A GIS Based Approach for Identifying a Suitable Location for Residence in the Ratnapura Municipal Council Area

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Abstract- When considering Sri Lanka, with the developments in the country, the infrastructure of the urban city areas is being developed year by year. As a result of these conditions, people in rural villages are moving to cities for a better future. With the increasing demand for urban areas, countries are facing the problem of finding the best place to live in urban areas. Available lands in urban areas are limited. Accordingly, the government of Sri Lanka has faced some problems in finding enough spaces for all citizens for establishing their residential places. . This study focuses to develop a method from GIS (Geographical Information Science) providing some facilities for finding suitable locations for the new residential areas with respect to the criteria people desire. The integrating with the GIS data layers of the real world and the criteria of the people, the GIS can be defined as better solutions for finding suitable locations for new residential areas. In this research, the Ratnapura Municipal Council (MC) area was selected as the study area and distance from the roads, water features, religious places, service buildings, new town, and the police station have been selected as criteria for integrating with GIS. To identify the new residential locations, the reclassify and weighted overlay functions of Arc GIS software were used. 0.25% area has been established as new residential places in the Ratnapura MC Area. The digital data layers used in this study were 1:10000. If it was scaled up to 1:1000 data layers, the accuracy of the result may be high. Further, the results accuracy too would be satisfiable as suitable areas were inside the existing high residential zone.

Keywords*: GIS, spatial data, reclassify*

I. INTRODUCTION

The world is developing rapidly with technology and accordingly the living needs of the people on the earth are increasing. Not only for the developing countries as well as the developed countries have been facing the problem of population increasing. Because of increasing the population of any country they have to develop their cities as parts for the human accommodations. In Sri Lanka, most of situations the population are gathered to the main cities of every district. With the increase in infrastructure in urban areas, people are trying to move to urban areas. Figure 1 illustrates the increasing in the urban population of Sri Lanka from 2006 to 2017.

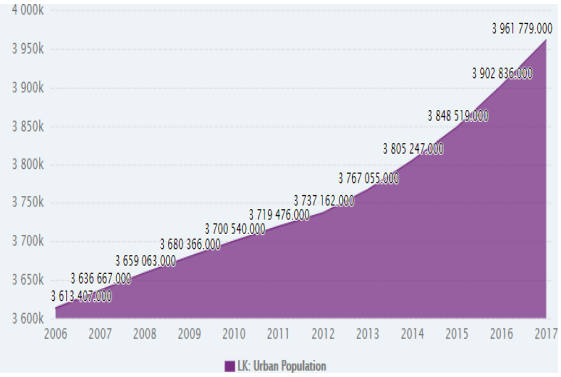

Figure 1.Increasing Urban Population

Source: Statistical Department of Sri Lanka

When increasing the urban infrastructures in the city area the people who are in rural areas are moving to the urban cities for getting better future. Therefore, the government is facing some difficulties in finding residential housing for the growing urban population. Due to limited amount of land in city area there are not enough spaces for finding the residential for every people in separate lands. So the solution to this problem is to find the most optimal locations for residential areas within the city limits and build

new high-rise residential buildings. It will be a best solution for the finding the newly residential places for the people who are coming from rural villages to urban cities. People are searching some factors for establishing their residential such as transportation, education, electricity, and distance to facilities as supermarkets, ground variance and land use.

GIS (Geographical Information Science) acts important role for finding best suitable location by using geospatial data analyzing. One of the most useful application of GIS for planning and management is the land use suitability mapping and analysis (McHarg, 1969; Hopkins, 1977; Brail and Klosterman, 2001; Collins et al., 2001).GIS provides some visual interface with coordinate systems for overlaying different geographical features such as road network, land use, water features, distance with infrastructure facilities as spatial data layers. Figure 2 describes GIS Suitability Map.

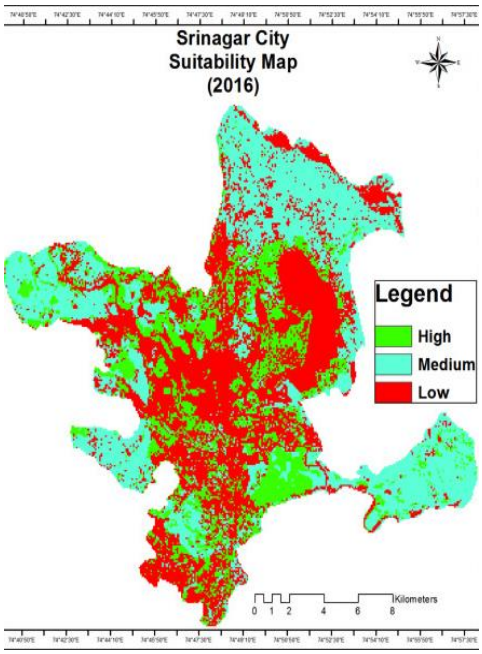

Figure 2.GIS Suitability Map

Source: Internet

GIS provides some most flexible functions for creating and decision making process to urban planning. When considering the decision making process for finding the suitable location approaches. GIS has some capabilities, such as buffer zone generation, criterion classification, and weighted cover functions. Ratnapura MC Area was selected as study area for this research. The selected area is located in the Ratnapura District of the Sabaragamuwa Province. Figure 3 describes area of Ratnapura MC Area.

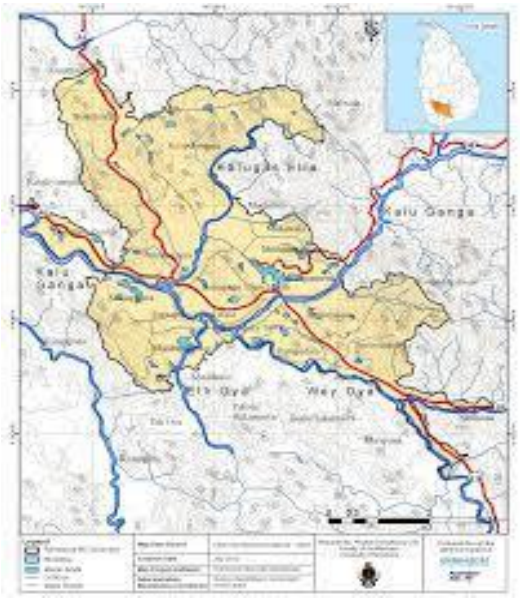

Figure 3.Ratnapura MC Area

Source: Urban Development Authority

The urban population of the Ratnapura urban area is increasing year by year and the city is merging with buildings and people are looking for new places for residential areas. Figure 4 describes the population in Ratnapura.

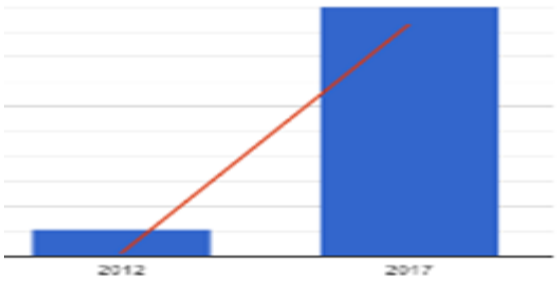

Figure 4.Population of Ratnapura

Source: Statistical Department of Sri Lanka

There is a project which regenerating the Ratnapura town area in another place and it is called Ratnapura new town Project. With this Situation finding the suitable location for newly residential place in Ratnapura MC Area is very important factor to reducing urban population compactness in future. Because of increasing

infrastructure facilities like schools, Transportations and other facilities people who are in rural villages in Ratnapura district but have middle income try to find the residential places in Ratanpura MC Area. So such kind of research is very important for the urban planners for developing the urban cities which not being compactness of urban population in future. The main Objective of this research is finding the newly residential location for urban planning and sub objective of this research is creating GIS models for decision making process for finding the suitable locations.

II. METHODOLOGY

The digital spatial data layers from Survey Department of Sri Lanka was used for creating the real situation in Ratnapura MC Area details. Several criteria in GIS were used for finding the suitable locations for establishing newly residential place in Ratnapura area and they were distance form road, distance from water features, distance from religious places, distance form schools, supermarkets and hospitals, distance from government service buildings and as well as the distance from police station. Euclidean distance zones and buffer zones were created for all the data layers and the reclassify them under the statically data of the criteria. For finding the criteria, questionnaire survey was conducted for the city people. According to the willingness of the people the criteria were scaled. Weighted overlay was used for finding the best locations for establishing newly residential areas. The flow chart in figure 5 describes the steps taken to perform to finding the best suitable location for establishing the newly residential area in the Ratnapuara MC area.

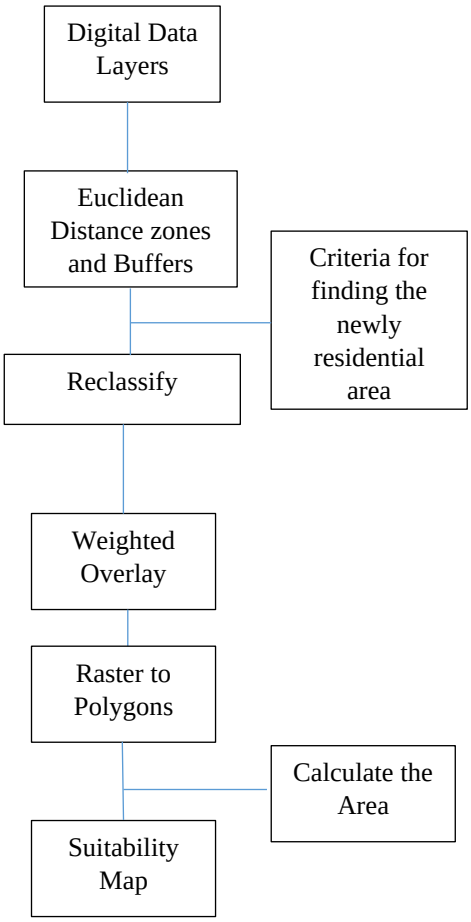

Figure 5. Flow Chart

A. Digital Data Layers

Vector format of road layer, water feature layer, school hospital and supermarket layer, religious places layer, new town layer, government service building layer and police station layer were overlapped for finding the place for newly residential area. Figure 6 of result and discussion is described the digital data layers as a map.

B. Criteria for finding the newly residential area

Comments of sample of thirty people who are coming to Ratnapura city from the villages for doing their jobs were selected for identifying which factors about people need to fulfill for selecting the residential location in Ratnapura MC Area. Those people were working in government and non-government agencies and they were 30-45 years old. Distance from roads, water features, government service buildings, religious places, schools, hospitals and

supermarkets, police station and new town area were selected as their criteria for finding the residential location. Ten people have selected distance from the road as the first choice and as well as the eight people have selected distance from water features as their first choices. The criteria which would be needed to selecting the newly residential location was scaled with respect to the choices of people. Table 1 describes the scales of the criteria.

C. Reclassify and Weighted Overlay

Analytic Hierarchy Process (AHP) method has been used for finding the weights of each criteria for the research. Basically scale of the criteria was used for calculating the weights values. The number of classes was defined according to the condition of each criteria. Four classes were defined as reclassify classes. Table 2 describes the weights.

III. RESULTS AND DISCUSSION

Table 1. Scales of the Criteria

Criteria	Conditions	Scales
Distance from Roads	<10m 10m-100m 100m-1000m >1km	1 4 3 2
Distance from Rivers	<100m 100m-500m 500m-1000m >1km	1 2 3 4
Distance from Schools-Hospital-Supermarkets	<50m 50m-500m 500m-1000m >1km	1 4 3 2
Distance from Religious	<100m 100m-500m 500m-1000m >1km	1 2 3 4
Public Buildings	<100m 100m-500m 500m-1000m >1km	2 4 3 1
New Town	>100m 100m-1000m 1000m-2000m >2km	3 4 2 1
Police Station	<500m 500m-1000m 1000m-2000m >2km	1 2 3 4

Table 2.Weights of Criteria

Criteria	Weight (%)
Road	29
Rivers	23
Schools-Hospitals-Supermarkets	18
Public Buildings	13
New Town	11
Religious Places	03
Police Station	03

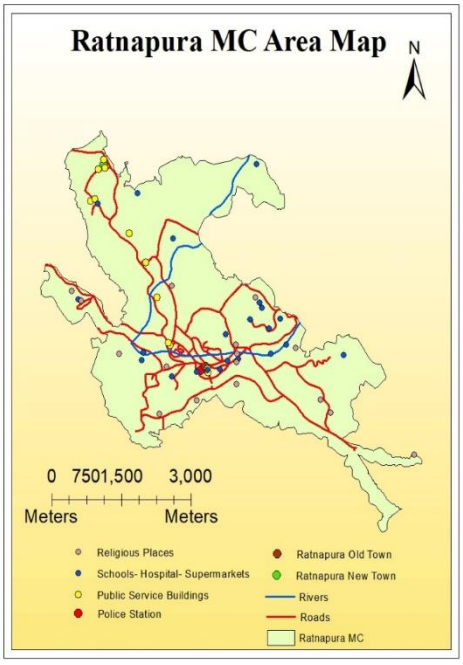

Figure 6. Ratnapura MC Map

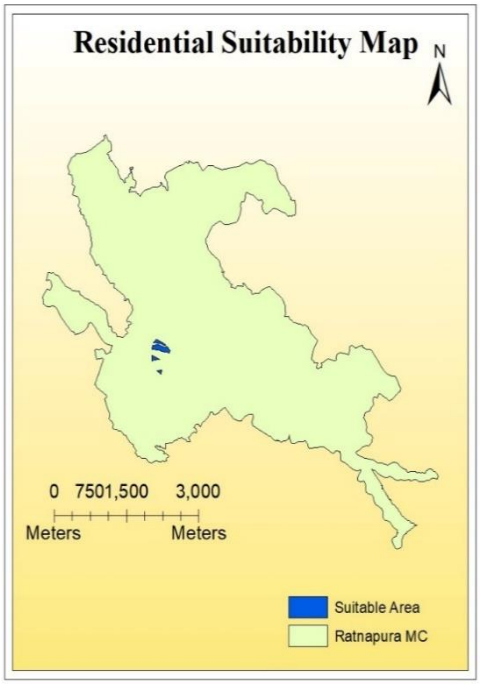

Figure 7 Residential Suitability Map

Figure 8. Area Validation

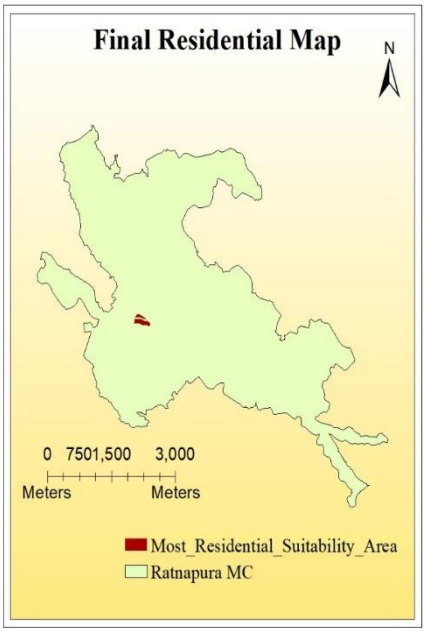

Figure 9. Final Residential Map

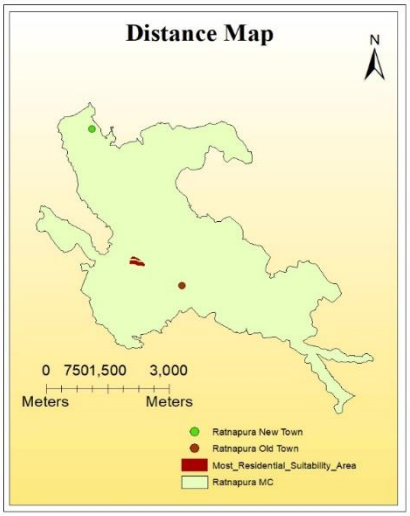

Figure 10. Distance Map

When considering the suitable locations, it describes in figure 7 for establishing the newly residential area. When considering the sizes of the area, it was eliminated the area which is less than 500m^2 according to the choices of the people. The total area of Ratnapura MC Area is 22453678m^2 and suitable area for residential location was calculated as 56220m^2. The percentage of the suitable area with respect to the total area of Ratnapura MC Area is about 0.25%. After checking the accuracy of four isolated parts of the suitable residential areas with ground truth data from field verifications, the number 1 and number 2 parts were confirmed as more accurate locations. The final residential map is described in figure 9 the more accurate locations for newly residential locations and it is about 44531m^2. The distance to suitable residential location from Ratnapura old town is less than from new town.

IV. CONCULSION

The accuracy of output result of this study was increased due to consideration of more number of criteria. In testing the accuracy of selecting suitable locations in the Arc GIS with respect to the ground observation data, it was most satisfactory. The elevation of the area was not selected as a criteria by the target group. The reason for that may be, people are living in hilly areas in current situations. When examining from the Google map, some houses are about 200 feet with respect to the main road. The scales of all digital data layers were 1:10000 further if there was 1:1000 data the final output would be more accurate. Although most of features which were considered as criteria for finding the suitable location, the best locations were shifted here to closer to the Ratnapura old town area than the new town area. It is described in figure 10. When considering number 1, 2, 3 and 4 in figure 8 Area Validation, number 3 area is not applicable for residential because of it is situated close to the reservation of the Kalu Ganga and number 4 area is situated in existing building area. The distance from water features has been considered as main criteria by people for finding the suitable locations for their residential places. The suitable location is mostly away from the water features. The best suitable location is situated closer to the public service buildings and very famous schools like as Aloysius' college, Seevali college and Ferguson college. As future recommendation, if it was considered about the flood levels and areas of crimes, sometimes the final result may be changed to good accurate point of view than this.

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AUTHOR BIOGRAPHY

I have Studied BSc Surveying Sciences (GIS and Cartography). I have an interest for visualizing environmental problems by using GIS and cartography. Arc GIS provides very important mapping environment with cartographic visualization for spatial mapping. Here I have prepared a Residential Suitability Map for urban planning.