

An Application of Geographic Information System to Select Areas for Sanitary Landfill in Bang Nok-Khwaek Municipality

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Abstract—The study of Sanitary landfill in Bang Nok-khwaek municipality consists of two procedures. First, to survey and create the spatial database by using physical factor, environmental factor, economical factor and social factor to follow the method of Geographic information system: GIS, second, to analyze the proper spatial for allocating the sanitary landfill in Bang Nok-khwaek municipality by using Overlay techniques to calculate the weighting linear total in Arc GIS program.

The study found that there are 2.49 sq.km. proper spatial for the sanitary landfill in Bang Nok-khwaek municipals city which is 66.76% of the whole area. The highest proper spatial is 0.02 sq.km. which is 0.54%, The high proper spatial is 0.3 sq.km. which is 8.04%, the moderate spatial is 1.62 sq.km. which is 43.43% and the low proper spatial is 0.55 sq.km. which is 14.75%. These results will be used as the guideline to select the sanitary landfill area in accordance with sanitation standard for Subdistrict Administrative Organization and Subbdistrict Municipality in Samut Songkhram province.

Keywords—An application of Geographic Information System, select areas for sanitary landfill and Bang Nok-khwaek municipality.

I. INTRODUCTION

MUNICIPALITY is the local administrative organization who takes full responsibility in solid waste disposal according to the law of the kingdom of Thailand. In order to take action, the local administrative organization needs cooperation to process the method in the right way. However, this was against by local people because most of the sanitary landfills areas prepared by the Municipality were tenanted private spaces and local public spaces. It is because there was lack of supportive information to plan to select the appropriate area which was supposed to demonstrate the physical context, economical context, social context and environmental context fully and correctly.

The technologies that applied for supportive data management (Spatial data) are Geographic information database and storage, process, analysis and display devices. The geographic information system needs many supportive information formats. To analyze and to set conditions on data needs an up-to-date database which includes spatial information overlaid and stored systematically in keeping with geographical coordination, and be able to evaluate statistical data related to spatiality.

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Managing Geographic Information System allows all spatial data to be analyzed in the same time that the results must be corrected and accurate in conformation with scientific principle which can be proved and referred. [1]

Bang Nok-khwaek municipals city, Bang Khonthee district, Samuth Songkhram province is 3.73 square kilometers, contains with 674 households and 1,871 householders.

Mostly, householders in Bang nok-khwaek municipality run the small and medium entrepreneur including tourism industry such as coconut oil refinery, furniture factory, bakery shop, bristle fiber industry, slaughterhouse, home stay, resort and 100 years old floating market. These industries make a huge bunch of waste in the area. It is said in Reference [2] report that the amount of waste is 3 tons a day. There is sanitary management system that each day, the waste collection vehicle will collect and move the waste to be disposed in the area allocated by the municipality who rent the private space 45 kilometers away from the community area. Nevertheless, Bang Nok-khwaek municipality can dispose only 50-60% of the waste each day because they have not analyzed the proper space for disposing which causes waste accumulation in the area and also causes a lot of expense in each month as they need to pay average 45,000 THB every month for transportation and area rental cost. This leads to some problems because municipality cannot dispose all waste in a day and to let them in the rental area was against by nearby householders. The municipality is trying to solve these problems since the waste is increasing. However, the huge waste dump leads to other problems that are the lack of operation staff to work on it and the lack of tools and machines to felicitate the work. The major problem is there is lack of proper space to depose the waste which has less affection on environment of the community, said Mr. Sunan Noonoi, the former chief of village moo 3 Bang Nok-khwaek sub district.[3]

Thus, this study focuses on searching for the proper area for the effective sanitary landfill in Bang Nokkhwaek municipals city by using collected information based on physical, environmental, economic and social factor.

II. OBJECTIVES OF STUDY

- A. To explore and create spatial database according to Geographic information system (GIS) standard.
- B. To apply and analyze the spatial database collected from exploring in order to search for proper sanitary landfill in Bang Nok-khwaek municipals.

III. METHODOLOGY AND DATA ANALYSIS

The study aims to search for the proper sanitary landfill in Bang Nok-khwaek municipals city by using physical, environmental, economic and social factor as the database and the model of analyzing process are as follows:

A. Specifying Factors

To specify factors that have an effect on searching for sanitary landfill contains with the factors that applicable for searching the sanitary landfill; gradient, stratum, soil texture, infiltration, groundwater level, soil fertility, soil type, basin, rainfall and the depth of soil area.

It also needs to study inapplicable factors for considering searching for the sanitary landfill; basin level, national park area, wildlife refuges, concession area, military zone and limestone area.

Factors that used for specifying buffer zone: Community area, Ancient area, Water pond and irrigation area, main road and minor road, and natural water source. [4]

B. Managing and Storing Data

To manage and store data needs to record them in the GIS program on computer, digitize spatial data or specify position by using Global Positioning System; GPS and descriptive data. After inserting data on the program, it is necessary to check data and update them at all time in order to correct the mistake and connect spatial data and descriptive data together regarding to data analyzing step.

C. Evaluation and Analyzing

To evaluation and analyze the proper area is masking the inapplicable area by using study factors as information and also masking the Buffer zone by using study factors as information.

The remained areas that are not masked will be studied again by using Overlay Techniques to estimate weighting Linear Total as follows [5]:

$$S = W_1R_1 + W_2R_2 + \dots W_nR_n \quad (1)$$

where S is the proper area weighting total; $W_{1\dots n}$ is weighting of weighting factor 1-n; $R_{1\dots n}$ is weighting of rating factor 1-n.

Weighting factor and Rating factor are provided by geography specialists who specialize in natural resources and environment. Then, divide the weight total as norm reference to 3 groups: the high proper area, the moderate proper area and the low proper area. After that, use the data dispersion to specify the range of weight total [6].

The high proper area, weight total is higher than:

$$X + SD \quad (2)$$

The moderate proper area, weight total is between:

$$X - SD \leq S \leq X + SD \quad (3)$$

The low proper area, weight total is lower than:

$$X - SD \quad (4)$$

V. RESULT AND ANALYSIS

The study of the proper area for sanitary landfill in Bang Nok-khwaek municipals city is the combination of science and social science that shows the results as following;

The result of Overlay Analysis uses weighting linear total evaluation on the Weighting total and Rating total provided by specialists to divide into 3 groups of area which are the high, moderate and low proper area.

The result demonstrates that the mean of weighting total is 76, the standard deviation is 42 and the factors evaluation result finds that the highest proper area weighting total is higher than 141, the high proper area weighting total is between 99-140, the moderate proper area weighting total is between 59-98, the low proper area weighting is lower than 58.

The map of proper area for sanitary landfill is created by using the results as shown in Fig. 1.

V. SUMMARY OF RESEARCH

The study of searching the sanitary landfill in Bang Nok-khwaek municipals city by using Geographic information system: GIS to overlay data in order to mask the improper area and Buffer zone shows that there is very little of proper area for managing the sanitary landfill. This leads to the difficulty of allocating the area for the process. Therefore, it needs these spaces to evaluate the possibility to create the sanitary landfill. However, if it is impossible to do so, it is necessary for the municipals to find another process of solid waste disposal instead of sanitary landfill. Reference [7] shows the research work that an area in each municipal cities in Ubonratchathani had the very few remaining landfill facilities. The concept to find potential area to establish the joint center of refuse disposal occurred for saving the budget and solving the problem of lacking proper refuse disposal area which should be generated physically by nature.

TABLE I
 SPECIFYING THE DISTANCE OF BUFFER ZONES CLASSIFIED ACCORDING TO THE DATA

Data	Distance of buffer zone (Meters)
1. Community area	300
2. Ancient area	1000
3. Water pond, Waterworks, Irrigation area	700
4. Natural water source	300
5. Main Road	1000

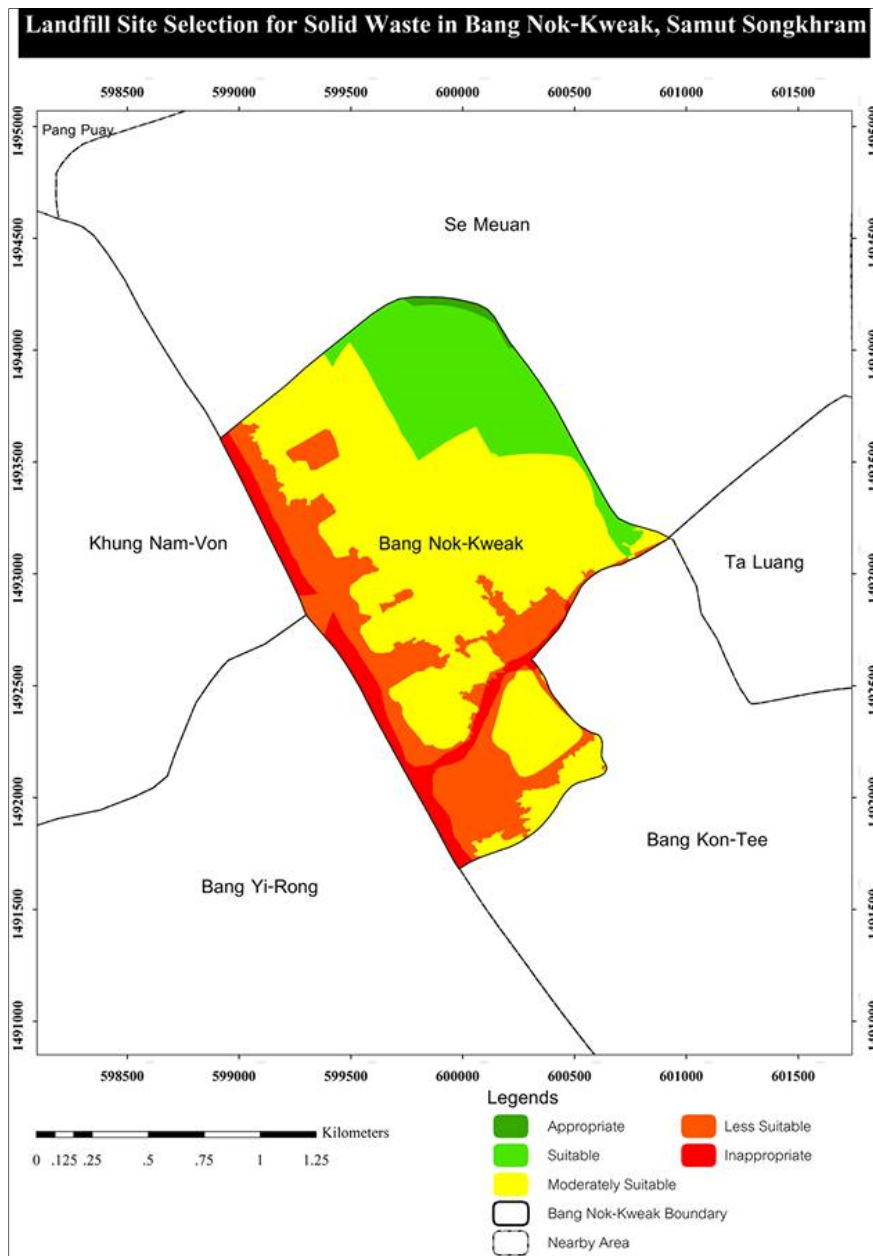


Fig. 1 The map of proper area for sanitary landfill created by using the results as data

TABLE II
 DEMONSTRATE THE PROPER AREA FOR SANITARY LANDFILL IN BANG NOK-KHWAEK MUNICIPALS

The proper area	Area (Sq.Km.)	Percentage
Highest	0.02	0.54
High	0.30	8.04
Moderate	1.62	43.43
Low	0.55	14.75
Inappropriate	1.24	33.24
Total	3.73	100.00

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REFERENCES

- [1] SiripornKamontham, *Introduction of geographic information system*. Bangkok: Siam N&BP publishing Co.Ltd., 2003, pp. 62-75.
- [2] Public Health and environmental Unit, *Annual Report 2012*. Samutsongkram: Bang Nok-khwaek municipality, 2012, pp 14.
- [3] SunanNoonoi, the former chief of village moo 3, BangNokkhwaek sub district. (interview) 18th May 2013.

- [4] Department of Environmental Quality Promotion, *Method of Refuse Disposal*. Bangkok: Lard Praew- teachers association's printing House, 1999.
- [5] SuphetJirakajohnkul, *Geographic information system and manual of ArcGIS Desktop program*. Bangkok: SR printing mass product Co.Ltd. 2006, pp. 160-167.
- [6] ManasSuwan, *Quantitative techniques for Geography*. Bangkok: OS printing House, 1998, pp. 180.
- [7] WichitPhumjan, "Geo-informatics for Potential Site Selection of Landfill Construction Center of Tambon Municipal, Ubonratchathani Province." *Geo-Informatic in Ecology and Environment* Bangkok: United Production printing House, 2003, pp.132-144.