

Geospatial based Land suitability assessment for waste dumping A case study on Kesbewa DSD, Sri Lanka.

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Abstract: In the current context, waste dumping could be identified as the foremost and rising issue of Sri Lanka. Still, Sri Lanka has not followed a proper waste recycling system and as a result, the number of waste dumping sites was increased in nearby suburbs and those locations endangered to nature. Therefore, systematic waste disposal and scientific location selection for waste dumping is a national requirement.

This study investigated the waste dumping problem in the third high populated area in Colombo District, the Kesbewa Divisional Secretariat Division. The suitability of waste dumping of each land parcel was analyzed by utilizing both raster-based and vector-based approaches. Data were collected from Survey Department of Sri Lanka and open-source satellite data platforms. There are eight data layers manipulated over the study such as Building, Land use, Slope, Waterbody, Road, Reservation, and Population. Further, an investigation performed by using the Geographical Information Sciences (GIS) environment with the use of ArcGIS 10.5 software.

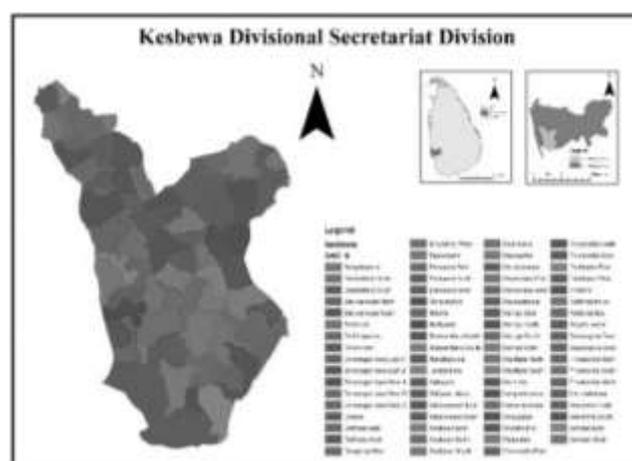
Finally, prepared the factor maps and identified the suitability of land parcels for waste dumping. Further, it has revealed that the existing Karadiyana waste disposal site only has 38% of suitability and not in suitable condition for waste dumping. In addition, it directly connected to the nearby Bolgoda river and emphasized as a major warning to human and environment in future. Consequently, in order to overcome that issue

identified three suitable locations for waste dumping by the study in the Kesbewa area.

Keywords: GIS, Karadiyana, Kesbewa, Waste dumping

Introduction

The Colombo District includes with 13 local authorities and has three final disposal sites (DS). Among the disposal sites, the Karadiyana DS is



located in the very south of the district and receives waste from Moratuwa Municipal Council, Mount Lavinia – Dehiwala Municipal Council, Sri Jayawardanepura Kotte Municipal Council, Maharagama Urban Council, Panadura Urban Council, Kesbewa Urban Council and Boralegamuwa Urban Council ('Karadiyana Garbage Dump – Environment Foundation (Guarantee) Limited'). The disposal site is operated by the Waste Management Authority of the Western Province and the area of the DS is approximately 10.12ha ('Putrescible Waste

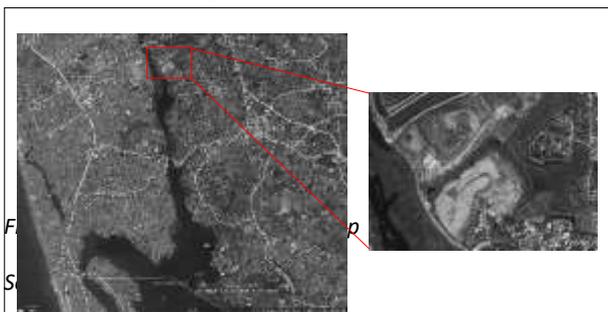
Landfills as Bird Habitats in Urban Cities: A case from an Urban Landfill in the Colombo District of Sri Lanka', 2019).

Kesbewa Divisional Secretariat Division was the target area for this study. It is situated in the Western Province of Sri Lanka, Colombo District, bordering to Lake Bolgoda, and between Latitude 6°44' to 6°51' North and Longitude 79°54' to 79°58' South (Fernando, G. M. T., Sangasumana, V., & Edussuriya et al., 2015). The division's total land area is of 61.44 square kilometres, and the population is 245,232 (ABS, 2012). Kesbewa DSD is the 3rd highest populated DSD in Colombo district. Therefore, generate high waste loads daily. Garment and agricultural industries (rice and rubber plantation) are the main industries of Kesbewa DSD (Fernando, G. M. T., Sangasumana, V., & Edussuriya et al., 2015).

This study is select a suitable location in Kesbewa Divisional Secretariat Division (DSD) by using suitable criteria and analyse the suitability of the Karadiyana garbage dump in Kesbewa Divisional Secretariat Division.

The Kesbewa Urban Council function solid waste management and sewage treatment activities based on the section 118-120 of the Urban Council Ordinance No. 61 (1939) and the Public Nuisance Ordinance (1863) and they haven't formulated any master plan or action plan relevant to solid waste management yet (Kogyo Co, 2016).

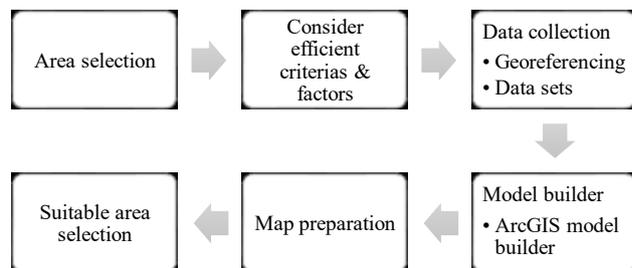
Uncontrolled open dumping and improper waste management causes for various problems such as including contaminating ground and surface water, attracting insects and rodents, increasing



flooding due to blocked drainage canals or gullies and generation of toxic, and heavy rainy days residents have to face lot of difficulties due to the waste mixed water flow ('Karadiyana garbage dump becomes threat for area residents - mirrorcitizen'). Landslide of The Meethotamulla garbage dump, lot of wastes are disposed here. All these problems directly effect on social, environmental sustainability of the ecosystems.

Geographic information system (GIS) is an efficient tool which can do several analyses. It efficiently stores, retrieves, analyses and display information according to our purpose. The software has an ability to manage large amount of spatial data from various sources and its saves time. The objective of this study is to select a suitable site using the GIS and assessment about the Karadiyana garbage dump.

Methodology and experimental design



Six steps in the methodology which used to select

Figure 3. Methodology Flow

the suitable sites for waste dumping as seen in Figure 5. Firstly, identified the study area. After that consider suitable criteria and factors, and did Data Collection according to developed criteria and factors in this study area for map preparation. In here, used model builder for vector based analysing part by using ArcMap 10.5 licensed software and finally prepared factor maps through the GIS based model and find the suitable areas.

Efficient criteria and considering factors

People can't waste dumping in some locations like Cultivation area, Forest area, Boggy Area, Rock area, Built-up area, Sand area and water area. Normally suitable locations for waste dumping is

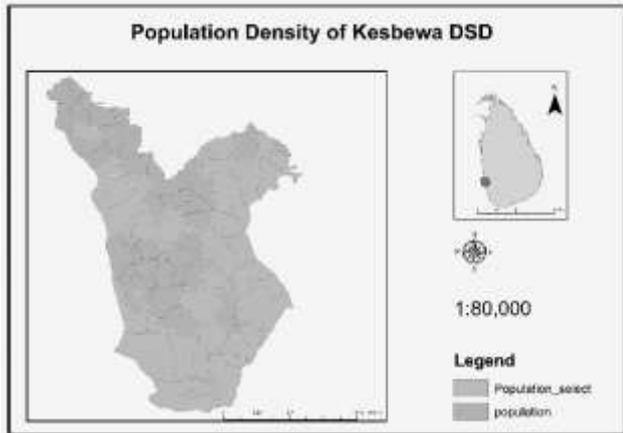


Figure 6. Population Density Map of Kesbewa DSD

Bare area. In here, consider Barren lands, Waste Land, Grassland, Scrub land.

Kesbewa DSD rank as the third highest population density in Colombo District (ABS, 2012). Population density of all GNDs in Kesbewa DSD is higher than 1000sqkm ('Divisional Secretariat - Kesbewa - Statistical Information'). Minimum population density value is 1312.209961sqkm and the highest value is 22201.400391sqkm ('Divisional Secretariat - Kesbewa - Statistical Information'). So, in here selected population density less than 4500sqkm areas for analysis.

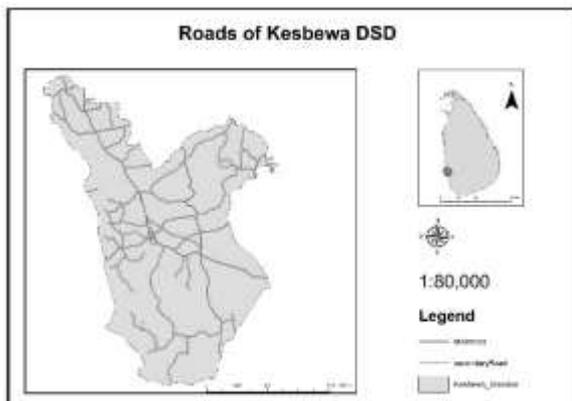


Figure 7. Road Map of Kesbewa DSD

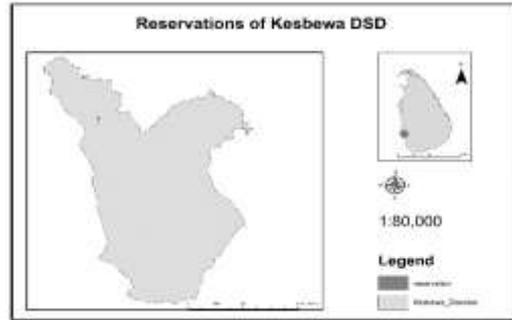


Figure 8. Reservation Map of Kesbewa DSD

Waste dumping site must locate with some distance from the road area. Because Kesbewa is populous area. If the suitable location is far away from the transportation network, authority has to disburse more cost for solid waste collection and transportation.

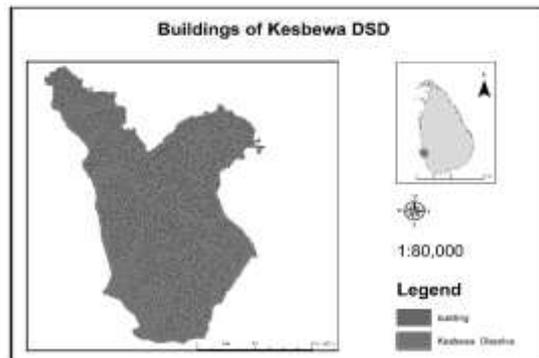


Figure 9. Building Map of Kesbewa DSD

Bellanwila – Attidiya sanctuary is the one of the reservations in Kesbewa DSD

There are lot of buildings in Kesbewa DSD due to the urbanization. But waste disposal site is not in a Build-up area.

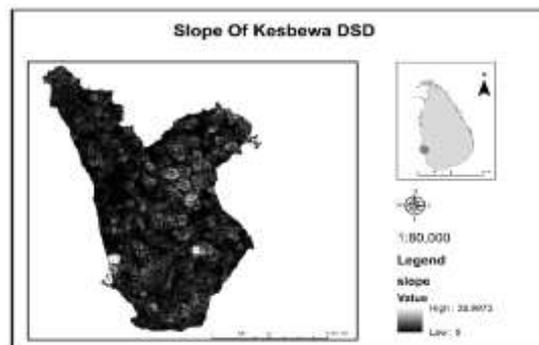


Figure 10. Slope Map of Kesbewa DSD

Normally, Kesbewa DSD is not in high altitude category. It is very close to sea level. This is very important for the waste dumping. If the slope is high, it is not suitable for waste dumping.

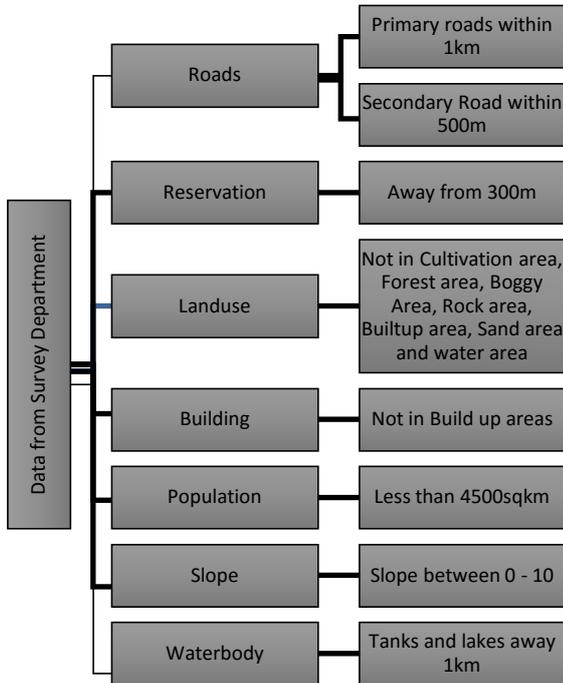


Figure 11. data processing



Figure 12. Suitable area for waste dumping

Finally, selected the suitable location intersecting the above criteria at last, by using a Raster format. The output represents with suitable areas and unsuitable areas. Land suitability is representing with a numbering system. E.g. Value No. 1 means

only satisfy a one criteria and no.8 means satisfy the all criteria.

For easiness of the study again reclassify the data; the area which satisfy only five conditions as not suitable areas, the area which satisfy only six conditions as moderately suitable areas, the area which satisfy only seven conditions

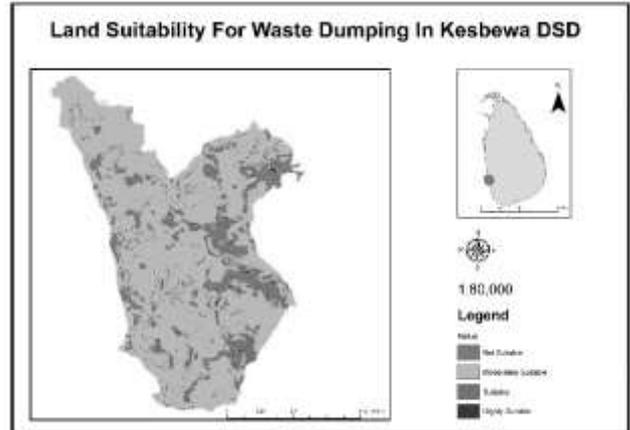
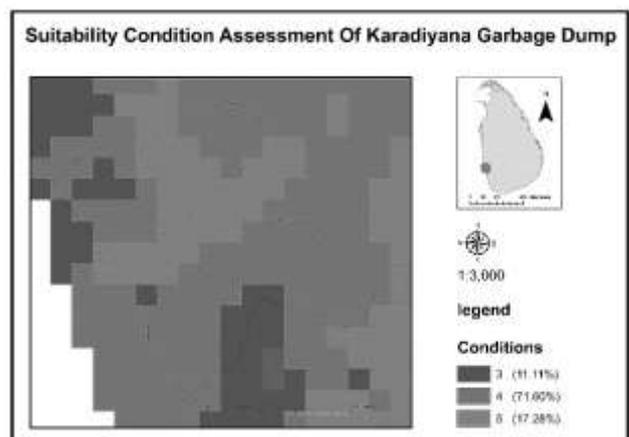


Figure 13. Reclassification of the suitable locations

as suitable areas and finally the area which satisfy all conditions as most suitable areas,

Finally, selected the Karadiyana area from Google Earth and Georeferenced to the ArcMap workspace to consider the suitability of Karadiyana Garbage Dump in Kesbewa DSD.

Enlarge karadiyana and only add that area.



According to this analysing, Karadiyana garbage Dump is not in the selected suitable area of Kesbewa Divisional Secretariat Division. The Bolgoda lake is very close to the Karadiyana garbage dump. It is a big issue. Karadiyana garbage dump may be a risk for the residents and directly cause for the contaminating ground and surface water in future Not only human, also it constrained for the animal's lives. It may be affected for the landslide in future.

Analysing the changes in Karadiyana Garbage Dump, can get an idea how the area is changed.

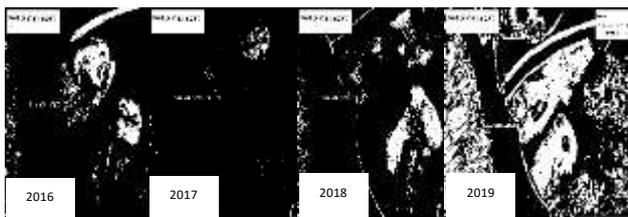


Figure 15. Changes in Karadiyana Garbage Dump

Source: Google Earth

Discussion and Conclusion

This analysis includes how to select a suitable area for waste dumping by using different criteria. The ArcMap licensed software is very useful for the investigation of this study. ArcMap licensed software is convenient for students to use for their project works.

There are several methods for waste disposal; landfill, waste compaction, composting, biogas generation. But unfortunately, in Sri Lanka, mostly use the open dumping landfill method. These areas generally satisfy the minimum requirements for the site selection. If select the suitable areas for waste dumping, it will protect the groundwater as well as surface water for the plantation and human purposes. In this base of Analysis suitable area for waste dumping in Kesbewa DSD was not in the Karadiyana area. However currently karadiyana is use for waste dumping. Although it's not satisfied basic

conditions that required (Figure: 14). Under this investigation, we have considered eight Characteristics to select to a suitable location for waste dumping.

Authority can do the landfilling as Open dumping and closed dumping. The most common one is open dumping. According to our analysis, we have found some suitable areas and three of them identified as ideal locations. Actually, authority can use these areas for closed dumping. And recommend using these places as a cycle. One

Figure 14. Karadiyana Garbage Dump

place used as a closed dumping area and rotate to another area. After that rotate each one, the first area that was chosen may be compost and again suitable for waste dumping. Rotating and closed dumping methods are very important because it prevents the landslides of the garbage dump.

The progress of the development control needs to be monitored and evaluated annually and to take remedial actions to rectify incompatible development activities. Monitoring the application of the regulation within the zones need to analyse properly by the GIS tool. GIS is very helpful for analysing and make predictions. Zoning and their regulations and promoting or discouraging the activities need to do then and there with the evaluation of GIS.

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