Sustainability Indicators as a Key for Sustainable Development of Special Border Economic Zones

Saniwan Buaban, Vilas Nitivattananon*, and Sangam Shrestha

***Abstract*— *Many studies focused on the indicators to be used in 'ex-post assessment' to see the success of the Special Border Economic Zone (SBEZs). The indicators to identify the current baseline and foreseen key sustainability issues have been less considered prior complete launching of the programme. This paper aims to present the indicator development process, by integrating between top-down and bottom-up approaches, for applying the set of indicators for the preliminary assessment to Tak SBEZ, as a case study for SBEZ development in Thailand. The way to synchronize between the existing data and a new policy was highlighted. The study first gathered relevant information from key informants to scope down the assessment theme based on the likely issues. Then, the preliminary indicators were selected based on literature review from relevant case studies with experts and related agencies consultation. Time Series Regression Model was applied to test the applicability of each indicator with trend analysis. The study came up with 17 sustainability indicators in 9 main themes under sustainability framework. The study found that some indicators, such as natural disasters, were not applicable with trend analysis. The unclear trends could result in uncertainty in predicting the likely impacts in the next steps of the assessment.*

***Keywords*— Indicator development, Special Border Economic Zone, Stakeholders engagement, Sustainability assessment.**

1. INTRODUCTION

Rapid increase of regional development without proper planning has the potential to bring about negative social and environmental impacts and lead to unsustainable development of the areas. Unsustainable development patterns are those which cause environmental degradation, cultural conflicts, and increase resource constraints. On the other hand, well planned development has the potential to enhance the national economy and lead to outcomes where such development does not bring serious concern towards the sustainability. The Special Border Economic Zone (SBEZ), an economic incentive tool, is one example of a mechanism for regional development which has the potential to integrate sustainable practices into development planning in order to sustainably enhance national and regional economies.

The adoption of SBEZ policy has been rapidly growing among developing countries, especially those within the Greater Mekong Subregion. However, the long-term impacts of the use of SBEZs are still controversial. One problem is that to date, environmental and resources sustainability has often been disregarded in the SBEZ development process, as typical SBEZs have focused predominantly on economic growth. Many scholars criticize that under current practices, the majority of SBEZs have little consideration of social and environmental concerns [1]–[3].

For SBEZs to integrate sustainable development, the challenge of environmental and resources constraints are must be taken into consideration [4]. Further, it is critical to ensure that SBEZ development does not harm society and environment, and at the same time that it can continue to promote socially and environmentally responsible economic growth.

Beginning in 2015, Thailand has established 10 SBEZs border regions throughout the country. Because SBEZ policy is new for Thailand, there is currently no stainability assessment framework, criteria or indicators to justify the sustainability of SBEZ development [5]. In order to ensure the sustainability of these large-scale developments, it is necessary to conduct a comprehensive sustainability impact assessment prior complete launching of the programme (ex-ante assessment).

This paper aims to present the process of developing and analyzing sustainability indicators for performing sustainability impact assessments of SBEZ developments. Stakeholder engagement is central to this process, as is the integration of top-down and bottom-up approaches. This process can be used by planners and developers for the ex-ante assessment in order to inform further SBEZ development, as well as applied to other regional development projects that have a similar context.

2. LITERATURE REVIEW

2.1 'Special Border Economic Zone'

2.1.1 Concept and definition

The 'Special Border Economic Zone' (SBEZ) is under the umbrella of 'Special Economic Zone' (SEZ), which includes a wide range of zones, such as free trade zones,

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export-processing zones, enterprise zones, economic and technology development zones, high-tech zones, industrial parks, science and innovation parks, free ports, etc. [6]. Generally, SEZ is an area which has specific boundary, is managed by single administrative agency, provides physical benefits for investors in the zone, and has a separated customs area [1]. The general objectives of establishing SEZs are to 1) attract foreign direct investment (FDI); 2) serve as 'pressure valves' to alleviate large scale unemployment; 3) act as experimental laboratories for the application of new policies and approaches; and 4) support wider economic reform strategies [7].

SBEZ is a specific type of SEZ which has the characteristics of sharing a common border with one or more bordering countries, and acts as a gateway for borderlands interactions in terms of, for example, cross-border trade, people, tourism and car mobility [8]. The SBEZ between Mexico and the United States is a good example where the SBEZ was established to promote economic growth.

2.1.2 SBEZs worldwide

The concept of a Border Economic Zone (BEZ) emerged from the establishment of Maquiladora (the export manufacturing sector) in Mexico beginning in 1965 [9]. The goal of the Maquiladora structure is to promote employment along the border area between Mexico and the United States, as well as strengthen local and national economies in both countries [10]. Fifty years passed, SBEZs have expanded around the world. The Middle East and North Africa is one continent that SBEZ has been used as an economic strategy in many countries and that now it is proliferating across Asia.

In Asia, more than hundred SBEZs have been established. Vietnam and China provide successful examples for successful SBEZs for the Association of South East Asian Nations (ASEAN) countries. In Vietnam, there are 18 SBEZs, including 15 economic zones and 3 export-processing zones. United Nations Industrial Development Organization (UNIDO) selected SBEZs in Vietnam to be pilot project for eco-SBEZs [11]. Factors in the selection included that many industrial zones in Vietnam did not have a centralized wastewater treatment or sewage system, and these sites have historically released toxic emissions, such as SO_2, NO_x, including GHG. As a result of improvements which have taken place as part of the UNIDO pilot program, Vietnam's SBEZs have become a benchmark for other SBEZs in retrofitting the existing SBEZs to be an eco-SBEZ.

China is another example for successful SBEZs establishment and implementation. China has invested to establish local SBEZs, an SBEZ in Africa, as well as in partnership with Singapore in established China-Singapore Industrial Park in Suzhou [1]. The first SBEZ in China was developed in Shenzhen. As rapid economic development and urbanization transformed the city, the Shenzhen Special Economic Zone (SSEC) was confronted with water shortages, flood hazards, and water pollution. The eco-SBEZ concept was introduced to not only mitigate these serious problems, but also to contribute to a livable environment for local communities [12].

2.1.3 Thailand's SBEZs

In 2015, Thailand established SBEZs in 10 provinces along the national border with neighboring countries. The first phase SBEZs are located in Tak, Mukdahan, Sa Kaeo, Trat, and Songkhla provinces. The second phase SBEZs are located in an additional five provinces, namely Nong Khai, Narathiwat, Chiang Rai, Nakhon Phanom, and Kanchanaburi [13]. The main objective of the SBEZs established in these areas is to enhance the Thai national economy by developing production bases linked to ASEAN countries [14]. Thirteen industries have been targeted for SBEZs in Thailand including: agriculture and fisheries; ceramics; garments; textiles and leather; furnishings and furniture; gems and jewelry; medical equipment; automobiles and parts; electrical appliances and electronics; plastics; pharmaceuticals; logistics; industrial estates and tourism-related [15]. All defined industries have to be established within industrial estate zone [16].

According to The National Committee on Special Economic Zone Development (NC-SEZ) agreement, The Thai government will provide necessary infrastructures, investment incentives, cross-border management of daily foreign workers, one stop service centers, and other necessary activities to all designated SBEZs [13]. Therefore, the negative consequences from the development are unavoidable. It has been estimated that the SBEZ strategy could enhance the growth of international border trade, which accounts for approximately 30% of the country's total exports [15].

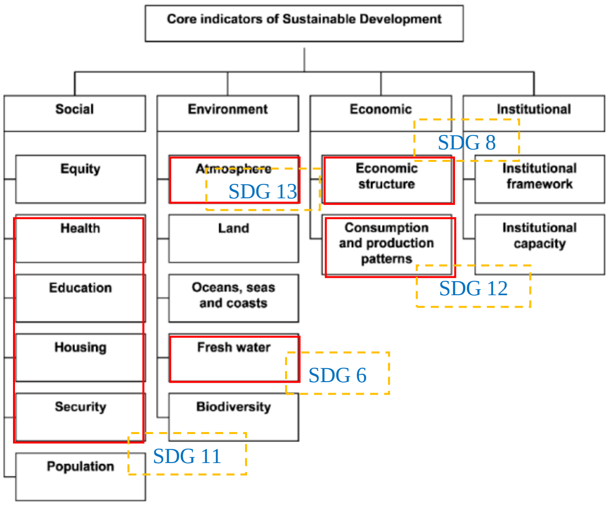
2.2 Sustainable development indicators

2.2.1 Purposes of indicators

The purpose of indicators is to provide information about system conditions and trends so that humans can understand and respond to them [17]. Indicators can be in the forms of Simple variable, Complex variable, or Composite index, depending on the purpose [18]. Indicators help us to answer questions on the amount, rapidity, and frequency of the variable. Using carefully selected indicators, it is possible to understand historic rates of change and exponential growth and extrapolate those trends into the future.

2.2.2 Indicator framework

The United Nations Commission on Sustainable Development (UNCSD) developed a sustainability indicator framework for evaluating governmental progress. It examines 15 main components under the themes of social, environmental, economic, and institutional aspects (Fig. 1).



Note: SDG 6 = Clean water & sanitation; SDG 8 = Decent work & economic growth; SDG 11 = Sustainable cities & communities; SDG 12 = Responsible consumption & production; SDG 13 = Climate action

Fig. 1. The UNCSD Theme Indicator Framework in Relation to SDGs for SBEZs [19]

Sustainable Development Goals (SDGs) (2015-2030) are built upon the Millennium Development Goals (MDGs), a set of eight international development goals for the year 2015 on the basis of the UNCSD framework. A number of SDG indicators relevant to SBEZs can be clearly linked to themes in the UNCSD indicator framework as identified in Fig. 1.

The individual components in development policies, plans or programmes (PPP) can often be viewed as a system. The selected indicators for monitoring and analyzing the system are interconnected under each theme of sustainability: environment, economy, and social. The Wuppertal sustainability development indicator framework is clear illustration for this concept (Fig. 2).

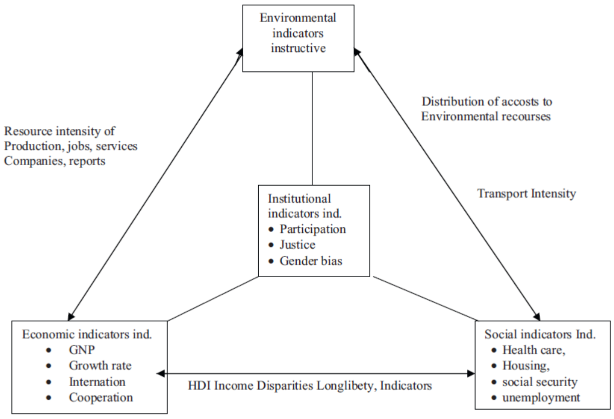


Fig. 2. The Wuppertal Sustainability Development Indicator Framework [18]

2.2.3 Indicator determination

The determination of indicators must take into account the information contained in the data set to be analyzed. The indicators selected for SBEZs should measure the sustainability of three dimensions: economic, social, and environment.

The matrix below can be applied to facilitate the selection of potential indicators from the list of UNSCD indicators of sustainable development. Those indicators which have higher relevance, and data available are the indicators which are chosen for use, wile those which are related are flagged to be modified (Fig. 3).

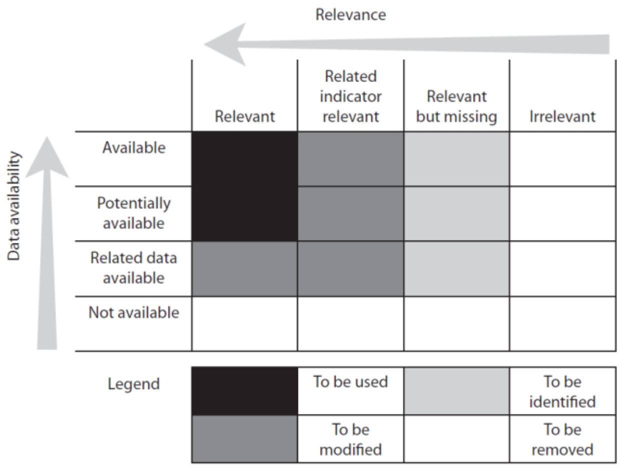


Fig. 3. Matrix for Adapting UNCSD Indicators of Sustainable Development [21]

2.2.4. Modification of indicators

Indicators can be applied at various spatial scales, and therefore it is important to modify the selected indicators to ensure they are well suited for the level of analysis to which they are applied. Common indicators might be applied to many areas which have similar characteristics, whereas site specific indicators should be tailored to the local context. For SBEZs, it is necessary to downscale global or national indicators to be local indicators in order to be applicable in practice.

Traditional indicators can be modified to be more personal indicator, such as changing ‘Total water use’ to ‘Water use per person’. Indicators can be combined, such as ‘Water use v/s Water availability’. This modification facilitates understanding of the data and ensures that indicator metrics are relevant to stakeholders. Furthermore, the indicators should be modified to focus on goals and behavior change, as well as relate to potential future identified development pathways.

2.2.5 Good and effective sustainability indicators

A good indicator should highlight the links between the community’s economy, environment, and social dimensions. Seven criteria of a good sustainability indicator include: 1) *Relevancy* - directly connected to the issues we are concerned with; 2) *Measurable* - objective or subjective, qualitative or quantitative; 3) *Reliability* - the data obtained can be trusted; 4) *Understandable* - the average person can understand the meaning of indicator; 5) *Clear in direction* – people can understand ‘what should we do’; 6) *Responsive* - indicators react when there are changes in the system; and 7) *Linked* - causal linkages with other indicators across sectors. In practice, sustainability indicators should effectively communicate technical issues to non-technical specialists; define the issue enough to measure it effectively; have available data in suitable format; be applicable for tracking differences in space or changes over time; link local with regional, national or global data; and lead to action, technical information, and/or awareness raising.

Table 1. Indicators to be Considered in Sustainability Impact Assessment [22]

Economic Impact Assessment	Social Impact Assessment	Environmental Impact Assessment	Health Impact Assessment
Changes in productivity in related industries	Day-to-day living of individuals and/or groups of people	Physical environment (Rock, Mineral, Soil, Water, Water resources, Wastewater, Air, Solid waste)	Environmental management technology
Changes in productivity in related community economy	Traditional communities / ethnic	Biological environment (Flora, Fauna, Forest, Aquatic plant/animal)	Waste / Pollution, including visual pollution
Changes in employment in related communities	Population demographic factors	Human utilization values environment (Agriculture, Industry, Transportation, Land use, Water supply, Irrigation, Aquaculture, Forestation, Human settlement)	Natural disasters
Changes in income in related communities	Male-Female relationship / Birth / Death / Migration	Quality of life environment (Population, Education, Public health, Culture, Economy, Safety of life & property, Recreation, Livelihood)	Social conflicts
Impacts on local government, schools, hospitals, etc.	Ritual, beliefs, religions, customs changes		Unproductive resource
GDP/ GNP/ GPP	Recreation / Heritage and cultural arts (Cultural value)		Human relaxation

The sustainability assessment considers the possible impacts on all the aspects of economy, society, health, and environment. Table 1 illustrates the indicators to be considered in impact assessment, before/during/after the development to assess impact of sustainable development measures applied.

3. METHODOLOGY

This study used an issue-based approach and applied a mix-method between qualitative and quantitative research. Data from both primary and secondary sources were collected. Five steps were taken in order to identify the sustainability indicators for SBEZs.

3.1 Step 1 - Scoping themes

A set of potential themes and sub-themes were identified through a series of key informant interviews. The purpose of the interview process is to identify the concerns from stakeholder's perspectives in order to identify key sustainability specific issues to be mitigated though the application of sustainable development measures.

Targeted key informants included in this study were from government, private, and household sectors. In total, 40 key informants were interviewed, including representatives from 10 central, 7 provincial, and 5 local government agencies; 6 private companies; 5 academic institutions; 2 civil society organizations; and 5 community members. Then, a qualitative content analysis was adopted to analyze the interview results. The grouped themes identified in the interview process were linked to the UNCSD sustainability indicator framework.

3.2 Step 2 - Development of indicators

Literature review from social science databases was the main method applied for analyzing potential sustainability indicators to be used in the impact assessment of SBEZs or site-specific regional development. The data were synthesized from reviewing journal articles, project reports, and case studies. Sixteen references were selected based on the relevancy to strategic environmental assessment, sustainability impact assessment, challenges and issues on special economic zones, and export processing zones development. All indicators have been grouped into 22 domains under the core pillar of sustainability. Preliminary indicators focused on economic, social, and environmental aspects, including 6 economic domains, 6 social domains, and 10 environmental domains. Each domain, defined as an element of sustainability, comprises a number of criteria that should be used to assess the significance of the impacts.

3.3 Step 3 – Selection and modification of indicators

The selection and modification of indicators was based on the review of existing plans, policies, and frameworks of sustainable development, and took into account the results of stakeholder consultation. Preliminary indicators for each theme were selected based on: 1) maximum data availability; 2) relevancy to the characteristics of SBEZ; 3) statistical feasibility; and 4) applicability in broad range of local area.

In order to modify the comprehensive indicators for the national and local context, the collected indicators were refined to be in alignment with the following frameworks: 1) The 12th National Economic and Social Development Plan (2017-2021); 2) Sustainable Development Goals (2015-2030); 3) Tak SBEZ Master Plan (2018-2021); and 4) Master Plan and Action Plan for the Development of an Eco-Industrial Town in Tak SBEZ.

The ability to collect sufficient data within the timeframe of this research was also considered in the confirmation and modification of the indicators. Prior to finalizing the indicators, stakeholders and responsible agencies were consulted regarding availability of preliminary data in order to ensure the reliability and applicability of the indicators.

3.4 Step 4 - Collection test of indicator data

The final set of indicators was tested for Tak SBEZ as a case study. Tak SBEZ is Thailand's first SBEZ and is located in the western part of Thailand on the border with Myanmar (Fig. 4).

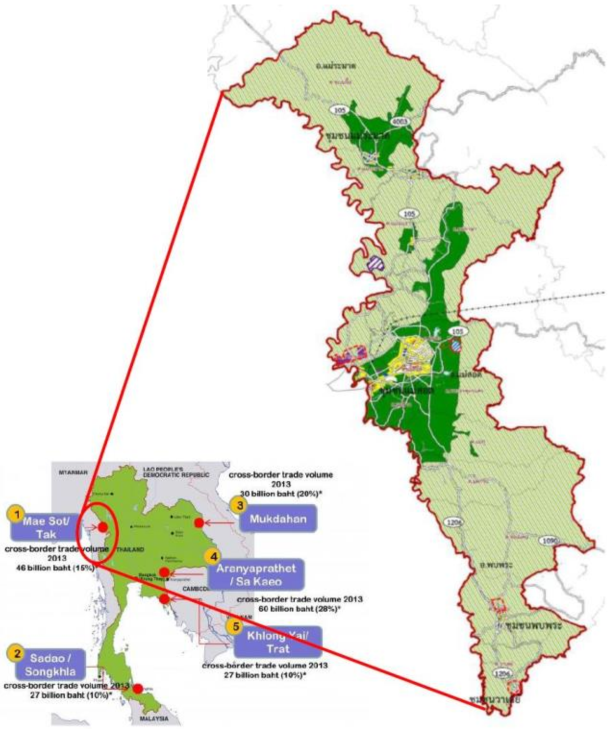


Fig. 4. Location Map of Study Area [23].

Tak SBEZ covers 8 sub-districts in Mae Sot District, 3 sub-districts in Phop Phra District, and 3 sub-districts in Mae Ramat District. The majority of the zone is in Mae Sot District which is the center of development activities. Since this area has the highest impact from development, the data collection focused on Mae Sot district level. As part of SBEZ implementation, the study area includes planned projects for industrial estate establishment, road expansion, and bridge construction to better connect road networks, among others.

In order to assess long term impacts and project future development trends, historical data for each indicator were collected in the form of time series. Statistical data were mainly provided as secondary sources by responsible governmental agencies.

3.5 Step 5 - Analysis and finalization of indicators

Since an ex-ante strategic assessment does not require conducting a detailed assessment, a Regression Analysis was applied to forecast future trends of every indicator. This analysis is needed to provide the basis on which to assess the future trends in socio-economic and environmental conditions with the planned SBEZ development. The application of the Regression Analysis can be used to evaluate the cumulative effects in the case of continuous data collection; however, sufficient continuous and long-term data is needed for the analysis.

Indicators with adequate information on current developments and trends for the system in question were chosen. The adequacy of information was measured by scatter plot, where multiple types of trends were tested. Possible trends include Exponential, Linear, Logarithmic, Polynomial, Power, and Moving average. A trendline is most reliable when its coefficient of determination (R-squared: R^2) value is at or near 1. The accuracy of selected indicators was measured by the percentage of the error (% Error) between actual value and simulated value resulted from Regression Model (Equa. 1). Then, the indicators that have the best trendline reliability (highest R^2) was choose for each sub-theme.

$$\%\,Error = \frac{|Actual\ value - Simulated\ value|}{Actual\ value} \times 100 \tag{1}$$

4. RESULTS

4.1 Scoping themes and sub-themes

Following the above methodology, the study resulted in 9 themes and 15 sub-themes identified through informant interviews. Table 2 shows themes and sub-theme development using the issue-based approach. The 'f' (Frequency) column presents number of times such issue was mentioned by the interviewees. This frequency represents the relative importance with which stakeholders perceived different issues.

4.2 Finalization of indicator data

After the application of the selected set of indicators to the area, the study found that some indicators did not have secondary data available at district level. These indicators included GHGs emissions and the proportion of forest area. In the case of these indicators, the data at provincial level was used as a proxy for further assessment. It should also be noted that the indicator on the abundance of key species did not have historical data recorded at either the provincial or district level.

Once all data was collected and analyzed, the research found that some indicator variables have non-linear trends and it was not possible to forecast future trends using Simple Linear Regression (SLR) analysis.

Therefore, a suitable trendline was needed to fit the data set. Table 3 illustrates the type of trendline used to forecast each indicator, including the reliability of the trendline in forecasting future trends.

Table 2. Scoping Themes and Sub-themes Based on Issues Revealed by the Key Stakeholders

No.	Likely issues	f*	Sub-themes	Themes
Economic				
1	Distribution to local prosperity	3	Local income	Economic structure
2	Job competition with local labours	1	Employment	
3	Solid waste generation/ management	7	Waste	Consumption & production patterns
4	Traffic congestion	1	Mobility	
Social				
5	Crowding of communities	1	Living conditions	Housing & settlement
6	Contagious diseases	7	Diseases	Health
7	Crime	6	Terrorism	Safety & Security
8	Road traffic accident	2	Transport	
9	Landslide & Flood induced by SBEZ development and climate change	2	Natural disasters	
Environment				
10	Water sources	7	Water quantity	Fresh water
11	Water pollution	5	Water quality	
12	Air pollution	5	Air quality	Atmosphere
13	GHG emissions from transportation and industry	3	Climate change	
14	Forest invasion	4	Forest	Land
15	Biodiversity loss	2	Species	Biodiversity

Note: *f = Frequency refers to how many of times those issues were mentioned by the interviewees.

Table 3. Trendline Reliability of Each Indicator

Baseline indicators	Regression type	R^2	%Error
1a) Avg. yearly income of population (baht/person/year) *	Linear	1.00	0%
1b) Growth rate of average yearly income of population (% of base year)	(Insufficient data)		
2a) Employment rate (% of total labour force)	Polynomial	0.45	11%
2b) Unemployment rate (% of total labour force) *	Polynomial	0.88	25%
3a) Amount of waste generation per capita (kg/person/day) *	Linear	1.00	0%
3b) Proportion of urban solid waste with proper disposal to total urban solid waste generated *	Linear	1.00	0%
3c) Proportion of waste recycling and reuse (% of total waste) *	Linear	1.00	0%
4a) Volume Capacity Ratio (V/C) *	Polynomial	0.42	7%
4b) Traffic Density (D)	Polynomial	0.14	347%
5a) Population growth rate (%/year)	Polynomial	0.12	75%
5b) Population density (person/km^2) *	Polynomial	0.43	1%
5c) Proportion of slum or squatter settlements to total household in border district	(No historical data available)		
6a) Proportion of infected patients with re-emerged diseases (e.g. tuberculosis, malaria and elephantiasis, etc.) to total border district population	(Insufficient data)		
6b) Ratio of infected patients, caused by major transboundary contagious diseases per 100,000 population in the area (people)	(Insufficient data)		
7a) Number of persons affected by flood (people)	Logarithmic	0.45	651%
7b) Proportion of persons affected by flood (% of total population) *	Logarithmic	0.45	645%
8a) Proportion of recorded crimes (% of total population) *	Exponential	0.35	20%
8b) Ratio of recorded crimes per 100,000 population in the area (case) *	Exponential	0.35	20%
9a) Proportion of persons injured by road accidents (% of total population)	(Insufficient data)		
9b) Ratio of deaths per 100,000 population in the area (people) *	(Insufficient data)		
10a) Proportion of forest area (% of land area) *	Linear	1.00	0%
10b) Change rate of forest area (% of base year)	(Insufficient data)		

Baseline indicators	Regression type	R^2	%Error
11) Annual withdrawal of ground and surface water (% of total available water) *	Polynomial	0.49	19%
12a) Water Quality Index (WQI) *	Polynomial	0.89	2%
12b) Quality of urban wastewater with applicable measurement indicators	(No historical data available)		
13) PM_{10} content (μg/m^3) *	Polynomial	1.00	0%
14a) Proportion of GHGs emission per capita (tCO_2eq/person/year) *	Polynomial	0.79	6%
14b) Proportion of GHGs emission per GPP (tCO_2eq/Mbaht)	Polynomial	0.35	10%
15) Number of plant/animal species listed in the list of species threatened (species) *	(No historical data available)		

Note: *Indicators that can be used for Tak SBEZ (Final set of indicators)

From Table 3, the indicators (with *) that have higher R^2 values and the lowest % Error were chosen to represent each sub-theme. Some sub-themes had more than two candidate indicators with the same level of reliability (R^2) (e.g. waste generation and management). Therefore, all candidate indicators were used to represent the sub-themes in this regard.

5. DISCUSSIONS

5.1 Theoretical implications

The majority of existing research centers on the development of indicators for 'ex-post assessment' to evaluate the performance of SBEZs, our study focused on the indicators to be applied for 'ex-ante assessment' planning for sustainable development prior to program commencement. The proposed indicator development process used in 'ex-ante assessment' is comprised of: 1) Scoping of sustainable development themes; 2) Development of indicators; 3) Selection and modification of indicators; 4) Collection of indicator data; and 5) Finalization of indicators. Steps 2, 4, and 5 are based on secondary data, and Steps 1 and 3 relied on primary data from stakeholder inputs. Integrating stakeholder engagement as part of top-down policy development ensures that policies implemented address stakeholder concerns. Although the theme indicator framework defined by the UNCSD [18] also includes indicators for institutional framework and capacity, stakeholders concerns focused on social and environmental issues rather than the institutional aspect.

In order to select those indicators which provide the most accurate prediction using the regression analysis, the best fit trendline should be applied to each indicator variable. The R-squared (R^2) value demonstrates how well-fit the trendline is to the data set. Indicators that have unclear trends (low R^2 value) result in large percentage of error as compared to other indicators. These indicators include population changed, transportation, and natural disasters, which are dynamic and have inconsistent trends. Therefore, in forecasting future trends for these types of indicators, more accurate methods are needed. For specific indicators, a more detailed analysis may be required. Modeling for specific issues (e.g. air/water quality modeling and land use changes using aerial photograph and satellite image) can provide more accurate results than simple regression analysis.

5.2 Practical implications

Selecting suitable indicators is a tricky task among planners and developers in developing sustainable SBEZs. The use of improper indicators has the potential to bring about inaccurate results. The presented indicator selection method was devised to guide the personnel responsible for the initial assessment of SBEZs. Since the data used in this study mainly based on the secondary data, this proposed method can be applied for the preliminary assessment with limited time, budget, and resources for conducting an analysis.

Since the main purpose of conducting a preliminary assessment is to identify key sustainability issues for further detailed impact assessment, this study simply chose the indicators that have secondary data available. Trend analysis was employed to identify suitable indicators and foreseen the likely issues. This method is limited by sufficient historical long-term data and accuracy of available data.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Fifteen sub-themes under nine main themes were the outputs from the scoping process. After consulting relevant agencies and stakeholders to find out on existing targets and standards, the study developed a set of 29 indicators. After each indicator was analyzed using Regression Analysis, the study revealed that some indicator variables were not reliable (low R^2 and high % Error). The indicators with no certain trend could not be analyzed using trend analysis, and these unreliable indicators were excluded from the final set of indicators. Finally, the study selected 17 out of the original 29 indicators for use. The indicators identified as not applicable from the trend analysis using Regression Model are an academic contribution from this study. Moreover, the findings on regression type of each indicator can serve as a guide for the planners and decision makers in analyzing the trend of each indicator.

It should be noted that there are number of limitations for this study. First of all, some indicators do not have long historical data recorded, which can result in inaccuracy in forecasting trends in time series analysis. Furthermore, data availability is limited at the micro-scale level. In the future, it is suggested that the developed set of indicators should be tested in various sizes of SBEZs in order to test the applicability of indicators in the different zones. Further study can continue to refine the type of trendline suitable for each specific data set.

6.2 Recommendations

The indicator development process presented in this paper can be applied by planners and developers for an ex-ante assessment in order to plan for the sustainable development of SBEZs. The responsible agency, i.e. SEZ Administration Sub-Committee, in each SBEZ should further develop sustainability assessment indicators specific to their areas where different key issues of concern are present.

The comprehensive indicators gathered can also be supporting information for further research or PPP to be conducted for sustainability assessment. The non-selected indicators should be revisited when applying the indicators for actual assessment. Clearly, those indicators in this study which were not considered because of insufficient data availability can be considered in other scenarios where data is available. The integrative method of scoping sustainable development themes and choosing the potential indicators is another significant contribution of this study. In addition to SBEZs, the method for indicator selection presented in this paper can be applied to other regional development projects in similar contexts, allowing planners identify site-specific indicators.

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