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Site Selection for Special Economic Zone using Spatial Planning with Strategic Environmental Assessment Application Case Study of Nongkai Province

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Abstract

This article presents site selection for special economic zone (SEZ) development at Nong Khai Province, and appropriate industrial type for the selected suitable SEZ site. The study steps consisted of spatial planning for site selection and industrial type by strategic environmental assessment (SEA). Spatial planning was started with 11 SEZ potential sites previously declared by Nong Kai Province. Then, 11 potential SEZ sites were screened out by excluding the area where have already been designated for other uses, including commercial area, tourism area, and industrial area; and with the criteria of industrial estate; 11 SEZ potential sites was cut down to 7 and 3 SEZ potential sites, respectively. Finally, overlaying of 3 SEZ potential sites on town planning map, only one SEZ site was classified as suitable SEZ site. It is Animal Raising Public area, Chai Ya Village, no 4, Sra Kai Sub-district, Sra Kai District, Nong Kai Province, covering total area of 718 rai or 115 hectares. Later, SEA was applied to assess the industrial alternatives proposed to such suitable site. Alternatives included no development of industrial (no action), all types of industries permission, only eco-industrial type permission. Impact assessment was performed through 3 implys; check list multi-criteria analysis indicators, impact matrices analysis for assessing impact score of alternatives. The maximum assessed impact score was calculated. With the maximum assessed impact score, eco industry was proposed to such defined suitable SEZ site

Keywords : Special Economic Zone; Spatial Planning; SEA; Eco-industry

Introduction

Sustainable Development Goals (SDG) are the world development framework after 2015. SDG has been continually designated by the United Nation after ending of the Millennium Development Goals (MDG). In accordance with the 70th session of the United Nations General Assembly, the 2030 Agenda for Sustainable Development and SDGs have been endorsed for the countries to implement and meet the sustainable development; economic, social and environmental perspectives for 15 years (September 2015- August 2030) [1]. Currently, Strategic Environmental Assessment (SEA) is the significant tool to drive the country to accomplish the SDG of the strategic level. SEA alleviates effectively systematic decision making for considering policy, plan and programs [2].

Under the 12th National Economic and Social Development Plan 2017-2021), SEA is considered as the major tool for Special Economic Zone (SEZ) defined in Strategy 9, Regional, Town and Economic Area Development [3]. National Economic and Social Development Board (NESDB) has initiated the SEZ particularly at the border area since 2000. SEZ has been established in order to develop the area in conformance with the potential area and the need of people as well as the good governance that will increase the economic competitiveness of the country.

Under the Committee of Social Economic Zone Policy, SEZ phase 1 has been designated for the area of Tak, Sra Kaew, Mukdahan, Trad and Songkla Provinces (declared on Jan 19, 2013); and SEZ phase 2 has been designated for Nongkai, Narathiwas, Chiangrai, Nakokn Panom and Kanchanaburi Provinces(declared on April 24, 2013) [4]. Although, SEZ is proposed to enhance the economy of the provinces along the border area, site selection of SEZ might not cover all concerning perspectives. It might consider only economic concern and geographical factors, but not social and environmental concerns. For geographical base, SEZ sites are considered in terms of advantageous toward transportation, border crossing, access to production factors, marketing, potential and readiness area for development, standing out production base, expansion opportunity, available infrastructures, finance, labor, no disaster, no stability effect, necessity or urgent need, memorandum of agreement of the countries. Along with SEZ development, particularly with the industrial estate development, site selection, raw material procurement, production, transportation, waste management are noted to cause environmental impacts that further impact to people living nearby relate social aspect or quality of life value. The suitable location for SEZ is primary need followed with the appropriate industrial type (environmental friendly industry) on the basis of sustainable considered as the balancing of three major pole; economic, social and environmental dimensions.

Regarding with SEZ plan, Nong Kai Province is the place designated for SEZ establishment. SEZ sites were firstly considered basing on the area of the state property or public area together with industrial estate criteria, the potential area located in 5 districts of 559,614 rai or 89,538 hectare. However, on the basis of sustainable development, the eco-SEZ (environmental and social friendly SEZ) is needed to re-consider for Nong Kai Province. In the implytime, the governmental policy has recently declared for application of SEA to SEZ. The concept of spatial planning (one of the SEA tools) proposed to identify the suitable SEZ site for Nong Kai Province, and appropriate industrial type using SEA approach (consisting of

alternative and participation) are therefore studied and presented herein.

Objective

The objectives of this work is to identify the suitable sites for SEZ using spatial planning approach and appropriate industrial type using SEA approach.

Methodology

Research methodology is as following

1. Preliminary study

1) Studying and reviewing secondary data of various documents including Policy of National Economic and Social Development, Environmental Quality Management Plan, Strategic Environmental Assessment, Policy of Special Economic Zone Development, National Logistic Policy and Strategic Plan, Socio Economic and Environment Status, and, Provincial and Provincial Cluster Development Plan; as well as relevant literature reviews and theories.

2) Reviewing 11 SEZ potential sites located in 5 districts previously declared by the Province.

2. Research study

1) Spatial planning for 11 SEZ potential sites with GIS application was performed as follows.

(1) Primary screening out against the criteria of excluding the area have already been designated for other uses, including commercial area, tourism area, and industrial area, called as the primary SEZ potential sites,

(2) Secondary screening out against the criteria of industrial estate (see below) for the primary SEZ potential sites; called as the secondary SEZ potential sites

Physical

- sufficient water quantity for water uses
- Soil is not suitable soil for agriculture
- area located near to the main road and readily access to road network

Environment

- area should locate far away water sources, for this study it should be away of the Mekong river, at least 200 meters.
- area is not located in the national park and wildlife sanction area, and conservative forest area
- area is not in the reserve wildlife habitat
- area is not at the crowded community area
- area (is not located near the conservative water resources and valuable ecosystem.

(3) Thirdly, overlaying of the secondary SEZ potential sites on town planning map, only one SEZ site was identified as suitable SEZ site.

2) SEA application

Assess the impact of the industrial type alternatives by SEA approach with following steps.

(1) Setting the indicators of economic, social and environmental dimensions by formal and informal check list for industrial type alternatives selection. This step included following sub-steps.

- proposing such mentioned indicators.
- consulting with the experts of economic, social and environmental indicators.

- collecting primary data (if needed) and secondary data for completeness of the indicators.
- consulting with the line agencies in the area for additional comments quality of data.

(2) Weighting the dimension and indicators using multi criteria analysis.

(3) Assessing impact of each alternative by impact matrices analysis as following calculation.

For each dimension of each alternative:

- multiplying weight score with impact score of each indicator, the result was impact assessed score
- Combining each impact assessed score to be sub-total impact assessed score of each dimension.

For three dimensions of each alternative

- Combining sub- total impact assessed score of each dimension to be total impact assessed score.

(4) Comparing total impact assessed score of each alternative, the output was the appropriate alternative site by considering the maximum total impact assessed score

Results

As declared by Nong Kai Province, 11 SEZ potential sites are presented in Table 1 and Figure 1. Such potential sites were res-studied to identify the suitable SEZ site.

Table 1 Preliminary Potential SEZ Using and Size of State Property Area or Public Area Industrial Estate Criteria

Name of Public Area	Location in Nong Kai Province			
	Sub-District,	District	Area (Rai)	Area (Ha)
1. Nata railway station	Nhong Kom Koa	Muang	219	35
2. Nong Kai railway station	Nhong Kom Koa	Muang	152	24
3. Nong Kai railway station (old)	Meechai	Muang	100	16
4. Animal raising area Koke Nong Pung, Pone Tan Village no 3	Kai Bok Whan	Muang	201	32
5. Industrial Estate	Kai Bok Whan	Muang	2,960	474
6. Pa Koke Yai Public Area (Plot 1)	Wat Luang	Pone Pisai	401	64
7. Pa Koke Yai Public Area (Plot 2)	Wat Luang	Pone Pisai	166	27
8. Animal raising area , Chai Ya Village, no 4	Sra Kai	Sra Kai	718	115
9. Koke Soke Dindang	Sra Kai	Sra Kai	700	112
10. Nong Mung, Ban Pone Sa	Ban Pone Sa	Ta Bo	259	41
11. Animal raising area, Tha Kathin Village, no 4	Ban Mho	Sri Chiang Mai	462	74

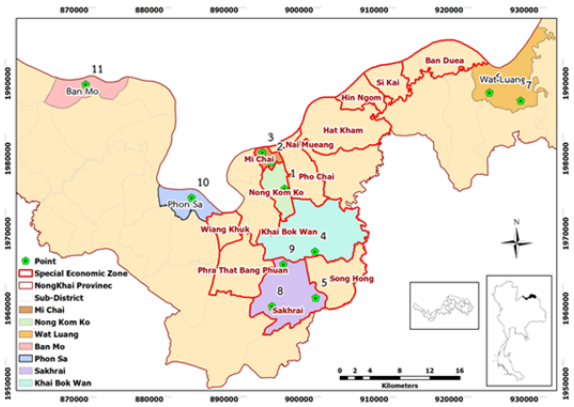
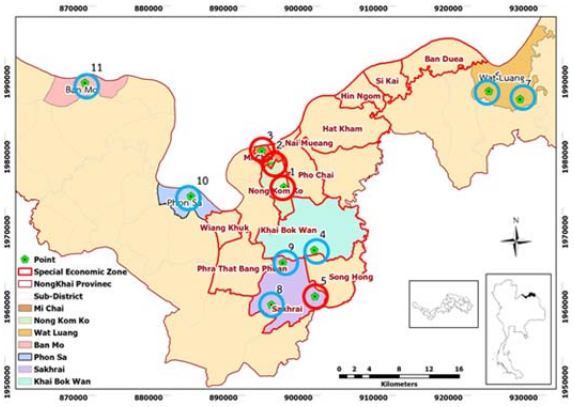


Figure 1 Eleven Potential SEZ Using State Property or Public area together with Industrial Estate Criteria

3. Study results

1) Spatial planning for the suitable SEZ site. This section is re-studied of such 11 potential SEZ site, which are subsequently described.

The first step was preliminary screening out the area have been already designated by the Provincial Development Plan for future use including commercial area, industrial area, tourism area; the output of this screening out was 7 screened feasible ZES potential sites (Figure 2).



Remark: The sites where were cut out

Figure 2 Seven screened SEZ Potential Sites

The second step was screening out the feasible SEZ potential sites to be the feasible alternative SEZ sites. With using industrial criteria with some modification and GIS application, 7 SEZ potential sites were cut down to 3 SEZ potential as shown in Figure 3.

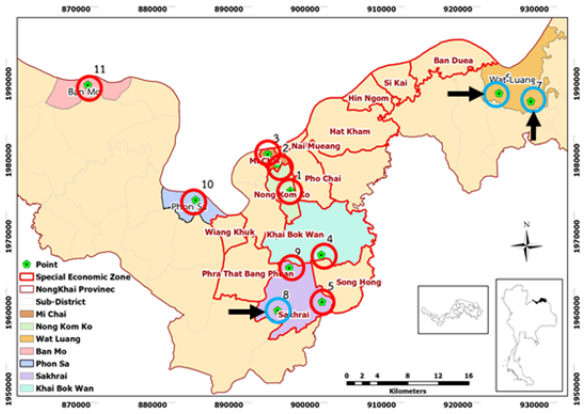


Figure 3 3 SEZ potential sites

Finally, overlaying of 3 potential SEZ sites on the town planning map, only one site was defined to be the suitable SEZ zone, which was Animal Raising Public area, Chai Ya Village, no 4, Sra Kai Sub-district, Sra Kai District, Non Kai Province, covering total area of 718 rai or 115 hectare. (Figure 4)

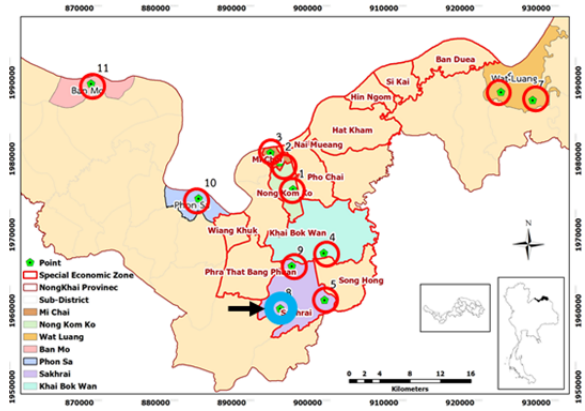


Figure 4 Sustainable SEZ site

2) SEA approach for appropriate industrial type.

Although the suitable SEZ site was accomplished, industrial types have to be considered as well. SEA tool (balancing of economic, social and environment dimension; alternatives, participation) was used on the principle of sustainable development. Three alternatives were proposed to carry out in such suitable SEZ site as follows; no industrial estate development (no action), all industrial types permission, and only eco-industry permission. Then, SEA approach with expert judgement carried out along SEA process was employed for assessing to appropriate industrial type as follows.

Firstly, indicators of each economic, social, and environmental dimensions were listed by formal and informal check list with expert comments [4, 5], indicators are listed in Table 2.

Secondly, weighting of each economic, social and environmental dimension, and weighting of indicators under each dimension were made by using MCA [6]. Weight of each dimension was assessed on the sustainable development concept which is the balancing of economic, social and environmental dimensions. In the other hand, weight score of each dimension can be evaluated by MCA with pairwise comparison as follows.

- Weight of column-indicator which is the same as row- indicator, the score was 0.
- Weight of column-indicator was higher than row- indicator, the score was 3.
- Weight of column-indicator was equal as row- indicator, the score was 2.
- Weight of column-indicator was lower than row- indicator, the score was 1.

For each dimension, weighting of all indicators was calculated using MCA based on pairwise comparison, as presented below, which is the example of environmental dimension presented herein.

- Weight of column-indicator which is the same as row- indicator, the score was 0.
- Weight of column-indicator was the highest compared to the row- indicator, the score was 5.
- Weight of column-indicator was higher than the row- indicator, the score was 4.
- Weight of column-indicator was equal as row- indicator, the score was 3.
- Weight of column-indicator was lower than row- indicator, the score was 2.
- Weight of column-indicator was the lowest compared to the row- indicator, the score was 1.

Weighting score of all indicators under each dimension are summarized in Tables 5-1, 5-2 and 5-3, respectively.

- Thirdly, impact assessment of the alternative based on matrices analysis, the assessed impact score are calculated as exampled for environmental dimension shown in Table 6, of which the impact score is assessed as below. Impact score 0.00-0.20 imply the positive impact is the lower level
- Impact score 0.21-0.40 imply the positive impact is low positive
- Impact score 0.40-0.60 imply the positive impact is moderate level
- Impact score 0.61-0.80 imply the positive impact is higher level
- Impact score 0.81-1.00 imply the positive impact is the highest level

Total assessed impact score of alternatives are presented in Table 7.

Table 2 List of Indicators of Each Dimension

Economic Dimension	Social Dimension	Environmental Dimension
1. National GDP	1. Ratio of non-registered population	1. Sufficient water use for all sectors
2. Provincial GPP	2. Workers with social security	2. Surface water quality
3. Inflation rate	3. GINI coefficient	3. Groundwater quality
4. Tax collected by Revenue Department	4. Average household debt	4. Air quality
5. Unemployment rate	5. Ratio of illness	5. Capability to traffic accommodation
6. Economic growth of industrial sector	6. Adequacy and access to education	6. Sufficient of electrical service/energy
7. Economic growth of agriculture sector	7. Average education year of people	7. Capability of domestic solid waste management
8. Economic growth of service sector	8. Number of crimes against property	8. Capability of industrial waste
9. Economic value	9. Recreation area	
	10. Number of complaints to environment	

Table 3 Weighting of Economic, Social and Environmental

Dimension	**Economic**	**Social**	**Environment**
Economic	0	2	2
Social	2	0	2
Environment	2	2	0
Total	4	4	4
100	33.33	33.33	33.33

Table 4 Example of Weighting Score of Indicator Under Environmental Dimension

Indicators	1. Sufficient water use for all sectors	2. Capability of industrial waste	3. Groundwater quality	4. Air quality	5. Capability to traffic accommodation	6. Sufficient of electrical service/energy	7. Capability of domestic solid waste management	8. Capability of industrial waste
1. Sufficient water use for all sectors	0	2	2	2	2	2	3	3
2. Surface water quality	4	0	2	2	2	2	4	4
3. Groundwater quality	4	4	0	2	2	2	3	3
4. Air quality	4	4	4	0	3	2	4	4
5.Capability to traffic accommodation	4	4	4	3	0	2	4	4
6.Sufficient of electrical service/energy	4	4	4	4	4	0	5	5
7. Capability of domestic solid waste management	3	2	3	2	2	1	0	4
8.Capability of industrial waste	3	2	3	2	2	1	2	0
Total weight of each indicator	26	22	22	17	17	12	25	27
Weight of each indicator for social dimension score of 33.33	5.2	4.4	4.4	3.4	3.4	2.4	5.0	5.4

Remark Weight of each indicator = Total weight of each indicator/ Total weight of all indicator

Ex: Non-registered population indicator,

Total weight of each indicator = 26

Total weight of all indicator = 26+22+22+17+17+12+25+27 = 168

Weight of non-registered population = (26/168) x 33.33 = 5.2

Table 5-1 Indicators and Weighting of Economic Dimension

Economic Dimension	
1. National GDP	2.1
2. Provincial GPP	3.5
3. Inflation rate	3.2
4. Tax collected by Revenue Department	3.2
5. Unemployment rate	3.0
6. Economic growth of industrial sector	3.7
7. Economic growth of agriculture sector	3.5
8. Economic growth of service sector	3.2
9. Economic value	2.4

Table 5-2 Indicators and Weighting of Social Dimension

Social Dimension	
1. Ratio of non-registered population	3.2
2. Workers with social security	3.3
3. GINI coefficient	2.6
4. Average household debt	3.0
5. Ratio of illness	4.3
6. Adequacy and access to education	4.2
7. Average education year of people	4.1
8. Number of crimes against property	2.6
9. Recreation area	2.6
10. Number of complaints to	3.5

Table 5-3 Indicators and Weighting of Environmental Dimension

Environmental Dimension	
1. Sufficient water use for all sectors	5.2
2. Surface water quality	4.4
3. Groundwater quality	4.4
4. Air quality	3.4
5. Capability to traffic accommodation	3.4
6. Sufficient of electrical service/energy	2.4
7. Capability of domestic solid waste management	5.0
8. Capability of industrial waste	5.4

Table 6 Example of Impact Assessment of Alternatives Under Environmental Dimension

Indicator	weighting	alternative 1		alternative 2		alternative 3	
	Weighting Score	impact	score	impact	score	impact	score
1. Sufficient water use for all sectors	5.20	0.70	3.64	0.35	1.82	0.80	4.16
2. Surface water quality	4.40	0.55	2.42	0.40	1.76	0.80	3.52
3. Groundwater quality	4.40	0.55	2.42	0.40	1.76	0.70	3.08
4. Air quality	3.40	0.40	1.36	0.30	1.02	0.80	2.72
5. Capability to traffic accommodation	3.40	0.60	2.04	0.50	1.70	0.70	2.38
6. Sufficient of electrical service/energy	2.40	0.70	1.68	0.50	1.20	0.80	1.92
7. Capability of domestic solid waste	5.00	0.50	2.50	0.40	2.00	0.70	3.50
8. Capability of industrial waste	5.40	0.50	2.70	0.40	2.16	0.70	3.78
total	33.6		18.76		13.42		25.06

Table 7 Total Impact Assessment of Alternatives

Dimension	Weight	Alternative 1	Alternative 2	Alternative 3
Economic	33.33	16.30	19.80	19.81
Social	33.33	19.98	19.58	20.28
Environmental	33.33	18.76	13.42	25.06
Total	100	55.04	52.80	64.97

Conclusion

With spatial planning approach by GIS application on the designated criteria step by step; 11 SEZ potential sites preliminary declared by the Province had been cut down to one suitable SEZ site. Animal Raising Public area, Chai Ya Village, no 4, Sra Kai Sub-district, Sra Kai District, Non Kai Province, covering total area of 718 rai or 115 hectare. In order to accomplish the sustainable development for the suitable SEZ site, SEA approach for the proposed alternatives including no industrial development (no action), all industrial type permission, eco-industrial type permission. Academically, eco-industry is advantageous to the environment and social aspects but might not be economic aspects. With SEA tool, it has proved that eco industry is kind of balancing such three dimensions. Suitable SEZ with eco-industry would be the most important path of sustainable development.

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