Suitability Analysis of Secondary School Accessibility in Andoni L,G.A, Rivers State, Nigeria

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Abstract: The problem of accessibility to secondary schools is a serious concern to policy makers on education. Andoni L.G.A. River State, Nigeria is one of these areas that encountered similar challenge due to River network forming barriers for accessing secondary schools, this study seek to address selecting suitable site among several settlements without secondary school for siting new secondary school in the study area. The dataset used for this study include settlement, secondary school point data, and land use/ land cover. The settlement and school data were collected using hand held GPS in UTM Zone-32 North, and the lu/ lc was obtained from Landsat image downloaded from its web site. The software used for the study is ArcGIS 10.1 and Idrisi Taiga 6.0. The lu/ lc was classified into water body, built up, nypa palm, and vegetation using maximum likelihood classification method in Idrisi Taiga 6.0. In other to performed Multi-criteria for selecting suitable sites for new schools Euclidean distance was first performed for the settlements and schools location data in ArcGIS 10.1, reclassified and rank according to most suitable with value 5 and least suitable with value 1. The reclassed settlement, school data and lu/ lc was weighted using weighted overlay tool with 50 per centage of influence for settlement, lu/ lc and school 35 and 15 per cent respectively. The study shows that Oronija, Akaradi, and Isiodum are the most suitable site for locating new secondary schools because of their distance from existing secondary schools and barrier caused by River network in the study area. Geographic information system has been proven as an effective tool in solving multi-decision problem of this nature. It is therefore recommends that local and state government should strategies on ways of constructing bridges and road network that will make all settlements accessible.

KEY WORDS: Accessibility, Suitability, Weighted overlay, Land use/ Land cover, GIS, Euclidean Distance, Secondary School

Introduction

The function of Government in any country including Nigeria is to provide basic educational facilities that are accessible by the society. This is aimed at eradicating illiteracy which ultimately indulges youth of secondary school age to criminal activities such as cultism, drug abuse, arm robbery, and youth restiveness. In many countries secondary education is very key to national development. The President of Tanzania Mr. Julius Nyerere being a teacher placed emphases on secondary education immediately after independence in 1961 [1]. Also, similar gesture was recorded in Uganda when President Milton Obote in 1962 gave priority to secondary education in other to meet national development. In Nigeria successive administration in a move to improved secondary education initiated policies aimed at restructuring the system. From 1984 Nigeria education was structured using 6-3-3-4 system representing three years junior secondary school and three years senior secondary school [2]. But the former President Olusegun Obasanjo on30th September, 1999 introduced Universal Basic Education which is intended to be universal, free, and compulsory education [3]. This was perceived as another milestone in secondary school education that separated junior secondary school from the senior secondary school.

Additionally, the concern of most Government is on how to make secondary school education accessible to all pupils. Accessibility according to [4] is defined as the ease with which opportunities are reached. An opportunity as used here refers to the school location in the context of this study which must be accessed by the pupils from a defined destination in this case settlement. Other researchers characterize accessibility to address three questions of who/where, what and how. This is because for accessibility to be fully understand the people or place (who/where) considered as origin [4] must be known, destination to be reached (what), and the transportation mode by which one gets to that destination (how) must also be considered.

According to [5] transportation is defined as the system of buses, trains, etc. provided for people to travel from one place to another. School transportation simply refers to the procedure and implemented plan by which pupils are conveyed to or from school usually from his/her settlement. Pupil's accessibility to secondary school education depends on the available transportation system which may be water, air, and land. Accessibility from origin to destination is separated by distance, time, and cost [4]. The walking distance of pupil from settlement to school represents the linear measure of a defined pedestrian route between these intervals. Since it is true that not all secondary school pupils utilized vehicle or bicycle to access destination because of lack of fund from pupils who might have come from poor homes, hence these classes of pupils preferred to walk to school. The distance covered by any journey is a function of time travel from origin to destination usually measured in mile per hour [6].

Geographic information systems (GIS) play a significant role in analysing spatial data such as school location when the data is integrated into spatial database. GIS analyses can be used to determined distance, travel time, and cost of travel from origin to destination. In education generally, GIS can be used to manage libraries, museums, schools, and universities [7]. In school specifically, GIS has been introduced into the curriculum to help students improved their potential to meet global challenges and more importantly, GIS also help the school to manage their facilities, routing of vehicle, safety planning, and emergency preparedness [7]. All these can be achieved by creating school spatial database for efficient management of the facilities of a given locality. Geographic information systems which is a computerize system of storing georeferenced data has been utilized to study spatial distribution of utilities including schools in different part of the world using different data sources and methods. [8] uses GIS to study the spatial distribution of elementary school in Czechia in the second half of the 20th century mainly due to the change in the spatial distribution of elementary schools in the area. The study concluded that there was a decrease in the number of elementary schools in large population areas.

GIS has been found as a very good tool in selecting suitable site for locating facilities such as power stations, ware houses [9], dumpsites [10], fire service station [11], and location for new schools. Suitability assessment utilized multi-criteria approach involving different datasets that are combined using weighted overlay tool for selecting school site for effective planning by decision makers. [12] suggested that for any school site selection it must be accessible to present and future populations and be free of harmful natural and environmental conditions, which threaten the pupils live. All these can easily be achieved using GIS spatial data analysis; hence, the objectives of this study are (a) to determine the spatial distribution of secondary school in the study area (b) to determine suitable location for locating new secondary schools.

Methodology

Study Area

The study area is Andoni Local Government Area, Rivers State, Nigeria and it lies between latitude 04º 26' 40"N-04º 35' 00"N and longitude 07º16'30"E-07º33'00'E. It has a total land mass of 342 square kilometres with a population 211,009 peoples [13]. The study area is bounded by Gokana and Khana LGAs in the north, Opobo/ Nkoro LGA in the east, Bonny LGA in the west, and South Atlantic Ocean occupied the whole southern part of the area. Being a coastal tribe of Niger Delta region the people are predominantly fishermen. The land mass is made-up off tributaries of Rivers, Creeks, and Lagoons of the main ocean which serves as fishing ground for the people to earn a living. The tributaries of Rivers network in the area actually poised serious challenges to transportation of goods and services since many people uses Canoe for transportation. Even the secondary school pupils from settlements without secondary school attended school by canoe through Rivers. This development has led to pupil's dropout of schools in pursuit of their parent line of occupation (fishing). The problem of accessibility to secondary school was still a serious issue in Andoni LGA, since some Towns with population up to having a secondary school navigate by local Canoe on the River before attending schools. In other to safeguard the lives, and minimized secondary school dropout of pupils as a result of travelling on the Rivers to attend schools, this study examine suitable site for locating new secondary schools in the study area.

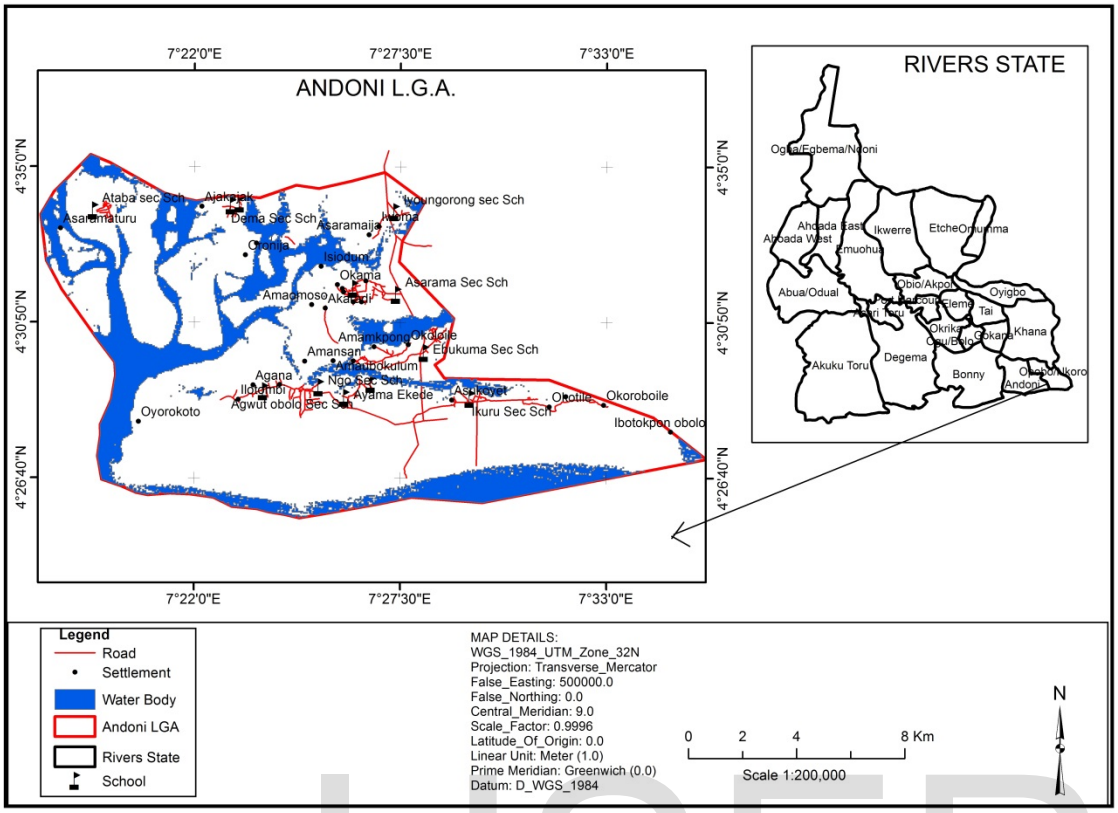

Figure 1. Study area location map.

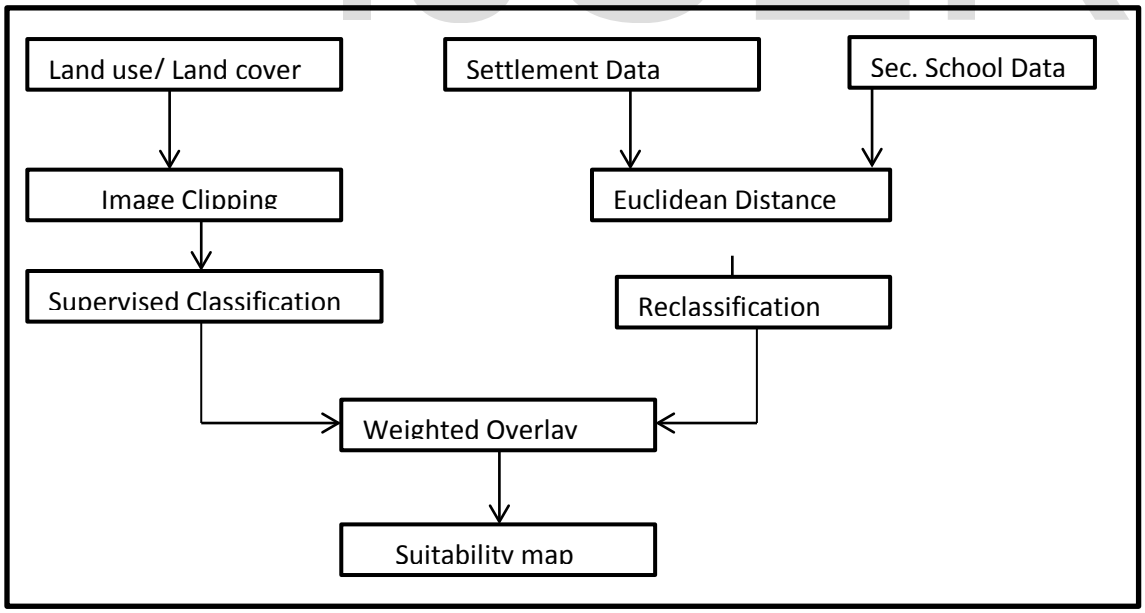

Figure 2. Flow Chart Methodology.

Software and Dataset

The following software and dataset were used for this study;

IDRISI TAIGA 16.0 was used to performed image classification on Landsat satellite image in other to extract land use and land cover in the study area.

ArcGIS 10.1 was used to perform all vector data processing such as shape file creation by digitization of points, and lines features and also performing suitability analysis using weighted overlay tool.

The dataset required for the study include; p188r57 1984 Landsat satellite image with spatial resolution 60m by 60m in WGS_84 Zone 32N was needed to extract land use/ land cover as shown in figure 2. The image was acquired from Global Land Cover Facility website (http://glcf.umd.edu/data/). Other dataset used for this study were settlements and secondary schools point data collected with the use of Garmin 76CSx Hand Held Global Positioning System in WGS_84 Zone 32 North. The point data was to enable the modelling of Euclidian distance used in the suitability analysis.

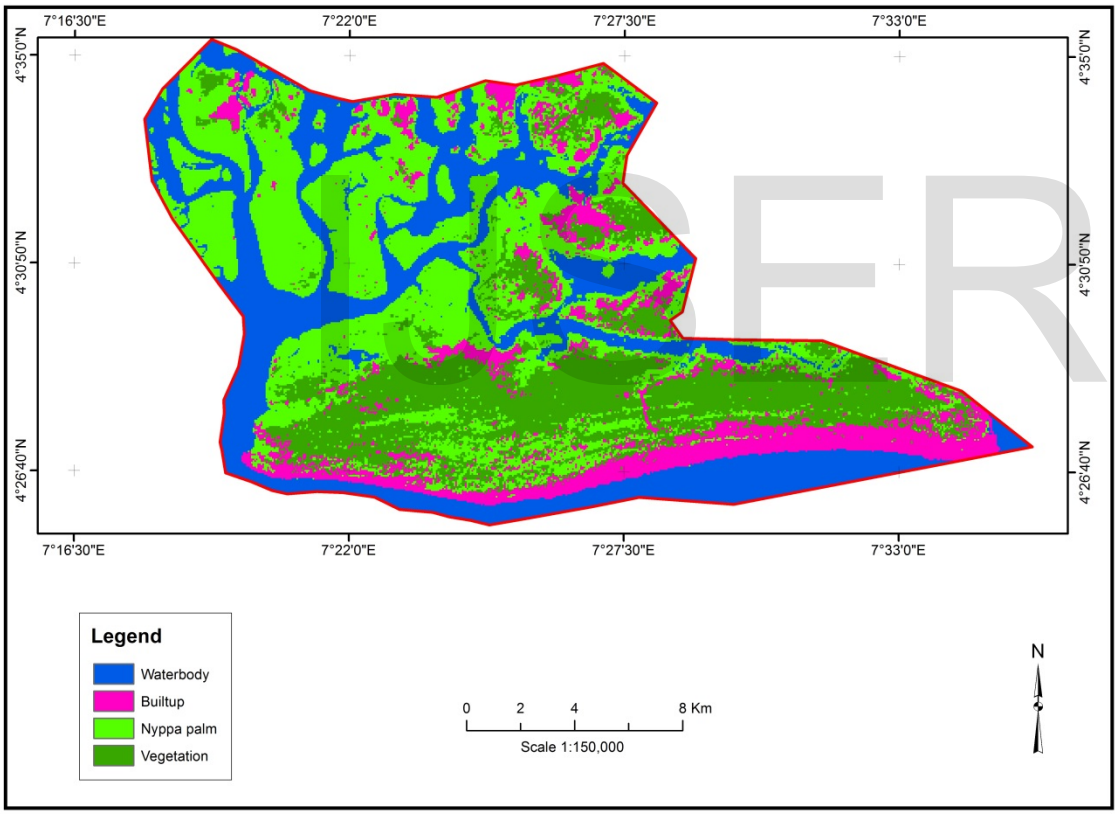

Figure 3. Classified Land use/ Land cover map.

Data Processing

In most GIS operations it is required that data needed for analysis must be organized in such a way that the analysis and result obtained are correct and consistent. Therefore the following data processing methods were taken during the study.

In other to extract land use/ land cover types of the study area the maximum likelihood supervised classification [14] was use for the classification of Landsat satellite image in Idrisi Taiga 16.0. The classification method adopted was supervised classification using level 1 [15] classification scheme. Supervised classification scheme was chosen to classified lu/ lc types based on the general

knowledge of the study area. The land use/ land cover types identified and classified in the study area are water body mostly salt water, built-up areas, Nypa palm and mangrove located in the salt water, and vegetation cover in some isolated area in the study area. Supervised classification was performed by defining aggregate of pixel as training site for land cover class. These four lu/ lc types was carefully chosen because then are critical factors in determining where the new secondary school will be built. After classification of the image in Idrisi Taiga 16.0 it was exported to ArcGIS 10.1 and clipped with the study area shape file.

The secondary school and settlement point datasets were created in MS excel spread sheet 2010 in Easting, Northing, and feature name relation. For this analysis, the secondary school data and settlement data were created in different MS excel sheets and plotted in ArcGIS 10.1. The plotted data was later converted to shape file for further analysis.

Euclidean Distance and Weighted Overlay Analysis

Euclidean distance which is a measure of distance from every cell to the nearest source was model for both the settlement and secondary school data. Euclidean distance calculates straight line distance to a source cell and this model are mostly applied in suitability studies for selecting optimum site [16], especially when data representing distance to feature is required. Based on this, Euclidean distance that will establish the fact that the location for new secondary schools should be in those settlements without schools was model. The Euclidean distance was reclassified into five (5) classes and new values of important were assigned. The reclassified secondary school data was rank with closest distance having value 1 being the least suitable and farthest distance rank 5 being the most suitable. Similarly, the settlement Euclidean distance was reclassified into five class and closest distance rank 5 being the most suitable site and farthest distance rank 1 being the least suitable site and the other distances rank in between them. This ranking was based on the fact that new secondary schools should be built close to settlement.

In determining suitable site for new secondary school in the study area, three factors such as settlement, secondary school and land use/ land cover data was considered. Locating suitable site for new schools in the study area slope data is not required since the area is located in the tidal flat of the Niger Delta Region of Nigeria. But what is salient here was to site secondary schools that will be accessible by major towns with required population to accommodate it. The land use/ land cover map was needed because secondary school cannot be sited on water especially the type of water body (salt water) in the study area and as such it was restricted in the weighted overlay analysis. Other lu/ lc classified and used in the weighted analysis includes built up areas rank 5 being the most suitable, vegetation rank 4, and Nypa palm rank 3 being the least suitable. Hence, by weighting these three factors (settlement, school, and land use/ land cover) using weighted overlay tool in ArcGIS 10.1 suitable sites for locating new secondary school can be achieved. In the weighted overlay percentage of influence for each factor was assigned with settlement data having 50 per cent since new secondary school should be built close to settlement, land use/ land cover 35 per cent, and school data 15 per cent because new schools are to be built away from existing schools. The suitability map is shown in figure 4.

Results and Discussion

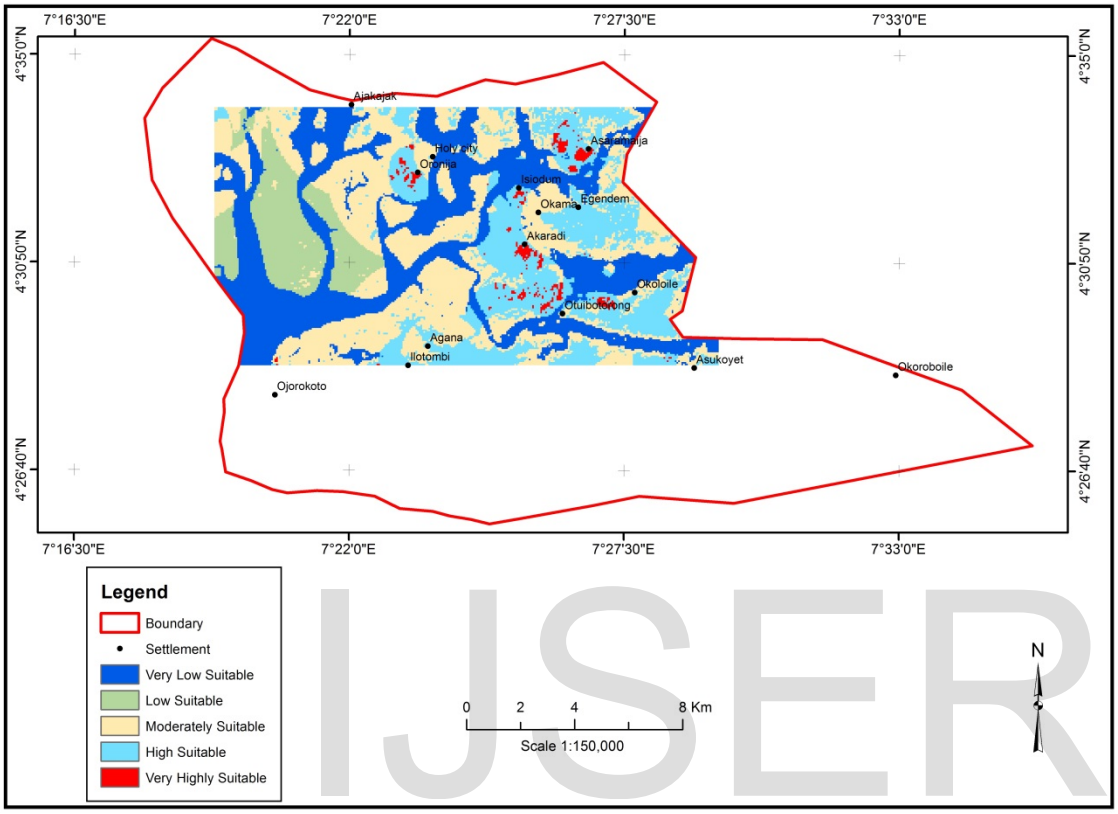

Figure 4.Suitability map of the area.

The suitability map was position on the northern part of the map where there was higher concentration of settlements and in the southern part empty area exists due to absent of settlements as a result of proximity to ocean. This condition depicted the behaviour of Euclidean distance for both settlement and school data. The output suitability map was rank as very highly suitable with value 5, high suitable with value 4, moderately suitable with value 3, low suitable with value 2, and very low suitable areas with value 0. The very highly suitable areas are represented in red colour on the suitability map and settlements affected include Oronija, Isiodum, Akaradi, and Asaramaija. Of these settlements Oronija, Isiodum, and Akaradi are towns situated on isolated land with the only means of transportation to other settlement that have secondary school as water. It took secondary school student to paddle through Rivers before getting to school. To paddle from Oronija to Ibotirem secondary school may take up to 40 minutes or more and to paddle from Akaradi to Unyeada secondary school may take up to 30 minutes, and this situation may not encourage zeal for secondary school education after primary school at home. Base on this analysis the most suitable site for siting new secondary school are Oronija, Akaradi, and Isiodum because they have land mass and population to accommodate secondary school and farthest from settlements with schools.

The second ranking is high suitable area which is location that are not slightly closer to existing schools and some of these settlements include Egendem, Agana, and Ilotombi. Egendem is closer to Unyeada and Asarama secondary schools compared to Oronija and Akaradi that are far from schools and as such represents high suitable location for siting new schools. Similarly, Aganna and Ilotombi are located within the neighbourhood of Agwutobolo secondary school which can be accessible by pupils. The least suitable site is represented by blue colour on the map and this is the rivers network in the study area and is rank very low suitable with value 0. This represents location that secondary school cannot be built due to hazardous terrain.

Conclusion

Accessibility to secondary school education is paramount to government when making policies on education. These policies cannot be achieved by layman point of view especially when it affects heterogeneous society like local government area, state, and the entire country. The introduction of remote sensing technique as a means of acquiring data in inaccessible areas without making any contact and geographic information systems for storing, maintaining, and analysing these data offers solutions in solving these problems. Selecting suitability location for siting new secondary schools in the study area the secondary data, settlement data, and land use/ land cover was needed to perform analysis. The condition for siting new secondary school was that it should be built close to settlements without secondary school. The data was processed and the result of multi-criteria shows that Oronija, Isiodum, Akaradi are the most suitable location for new secondary schools because of its location relative to existing schools. These results were achieved with the aid of GIS using ArcGIS 10.1 to performed multi-criteria for decision making. To curb secondary school dropout government at the local level should collaborate with state government to provide bridges across rivers and creeks to link settlements with secondary school.

For further study pupils enrolment in all the secondary schools should be added to the database to evaluate pupils- teacher ratio in each school. Also the population of all settlements without secondary school should be collected to ascertained areas that meet secondary school requirements.

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