RESEARCH ON SUSTAINABLE DEVELOPMENT LEVEL: A CASE STUDY OF HAI PHONG AND QUANG NINH

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ABSTRACT

The idea of sustainable development emerged several decades ago as a response to growing environmental problems related to inappropriate management of natural resources and increase in extreme weather phenomena, especially in developing countries. Using indicators is one of the best ways to monitor and measure progress towards sustainable development. In this article, we have presented the practical use of the Delphi technique and the Stable Prioritization Towards Ideal Solution (SPOTIS) method to in-depth assess the level of sustainable development of Hai Phong and Quang Ninh in the period 2016 - 2021. The research findings are as follows: First, the research build a sustainable development assessment system including 26 indicators that are compatible and have data available in accordance with the economic, social and environmental characteristics of the study area. Second, Hai Phong and Quang Ninh generally developed in a positive direction with sustainable development index (SDI) continuously increasing with increase of 1.07% and 1.09% respectively from 2016 to 2021. Third, the economic, social, and environmental aspects in both provinces developed unbalanced. The study recommends that it is vital to strengthen the policies to have a simultaneous development on the four dimensions of HDI, economy, society and environment to improve the SDI. Finally, based on research findings, the research indicators and methods can be put forward to assess the sustainable development level in other provinces and specific cases with similar characteristics.

NGHIÊN CỨU MỨC ĐỘ PHÁT TRIỂN BỀN VỮNG: NGHIÊN CỨU ĐIỂN HÌNH Ở KHU VỰC HẢI PHÒNG VÀ QUẢNG NINH

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TỪ KHÓA

Mức độ phát triển bền vững
Hải Phòng
Quảng Ninh
Phương pháp Delphi
Phương pháp SPOTIS

TÓM TẮT

Phát triển bền vững xuất hiện cách đây vài thập kỷ như một giải pháp ứng phó đối với các vấn đề môi trường ngày càng gia tăng, liên quan đến quản lý tài nguyên thiên nhiên không hợp lí và gia tăng các hiện tượng thời tiết cực đoan, đặc biệt là ở các nước đang phát triển. Sử dụng các chỉ thị là một trong những phương cách tốt nhất để quan trắc và đo lường tiến trình hướng tới phát triển bền vững. Nghiên cứu này đã sử dụng kỹ thuật Delphi và phương pháp SPOTIS để đánh giá mức độ phát triển bền vững của Hải Phòng và Quảng Ninh trong giai đoạn 2016 - 2021. Kết quả nghiên cứu đạt được như sau: thứ nhất, nghiên cứu đã xây dựng hệ thống đánh giá phát triển bền vững gồm 26 chỉ thị phù hợp và có sẵn dữ liệu phù hợp với đặc điểm kinh tế, xã hội và môi trường của khu vực nghiên cứu. Thứ hai, Hải Phòng và Quảng Ninh nhìn chung phát triển theo hướng tích cực với chỉ số phát triển bền vững (SDI) liên tục tăng với mức tăng lần lượt là 1,07% và 1,09% từ năm 2016 đến năm 2021. Thứ ba, các khía cạnh kinh tế, xã hội và môi trường ở cả hai tỉnh phát triển không cân bằng. Nghiên cứu kiến nghị rằng để cải thiện SDI thì điều quan trọng là phải tăng cường các chính sách để có sự phát triển đồng thời trên bốn khía cạnh HDI, kinh tế, xã hội và môi trường. Cuối cùng, dựa trên kết quả nghiên cứu, các chỉ thị và phương pháp nghiên cứu có thể được áp dụng để đánh giá mức độ phát triển bền vững ở các tỉnh khác và các trường hợp cụ thể có đặc điểm tương tự.

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1. Introduction

Intending to develop a green economy, all countries in the world agree on implementing sustainable development goals [1]. Sustainable development is researched in many different fields, including the assessment of sustainable development indices, which will provide essential information for building a better and more sustainable society. The set of sustainable development indicators (SIs) plays an extremely important role in assessing and monitoring the current state of sustainable development at local, provincial, national and global scales [2]. A set of SIs will be the foundation for policymakers to provide better policies and allocation of resource use.

Vietnam is one of the countries strongly committed to implementing sustainable development goals through the issuance of strategic directions, policies and decisions to implement sustainable development policies and goals of Vietnam such as Decision No. 153/2004/QD-TTG, No. 432/QD-TTg, No. 1602/QD-TTg, No. 160/QD-TTg and Decision No. 2157/QD-TTg [2], [3]. In particular, Decision 2157/QD-TTg issued a system of 28 general statistical indicators, consisting of economic, social, and environmental aspects and 15 specific indicators for each region. In the work of Tran Van Y and others, the authors suggested a sustainable development evaluation system including 77 regional indicators, 70 provincial indicators and 49 district indicators for the Central Highlands [2]. Another research with 39 indicators on economic development issues, sea and island areas, natural disasters, etc to evaluate sustainable development level for Quang Tri and Thai Binh [6], [7]. The research work of Nhung proposed a set of 18 indicators for sustainable development assessment in Ha Tinh [5]. The sustainable development indicator system of Lam evaluates the SDI of Thanh Hoa province for the period 2010 - 2014 including 33 indicators in 5 areas of economic, social, environmental, infrastructure and governance [8].

These findings contribute to broadening the application of sustainable development assessment but may reveal some certain limitations as follows: (1) The SIs system is very extensive and difficult to apply to various geographical areas, (2) There are numerous applications to monitor sustainable development in different areas [8] and (3) Indicators are not updated according to the latest United Nations sustainable development goals. To address those limitations, the Stable Priority Order Towards Ideal Solution (SPOTIS) method is an effective solution to assess the level of sustainable development for Hai Phong and Quang Ninh. This method similar to the Characteristic Objects Method (COMET) was created with being rank reversal phenomenon resistant. To increase the reliability of the above assessment method, we combine with the Delphi method to provide a set of indicators for sustainable development in each field. The Delphi method is an iterative process used to collect and distill expert judgments using a series of questionnaires interspersed with feedback. The purpose of this method is to build consensus forecasts from a group of experts in a structured iterative manner [9].

Therefore, the objective of this research is to establish a system of SIs to evaluate the sustainable development level of Hai Phong and Quang Ninh in the period 2016-2021. The results of the research are reference for managers, communities, and policymakers of the two provinces to build solutions and strategies for sustainable development aiming to become the marine economic centres of the country.

2. Methodology

2.1. Study area

Hai Phong is a coastal city located downstream of the Thai Binh river system, in the Northeast region of the Red River Delta about 120km east-northeast of Hanoi. Currently, Hai Phong has 15 districts, 11 towns, 14 industrial parks, and 1 economic zone adjacent to Hai Phong port, and is a multi-industry, multi-sector marine economic center of the Northern coastal region and the whole [10]. With its exceptional geographical location characteristics, Hai Phong was selected as the site for a seaport and in fact has become a prime port city, the largest in the North. Hai Phong is

one of the traffic hubs, including roads, railways, aviation and especially sea routes, with the largest trade opening with the world in the North [4]. Therefore, Hai Phong (along with a part of Quang Ninh) naturally becomes the "gateway" for the entire Red River Delta, the Northern Midlands and Mountains, and even further, the Southern region of China.

Quang Ninh is a coastal province in the Northeast region of Vietnam, about 125 km east of Hanoi. Quang Ninh has 4 cities, 2 towns and 16 industrial parks, located near seaports, convenient for trade. With a favorable terrain, there are both land and sea borders, with a sea length of up to 250 km, a width of over 6,000 km^2 of sea surface, over 1,000 km^2 of island area and a system of inland waterways near the [11]. With 800 km and more than 130 inland waterway ports, Quang Ninh is a locality with many advantages to develop into one of the sustainable marine economic centers of the country (Figure 1**)**.

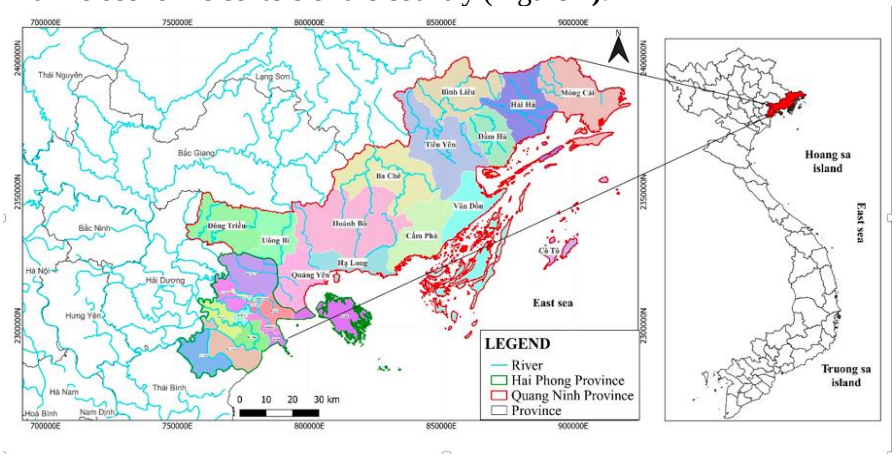

Figure 1. *Location of study area (Quang Ninh and Hai Phong Provinces -Viet Nam)*

Along with its potential, the region is one of the regions in Vietnam strongly affected by climate change [12]. Other natural disasters frequently occur such as flash floods and landslides, killing 10 people and 42 houses being swept away (1999-2022) [4], [13]. In addition, socio-economic development is still significantly and sustainably limited because excessive population growth and increased environmental pollution. Therefore, analyzing and evaluating the sustainable development of Hai Phong and Quang Ninh will provide important knowledge to improve economic, social, and environmental sustainability. This topic will also provide recommendations on how to reverse "negative" benefits or maintain "positive" benefits from a sustainable development perspective.

2.2. Research method

The SIs system is established and evaluated based on the combination of two approaches, the Stakeholder Delphi technique, and the Stable Preference Ordering Towards Ideal Solution (SPOTIS) method. The indicator system inherits the content of case studies in the world [14], [15] and is suitable for Vietnam's sustainable development curriculum [16] in general and regional in particular. The indicators framework to evaluate the sustainable development level of Hai Phong and Quang Ninh consists of HDI, economic, social, and environmental aspects along with corresponding indicators. In this research, 26 proposed indicators were selected to evaluate 3 main dimensions of sustainable development.

2.2.1. Secondary data collection

The research collected and processed available domestic and international data on Google Scholar to statistically analyse and evaluate the economic, social and environmental indicators announced by local authorities and other data sources at different levels (national, regional, and

provincial). Moreover, the study also collects information and data from relevant departments, localities, research and projects to synthesize and analyse necessary documents and data to establish an indicators set for sustainable development assessment at the city level.

2.2.2. Primary data collection

This study applied the Delphi method and field surveys to collect data for sustainable development assessment for Hai Phong and Quang Ninh. Delphi method is through an iterative, stakeholder consultation process [6]. 50 experts were randomly selected from 04 stakeholder groups representing local governments, citizens, interdisciplinary scientists and businesses. Two rounds of the Delphi method are conducted using a questionnaire system on 50 selected experts. The first round was carried out from August 2022 to November 2022 and the second round was taken place from December 2022 to March 2023 in Hai Phong and Quang Ninh.

2.2.3. Establishment of indicator set for sustainable development (Delphi Technique)

The RAND Corporation created the Delphi technique in the 1950s to forecast the effect of technology on warfare [27]. The topics that have been applied to this method of research are health care [20], education [21] management [22] and environmental science [23], [24] and being comprehendly assessed in many topics [25]–[27]. The Delphi method will require 2 rounds of questioning [28] and panel members respond in the anonymous feedback form. The method can predict future problems [19] and then have solutions to deal with [29].

In this study, the Delphi process is implemented according to the following steps:

Step 1: Preparation

• Collect, synthesize and analyze domestic and international data to develop a set of indicators for sustainable development assessment.

• The sustainable development assessment indicator system was tested and investigated in a small group of 10 experts and further adjusted. 33 initial indicators were identified for inclusion in the review.

Step 2: Adjustment

• Delphi questionnaire round 1 was sent to 50 experts. Analyze the Delphi questionnaire round 1 's results by testing the concordance (Kendall's W, Schmidt, 1997- see Table 1) and reliability (Cronbach's alpha, Cronbach L.J., 1951- see Table 2) coefficient to prepare for develop the Delphi questionnaire round 2.

• Construct the Delphi questionnaire round 2 based on the results of Delphi questionnaire round 1.

• Delphi questionnaire round 2 was sent back to the experts who participated in round 1.

Step 3: Analyzation and assessment

• Analyze Delphi questionnaire round 2's result by evaluating the concordance (Kendall's W) and reliability (Cronbach's alpha) coefficient to develop a sustainable development indicators set.

Table 1. *The agreement and confidence associated with Kendall's W* [17]

	Value of Kendall's W				
	0.1	**0.3**	**0.5**	**0.7**	**0.9**
Interpretation	Very weak agreement	Weak agreement	Average agreement	Strong agreement	Unusually strong agreement
Confidence in ranks	None	Low	Fair	High	Very high

Table 2. *Cronbach's Alpha Level of Reliability* [18]

Cronbach's Alpha Score	**Level of Reliability**
0.0 – 0.1	Less Reliable
0.1 – 0.3	Rather Reliable
0.3 – 0.5	Quite Reliable
0.5 – 0.7	Reliable
0.7 – 1.0	Very Reliable

One workshop was carried out with, the Delphi method concluded after 2 rounds of expert consultation. The information collection process was included in the Delphi questionnaire to express the individual opinions of each expert. Through consultation, experts said that 26/33 indicators are essential in assessing the sustainable development level of Hai Phong and Quang Ninh. The sustainable development assessment system has 26 indicators including 7 economic indicators, 11 social indicators, 7 environmental indicators, and 1 composite index (the Human Development Index (HDI)). After establishing a sustainable development level assessment system, the authors collected the necessary data, and calculated and evaluated the level of sustainable development. From there, the results will help provinces monitor the level of sustainable development over the years and adjust appropriate plans and decisions to achieve sustainable development goals (Figure 2).

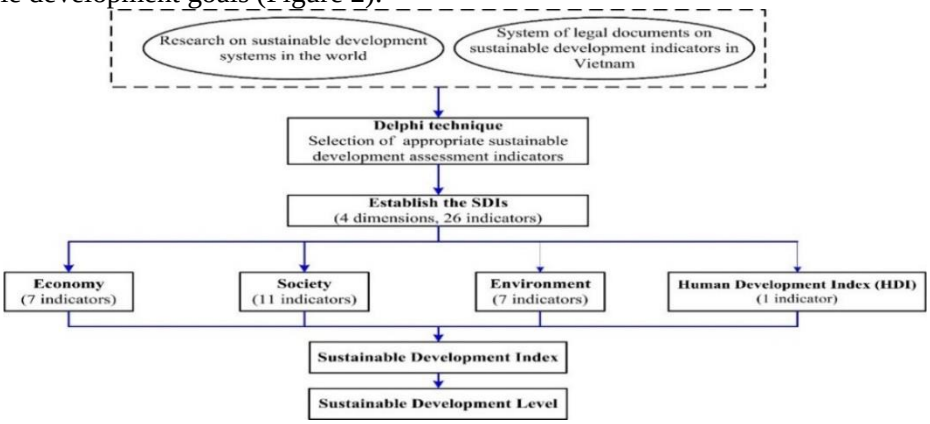

Figure 2. *Framework for assessing sustainable development*

2.2.4. Stable Preference Ordering Towards Ideal Solution (SPOTIS) method for sustainable development assessment

The Stable Preference Ordering Towards Ideal Solution (SPOTIS) method is a newly developed method dedicated to multi-criteria decision-making [30]. It requires much less information than the other approaches. Moreover, SPOTIS fits in the framework of classical Multi-Criteria Decision Making problematic because it uses directly the MCDM score matrix available, and the important weighting factors of criteria [30]. In addition, this method can also guarantee that each indication has the same weight and keep cities with uneven development from reaching high SDI.

In this paper, the real static value of the indicators was normalized to the range value between 0-1. To perform this work, the expert evaluation and Min/Max calculation were applied.

Step 1: SIs contain two types of indicators, consisting of positive indicators (increased indicator values have a positive impact on sustainable development), and negative indicators (increasing indicator values have a negative effect on sustainable development). Each indicator type is applied in different equations as follows:

- For positive indicators:

$$I_{pos} = \frac{x_j - x_j^{min}}{x_j^{max} - x_j^{min}} \quad (1)$$

- For negative indicators:

$$I_{neg} = \frac{x_j^{max} - x_j}{x_j^{max} - x_j^{min}} \quad (2)$$

For Eq. (1) and Eq. (2), x_j is a value of indicator x, x_j^{max} and x_j^{min} denotes for the maximum and minimum scaled values of indicator x, respectively.

Therefore, we have 2 separate equations for the indicators that have different impacts on the sustainability index. Equation (1), and (2) apply to positive, and negative indicators, respectively, and the standardized indicators are within the interval (0, 1). We need to set a minimum value to ensure that all normalized indices are in the range [0, 1] and also need to set an upper limit [31]. For some indicators with extreme values, we need to treat them by logarithmic transformation before normalizing. Logarithmic transformations can also reduce the margins of soil ecological indicators such as forest cover. Some cities have a forest cover rate of 10%, while in others it is 85%. Scoring 10 and 85 is not reasonable. Logarithmic transformation effectively prevents undue hindrance to resource-poor regions. Also, make sure that all values are greater than 1 before converting logarithms. The maximum, and minimum values and criteria calculation will be shown in the Results.

Step 2: Economic, social and environmental indicators will be used with the average formula of the following form:

$$Economic\ SDI = \sqrt[7]{E_1 \times E_2 \times \ldots \times E_6 \times E_7} \quad (3)$$

$$Social\ SDI = \sqrt[11]{S_1 \times S_2 \times \ldots \times S_{10} \times S_{11}} \quad (4)$$

$$Environmental\ SDI = \sqrt[7]{ENV_1 \times ENV_2 \times \ldots \times ENV_5 \times ENV_7} \quad (5)$$

E stands for the economic indicator, S stands for the social indicators and ENV stands for the environment indicator.

Step 3: Calculate the SDI

$$SDI = \sqrt[3]{Economic\ SDI \times Social\ SDI\ \times Environmental\ SDI}$$

The scale for measuring sustainable development is inherited and used with the set of SIs that the Vietnamese government issues, based on the research of Nguyen Thi Minh Thu [32]. Because the development process is always changing daily, the system of SIs will have changes in the future. However, the scale is still applicable to any proposed principles and methods

Table 3. *Scale for assessing the level of sustainable development*

Degree evaluation	
Very unsustainable development	0.0 – 0.2
Unsustainable development	0.2 – 0.4
Relatively sustainable development	0.4 – 0.6
Fairly sustainable development	0.6 – 0.8
Very sustainable development	0.8 - 1.0

3. Results and discussion

Table 4 summarizes the maximum and minimum values of 26 indicators selected for sustainable development analysis for Hai Phong and Quang Ninh in the period 2016 - 2021. In addition, the "Human Development Index" is an indicator that receives values in the range [0-1], becoming separate indicators respectively, and does not participate in this calculation process. The maximum and minimum values can be adjusted to ensure significance in the time series as well as following the development strategy in each period. This will be the basis for calculating the indicators of three sustainable development criteria.

Table 4. *Sustainable development indicators for Hai Phong and Quang Ninh*

Criteria		Indicators	Maximum value	Minimum value	Effect
Economy	E1	Ratio of regional development investment capital to the gross regional domestic product (%)	100	0	Negative
	E2	Social labor productivity (Million dong per employee)	200	50.0	Positive
	E3	Contribution of total factor productivity (TFP) to the overall city's economic growth (%)	80	5.0	Positive
	E4	Incremental Capital Output Ratio - ICOR	10	0.0	Negative

Criteria		Indicators	Maximum value	Minimum value	Effect
	E5	Annual GRDP growth rate (%)	100	3.0	Positive
	E6	Ratio of exports to imports (%)	10	0.0	Positive
	E7	Consumer Price Index - CPI	150	80.0	Positive
Social	S1	Provincial poverty rate (%)	100	0.0	Negative
	S2	Unemployment rate (%)	10	0.0	Negative
	S3	Sex ratio at birth (Boy per 100 girls)	125	102.0	Positive
	S4	Population density (people/km^2)	1500	0.0	Negative
	S5	Population growth rate (Person per 100.000 population)	5	0.0	Positive
	S6	GINI coefficient			
	S7	Percentage of population participating in health insurance (%)	100	0.0	Positive
	S8	Mortality rate of children under 5 years old (%)	30	0.0	Negative
	S9	Percentage of students attending high school at the right age (%)	100	0.0	Positive
	S10	Availability of doctors (people)	20	0.0	Positive
	S11	Traffic fatalities (%)	110	0.0	Negative
Environment	ENV1	Percentage of population with access to clean water	100	0.0	Positive
	ENV2	Percentage of industrial parks and export processing zones in operation with centralized wastewater treatment system meeting environmental standards (%)	100	0.0	Positive
	ENV3	Number of days per year with poor Air Quality Index	100	0.0	Negative
	ENV4	GHG emissions per capita (Million tons CO_2/thousand people)	5	0.0	Negative
	ENV5	Forest cover rate (%)	5	0.0	Positive
	ENV6	Area of public green land per capita in inner city (Area of green trees/person)	47	0.0	Positive
	ENV7	Level of damage caused by natural disasters	20	0.0	Negative
Human Development Index	HDI	Human Development Index			

Note: Positive indicators (increased indicator values have a positive impact on sustainable development), and negative indicators (increasing indicator values have a negative effect on sustainable development).

3.1. Assessment of sustainable development level of Hai Phong

The Human Development Index (HDI) is stable and tends to increase in the period 2016 – 2021. The social development index tends to increase, the economic and environmental development index fluctuates unstable. This situation is due to the COVID-19 pandemic lasting till 2020, affecting economic development and ecological imbalance. Regarding the environmental aspect, "GHG emissions per capita" in 2019 is one of the main causes affecting the environmental index, increasing 1.1 times compared to 2018. The city has increased production and product trading to ensure supply because the city is not affected by social distancing. Therefore, "Number of days per year with poor Air Quality Index" has also increased 1.5 times compared to previous years, the average AQI index is at 105, showing poor air quality. As for economic dimension, the TFP and GRDP indices have decreased sharply. Specifically, in the first 9 months of 2018, Hai Phong's GRDP grew by 16.2%, and for the first 9 months of 2019, this figure was 16.42%. In 2020 (during the COVID-19 epidemic), Hai Phong's GRDP growth

still reached 11.39% and by 2021 it reached 12.38%. This shows a lack of balance and an uneven level of sustainable development among the component indices. The component indices are all at a fairly sustainable level of development, except for the economic component index which is at a relatively sustainable level [4].

Table 5. *Results of Sustainable Development index in Hai Phong*

Criteria	2016	2017	2018	2019	2020	2021
HDI	0.745	0.759	0.769	0.777	0.782	0.783
Economic	0.510	0.571	0.587	0.574	0.492	0.518
Social	0.513	0.557	0.600	0.639	0.686	0.687
Environment	0.769	0.780	0.786	0.727	0.711	0.703
SDI	0.622	0.659	0.679	0.675	0.658	0.666

The SDI of Hai Phong city is in the range of 0.622 to 0.666, this is a fairly sustainable level of development, starting at a low level at the beginning of the period, but at the end of the period, there was an increase. However, Hai Phong City's SDI in 2020 tended to go down. This is a consequence of the COVID-19 pandemic lasting 2 consecutive years leading to a decrease in several indices especially in the economic and environmental fields, leading to the composite SDI being pulled down. This fluctuation shows that the sustainable development of Hai Phong City is imbalance, in which environmental index and HDI have high values but economic and social index are much lower.

3.2. Assessment of sustainable development level of Quang Ninh

With positive changes from the index over the years, Quang Ninh province's SDI tends to increase from 0.589 in 2016 to 0.644 in 2021, but bottomed out at 0.628 in 2020 and is trending up again. The results show that Quang Ninh's SDI has increased in the period 2016 - 2019 mainly due to the positive shift in the environmental aspect (0.770). Because of the government's attention through the issuance of decisions on solid waste treatment and wastewater, environmental issues in Quang Ninh have made remarkable improvements. In 2019, percentage of industrial parks and export processing zones in operation with centralized wastewater treatment system meeting environmental standards index increased 2 times compared to 2016. Besides, the social field has notable changes. In 2020, the social index (0.445) was seriously affected by the prolonged COVID-19 pandemic, causing negative impacts on social security of the province. The population growth rate is decreased sharply. According to the Department of Statistics, the population growth rate of Quang Ninh province is 0.96, lower than 2018 and 2019 which were 1.46 and 1.61 respectively. The main reason is the low immigration rate (0.95) due to social distancing during the epidemic situation. Furthermore, Quang Ninh has a high gender balance rate at birth. According to a report by the Statistics Department of Quang Ninh Province, Ha Long has a high sex ratio at birth. In 2020, the total number of children born in the area is 3,448, of which the number of male children is 1,869, the number of female children is 1,579, equivalent to a sex ratio at birth of 118.4 boys/100 girls. Across the province, the sex ratio at birth in urban areas tends to decrease but in rural areas it still remains high at 113 boys/100 girls. The province has many ethnic minorities, so propagating the Party and state's contents on gender equality still faces many difficulties. In 2021, social index have tended to recover, economic and environmental indices have decreased due to ineffective use of investment capital and the level of damage caused by natural disasters [33].

From 2016 to 2021, some indicators such as social labor productivity, population growth rate, percentage of industrial parks and export processing zones in operation with centralized wastewater treatment systems meeting environmental standards, number of days per year with poor Air Quality Index contributed significantly to the improvement of Quang Ninh's SDI (Table

6). On the other hand, a bunch of indicators have low scores causing a drop in the SDI: Incremental Capital Output Ratio – ICOR, ratio of exports to imports, and traffic fatalities in 2020. Following the same trend as Hai Phong, the province also has a higher environmental index and HDI than the economic and social index.

Table 6. *Results of Sustainable Development index in Quang Ninh*

Criteria	2016	2017	2018	2019	2020	2021
HDI	0.743	0.747	0.757	0.769	0.769	0.772
Economic	0.554	0.558	0.558	0.558	0.575	0.551
Social	0.436	0.514	0.500	0.500	0.445	0.513
Environment	0.672	0.714	0.738	0.770	0.789	0.787
SDI	0.589	0.625	0.628	0.638	0.628	0.644

3.3. Comparison of sustainable development levels of Hai Phong and Quang Ninh

The graph illustrates information about the sustainability in Hai Phong and Quang Ninh over a period of time. Generally, Hai Phong and Quang Ninh were still at a fairly sustainable development level and moving slowly toward a higher level of sustainability. The Hai Phong's SDI shows that the level increased gradually from 0.622 in 2016 to 0.666 in 2021. Quang Ninh's SDI has a later starting point with 0.589 in 2016 to 0.644 in 2021. It also provides the significant differences in the level of sustainable development between these four components. In the four components of sustainability, Hai Phong got the highest level for environmental, followed by HDI, social and economic components. Quang Ninh got the highest level for HDI, environmental, social and economic components.

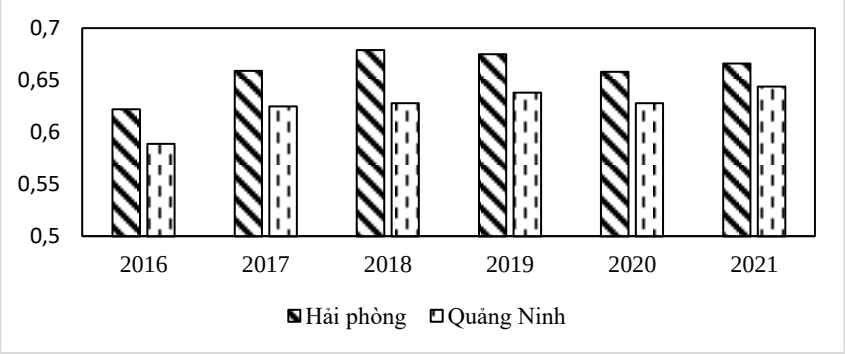

Figure 3. *Sustainable development level of Hai Phong and Quang Ninh from 2016 to 2021*

Hai Phong has made great strides in achieving its goal of becoming a modern industrial city and in 2018, the city has gradually moved closer to the goal of very sustainable development. But when measuring the distance to economic sustainability, Hai Phong is stuck at the lower rungs of the ladder. According to 2016 data, the index of Hai Phong's economic sectors is low (0.510) and ranked at a relatively sustainable level of development. Gradually increased to 0.571 in 2017, and 0.587 in 2018 but still at a relatively sustainable level. The situation is even less positive when Hai Phong's economic sector index tends to decrease with 0.574 in 2019 and 0.492 in 2020 (Table 3). In the case of Quang Ninh, the economic sector index in 2016 was low (0.554), reaching a relatively sustainable level of development. Maintained 0.558 from 2017 to 2019 but still classified as unsustainable development. By 2021, the economic sector index decreased significantly to 0.551. The main cause of this problem is low regional development investment capital to the gross regional domestic product rate and proportion of exports to imports. Moreover, ICOR, an indicator used to determine a city's level of production efficiency, was still high and going to increase. It makes the score for ICOR was going to decrease. The bright spot in the economic component is social labor productivity increased 1.7 times in the period 2016 – 2021.

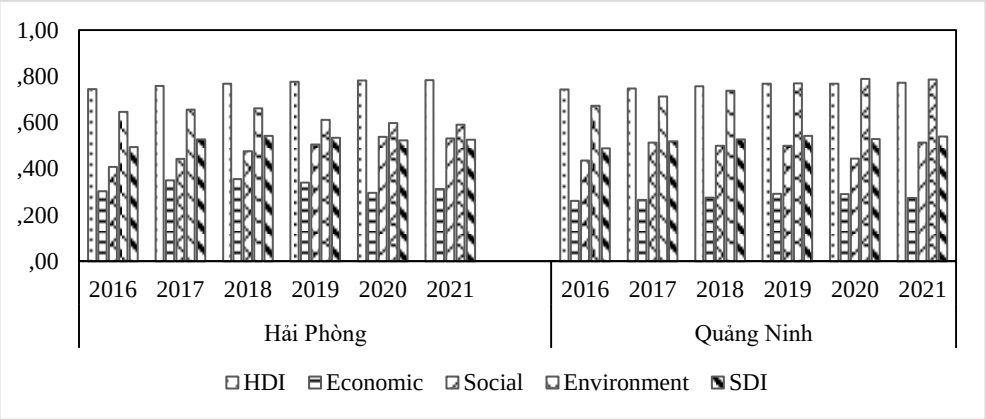

Figure 4. *Component index and composite index of sustainable development of Hai Phong and Quang Ninh in the period 2016 - 2021*

Both Hai Phong and Quang Ninh governments have several policies to take care of human well-being such as education, living conditions, healthcare, quality, etc… That is the main reason why the social component in the sustainable development of these 2 provinces is relatively sustainable development. Despite experiencing the severe and prolonged COVID-19 pandemic, social security is still guaranteed. In 2016, Hai Phong's social component index was 0.513 and increased to an astonishing 0.686 in 2021, reaching a fairly sustainable development level. Sharing the same trend as Hai Phong, Quang Ninh has increased from 0.431 (in 2016) to 0.513 (in 2021).

Moreover, the results of the study show that the environmental index of the two cities has surprising compared to the remaining indices. Due to the low indicator value for forest cover rate, number of days per year with poor Air Quality Index, GHG emissions per capita, and area of public green land per capita in inner city, the synthetic indicator for the environmental component was bad with 0.769 in 2016 to 0.711 in 2021 for Hai Phong. On the other hand, Quang Ninh's environmental component indicator value was good from 0.672 (in 2016) to 0.787 (in 2021). The main reason is that the high indicator value for high GHG emissions per capita and forest cover rate has caused Quang Ninh's environmental component index to increase.

Both cities are very concerned about environmental protection, however, the economy has not yet been exploited to its full potential and the social life can be further improved. This can be clearly seen during the research period: the HDI and environmental indices are at a fairly sustainable development level and the economic and social indices are at a relatively sustainable development level. Therefore, it is important to maintain the sustainability of economic, social, environmental and HDI at the same time.

4. Conclusion

To compare the sustainability of Hai Phong and Quang Ninh from 2016 to 2021, the authors have built a system of 26 indicators to evaluate the level of sustainable development for Hai Phong and Quang Ninh aiming to address four aspects of sustainable development: HDI, economic development, social security and environmental ecological balance. The study used the latest available data for each province's index and analyzed historical data to study changes in the two provinces over time. The research presented in detail the SIs system and the method of assessing the level of sustainable development of Hai Phong and Quang Ninh in the period 2016 - 2021. A set of SIs is built by Delphi Technique. The Stable Preference Ordering towards Ideal Solution (SPOTIS) method is used to calculate component indices and composite indices of sustainable development. The main research results show the change in the level of sustainable development of Hai Phong and Quang Ninh from a relatively sustainable development to a fairly sustainable development in the period 2016 - 2021. In general, the two provinces of Hai Phong and

Quang Ninh have succeeded in improving the SDI over the years, and the SDI is at a fairly sustainable level (0.666 for Hai Phong and 0.644 for Quang Ninh in 2021) and is trending towards better progress. However, the uneven development of economic, social and environmental aspects has affected the sustainable development process in two localities. The formation of an indicator system to evaluate the two cities' sustainable development level based on national indicators aims to recognize difficulties and resolve shortcomings of the existing set of indicators such as reducing the number of indicators and unifying the best calculation method...

Through the current state of sustainable development in these two provinces, solutions should focus on economic, social aspects and maintaining environmental protection. These two cities need sustainable, balanced development in four dimensions: economy, society, environment and human. Synchronous development will easily achieve the goal of sustainable development. Based on the analysis results of this article, the two cities mainly focus on developing the environmental aspect, but the economic aspect has not been exploited to its full potential, and social security has not been given due attention. Therefore, to achieve a higher level of sustainable development, they should focus on developing strong industries of each locality, promoting the development of connection systems outside industrial parks and industrial clusters, promoting the application of science and technology, innovating technological equipment, etc. In addition, for the social aspect, it is necessary to accelerate the progress of urbanization and strongly develop satellite economic zones, industrial parks, restructuring the workforce and improving people's qualifications.

For future research, the sustainable development indicator system should be considered for calculating the sustainable development index in other provinces and specific cases with similar characteristics. The research results will be the basis for further research based on appropriate weights for indicators and trends. In the future, this research direction can be expanded to other research subjects such as comparing cities in Vietnam's key economic regions. Research results can be compared with the development of Vietnamese provinces and cities in a specific period.

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