

A web-based gis: area selection system for waste disposal in agusan del norte

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A Web-Based GIS: Area Selection System for Waste Disposal in Agusan Del Norte Presented to The Faculty of the Information Technology Department College of Engineering and Information Technology (CEIT) Caraga State University Ampayon, Butuan City Researchers: Michelle B. Caingles Sharine B. Batausa Chapter I Introduction 1. 1Background of the study Waste management is a global environmental issue which concerns about a very significant problem in today's world. Solid waste is the term used to describe non-liquid waste materials arising from domestic, trade, commercial, agricultural, industrial activities and from public services. ' One of the threats to global environmental health is solid waste generation. Land filling is now accepted as the most widely used method for addressing this problem in all countries of the world. However, appropriate site selection for land filling is a problem in waste management and therefore needs to be addressed', (Yahaya 2010). Municipal solid waste management (MSWM) is an ' important entry point for integrated urban management support (Schubeler 1996)'. It refers to the collection, transfer, treatment, recycling and disposal of solid waste in urban centers (Schubeler 1996). The primary objective of waste management is to give adequate protection to the general public and environment from harmful effects of waste (Yahaya 2010). Municipal solid waste management is a problem that is experienced by all countries in the world. It is an issue mostly witnessed in urban areas as a result of high surge in population growth rate and increase in per capita income thus posing a danger to environmental quality and human health (Javaheri 2006). Because of its nature, it has remained one of the major environmental problems man continues to face (Yahaya 2010). Using GIS it could be faster and easier to

identify and select a new suitable area for solid waste disposal. Geographical Information System (GIS) can be used as a decision support tool for planning waste management. GIS, as the work is carried in layers, there are least chances of confusion or error and the system is capable enough to coordinate between spatial and non spatial data. There are several areas where the municipal bodies are striving hard to provide best of their services for the betterment of the city. This can be achieved with the help of GIS which can handle different data forms like spatial as well attribute data simultaneously. It can also help manipulate data in the computer to simulate alternatives and to take the most effective decisions. This paper shows such alternatives by using GIS techniques to identify appropriate areas suitable for waste disposal at Agusan Del Norte. It provides a selection of environmentally friendly disposal sites, thus supplying reasonable convenient and administratively transparent solutions to the waste disposal problem.

1. 2 Statement of the Problem The cities and municipalities of Agusan Del Norte in the present time need to have an area for solid waste disposal which is far from the community, and some problems were noticed as follows:

- * There is a difficulty in identifying and selecting suitable areas for solid waste disposal in the cities and municipalities of Agusan Del Norte.
- * There is a possibility that some part of Agusan Del Norte have not yet been surveyed for a possible solid waste disposal space.
- * There is a need of an automated map for faster identification and easier selection of suitable areas.

1. 3 Objectives Upon observation on the problem stated above, the researchers have come up to the following objectives that could be the solution to the problem. Here are those:

- * To identify and select a suitable

areas for solid waste disposal in the province of Agusan del Norte using GIS.

* To survey the areas of Agusan Del Norte for possible suitable space for solid waste disposal. * To automate the map for the identification and selection of the area for solid waste disposal.

1. 4 Scope and Limitations

The aim of this study is to help the municipalities of Agusan Del Norte to identify and select new suitable areas for solid waste disposal using Geographic Information System (GIS).

1. 5 Significance of the Study

In the present condition of Agusan Del Norte solid waste management needs a big part of attention. As the population grows the percentage of solid waste is also rapidly increasing. Finding new suitable area for solid waste disposal far from the community can be a big help not just to the people but also to the local government for the betterment of the city. Modern technologies already exist and this Geographic Information System can be a solution to the problem Agusan Del Norte is experiencing nowadays.

Chapter II. Related Literature

This part of the paper sights the related previous studies, project and researches done in the other places.

2. 1 Solid Waste Management (SWM)

Management of Solid Waste in an efficient manner is one of the key challenges our cities are facing. For any given city, its management in environment friendly manner is a daunting task (Best Practices in e-Governance Ministry of Urban Development).

2. 2 Geographic Information System (GIS)

Technically, GIS is a set of software tools that is used to input, store, manipulate, analyze and display geographical information. GIS also may be a philosophy, a way of making decisions within an organization where all information is held centrally and is related by its location.

Geographic Information System (GIS) is a method to visualize, manipulate,

analyze, and display spatial data, " Smart Maps" linking a database to the map, it can also create, edit, query, analyze, and display map information on the computer (Nasser). " GIS is a system of computer hardware and software, design to allow users to collect, manages, analyse and retrieve large volume of spatially referenced data and associated attribute data collected from a variety of sources. " (S. Upasna & M. S Natwat., 2003) 2. 3

The role of GIS in solid waste management The role of Geographic Information Systems (GIS) in solid waste management is very large as many aspects of its planning and operations are highly dependent on spatial data. In general, GIS plays a key role in maintaining account data to facilitate collection operations; customer service; analyzing optimal locations for transfer stations; planning routes for vehicles transporting waste from residential, commercial and industrial customers to transfer stations and from transfer stations to landfills; locating new landfills and monitoring the landfill. GIS is a tool that not only reduces time and cost of the site selection, but also provide a digital data bank for future monitoring program of the site.

2. 4 Previous studies 2. 4. 1 Land Fill Site Selection for Municipal Solid Waste Management using Geographic Inormation System and Multicriteria Evaluation This project was conducted by Sani Yahaya, Christopher Ilori, Shittu Whanda J, and Jibril Edicha. This study aims to identify a suitable landfill site for waste disposal in Ibadan North Local Government Area of Ibadan, Nigeria. Geographical Information System (GIS) and Multi-criteria Evaluation (MCE) were applied in order to display and rank candidate sites. The analysis was limited to criteria that were selected and relevant to the area under investigation. The result obtained provides clear areas for landfill

sites in the study area and finally arrives at suitable areas. At the end of the analysis, two candidate sites were selected and were chosen as the best site using super decision software from the AHP component. Municipal authorities can now have ability to benefit from GIS and MCE solutions by leveraging on them to address the problem of waste management.

2. 4. 2. Suitable site determination for urban solid waste disposal using GIS and Remote sensing techniques in Kottayam Municipality, India Suitable site determination for urban solid waste disposal using GIS and Remote sensing techniques in Kottayam Municipality, India was done by Nishanth T., Prakash M. N., Vijith H. This paper deals with determination of suitable site for the disposal of urban solid waste generated from Kottayam Municipality and surrounding areas using GIS techniques. The GIS aided methodology presented here utilizes to create the digital geo database as a spatial clustering process and easily understood way of landfill process in Kottayam Municipality.

2. 4. 3 Selection of Landfill Sites for Solid Waste Treatment in Damaturu Town-Using GIS Techniques This paper was made by Ayo Babalola and Ibrahim Busu. Landfill has been recognized as the cheapest form for the final disposal of municipal solid waste and as such has been the most used method in the world. However, siting landfill is an extremely complex task mainly due to the fact that that identification and selection process involves many factors and strict regulations. For proper identification and selection of appropriate sites for landfills careful and systematic procedures to be adopted and followed. Wrong siting of landfill may result in environmental degradation and often time public opposition. In this study, attempts have been made to determine sites that are appropriate for landfill siting in

Damaturu town Nigeria, by combining geographic information system (GIS) and a multi-criteria decision making method (MCDM) known as the analytic network process (ANP) for the determination of the relative importance weights of factors (criteria). The land suitability output is presented from the less suitable to the most suitable areas. The final map produced shows the areas that are suitable for landfill siting. Based on the analysis fourteen sites were identified to fulfill the required criteria, however, only even met the land availability criteria fo twenty hectares and above. The result showed the efficacy of GIS and multi-criteria decision making method in decision making.

Chapter III. Methodology

3. 1 Study Area Agusan Del Norte is divided into 11 municipalities. The highly-urbanized city of Butuan, being geographically located in Agusan Del Norte, is traditionally grouped with the province, although it is governed independently from it. Cabadbaran City is the officially-designated capital of the province per Republic Act 8811, which has a total barangays of 31, area of 311. 02 km², population of 55, 006 and population density of 177 per km². Total Area = 2, 730. 24 km² (1, 054. 15 sq mi)

Divisions Independent cities = 1 Component cities = 1
Municipalities = 10 Barangays = 116

Municipality	No. of Barangays	Area (km ²)	Population (2000)	Pop. density (per km ²)
Buenavista	26	473. 92	50, 612	107
Carmen	8	211. 42	17, 307	82
Jabonga	15	293. 00	20, 501	70
Kitcharao	11	212. 40	14, 604	69
Las Nieves	20	582. 69	21, 530	37
Magallanes	8	49. 91	19, 895	399
Nasipit	19	236. 36	35, 817	152
Remedios T. Romualdez	8	81. 47	13, 359	164
Santiago	8	286. 65	17, 925	63
Tubay	13	138. 00	17, 668	128

Figure 1. Map of Agusan Del Norte main roads Figure 2. Map of Agusan Del

Norte and neighboring provinces

3. 2 Data collection

For this study, data and information from different sources were collected and integrated for the study area. Most of the information gathered was taken from the internet for the meantime, and also from the previous studies done in other places in relation with this project.

3. 3 Siting criteria

There are a lot of important factors to consider in selecting a dumpsite for solid waste disposal. Due to information constraints the researchers only used the available gathered information to come up with these criterias:

- 300 meters away from the main road
- areas less than or equal to 230 square meters based on the contour map
- minimal noise contamination from truck movement
- 300 meters away from water bodies
- located in area not crossed by major roads.
- not located in areas of active agricultural land or near land under development.
- 20 kilometers away from the nearest population centers

These criteria were also used before in Niamey, Niger to locate and select a suitable landfill for solid waste.

3. 4 Conceptual Framework

The generation of criteria bears close resemblance to the generation of objectives (Rahman, Sultana, Hoque , 2007). There are two approaches deductive and inductive for generating the criteria. In deductive approach some general criteria are developed and each criterion must then be specified in terms of one or more evaluation criteria. The inductive approach starts with an inventory of all features of the choice-possibilities. In addition, these features are grouped and eventually aggregated in such a way that a set of evaluation criteria arises. Though there are numerous criteria used for evaluation. The ones used here presents local factors. These are classified as environmental, economical, social and technical operational.

Christopher Ilori, Shittu Whanda J, Jibril Edicha 2010. Land Fill Site Selection for Municipal Solid Waste Management using Geographic Information System and Multicriteria Evaluation [2] Shaikh Moiz Ahmed 2006. Using GIS in Solid Waste Management Planning: A case study for Aurangadab, India [3] Eng. Liana Nasser. Geographic Information System & Solid Waste Management [4] Nishanth T., Praskash M. N., Vijith H. 2010. Suitable site determination for urban solid waste disposal using GIS and Remote sensing techniques in Kottayam Municipality, India [5] Yaw A. Twumasi, Andrew Manu, Tommy L. Coleman, and A. Moustapha. Use of Geo-Spatial Data for Sustainable Management of Solid Waste in Niamey, Niger [6] V. Sengtianthr, Lao PDR 2004. Solid Waste Management in Urban Areas of Vientiane Capital City using GIS [7] Ayo Babalola, Ibrahim Busu 2011. Selection of Landfill Sites for Solid Waste Treatment in Damaturu Town-Using GIS Tehniques [8] Ellen Mickel 2009. Using GIS to Locate Areas for Growing Quality Coffee in Honduras [9] M. Waste (2000). Best Practices in e-Governance Ministry of Urban Development Web Page URLs <http://proceedings.esri.com/library/userconf/proc98/proceed/to150/pap107/p107.htm> http://maps.google.com/maps?hl=en&gbv=2&bav=on.2,or.r_gc.r_pw.r_qf.,cf.osb&biw=1348&bih=642&q=butuan+city+philippines&um=1&ie=UTF-8&hq=&hnear=0x3301e998b1704fcf:0x85e95810384ea2d6,Butuan+City,+Philippines&ei=1FfPT_vABczomAXWq_m-Cg&sa=X&oi=local_group&ct=image&ved=0CKkBELYD