Analysis and Spatial Application of Human Security Indicators in Perspectives of Sustainable Development

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Abstract

This study aims to analyze the implications of human security indicators and sustainable development, in perspectives of economic, social, and environmental aspects for investigating development opportunities in the study area, the Central-West region of Thailand. The Human Achievement Index (HAI) from the National Economic and Social Development Board (NESDB) was exploited as a based case of human security indicators for a mixed-method research in the study. The data collection was conducted by a purposive sampling method towards the Delphi technique, which 18 participants were invited to deliver their opinions as the panelists, prior to integrate the significant indicators with the spatial application, namely ArcGIS. This analysis exploited various statistical measurements, including Mean, Median, Mode, and Interquartile to pursue central tendency and implication levels of the data collected. The findings expressed a series of implications, which human security affect to sustainable development, for instance,

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the top three highest significant indicators in each perspective could be ranked, as follows: 1) economic security--family income, consuming debt, and poverty rate, 2) social security--unemployment rate, social insurance, and high school and vocational training opportunity, and 3) environmental security--serviceable main road, greenhouse emission rate, and house and land owner, respectively. The study also derived various indicators from the panelists via the Delphi technique, for example, sufficiency economic village, drug-trafficking case, immigration rate, medical personnel rate, and air quality index. Furthermore, the panelists contributed some recommendations, regarding ecology and creative tourism, local business mechanism, smart city, empirical indicator, multi-dimensions of social and environmental issues. Nevertheless, the study suggested that the political vote rate in the year 2016 should be dismissed from the HAI.

Keywords: Human Achievement Index (HAI), Human Security, Spatial Analysis, Sustainable Development

การวิเคราะห์และประยุกต์ใช้โปรแกรมเชิงพื้นที่สำหรับตัวชี้วัดความมั่นคงของมนุษย์ในมุมมองของการพัฒนาที่ยั่งยืน

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บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อวิเคราะห์ความเกี่ยวพันระหว่างตัวชี้วัดด้านความมั่นคงของมนุษย์กับการพัฒนาที่ยั่งยืนในแง่เศรษฐกิจ สังคม และสิ่งแวดล้อม โดยใช้เครื่องมือวิเคราะห์เชิงพื้นที่มาพิจารณาโอกาสในการพัฒนาประเทศไทย ซึ่งการศึกษาครั้งนี้ได้ใช้ดัชนีความก้าวหน้าของคน (Human Achievement Index - HAI) ของสำนักงานสภาพัฒนาการเศรษฐกิจและสังคมแห่งชาติมาเป็นพื้นฐานของตัวชี้วัดด้านความมั่นคงของมนุษย์ และใช้กระบวนการวิจัยแบบผสมผสานที่เลือกกลุ่มตัวอย่างแบบเจาะจงผ่านเทคนิคเดลฟาย (Delphi technique) ในการหาระดับความเกี่ยวพันของตัวแปรที่ทำการศึกษาเพื่อวิเคราะห์ความเห็นของผู้เชี่ยวชาญ จำนวน 18 คน แล้วนำข้อมูลที่ได้ไปบูรณาการในโปรแกรมประยุกต์เชิงพื้นที่ (โปรแกรม ArcGIS) เพื่อเปรียบเทียบศักยภาพการพัฒนาในพื้นที่ศึกษา (ภาคกลางฝั่งตะวันตกของประเทศ) รวมทั้งมีการใช้เครื่องมือทางสถิติในการหาค่ากลางของข้อมูล ได้แก่ ค่าเฉลี่ย ค่ามัธยฐาน ค่าฐานนิยม และค่าอินเตอร์คลอไทล์ ผลการศึกษาแสดงให้เห็นลำดับความความสำคัญของดัชนีชี้วัดความมั่นคงของมนุษย์ที่มีผลต่อการพัฒนาที่ยั่งยืนอย่างมีนัยยะสำคัญในระดับต่าง ๆ ยกตัวอย่างในสามอันดับแรก ได้แก่ 1) ด้านความมั่นคง

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ทางเศรษฐกิจ--รายได้ของครัวเรือน ร้อยละครัวเรือนที่มีหนี้สินอุปโภคบริโภค และความยากจน 2) ด้านความมั่นคงทางสังคม--อัตราว่างงาน ร้อยละแรงงานที่มีประกันสังคม และอัตราการเข้าเรียนระดับมัธยมศึกษาตอนปลายหรืออาชีวศึกษา 3) ด้านความมั่นคงทางสิ่งแวดล้อม--ร้อยละของหมู่บ้านที่ถนนสายหลักใช้การได้ตลอดปี สัดส่วนการปล่อยก๊าซเรือนกระจก และร้อยละครัวเรือนที่มีบ้านและที่ดินของตนเอง และจากการรวบรวมความเห็นของผู้เชี่ยวชาญผ่านเทคนิคเดลฟายได้ข้อคิดเห็นว่าควรพิจารณาตัวชี้วัดเพิ่มเติมเกี่ยวกับหมู่บ้านเศรษฐกิจพอเพียง คดียาเสพติด อัตราการย้ายถิ่นฐาน อัตราส่วนเจ้าหน้าที่สาธารณสุขต่อประชากร ดัชนีชี้วัดคุณภาพอากาศ และจำนวนนักท่องเที่ยว รวมทั้งมีข้อเสนอแนะว่าควรให้ความสำคัญกับการท่องเที่ยวเชิงอนุรักษ์และเชิงสร้างสรรค์ กลไกขับเคลื่อนทางธุรกิจในพื้นที่ เมืองอัจฉริยะ ตัวชี้วัดเชิงประจักษ์ และพหุมิติของปัญหาทางสังคมและสิ่งแวดล้อม อย่างไรก็ตาม ผลการศึกษาได้เสนอให้ยกเลิกการใช้ร้อยละของประชากรที่ใช้สิทธิลงประชามติร่างรัฐธรรมนูญใน พ.ศ. 2559 เป็นตัวชี้วัดในดัชนีความก้าวหน้าของคนด้วย

คำสำคัญ: ดัชนีความก้าวหน้าของคน ความมั่นคงของมนุษย์ การวิเคราะห์เชิงพื้นที่ การพัฒนาที่ยั่งยืน

Introduction

In 1994, the first concept of human security was introduced in the Human Development Report (HDR) that human security was not only the security from violence and crime, but also the security of people's likelihood, in regard to economic, community, environmental, food, health, personal, and political dimensions (Gomez & Gasper, 2020). Thailand has also been emphasizing these issues, especially in perspectives of society, economy, and environment to achieve Sustainable Development Goals for the country. Although, Thailand has been concerning with demographic growth, socio-economic problems, and resources available; however, the challenge to cope with sustainability of human security still exists under the National Sustainable Development Strategy (NSDS). To maintain and enhance national interests along with socio-economic and environmental concerns, Thailand is to understand human security to reach sustainable development clearly.

Since, human security has been introduced to various agencies in Thailand for many years, including the National Economic and Social Development Board (NESDB), to cope up with a complexity of sustainable development; but, there was a puzzle that why human security indicators of NESDB, namely the Human Achievement Index, have not been applied in term of sustainable development, and also spatial analysis have been seldom applied to its planning too.

This research, therefore, aims to identify human security indicators in the Human Achievement Index (HAI) using the Delphi technique, in order to assess significant human security indicators towards sustainable development elements, including social, economic and environmental perspectives. The human dimensions and physical dimensions of the areas were, then, analyzed via a spatial analysis using the ArcGIS application to visualize their significant indicators in understandable perceptions.

Literature Review

Sustainable Development Perspectives

The classic study from Morse (2004) asserted that sustainable development was focused on protecting resources and environment for future generations; but in human aspect, it meant developing our needs without reducing capability to progress in our aspirations for the future. Moreover, there were some arguments that rights for

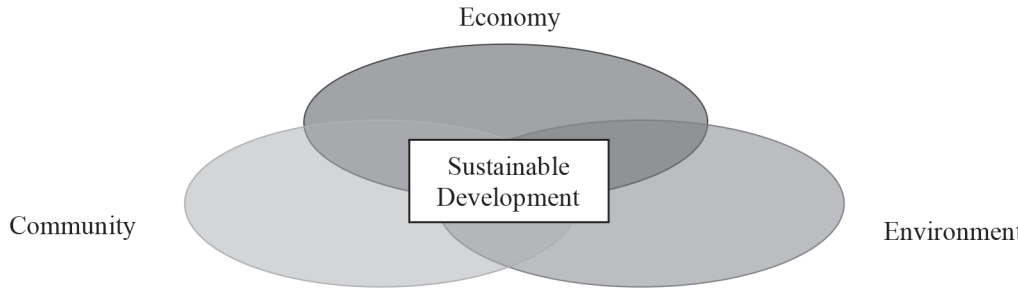


Figure 1: Interlink of Sustainable Development
Source: Dincer and Rosen, 2007.

future generations were to overlap between generations, especially the right of environmental sustainability and security. However, to achieve sustainability, it must satisfy the needs and aspirations of society together with environmental and ecological conservation as well (McPhail, 2012). Hence, sustainable development was represented by the overlapping area of three circles among economy, community and environment as shown in Figure 1.

It is a basic of human nature that people have limitless needs of what they want, while natural resources are scarce. Therefore, people are to consider the fact that the resources need to be protected, maintained, and enhanced (Camp & Heath-Camp, 2009). However, this concern should reflect the local people perceptions whether their human security is fulfilled in sustainable manner, as the UN General Assembly recently declared "the 2030 Agenda for Sustainable Development" to make progress towards the Sustainable Development Goals (SDGs). Human security approach is a people-centered framework to achieve sustainable development by eliminating poverty and promoting inclusive and resilient societies. The root causes of poverty are highlighted by the impact of inequality on people's income, living and dignity (UN Trust Fund for Human Security, 2019). To come up with sustainable development, Thailand's strategy was primarily focused on economic development since the 1st National Economic and Social Development Plan (NESDP) in 1961, and founded the National Sustainable Development Strategy (NSDS) in 2005 to comply with the ratification of Johannesburg Declaration and Agenda 21 (United Nations Conference on Environment and Development, 1992). After that, the 10th NESDP (2007-2011) had firmly integrated with sustainable development, covering three main dimensions of economics, society and environment, in order to minimize

negative impacts from various developments in the country, such as natural resources degradation, pollution emission and social issues. While the 11th NESDP (2012-2016), Thailand had been continuously implementing in sustainable development approach, but focusing more on human security, especially on natural resources and socio-economic (National Economic and Social Development Board [NESDB], 2011).

Moreover, the 12th NESDP (2017-2021) has declared to pursue the SDGs plan (2016-2031), focusing on people, global, partnership, prosperity and peace issues, via 17 goals and 169 objectives (NESDB, 2017). Then, the SDGs Committee, supervised by NESDB has purposed the 20-year National Strategy (2017-2037) for implementing sustainable development in 6 dimensions, including security, competitiveness enhancement, human capital development and strengthening, social cohesion and equity, eco-friendly development and growth, and public rebalancing and development (NESDB, 2018).

Human Security Indicators in Thailand

To balance all sustainable development concerns including environmental issues, the Thai government announced the NSDS Guidance Manual prepared by Thailand Environment Institute under the guidance of NESDB (NESDB, 2008). This strategy was to create a green and happiness society, in a good environment and sustainable natural resources. The areas of development were focused on 4 strategies, including: 1) eliminate poverty through sustained and equitable economic growth, 2) enhance environmental security and sustainability, 3) create a knowledge-based society and ethical society, and 4) ensure good governance at all levels of society. This approach was also a basic concept to establish human security in the country afterward.

Consequently, NESDB had been firstly launched the Human Achievement Index (HAI) as the human security indicators in 2015, in order to identify human fulfillment and well-being in the country (NESDB, 2015). After that, it was and revised in 2017 and 2019, so that decision makers and local authorities could realize their strength and weakness for developments in more comparative (NESDB, 2019; NESDB, 2019). However, the HAI version 2017 was classified the same approach as the HAI version 2019, consisted of 32 HAI indicators in 8 dimensions of health, education, employment, income, land and housing, family and community, transportation and communication, and participation, as shown in Figure 2.

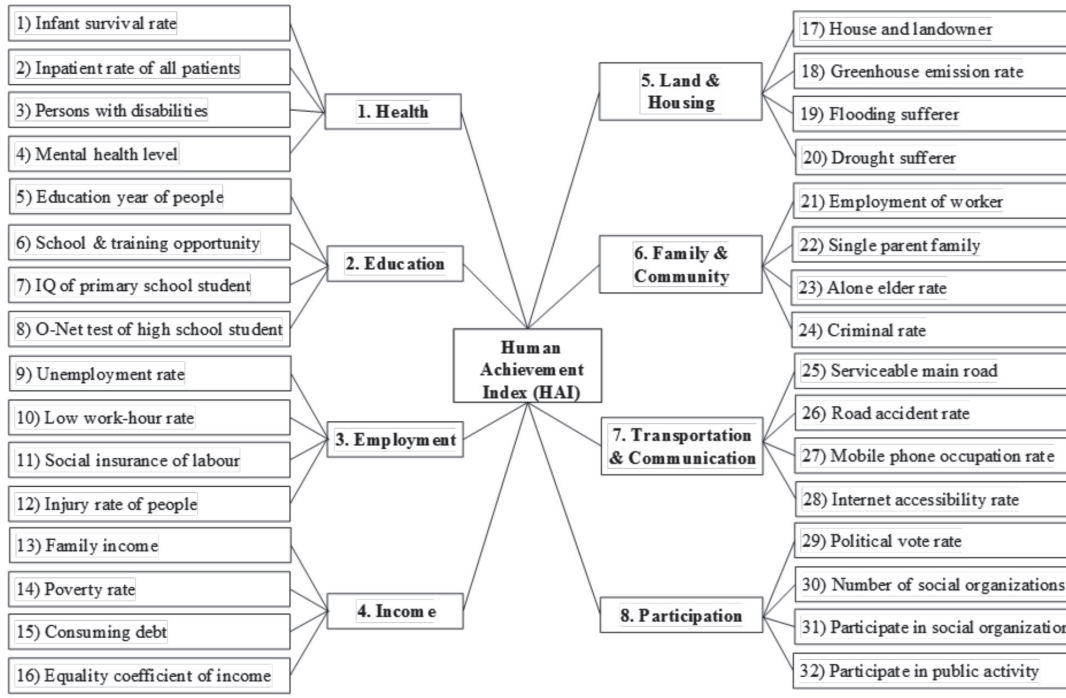


Figure 2: The Human Achievement Index (HAI)
Source: NESDB, 2017; NESDB, 2019.

Spatial Analysis and Its Application

To visualize the implication of sustainable development and human security, spatial analysis could go beyond providing of visualization, data management and simulation of commodity production. Spatial application could facilitate stakeholders into development processes by identifying the significant issues and transmitting the information from analysts to policy makers and people (Lan, Tan, Lee & Mohamed, 2009). However, the interaction of development and territorial characteristics, such as geography, cultures and living preferences could illustrate different patterns of developments and potentials. It meant that spatial analysis could orient more understanding views for developing and decision-making.

In the recent study, Murai (1995) proposed in the concept of Global Information system, together with the Global Eco-Engineering approach, which human and physical dimensions were analyzed by remote sensing and Geographic Information System (GIS).

This approach expresses how human driving forces apply to various variables and make impacts to global environmental changes and human response. The concept of this analysis was to form various maps into GIS formats, in order to calculate values of each parameter for certain criteria. The criteria in each concern would be compared and evaluated by spatial analysis via its application. It is an effective tool to execute for multi-criteria evaluation of environmental management and land use patterns (Seppelt, 2003). The flow diagram of this approach was illustrated in Figure 3.

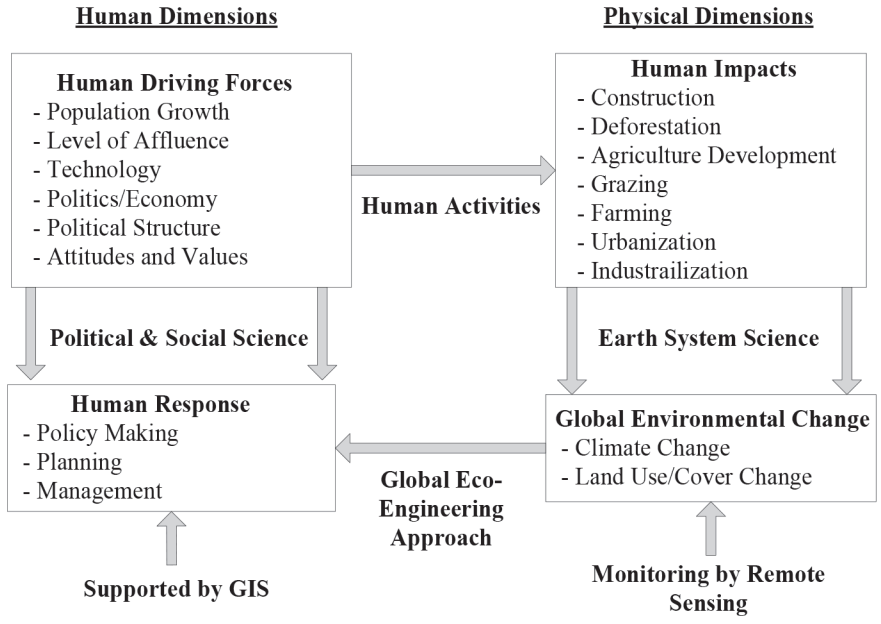


Figure 3: Flow diagram of the Global Information System
Source: Murai, 1995.

Research Methodology

This study employed a mixed-method design by defining the indicators from economic, social, and environmental perspectives as the dependent variables (DV); likewise, human security was considered as the independent variable (IV). While, national strategies and policies would be identified as the intervening variables, if there were influencing to the independent variable or the dependent variables. This analysis verified human security indicators both positive and negative sides, based upon relative an impact degree to human perceptions.

The sampling selection was conducted by the purposive sampling method, which focused on the experts who were keen in the areas of sustainable development and human security. The primary data was, then, collected from relevant policy makers, scholars and operational officers. These experts were invited to join in the Delphi technique as the panelists or the ad-hoc committees, in order to deliver their opinions about human security in perspectives of sustainable development. Whereas, the secondary data was explored mainly via relevant official records and GIS attributes, from NESDB and the Geo-Informatics and Space Technology Development Agency (GISDA). The spatial application, the ArcGIS version 10.2.2, was then used for analyzing a series of attributes to clarify spatial maps in the understandable approach.

The Research Model

Referred to the Figure 3, the concept of Global Information System and the Global Eco-Engineering approach (Murai, 1995) was adapted to be the research framework of sustainable human security, as shown in Figure 4.

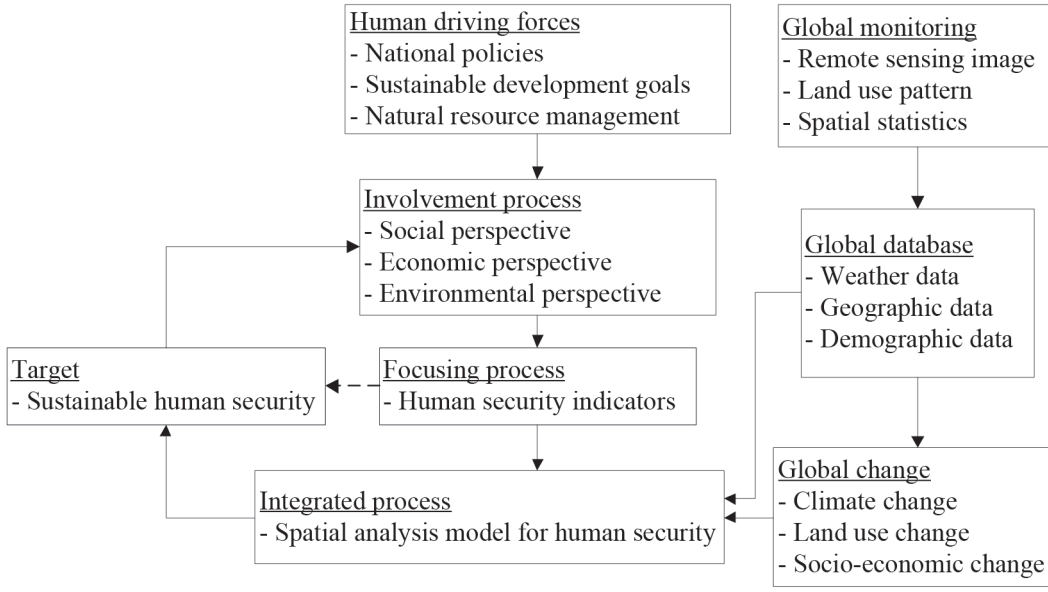


Figure 4: Research Framework of Sustainable Human Security

Starting from human driving forces, the research was conducted from relevant policies, which directed sustainable development goals and affected natural resource management. After that, the panelists were invited to attend to the involvement process, in terms of economic, social, and environmental perspectives. Then, the inputs from involvement process had been focusing on significant human security indicators prior to integrate with spatial attributes from global database and global change factors. Meanwhile, some indicators had shortly been reviewed as intermediate indicators if the relevant spatial attributes were not available or it had no need to integrate with spatial analysis. Finally, the target of developments would underpin sustainable human security for clarifying opportunities and appropriate directions in sustainable manner eventually.

The Research Participations

As the study adopted the Delphi technique as the research approach to collect the primary data, the data collection was, then, conducted as to four characteristics of this approach, including anonymity, iteration, controlled feedback, and the statistical aggregation of a group response. In practical, this anonymity means that the groups of participants is not aware of each other, but allow delivering their opinions without a pressure from the group. Also, they are free to change their opinions through the further rounds. Once the questionnaire is sent to the participants, they are given the feedbacks by being informed about the other participants' opinions. On the final round, the group judgment is considered as the statistical average of the participations' opinions (Rowe & Wright, 1999).

In 2002, Scheele's study suggested that the participants should include stakeholders who were directly affected by the study as the panelists, including policy makers, scholars, and practitioners to collect different points of views from various stakeholders. Thus, 18 panelists of committee were invited to join in the data collection process, following.

1) Policy maker group: 6 experts who worked as administrative officers and planning analysts in NESDB and involved in the policy planning at least 3 years.

2) Institution group: 6 scholars from the Civil Affairs School, the Royal Thai Army, who were keen in the field of development administration and human security at least 3 years.

3) Operation group: 6 staff officers from the 1st Development Division of the Royal Thai Army, who have input developing experiences in the field of study, as practitioners at least 3 years.

The panelists were invited to participate in a three-round Delphi process and joined in the questionnaire survey. Although, there were 18 panelists involving in the first round; however, there were 17 panelists involving until the rest of study, missing one participant from NESDB in the 2nd round. Nevertheless, the response rate could be considered acceptable number as the panelists were involved in a range of 13-77 members (Torrance et al., 2010). The number of participants from each group, who completed and returned questionnaires in each round, was shown as Table 1.

Table 1: Participation of the Delphi Process

Number of Participants	Round 1	Round 2	Round 3
Questionnaires delivered	18	18	17
Completed questionnaires	18	17	17
- NESDB	6	5	5
- The Civil Affairs School	6	6	6
- The 1st Development Division	6	6	6
Response rate of sending	100%	94.4%	100%

The Data Collection

The first round: the panelists had been asked 2 groups of the questions, which were the human security indicators section and the open-ended question section, as following:

1) Section A: giving a degree of implication between the HAI (32 indicators in the Figure 2) and sustainable development elements, including economic, social, and environmental perspectives, in forms of a Likert-type scale ranging from 1 (less relevant) to 5 (more relevant).

2) Section B: giving opinions on the open-ended questions, a) how human security take part in enhancing sustainable development and which direction would be suitable

for Thailand, b) based on section A, what are additional indicators reflecting that human security can enhance sustainable development potentials, and c) how spatial analysis support human security in perspectives of sustainable development. Moreover, the panelists had also been giving opportunities to deliver more various opinions as to the research topic as well.

The second round: the questionnaire in this round was specifically prepared for each panelist by sending the statistical preference (the Mode) of human security indicators to the panelist and asked them to review and re-evaluate the answers from the previous round. After comparing statistic values from other experts in the group, the panelists were also encouraged to give more opinions about the alternative preferences, if they wanted to change their degree of agreements.

The third round: the panelists had been asked to recheck the answers from the second round, after learning the point of views from other experts via Median in the previous assessment. Each panelist was sent a new form that included their own degree of agreement for each indicator along with the descriptive statistical answers, calculated from all panelist members to re-evaluate their degree of agreement in the previous round. If panelists wanted to amend their degree of agreement, they were expected to re-write the new degree and added more comments on the concerned issues as well. After that, the collected data was analyzed via the Mean and the Interquartile Range to clarify the implications of human security and sustainable development percepts at the final stage.

The collected scores in this study were measured by various statistical analysis to find central tendency or average values, as follows.

1) The Mean – the sum of a set of scores divided by the number of scores summed. In this study, the Mean expressed an average agreement of implication, which each human security indicator related to relevant sustainable development elements. The degree of implication was classified into 4 categories, including:

i) The average of 4.50 and over express a strong agreement of implication (level 4),

ii) The average between 3.50 and 4.50 express a moderate agreement of implication (level 3),

iii) The average between 2.50 and 3.50 express a weak agreement of implication (level 2),

iv) The average under 2.50 express disagreement of implication (level 1),

2) The Mode – the most often scores when listed a set of scores in numeric order. In this study, the percentage of panelists that changed their answers closer to the Mode was to be less than 15% for acceptable stability criteria (Scheibe, Skutsch, & Schofer, 2002).

3) The Median – the midpoint in a distribution when listed a set of scores in numeric order. In this study, the acceptable value of agreement based on the Median was to be different from the mode not less than or equal to 1.00 (Privitera, 2019).

4) The Interquartile Range – the range of the middle 50% of scores which differed between the upper quartile and lower quartile (the top and bottom 25% of scores). In this study, the acceptable value of interquartile range was to be less than 1.50 (Field, 2014).

The Study Area

The study area of this research has been focusing on 8 provinces in the Central West region of Thailand, including Kanchanaburi, Petchaburi, Prachuap Khilikhan, Nakhon Prathom, Ratchaburi, Samut Sakhon, Samut Songkham, Suphanburi provinces (Figure 5). This area had been selected as the research domain because of its diversity of human and physical dimensions, such as variety of livelihoods in various geographic areas (suburb, border, mountainous, low land, and coast), a number of socio-economic factors, and complex ecological system. The purposive sampling method had been also applied to this selected region for the spatial analysis in the study.

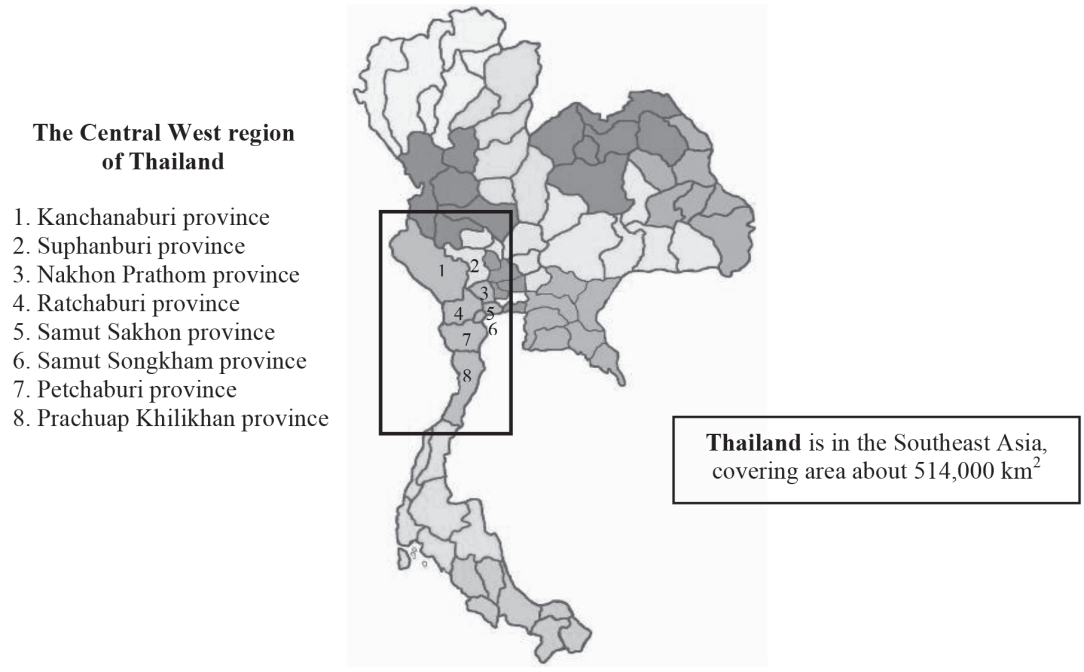


Figure 5: The Study Area

Source: Ministry of Interior, the Royal Thai Government, 2017.

Results

Contributions of involvement and focusing processes

After the panelists were involved in the questionnaire survey to clarify relationships between human security indicators (the HAI in Figure 2) and each sustainable development elements, the significant indicators from the participants could be identified and categorized via the Delphi process as shown in Table 2, 3, and 4, respectively. From Table 2, the HAI had been ranked and evaluated, based on economic perspectives. After the third round, the results of the Delphi survey were ordered, based on the Mean value of relevant indicators, as follows.

Table 2: The Ranking of Human Security Indicators in Economic Perspective

Rank	Economic Indicators	Mean	Mode	Median	Interquartile Range	Implication Level
1	Family income	4.94	5.00	5.00	0	4
2	Consuming debt	4.82	5.00	5.00	0	4
3	Poverty rate	4.76	5.00	5.00	0	4
4	Unemployment rate	4.71	5.00	5.00	1	4
5	Equality coefficient of income	4.71	5.00	5.00	1	4
6	Low work-hour rate	4.65	5.00	5.00	1	4
7	Employment of 15-17 years old worker	4.53	5.00	5.00	1	4
8	Serviceable main road of villages	4.41	4.00	4.00	1	3
9	Internet accessibility rate	4.41	4.00	4.00	1	3
10	House and land owner	4.24	4.00	4.00	0	3
11	Drought sufferer	4.24	4.00	4.00	0	3
12	Social insurance of labour	4.12	4.00	4.00	0	3
13	Flooding sufferer	4.12	4.00	4.00	0	3
14	Mobile phone occupation rate	4.12	4.00	4.00	0	3
15	O-Net test of high school student	3.94	4.00	4.00	0	3
16	Education year of people	3.88	4.00	4.00	0	3
17	Criminal rate	3.88	4.00	4.00	0	3
18	Road accident rate	3.82	4.00	4.00	0	3
19	High school and vocational training opportunity	3.76	4.00	4.00	0	3
20	IQ of primary school student	3.71	4.00	4.00	1	3
21	Infant survival rate	3.65	4.00	4.00	1	3
22	Persons with Disabilities	3.59	4.00	4.00	1	3
23	Injury rate	3.47	3.00	3.00	1	2
24	Greenhouse emission rate	3.41	3.00	3.00	1	2

Table 2: The Ranking of Human Security Indicators in Economic Perspective (cont.)

Rank	Economic Indicators	Mean	Mode	Median	Interquartile Range	Implication Level
25	Inpatient rate of all patients	3.18	3.00	3.00	0	2
26	Mental health level	3.12	3.00	3.00	0	2
27	Single parent family	3.12	3.00	3.00	0	2
28	Alone elder rate	3.06	3.00	3.00	0	2
29	Family participation in public activity	2.88	3.00	3.00	0	2
30	Number of social organizations	2.82	3.00	3.00	0	2
31	Family participation as a member of social organizations	2.65	3.00	3.00	1	2
32	Political vote rate	2.35	1.00	2.00	2	1

In economic perspective, most experts asserted that income acquisition was the most significant indicator, as it was economic power to purchase and fulfill what human wanted. Many experts inserted that sufficiency economic villages could be the new alternative indicator as well, since it expressed peaceful communities where people could stay happiness, no matter how much they earn. Furthermore, they also gave opinions that policy makers should promote sufficiency economy nationwide for fulfilling sustainable happiness in societies for a long term, and also local people should receive guidance and supports from governmental authorities or relevant agencies to initiate sufficiency economic villages. Moreover, many panelists also gave opinions in the open-ended questionnaire that local authorities and a private sector should establish industrial district, trade center, or distribution center to enhance economic security in the area, since these business mechanisms could significantly raise economic performance to achieve desirable economic outcomes for the people in the area.

Table 3: The Ranking of Human Security Indicators in Social Perspective

Rank	Social Indicators	Mean	Mode	Median	Interquartile Range	Implication Level
1	Unemployment rate	4.94	5.00	5.00	0	4
2	Social insurance of labour	4.82	5.00	5.00	0	4
3	High school and vocational training opportunity	4.76	5.00	5.00	0	4
4	Criminal rate	4.71	5.00	5.00	1	4
5	Equality coefficient of income	4.65	5.00	5.00	1	4
6	Consuming debt	4.59	5.00	5.00	1	4
7	Poverty rate	4.41	4.00	4.00	1	3
8	Single parent family	4.41	4.00	4.00	1	3
9	Low work-hour rate	4.35	4.00	4.00	1	3
10	Family income	4.35	4.00	4.00	1	3
11	Education year of people who is 15 years old and above	4.29	4.00	4.00	1	3
12	IQ of primary school student	4.24	4.00	4.00	0	3
13	O-Net test of high school student	4.12	4.00	4.00	0	3
14	Family participation in public activity	4.06	4.00	4.00	0	3
15	Family participation as a member of social organizations	4.00	4.00	4.00	0	3
16	House and land owner	3.94	4.00	4.00	0	3
17	Alone elder rate	3.94	4.00	4.00	0	3
18	Mental health level	3.82	4.00	4.00	0	3
19	Persons with Disabilities	3.59	4.00	4.00	1	3

Table 3: The Ranking of Human Security Indicators in Social Perspective (cont.)

Rank	Social Indicators	Mean	Mode	Median	Interquartile Range	Implication Level
20	Employment of 15-17 years old worker	3.53	4.00	4.00	1	3
21	Number of social organizations	3.47	3.00	3.00	1	2
22	Inpatient rate of all patients	3.41	3.00	3.00	1	2
23	Greenhouse emission rate	3.35	3.00	3.00	1	2
24	Injury rate	3.29	3.00	3.00	1	2
25	Internet accessibility rate	3.29	3.00	3.00	1	2
26	Infant survival rate	3.18	3.00	3.00	0	2
27	Mobile phone occupation rate	3.06	3.00	3.00	0	2
28	Road accident rate	2.94	3.00	3.00	0	2
29	Drought sufferer	2.88	3.00	3.00	0	2
30	Serviceable main road of villages	2.82	3.00	3.00	0	2
31	Flooding sufferer	2.59	3.00	3.00	1	2
32	Political vote rate	2.35	2.00	2.00	2	1

Regarding to social perspective, some experts also raised drug-trafficking rate as a new significant indicator since it could cause social problems and ruined the people's health at large scale, which society should realize that drug could affect to public health severely. Moreover, some panelists agreed with a vital comment to propose medical personnel rate as significant indicators as well. However, many of panelists commented on the political-vote-rate indicator that this indicator should be neglected as it was the out-of-date indicator, and also the participations were highly frustrated from political conflicts at the time of voting during year 2016.

Table 4: The Ranking of Human Security Indicators in Environmental Perspective

Rank	Environmental Indicators	Mean	Mode	Median	Interquartile Range	Implication Level
1	Serviceable main road of villages	4.94	5.00	5.00	0	4
2	Greenhouse emission rate	4.88	5.00	5.00	0	4
3	House and land owner	4.76	5.00	5.00	1	4
4	Criminal rate	4.71	5.00	5.00	1	4
5	Drought sufferer	4.59	5.00	5.00	1	4
6	Flooding sufferer	4.47	4.00	4.00	1	3
7	Injury rate	4.41	5.00	4.00	1	3
8	Road accident rate	4.35	4.00	4.00	1	3
9	Inpatient rate of all patients	4.24	4.00	4.00	1	3
10	Persons with Disabilities	4.18	4.00	4.00	0	3
11	Mental health level	4.06	4.00	4.00	0	3
12	Unemployment rate	3.82	4.00	4.00	0	3
13	Low work-hour rate	3.76	4.00	4.00	0	3
14	Internet accessibility rate	3.71	4.00	4.00	0	3
15	Family income	3.65	4.00	4.00	1	3
16	Poverty rate	3.59	4.00	4.00	1	3
17	Consuming debt	3.47	3.00	3.00	1	2
18	Equality coefficient of income	3.35	3.00	3.00	1	2
19	Social insurance of labor	3.24	3.00	3.00	0	2
20	Employment of 15-17 years old worker	3.24	3.00	3.00	0	2
21	Family participation in public activity	3.18	3.00	3.00	0	2
22	Single parent family	3.12	3.00	3.00	0	2
23	Alone elder rate	3.06	3.00	3.00	0	2
24	High school and vocational training opportunity	2.94	3.00	3.00	0	2

Table 4: The Ranking of Human Security Indicators in Environmental Perspective (cont.)

Rank	Environmental Indicators	Mean	Mode	Median	Interquartile Range	Implication Level
25	Mobile phone occupation rate	2.94	3.00	3.00	0	2
26	Number of social organizations	2.94	3.00	3.00	0	2
27	O-Net test of high school student	2.82	3.00	3.00	0	2
28	Family participation as a member of social organizations	2.82	3.00	3.00	0	2
29	Education year of people who is 15 years old and above	2.76	3.00	3.00	0	2
30	IQ of primary school student	2.65	3.00	3.00	1	2
31	Infant survival rate	2.59	3.00	3.00	1	2
32	Political vote rate	1.94	1.00	2.00	2	1

Regarding environmental perspective in terms of livelihood for living, immigration rate was purposed as a new indicator for the HAI as to it might reflect uncomfortable environment, which the people would struggle in one place and wanted to move to other places for better life or preferable environment. Moreover, air quality index in each area was also purposed as a significant indicator since it affected to well-being of people directly. Furthermore, some panelists raised a concept of smart city for promoting an environmental security policy, which people would be appreciated to live in a good built environment, including convenient lifestyle.

Contributions of Integrating Process to the Target

After the human security indicators from the focusing process were critiqued by the experts, various comments and recommendations had been proposed and integrated towards the spatial application. The GIS maps were, then, manipulated as to the potential opinions in economic, social, and environmental perspectives, as follows

Economic perspectives: family income versus poverty and its root cause.

Regarding the finding of spatial analysis in the 2nd round showed that stakeholders in Supanburi province had strong negative value of family income; then, the study in

the 3rd round raised field crop plantations to analyze the potentials of agricultural developments in the study area to integrate with the family income indicator. From the Figure 5, the spatial map showed the agricultural potentials, which was classified into 3 zones of soil suitability: S1 (the most suitable area), S2 (the moderate suitable area), and S3 (the less suitable area). To increase family income or reduce poverty, the panelists asserted that policy makers and farmers should find an alternative strategy to enhance family income or reduce poverty for Supanburi province, rather than highly project to field crop plantation in the area, especially in the Eastern of the province where had less suitable area for plantation. Likewise, Kanchanaburi and Ratchaburi provinces had widely S1 areas of soil suitability, the experts also commented that the province could enhance their agricultural potentials by integrating with other relevant indicators for mitigating planting problems from environmental effects, such as drought and flooding in specific areas as well.

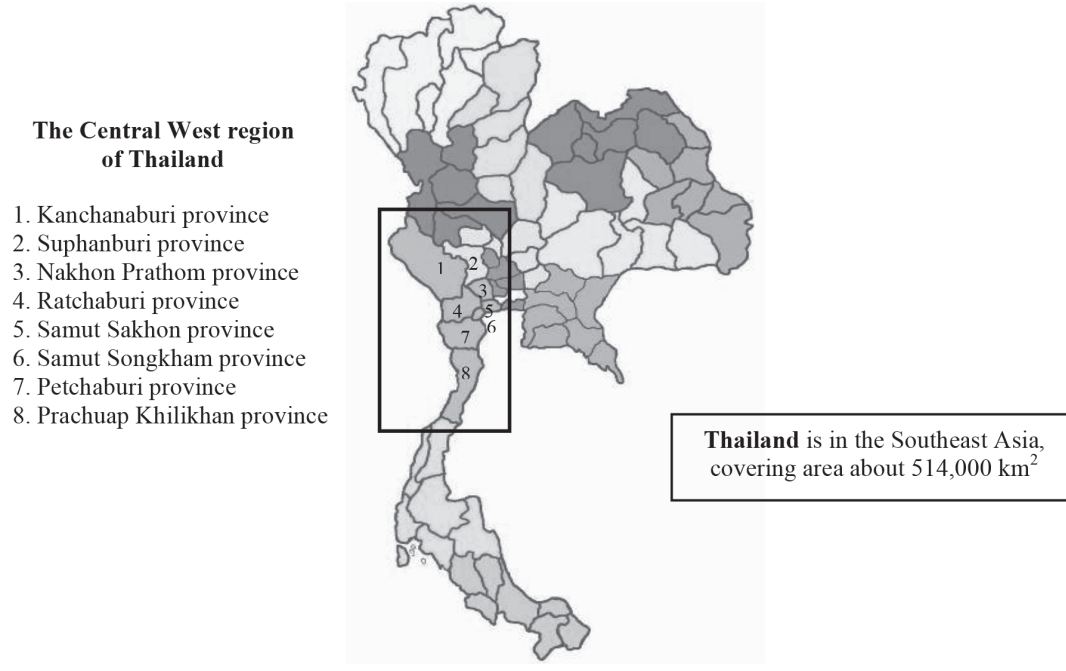
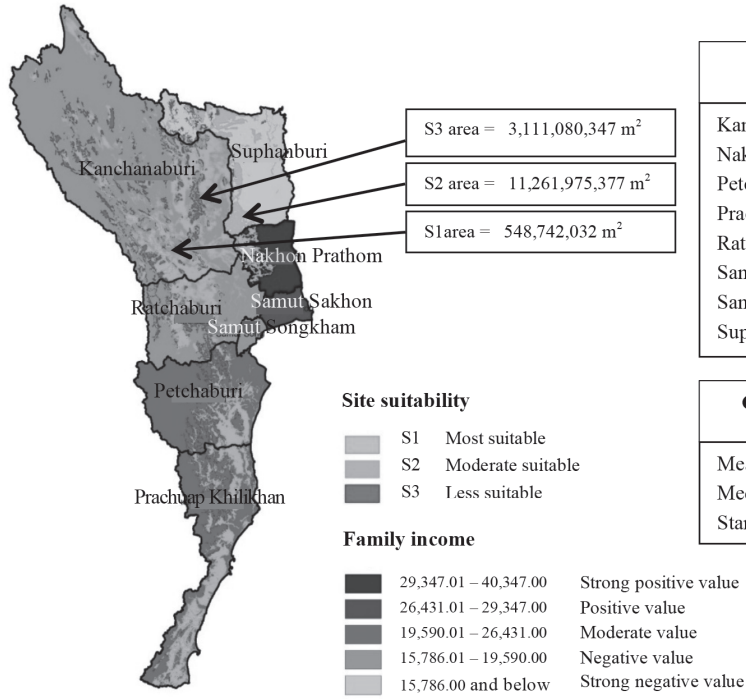


Figure 5: The HAI of Family Income and Agricultural Potentials

Source: NESDB, 2019; the Land Development Department, 2014.

However, based on the analysis of the Nakhon Prathom Provincial Development plan, the incident of high family income rate in Nakhon Prathom province would refer to successful developments, complying with appropriate strengths, which the people have high economic performance to exploit their resources, conforming to good geo-economics itself (Nakhon Prathom Provincial Governor's Office, 2020).

Whereas, the spatial map in Figure 5 showed that Suphanburi province has relatively strong negative value of poverty, relying to the strength and weakness of the province were not so many significant investments, but rich in cultures and local commodity (Suphanburi Provincial Governor's Office, 2020). Complying with these incidents, the experts also agreed with the province's development plan in focusing on promoting ecological or creative tourism as well. In the meantime, the experts also proposed that local authorities and policy makers should promote human capital for knowledge-based society to establish value-added economy or creative economy for tourism for the province as well.



Province	Family income
Kanchanaburi	18,883.71
Nakhon Prathom	40,346.95
Petchaburi	26,430.65
Prachuap Khilikhan	23,522.50
Ratchaburi	19,589.97
Samut Sakhon	29,347.37
Samut Songkham	18,310.15
Suphanburi	15,786,19

Classification statistics	Family income
Mean	24,027
Median	21,557
Standard deviation	7,478

Figure 6: The HAI of Poverty Related to Education Year of People in the Age of 15 Years Old and Above

Source: NESDB, 2019.

Regarding the spatial analysis in economic perspective in Figure 6, Nakhon Prathom province was likely to be successful in economic security; consequently, most experts agreed that educational opportunities is the most important root cause of economic problems, especially in the higher educational system. Some experts, then, raised Nakhon Prathom province to be the best practice of education in the region, for learning how to induce their people pursuing in higher degrees, or even investing more in education. They also gave comments that governmental agencies or policy makers were to increase education years of learning for the people to make knowledge-based societies in the area. Furthermore, many experts stated that an educational opportunity in high school and vocational training is also a significant foundation of nation building as well.

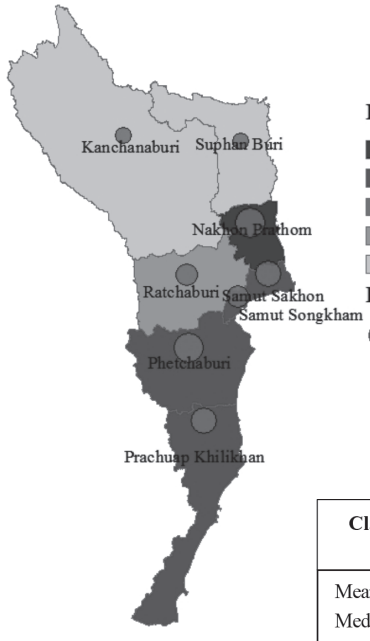
Social perspectives: interrelation of multi-dimensions of social issues

Referred to Figure 2, it has the common idea from the experts that there were so many dimensions of the HAI related to social issues, such as health, education, employment, income, family and community, and participation. A variety of these dimensions played complex roles to human security as to it could be implied to human's dignity and fulfillment of life in various perspectives.

For instance, unemployment rate in the employment dimension could express economic potentials of workforces that facilitated competitive advantage for the country; on the other hand, employment of worker in the family and community dimension was likely to reflect on social security more, as it could directly impact to family and society. Nevertheless, it was noted that unemployment might also derive from various root causes, such as huge immigrants from neighbor countries, leading high rate of unemployment for native people as well. Therefore, some of the panelists asserted that local authorities and policy makers should take migration rate into account of the proposed indicator as well.

While social insurance indicator was referred to partial assistances from governments, reflecting to a security of safe life; the finding in the study showed that the people in Kanchanaburi and Suphanburi provinces were less social insurances, based on the Social Security Act, B.E. 2533 (1990) - Section 33, 39, and 40 (NESDB, 2019) (Figure 7). In accordance with the finding, the panelists delivered encouragements to relevant agencies or private sectors for applying this social supports for their people largely.

Moreover, there were some concerns from the panelists, realized that human right should be a part of society equally with freedom and fairness was the significant issues to enhance human dignity as well.



Poverty

2.23 - 5.24	Strong positive value
5.25 - 8.26	Positive value
8.27 - 11.27	Moderate value
11.28 - 14.29	Negative value
14.30 - 17.30	Strong negative value

Education year (age 15 years old-above)

8.47 - 8.75	Strong positive value
8.18 - 8.46	Positive value
7.90 - 8.17	Moderate value
7.61 - 7.89	Negative value
7.31 - 7.60	Strong negative value

Province	Poverty
Kanchanaburi	15.14
Nakhon Prathom	2.23
Petchaburi	6.86
Prachuap Khilikhan	7.47
Ratchaburi	11.39
Samut Sakhon	5.31
Samut Songkham	7.25
Suphanburi	17.30

Province	Education year
Kanchanaburi	7.34
Nakhon Prathom	8.57
Petchaburi	8.75
Prachuap Khilikhan	8.46
Ratchaburi	8.04
Samut Sakhon	8.36
Samut Songkham	8.17
Suphanburi	7.31

Classification statistics	Poverty	Education year
Mean	9.12	8.05
Median	7.36	8.25
Standard deviation	4.76	0.55

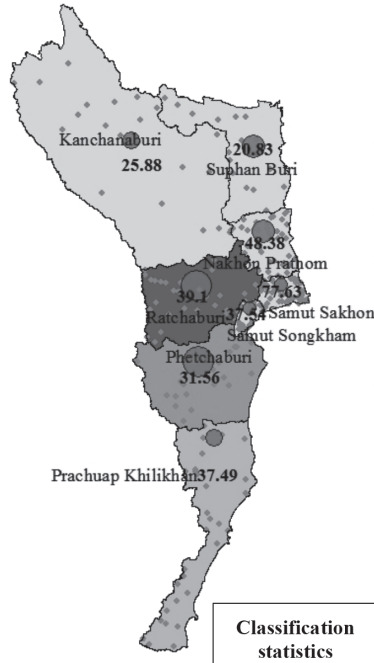
Figure 7: The HAI of Unemployment, Related to Social Insurance and Political Vote Rate
Source: NESDB, 2019.

Regarding to the participation dimension, the concept of this aspect implied that people get involvement with a community as public awareness or political activities, as well as deliver their own opinions for a better community. The panelists also expressed the opinions that the indicators in the participation dimension were to stand for strength of society that individuals or family contribute their efforts to play voluntary roles in societies or communities. They gave more significant opinions that the political vote rate in the year 2016 should be dismissed from the HAI list as it had strongest negative value of social security implication (Mean 2.35, Mode 2.00, Median 2.00, and Interquartile 2).

Environmental perspectives: livelihoods to global environmental issues

Since NESDB (2019) defined serviceable main road indicator that it was available transportation networks for logistics and traveling in the area for the whole year; the study showed that Kanchanaburi province obviously had the most vulnerable main road, comparing with other provinces in the region. Then, the panelists recommended that local authorities and policy makers should plan to construct new routes or prioritize road maintenances regularly for making a good built environment in the area, which was the most significant requirement effecting directly to their livelihoods.

Meanwhile, the people in Samut Sakhon province had some difficulties about land and housing possession as to low house land owner rate. Since this concern was referred to less environmental security in the province, defined by from house and land belonging to households in the area; the panelists, then, critiqued that the local authority or interested private sectors should provide financial supports or promote real estate developments for establishing good environment for the people in the area. However, there were comments on the HAI definitions in some indicators that it was to be reviewed in understandable and clearer meanings to various stakeholders, such as the units of household within the definition of house and land owner, the calculation of serviceable main road, the reality of GHG emission, and the up-to-date information of internet accessibility and mobile phone occupation rates.



Unemployment

.47 - .63	Strong positive value
.64 - .78	Positive value
.79 - .94	Moderate value
.95 - 1.09	Negative value
1.10 - 1.25	Strong negative value

Social insurance

1 Dot = 1.3 As per number in the map

Social insurance

Political vote rate

63.02 - 64.81	Strong positive value
61.21 - 63.01	Positive value
59.41 - 61.20	Moderate value
57.60 - 59.40	Negative value
55.79 - 57.59	Strong negative value

Province	Unemployment
Kanchanaburi	0.47
Nakhon Prathom	0.59
Petchaburi	0.91
Prachuap Khilikhan	0.71
Ratchaburi	1.25
Samut Sakhon	0.61
Samut Songkham	0.55
Suphanburi	0.59

Province	Political vote rate
Kanchanaburi	58.36
Nakhon Prathom	60.37
Petchaburi	64.81
Prachuap Khilikhan	59.31
Ratchaburi	63.17
Samut Sakhon	55.79
Samut Songkham	56.86
Suphanburi	59.80

Classification statistics	Unemployment	Social insurance	Political vote rate
Mean	0.71	39.80	59.81
Median	0.60	37.51	59.55
Standard deviation	0.24	16.35	2.82

Figure 8: The HAI of House and Land Owner, Related to Serviceable Main Road

Source: NESDB, 2019.

Conclusions and Discussions

Regarding to the HAI in the Figure 2, the human security dimensions has been changed since the first introduction in the 1994 HDR in many aspects, such as extracting economic dimension to income and employment dimensions, extending community dimension to family and community dimensions, elaborating environmental dimension for land, housing, transportation, and communication dimensions, and regrouping personal and political dimensions into education and participation dimensions. However, the challenge of human security recently was that how to achieve the concept of human security in practice at this moment. It concerns more on the security of people, rather than the security of territory in the past, based on the concept of "left no one behind" and freedom with opportunity (Gomez & Gasper, 2020).

In this study, the strategic framework of human security in Thailand was challenged to imply human security indicators to sustainable development perspectives directly, since NESDB insisted on promoting human security and SDGs together in the country. This study was, then, defined the HAI as a base case of human security indicators to analyze development opportunities. The stakeholders would be induced by learning from each other and cooperating as a partnership, for exchanging external knowledge and technologies together as well.

From the focusing process of the research framework, the study could identify the top three highest significant human security indicators in each perspective of sustainable development, as following: 1) economic security--family income, consuming debt, and poverty rate, 2) social security--unemployment rate, social insurance, and high school and vocational training opportunity, and 3) environmental security--serviceable main road, greenhouse emission rate, and house and landowner, respectively.

Furthermore, the panelists proposed the new additional indicators of human security and alternative policies, such as sufficiency economic village, drug trafficking, air quality index, immigration rate, and medical personnel rate. Moreover, the findings also asserted that the scopes of environmental indicators were to be defined more understandable definitions to get involve from relevant stakeholders in development practices, such as the definition of house and land owner indicator.

Recommendations

Although some panelists commented that socio-economic security was realized as the most important concern; however, the panelists also agreed with Doppenberg & Aar (2007) study that developers, especially who were in agricultural industry, should not merely focus on sustainability of a socio-economic aspect; but they should also concerned about environmental issues, including environmental burden from land use change, competition for water, and GHG effects as well.

Nevertheless, it is to be noted that economic potentials, such as family income and poverty could express a contradiction of economic security both positive and negative sides. Having doubts with redundant human security indicators, the experts insisted that these redundant or vague indicators should be clarified more explicit to be

empirical indicators in the HAI, for example, unemployment rate versus employment of worker and poverty rate versus consuming debt.

As the government had been promoting knowledge-based society for sustainable development; the local leaders should, therefore, get an opportunity to attend spatial analysis courses from governmental supports, so that they could plan and implement various developments using spatial analysis by themselves in the meantime. Likewise, if we could disseminate spatial perceptions and exploited the spatial application for all stakeholders; it would magnify benefits to human security and enhance sustainable growth for the country eventually. The study was, then, compiled with the study from Dewulf & Langenhove (2006) that human security was to involve with three main aspects of sustainable development to enhance dignity and fulfillments of the people, as following: 1) ecological balance, 2) sustained economic stability, and 3) social development and equity.

It is recommended for a further study to apply spatial analysis to various public awareness of volunteer activities that have been implementing in several campaigns in Thailand nowadays, especially regarding to the Volunteer Spirit Projects, Royal Initiative. The study would visualize an achievement of human participations via spatial applications in a comprehensible manner, in order to enhance sustainable development and strengthen human security in the country eventually.

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