AN APPLICATION OF GIS FOR A SUITABILITY ASSESSMENT OF FACTORY PLACEMENT IN LAM THAP DISTRICT, KRABI PROVINCE

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ABSTRACT

In this study, a geographic information system was used to determine land suitability for locating type 1, type 2 and type 3 factories in Lam Thap District, Krabi Province, Thailand. Environmental factors used to assess suitability were proximity to roads, rivers, urban areas, public areas, watershed areas, forest areas, wildlife areas, as well as land use type. Numerical weights of the main factors were assigned and suitability rankings were derived from a survey of experts as well as legal infommation relating to factory placement, A series of overlays were conducted and ranks from each layer were combined additively to form a final suitability score for all type of factories. The results from this study suggest that the total area of marginally, moderately and highly suitable land for type 1 factories was 4.42 % of the total study area, 0.10 % and 0.75 % respectively. The remaining area of 94.73 % was considered unsuitable for factory type 1 placement. The total area of marginally, moderately and highly suitable land for type 2 factories was 2.36 %, 0.72 % and 0.11 % respectively. The remaining area of 96.81 % was considered unsuitable for factory type 2 placement. The total area of marginally, moderately and highly suitable land for type 3 factories was 2.94 %, 2.45 % and 0.87 % respectively. The remaining area of 93.74 % was considered unsuitable for factory type 3 placement. A comparison of the area of suitable land for all factory type, reveals that highly suitable land for type 3 factories covers more area than other type of factories. High suitability (0.87 %) for factory type 3 was due to the fact that much of the land is abandoned area or still far away from urban areas, public areas, forest areas, wildlife areas, roads and rivers.

Keywords: geographic information system, suitability assessment

Introduction

The National Research Council of Thailand (2011) formulated the eighth National Research Policy and Strategy (2012–2016), which commanded high quality research towards a new body of knowledge to develop the country. This supports the potential to improve research works and new innovations as well as enhancements to new knowledge in social science and geo-information for a balanced and sustainable national development.

Krabi Province has been giving the importance to the development of the green world under the concept of Krabi Goes Green. It is employing strategies to stabilize agricultural production, e.g., supporting Lam Thap District to be rubber and palm plantations and a centre for other agricultural products. The province also supports the on-going development of factory that facilitates agricultural productions, which are pollution-free and friendly to environment and the community (Krabi Provincial Hall, 2013).

An evaluation conducted by the Department of lndustrial Works indicated that the level of pollution caused by factories located in Lam Thap District is not at a critical level at the moment. However, data indicates that more than 50 % of the factories produce some pollution and are likely to worsen the problem to a serious level. To control and protect against the pollution problems in the near future it is important that the environmental factors should be considered for factory zoning and planning (Krabi Industrial Office, 2016).

The people in the area have suffered so heavily from the plant latex and palm oil mill that they complained. About 100 of them signed a petition and handed it to the district office, the province's industry office, the governor of Krabi Province to request them to solve the problem (Dailynews, 2015). The researcher conducted a field trip to study the issue and met with the public. It was found that Lam Thap has been facing with environmental problems caused by factories. The local people wanted to have a study that explores and searches for a more suitable location for the industry base. Results can be used to prevent the expansion of the factories and protect agricultural areas from the encroachment of urban and industrial activities in the future. The Geographic Information System (GIS) is a technology that can analyse the suitability of the industry. Therefore, the GIS will be applied in this study in conjunction with the analysis of the factory laws. This is in order to manage industry effectively and in accordance with the measures to protect the environment and to maximize the benefits of all kinds.

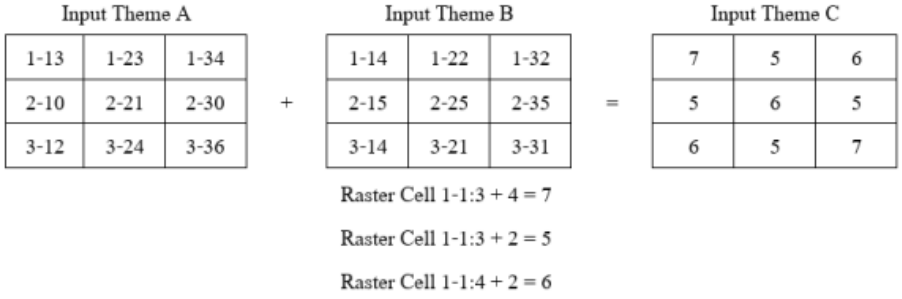
This research article is purposed to present suitability assessment of factory placement in Lam Thap District, Krabi Province, Thailand using the GIS which is a spatial data management system. It is useful for the Land Suitability Evaluation, which is a tool used extensively by the SIEVE Analysis technique which converts the factor data into a geographic map and then all of the maps are overlaid according to Boolean algebra. The areas with higher scores will be overlaid on a geographic map. The result of the analysis is shown on a geographic map. This research article is divided into 4 parts: the introduction, the methods, the results and the conclusion.

Methods

In this study, a geographic information system was used to determine land suitability for locating type 1, type 2 and type 3 factories in Lam Thap District, Krabi Province, Thailand. (Type 1 factories do not produces any pollution, type 2 produces relatively little pollution and type 3 produces the most). Environmental factors used to assess suitability were proximity to roads, rivers, urban areas, public areas, watershed areas, forest areas, wildlife areas, as well as land use type. Numerical weights of the main factors were assigned and suitability rankings were derived from a survey of experts as well as legal infommation relating to factory placement (Table 1 - 3) , After that, the maps are overlaid, which is called (Overlay Analysis) based on Boolean algebra (NC Division of Coastal Management, 2005; Baniya, 2008; Mohammad, & Mohammad, 2014). GIS is used in this technique for analysis, and the concept is shown in Figure 1.

The first step was identification of relevant datasets for the study. In this, the factors are roads, rivers, urban areas, public areas, watershed areas, forest areas, wildlife areas and land use. These datasets were collected from remote sensing data processing. Following this, data editing and creation of a database for efficient data management was done. The various factors affecting land suitability were then processed, standardized, weighted and overlaid to produce individual suitability maps and a final suitability map (Department of Natural Resources and Mines, 2013).

Figure 1: Overlay SIEVE Analysis using addition



Source: NC Division of Coastal Management (2005)

Next, the suitability score of all factors is determined. “S is the Total Suitability Score, “n” is the number of factors and “R” is the weight of the suitability score of each factor from 1 to n as equation (1) (Victorian Government, 2006).

$$S = \sum_{i=1}^{n} R_i \qquad (1)$$

Table 1 The factor of land suitability for locating type 1			
Factor	Value	Score	Weight
Road	0 - 50	0	2
	50 - 100	3	
	100 - 200	2	
	> 200	2	
River	0 - 50	0	3
	50 - 100	2	
	> 100	2	
Urban Area	Urban Area	0	3
	0 - 50	2	
	> 50	2	
Public Area	0 - 50	0	4
	> 50	2	
Land Use	Village	0	3
	Paddy Filed	1	
	Orchard	1	
	Farm House	2	
	Open Space	3	
	Wilderness Area	3	
	Orchard / Village	2	
	Other	2	
Conservation Area	Watershed 1 and 2	Restricted	
	Forest		
	Wildlife		

Table 2 The factor of land suitability for locating type 2			
Factor	Value	Score	Weight
Road	0 - 50	0	2
	50 - 100	2	
	100 - 200	2	
	> 200	2	
River	0 - 50	0	3
	50 - 100	2	
	> 100	2	
Urban Area	Urban Area	0	3
	0 - 50	1	
	> 50	2	
Public Area	0 - 50	0	4
	> 50	2	
Land Use	Village	0	3
	Paddy Filed	1	
	Orchard	1	
	Farm House	2	
	Open Space	2	
	Wilderness Area	3	
	Orchard / Village	1	
	Other	2	
Conservation Area	Watershed 1 and 2	Restricted	
	Forest		
	Wildlife		

Table 3 The factor of land suitability for locating type 3			
Factor	Value	Score	Weight
Road	0 - 50 50 - 100 100 - 200 > 200	0 2 2 3	3
River	0 - 50 50 - 100 > 100	0 1 2	4
Urban Area	Urban Area 0 - 100 > 100	0 1 3	5
Public Area	0 - 100 > 100	0 3	5
Land Use	Village Paddy Filed Orchard Farm House Open Space Wilderness Area Orchard / Village Other	0 1 1 2 2 3 1 2	4
Conservation Area	Watershed 1 and 2 Forest Wildlife	Restricted	

The area then is divided, this research article divided the area into 4 levels (or 4 intervals): highly suitable, moderately suitable, marginally suitable and unsuitable area (Table 4 - 6).

Table 4 Suitability level classes (type 1)	
Suitability	Score
Highly Suitable	33 - 35
Moderately Suitable	30 - 32
Marginally Suitable	27 - 29
Unsuitable	6 - 26

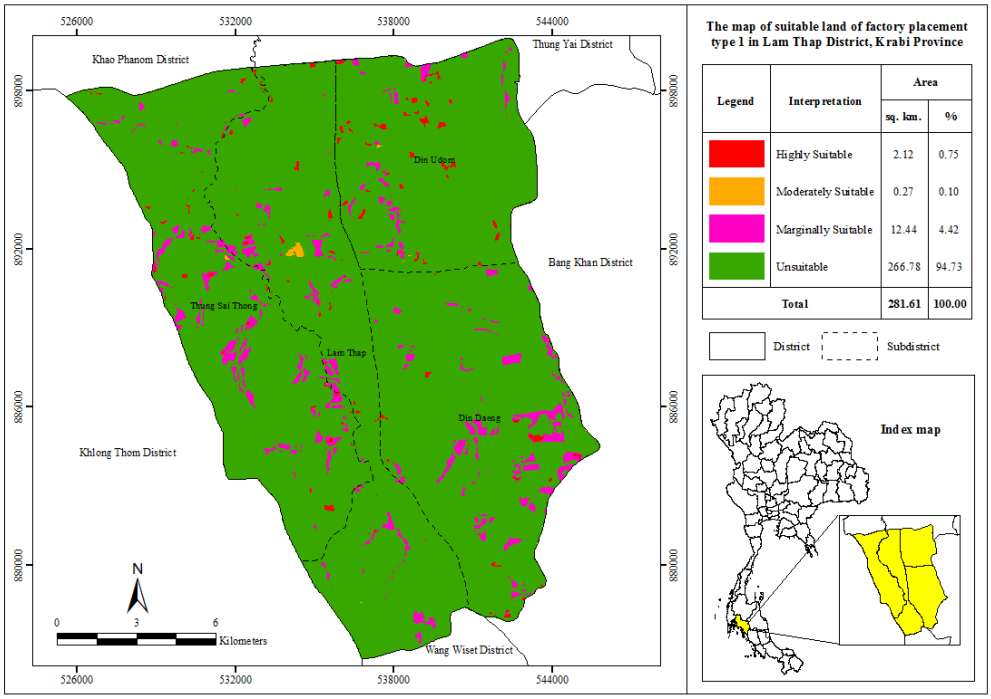
Table 5 Suitability level classes (Type 2)	
Suitability	Score
Highly Suitable	30 - 33
Moderately Suitable	27 - 29
Marginally Suitable	24 - 26
Unsuitable	3 - 23

Table 6 Suitability level classes (type 3)	
Suitability	Score
Highly Suitable	50 - 59
Moderately Suitable	43 - 49
Marginally Suitable	34 - 42
Unsuitable	3 - 33

Results

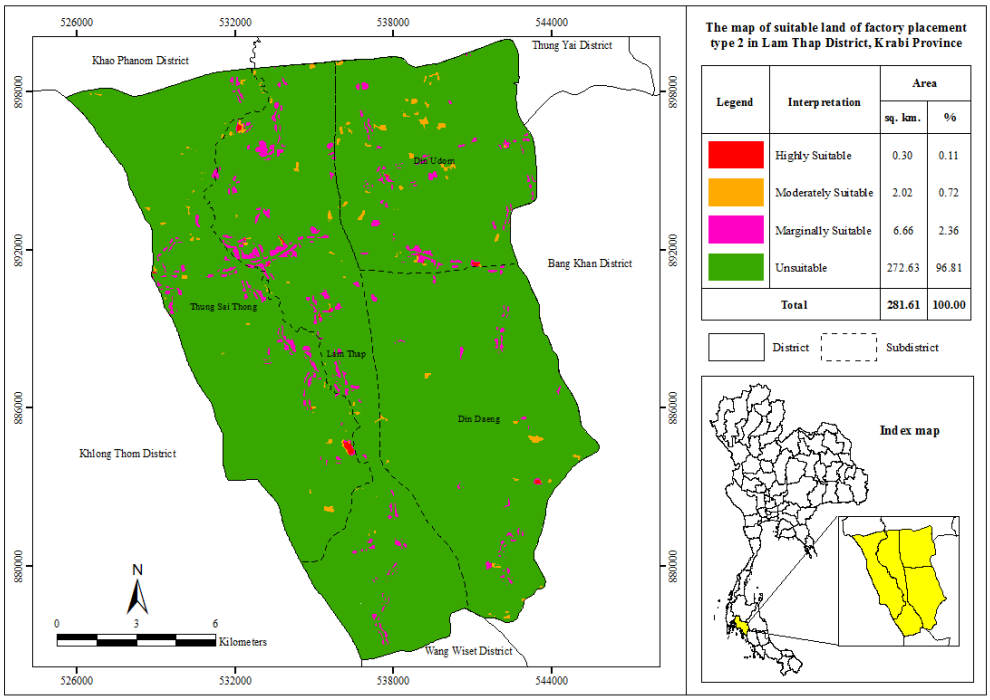
The results from this study suggest that the total area of marginally, moderately and highly suitable land for type 1 factories was 12.44 km^2 or 4.42 % of the total study area, 0.27 km^2 or 0.10 % and 2.12 km^2 or 0.75 % respectively. The remaining area of 266.78 km^2 or 94.73 % was considered unsuitable for factory type 1 placement (Figure 2). The total area of marginally, moderately and highly suitable land for type 2 factories was 6.66 km^2 or 2.36 %, 2.02 km^2 or 0.72 % and 0.30 km^2 or 0.11 % respectively. The remaining area of 272.63 km^2 or 96.81 % was considered unsuitable for factory type 2 placement (Figure 3). The total area of marginally, moderately and highly suitable land for type 3 factories was 8.29 km^2 or 2.94 %, 6.89 km^2 or 2.45 % and 2.45 km^2 or 0.87 % respectively. The remaining area of 263.98 km^2 or 93.74 % was considered unsuitable for factory type 3 placement (Figure 4). A comparison of the area of suitable land for all factory type, reveals that highly suitable land for type 3 factories covers more area than other type of factories. High suitability (0.87 %) for factory type 3 was due to the fact that much of the land is abandoned area or still far away from urban areas, public areas, forest areas, wildlife areas, roads and rivers.

Figure 2: The map of suitable land of factory placement type 1



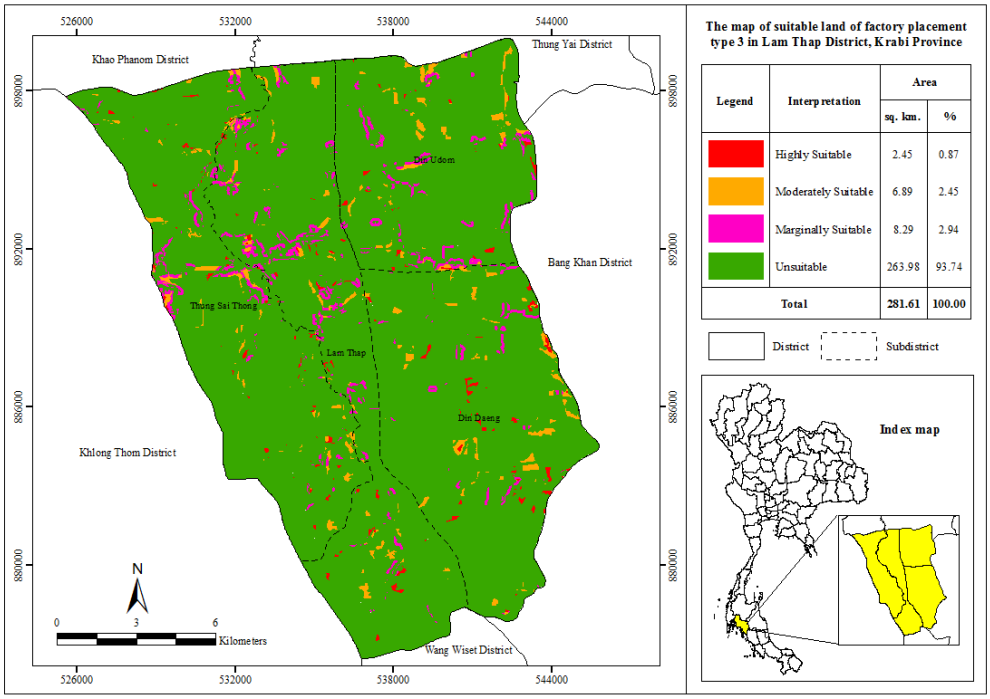
Source: Author

Figure 3: The map of suitable land of factory placement type 2



Source: Author

Figure 4: The map of suitable land of factory placement type 3



Source: Author

Conclusion

This research article presents the land suitability for locating type 1, type 2 and type 3 factories in Lam Thap District, Krabi Province, Thailand. There are 8 main factors used for the analysis, including the road factor, the river factor, the urban area factor, the public area factor, watershed area factor, forest area factor, wildlife area factor and the land use factor.

A comparison of the area of suitable land for all factory type, reveals that highly suitable land for type 3 factories covers more area than other type of factories. High suitability (0.87 %) for factory type 3 was due to the fact that much of the land is abandoned area or still far away from urban areas, public areas, forest areas, wildlife areas, roads and rivers.

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Biography of Author

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