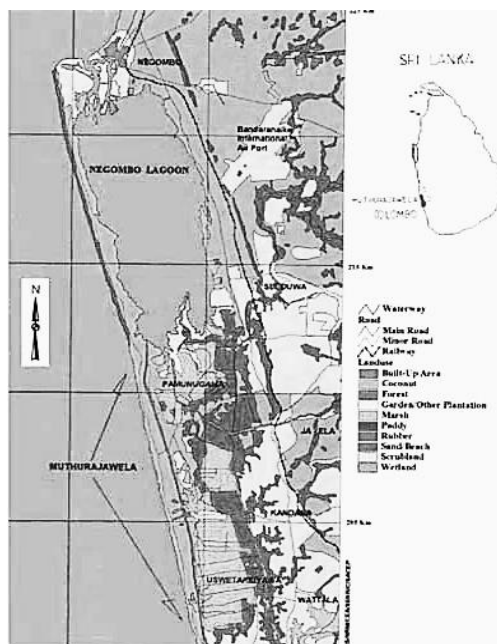


Figure 20: The location of Muthurajawela Wetland Sanctuary
Source: (Bambaradeniya, et al., 2002)

Research problem statement

Muthurajawela Wetland is located in an urbanizing area where inadequately planned development activities happen due to the high growing human population, and is being highly degraded in human activities. At present, they have been major threats to the Muthurajawela Wetland. When cities being developed, people mistakenly or deliberately neglect to integrate the natural system into ongoing development and the changing urban living style so that future in transformation will have issues with sustainability. More specifically, following research questions need to be addressed:

1. What are the direct economic uses, benefits of wetland resources?
2. How those uses have been impacted on the biodiversity of Muthurajawela?
3. How the relevant human activities lead to degrade the biodiversity of Muthurajawela?

Research objectives

The objective of this research is to study the effects of human activities which are leading to degradation of the biodiversity of Muthurajawela Wetland. Particularly, this research intends to identify the threats and impacts of human activities on Muthurajawela wetland and provide insight to facilitate future inventiveness to conserve this valuable coastal wetland ecosystem. This would encourage authorized bodies to mitigate those problems in systematic way, conduct awareness programs for Negombo community convincing the value of wetland to enhance the uniqueness of the city. Furthermore, their concern on policy recommendations on conservation are expected to be motivated

Methodology

Data for this research is collected by direct investigation, questionnaire development and data collection using appropriate review of literature: report from IUCN on 'An Assessment of the Status of Biodiversity in the Muthurajawela Wetland Sanctuary are collected to carry out this research study. Questionnaire developed for a group of people at central side (Bopitiya) of the Muthurajawela. The questionnaire divides into two parts. Part one consists of the direct uses of Muhturajawela marsh and second part is focused on human activities that lead to degrade the biodiversity of Muthurajawela.

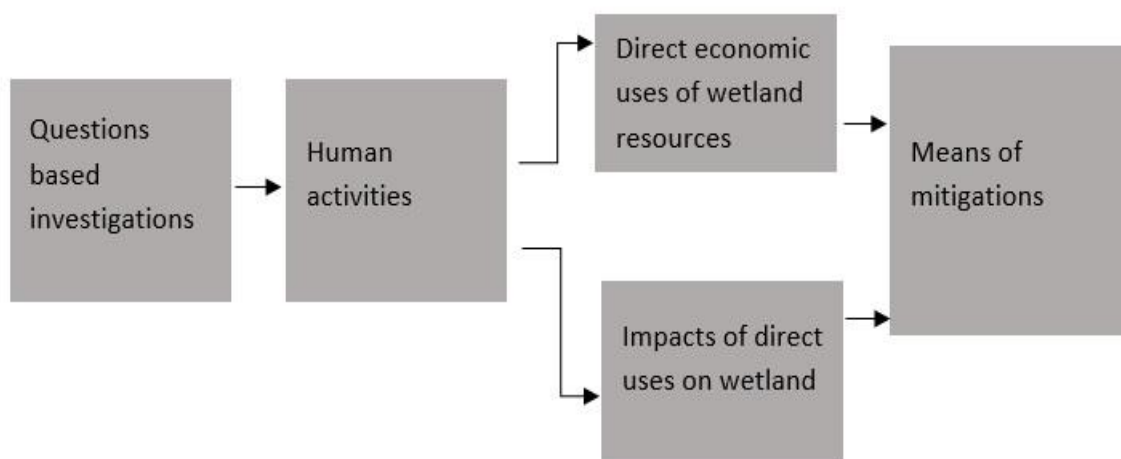


Figure 2: Conceptual framework
Source: Compiled by author

Limitation of the study

This research is limited to investigate on human activities which have been an adverse impact on the biodiversity of Muthurajawela Wetland. Moreover, the research mainly focuses on the central part of the Muthurajawela Wetland where the ecosystem is extremely vulnerable for degradation. The study may also be limited using a group of ten people in Bopitiya area (central part of the Muthurajawela) for the development and obtaining responses of questionnaire based on human effects.

Literature Review

The Muthurajawela Wetland system has been served multiple uses including agriculture, fishery, trade, shipping and habitation since historical times. Following reviews and studies were carried out on the ecological significance of the Muthurajawela Marsh to document threats in the study area.

Significance of Biodiversity in The Muthurajawela Marsh:

When considering about the biological value of Muthurajawela it can be categorized into three major areas such as flora, fauna and water quality of Muthurajawela. Over 194 species of flora of Muthurajawela has distributed seven major vegetation types: marsh, lentic flora, grassland, shrubland, reed swamp, stream bank and mangrove forest (Travels, 2018). Figure 3 shows the rich diversity of flora in different vegetation types of the Muthurajawela Wetland. Physiography, land form, soils, salinity, hydrological conditions are the primary factors to have a such rich diversity among flora within the Muthurajawela Marsh. In addition to above factors human disturbances activities and the spread of invasive alien species have also affected the diversity of vegetation types in Muthurajawela Wetland and seems to be changing rapidly.

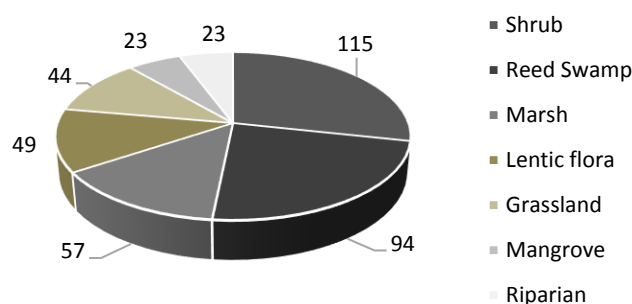


Figure 3: Species richness of flora of the Muthurajawela Marsh,
Source: (Bambaradeniya, et al., 2002)

Considering fauna of Muthurajawela Wetland sanctuary, including 14 species of reptiles, 40 species of fish, 102 species of birds and 22 species of mammals can be found within the Muthurajawela Wetland. The total documented vertebrate species 17 are endemic and 26 are nationally endangered. The fish consisted of 40 species, representing approximately 45% of Sri Lanka's native inland fishes and includes 5 endemics, 5 nationally endangered, and 4 exotic species (GCEC, 1991).

The Mammals of Muthurajawela representing 25% of the island's mammal species consist of 22 species including one endemic while 4 species are nationally endangered. The mammalian species diversity Muthurajawela is still rich. (Refer the figure 4)

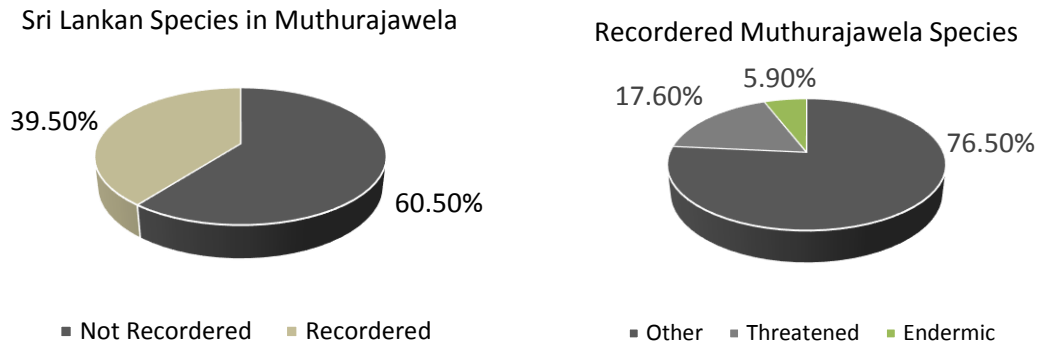


Figure 4: Status of the mammals of Muthurajawela
Source: (GCEC, 1991)

Socio - Economic Impact:

Directly or indirectly number of people have been involving for their livelihood on the Muthurajawela Wetland. Fishery is important aspect for that area. Currently fishery industry has been a threat to the lagoon and to the Muthurajawela Marsh (GCEC, 1991). They are polluting the marsh with heavy metals and other contaminants. Agriculture lands also contributes to affect the Muthurajawela Marsh. The coconut cultivation has adverse impacted on the habitat structure as well as water quality (GCEC, 1991).

The socio-economic significance of this marsh has opportunities for low-income, primarily rural people mostly from the surrounding area. Economic possibilities brought immigrants into the marsh area. The implication for land use in the marsh is that gradual marsh reclamation will continue and expand if not actively prohibited. The socio-economic trends and impact to the Muthurajwela and the Negombo lagoon mainly relate to exploitation of natural renewable resources, health and housing (GCEC, 1991).

Exploitation of Natural Resources:

There are many natural resources can be found within the marsh, all renewable nutritional or commercial value including fish, fuelwood, wildlife, material for mat and basket weaving are exploited. It is evident that the marsh residents and other directly dependent on the natural resources for nutrition and income are already experiencing the effects of over exploitation. Contribution of fish to nutrition is diminishing mainly because the major effort is exploitation of exportable species. The useable wood available is being rapidly cut down. Firewood is being brought to the marsh from the outside is increasing (GCEC, 1991).

Impact of Housing Development:

Housing is one of the considerable factors of socio-economic development in Sri Lanka. The housing development programs have been led as a prominent adverse impact on the ecosystem

of Muthurajawela. The requirement of drainage for housing has been a major threat to the marsh. Drainage system of housing program destroys the ecosystem of marsh. Particularly, unplanned housing mainly lacking drainage and sewage disposal, beaks out health problems as a result of encroachment of settlements in the marsh. Since many people depend on the lagoon for living, their income must decline if fish stocks become depleted (GCEC, 1991).

Major Threats to The Biodiversity of Muthurajawela:

Threats have been taken place to considerable changes with regards to the biodiversity of Muthurajawela, over a period of 10 years. These changes have an adverse impacted on biodiversity with the various of anthropogenic factors. The major threats can be categorized under tree main sectors: habitat degradation, direct exploitation of species and impact of exotic species (Bambaradeniya, et al., 2002).

Factors Leading to Habitat Degradation:

The adverse factors that resulting the deterioration and degradation of habitats in Muthurajawela including land reclamation, clearing of vegetation, deliberate fire, dumping of garbage, discharge of agro-chemicals and organic pollution. Illegal reclamation has been a major problem in Muthurajawela, which contributed to a change in vegetation and habitat types within the sanctuary. Material such as polythene, rubber refuse and garbage with soil are being used to fill the marshy areas. They are filling the lands mainly for construction of houses access roads, and pathways. Even the established residents also fill their backyards illegally, in order to expand land space. Particularly land filling has also affected on the fragmentation of natural habitats and affected the free movement of water between different aquatic habitats (Bambaradeniya, et al., 2002). Agriculture chemicals are heavily used in cultivation lands, especially in the Minuwambemma area. Particularly, these chemicals have been major threats to the aquatic organisms. The degradation of aquatic habitats has occurred as a result of releasing various chemicals in to the water during the production of local alcohol ('kasippu'). In addition to that, small animals such as reptiles, amphibians, mammals are also used to produce for their local alcohol, and it has become a threat to these organisms (Bambaradeniya, et al., 2002).

Factors Leading to Direct Exploitation of Species:

Poaching of animals such as hare, waterfowl, mouse deer, terrapins etc, which takes place in certain parts of the Muthurajawela Wetland. Danduganoya and marsh-lagoon transition zone has traditional fishing families are involved in small-scale commercial subsistence fishery, in the canals. The ornamental fish trade is being done by the people in Muthurajawela Marsh involving the large-scale harvesting of fish species parts of the Sanctuary. For the aquarium trade, major fish species that are captured including endemic and threatened species such as the day's killifish, blue-eye, dwarf panchax, horadandiya, flying barb, striped rasbora, filamented barb and the Mono. Moreover, trees are cut in an unsustainable manner to produce of illegal liquor, to use as fuel-wood (Bambaradeniya, et al., 2002)

The Assessment of Threats to Biodiversity of Muthurajawela:

According to the following assessment the threats has been identified at the different areas of the Muthurajawela Wetland Sanctuary. The following threats were assessed at the different sampling sites of the Muthurajawela Wetland Sanctuary, and the results are presented in table 1.

Table 13: Assessment of sites based on threats to biodiversity
Source: (Bambaradeniya, et al., 2002)

Strata	1				2		3		4		5	
	1.1	1.2	1.3	1.4	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2
Reclamation	L	L	L	H	H	H	M	M	H	H	H	H
Habitat clearing	L	L	L	M	H	H	M	M	M	H	H	H
Fire	L	L	L	M	M	M	L	L	L	L	H	H
Garbage disposal	L	L	L	M	M	M	L	M	M	M	H	H
Agrochemical discharge	L	L	L	L	L	L	H	M	L	L	L	L
Effluent discharge	M	L	L	M	M	M	M	M	M	M	M	M
Poaching	L	L	L	M	H	M	L	L	M	M	L	L
Over exploitation	L	L	L	M	M	H	L	L	M	M	M	M
Spread of LAS	L	M	M	M	H	H	M	M	H	H	M	M
Unmanaged domestic animals	L	L	L	H	H	H	M	M	H	M	H	H
Overall level of threats	L	L	L	M	H	H	M	M	M	M	H	H

1 - Northern Area:

1.1 - Danduganoya-lagoon transition zone; 1.2 - Nona-ela to Matiwalabokke; 1.3 - Wahatiyagama West; 1.4 - Wahatiyagama East.

2 - North-central area:

2.1 - Lenus Bund; 2.2 - Kadola

3 - Central area:

3.1 - Minuwambemma; 3.2 - Bopitiya

4 - South-central:

4.1 - Amnahiti-ela; 4.2 - Nugape

5 - Southern area:

5.1 - Mudiyanse-ela; 5.2 - Farmwatte

Overall level of threats: H - High, M - Moderate, L - Low

Regions of the Muthurajawela Wetland based on threats:

According to the above evidence the highly threatened regions of the Muthurajawela Wetland sanctuary is documented in residential areas with high human population pressure (Kadola, Lenus Bund, Mudiyanse-ela, Jayasooriya Bund). The figure 5 shows the zonation of the Muthurajawela based on various threats.

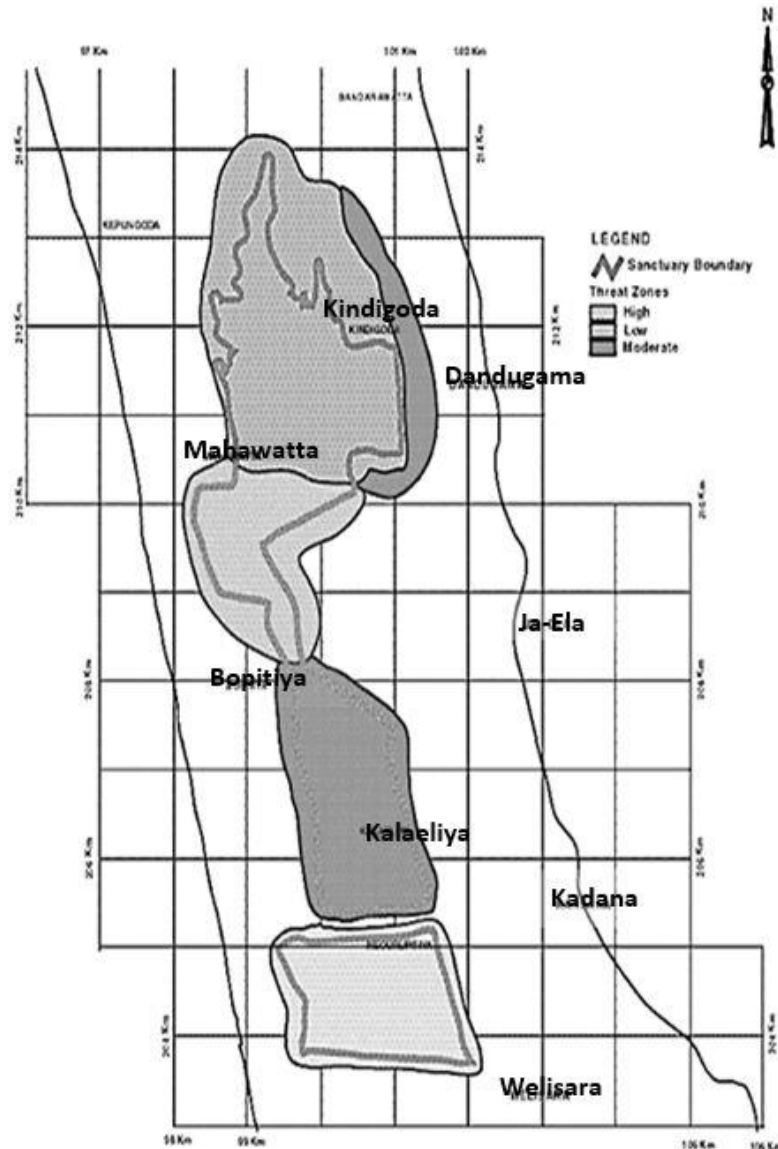


Figure 5: Zonation of Muthurajawela based on threats to biodiversity
Source : (Bambaradeniya, et al., 2002)

The central part of the Muthurajawela Wetland Sanctuary (Bopitiya, Minuwambemma, Lenus Bund) has high ecological significance and also it is under moderate to high level of threat due to various factors. Kadola, Lenus Bund, Mudiyanse-ela, Jayasooriya Bund are the highly threatened regions of the Muthurajawela wetland sanctuary while the northern part seems to be the least threatened area (Figure 5). Therefore, the central part of the Muthurajawela Wetland Sanctuary needs immediate attention to conserve (Bambaradeniya, et al., 2002).

Presentation and analysis of Findings

This section reviews the results and analysis of the research data. The findings are also discussed with the previous research findings and available literature in order to identify similarities and difference between this study and previous study of literature.

The Direct Economic Uses, Benefits of Wetland Resources:

During this study, the direct use of Muthurajawela was collected using a questionnaire developed by a group of people in study area at central side (Bopitiya) of the Muthurajawela. The question was based on the direct use of Muthurajawela.

1. What are the direct economic uses of wetland resources?
2. How those direct use impact on the biodiversity of Muthurajawela?

The direct use of Muthurajawela Marsh can be categorized under 3 major activities according to the given answers from selected people based on the question number 01. The following illustration depicts the status on direct use of Muthurajawela and which activities are widely done in the current situation.

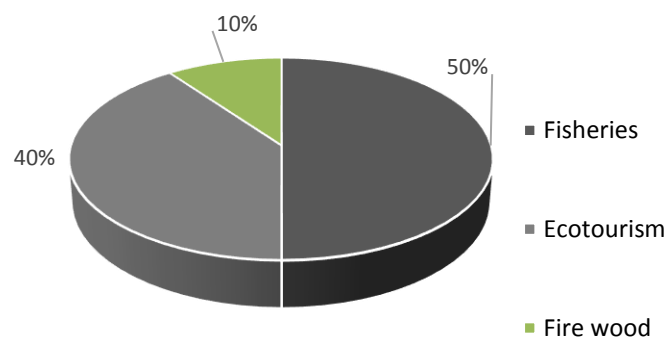


Figure 6: The status of direct use of Muthurajawela Marsh.
Source: Compiled by author

According to the above analysis fishery is the main direct use of Muthurajawela Marsh and it says use of fire wood from the marsh is less in study area (central part of the Muthurajawela). According to the related literature I studies it is also documented the useable wood available is being rapidly cut down.

Fishery:

According to the related literature fishermen use traditional fishing methods to catch fish. It is considered as sustainable practices. Even though they use those traditional methods people use mangrove species as brush- piles. It is not considered as a sustainable manner. People around Muthurajawela Wetland catch fish mainly for two purposes. One is for ornamental fish and another one is for sea food.



Figure 7: Fishing in Muthurajawela Sanctuary
Source: (Weerasinghe, 2018)

Eco- Tourism:

Muthurajawela eco-tourism is prominent aspect. There are Foreign tourists in many times because the International Airport is close to the Muthurajawela. Eco-tourism mainly based on the mangroves, birds watching, and educational purposes



Figure 8: Tourism in Muthurajawela Wetland
Source: Compiled by author

Fire Wood:

People use mangroves for firewood to produce local alcohol. Exploiting firewood as direct use of Muthurajawela is less within the study area.

Impacts of Direct Uses on the Muthurajawela Marsh:

According to the literature review, the study area is in a rapidly developing urban area and it makes an extremely vulnerable ecosystem. The direct uses of Muthurajawela is leading to degrade the wetland ecosystem. According to the analysis, on related literature review and questionnaire, the impacts of direct uses on Muthurajawela Marsh can be summarized as follow.

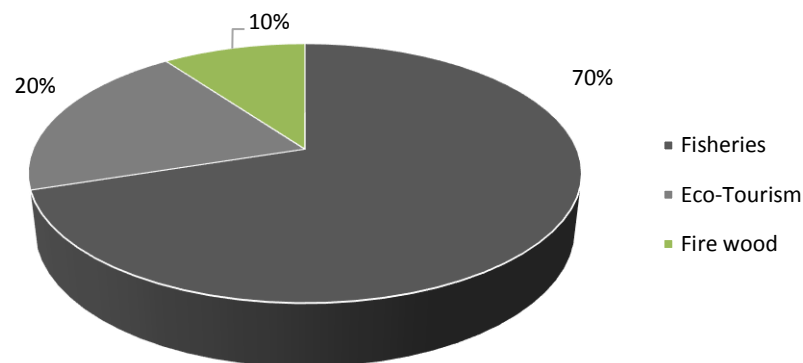


Figure 9: Status of Impacts of Direct Uses on Muthurajawela.
Source: Compiled by author

Impacts of Fisheries:

According to the above analysis fisheries is the mostly impacted activity on the biodiversity of Muthurajawela under the direct uses. According to the related literature review it says that the aquarium trade, major fish species that are captured includes endemic and threatened species and recent trends in fishing practice is not environmentally friendly and it is not supportive sustainable exploitation. The use of fishing gears is destructive for sea grass beds in the lagoon. There are several controls have been suggested such as restriction of fishing areas, regulations and control of allowable fishing gears and mesh size, registration of gear control of catch ornamental fish species (GCEC, 1991).



Figure 10: Environment effect of fisheries
Source: Compiled by author

Impact of Tourism:

Tourism does not much impact on the biodiversity of Muthurajawela. Through the eco-tourism noise pollution, disturbance of wildlife due to high speed of boat riding can be occurred.

Results and Analysis of the Major Human Activities on Muthurajawela Marsh:

During this study, the effects of human activities on Muthurajawela Wetland were collected from the related review of literature. The recorded threats have been documented by the previous studies. According to the analysis in study area (central part of the Muthurajawela) land reclamation, dumping of garbage, clearing of vegetation, deliberate fire has been adverse impacts on the biodiversity of Muthurajawela. The following illustration depicts the effects of the human activities on Muthurajawela Wetland and which activities are adversely impact on the biodiversity of Muthurajawela.

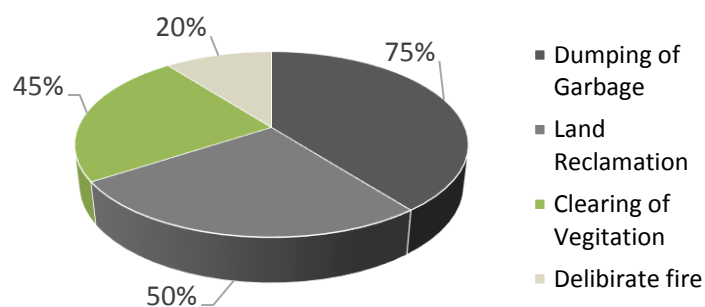


Figure 11: The major impact of human activities on Muthurajawela Marsh
Source: Compiled by author

Dumping of Garbage:

Dumping of garbage in Dalatura, Nugape, Uswetakeyyawa and Bopitiya areas in the Muthurajawela Wetland is having serious environmental impact. It has been violated the fauna and flora protection ordinance as well as the National Environmental Act. Disposing waste is adversely impact on endemic and endangered species including migratory birds and it impacts on hydrological and ecological services (EFL, 2017).



Figure 12: Dumping of garbage
Source: (Lanka, 2017)

Dumping of garbage is leading to an adverse impact on aquatic habitat and severe health hazard as well. In other hand, it has decreased scenic value of Muthurajawela Wetland (Bambaradeniya, et al., 2002). When disposing hundreds of tons garbage, plastic bags, rubble organic material engage with the ecosystem of the Muthurajawela. The dengue cases have been increasing in Muthurajawela after the dumping of garbage (Lanka, 2017).

Land Reclamation:

Land reclamation has been another major threat to the biodiversity of Muthurajawela up to now. The land reclamation develops for housing and industrial purposes. There are possible environmental impact resulting because of the land reclamation such as loss of natural value and eco system functioning, hydrological changers, salt water coming into the marsh. The loss of natural value and eco system has been a major effect on biodiversity of Muthurajawela by filling lands. Fauna, flora communities including aquatic wildlife, breeding site and function of wetland will be lost during the land reclamation. The hydrological changes resulting from sand fill reclamation. The impacts of housing project and industrial project on reclamation land increase the environmental problems because of waste disposal, sewage disposal (GCEC, 1991). According to the analysis dumping of garbage and land reclamation has been major impact on the biodiversity of Muthurajawela. Dumping of garbage, land reclamation has been directly influenced to degrade the biodiversity of Muthurajawela and it cannot be irreversible.

Recommendations

Under this research following activities were recommended to protect the importance of biodiversity in Muthurajawela Wetland while providing a sustainable urban development.

- Initiate high conservation status on the central part of the sanctuary
 - Central part of the Muthurajwela has been identified as extremely vulnerable area therefore it needs immediate attention to conserve and sustainable use.
- Conduct awareness program among people around Muthurajawela

- When conducting awareness program among people and convince the importance of biodiversity of Muthurajawela will help to protect the wetland and can be mitigated human activities as much as possible.
- Enhance the value of Muthurajawela under the education system
 - Muthurajawela Wetland has been declared as a Ramsar Wetland site because of its rich biodiversity. At present, most of the people do not consider it as a valuable site. From my point of view there should be a proper understanding on the value of Muthurajawela through the education.
- Promote Muthurajawela as a visitor attractive place while adding socio cultural and economic value
- Promote the place as a knowledge building activity place.
 - Through the educational trip, the value of the Muthurajawela can be enhanced among people.
- Initiate restrictions for dumping of garbage and land reclamation
 - When the dumping of garbage and land reclamation is extremely serious problem, the solving exercise also hard. While initiating restrictions for dumping of garbage bio gas, composting, recycling methods can be done for the sustainable way of uses.
 - From my point of view since people in Muthurajawela, consider this wetland as its own property they attempt to extend their lands. When they consider it as a public area, they not attempt to extend their land as they want. Therefor making boundary of the Muthurajawela Wetland as public uses such as jogging track, leaner parks people will not extend their lands to the wetland.

Conclusion

According to the study, Muthurajawela Wetland is an important habitat for unique and indigenous flora, fauna and it is an integrated coastal wetland system of high biodiversity and ecological significance. However, despite its protected status, human activities and unplanned urban developments have been involving to degrade the wetland ecosystem. The effects of human activities adversely contribute to a change in vegetation and habitat type. Dumping of garbage, land reclamation, clearing of vegetation and deliberate fire are the major human activities which lead to degrade the biodiversity of Muthurajawela and dumping of garbage, land reclamation is the most effective activities which have been documented. There is a strong bond between urban quality of life and, manage and use natural resources in cities have become essential approaches to create a sustainable urban development. Unless the Muthurajawela Wetland is protected due to the high effects of human activities the value of the Muthurajawela Wetland will be irreversibly lost.

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