

# ASSESSMENT OF ENVIRONMENTALLY SUSTAINABLE CITY IN VIET NAM: A CASE STUDY OF BAC NINH CITY, BAC NINH PROVINCE

Cung Hong Viet<sup>(1)</sup>, Pham Thi Mai Thao<sup>(2)</sup>, Bui Hoai Nam<sup>(3)</sup>

<sup>(1)</sup>Viet Nam Institute of Meteorology, Hydrology and Climate Change

<sup>(2)</sup>Ha Noi University of Natural Resources and Environment

<sup>(3)</sup>Institute of Environmental Science, Viet Nam Environment Administration

Received: 6 July 2020; Accepted: 3 August 2020

**Abstract:** *The aim of this study is to indicate the pathways and activities in reaching sustainable development in Viet Nam. In particular, the process of becoming an environmentally sustainable city in Bac Ninh city (11<sup>th</sup> goal - National action plan for implementing the 2030 Agenda for sustainable development) is analyzed. Viet Nam's environmentally sustainable city criteria are selected as an assessment tool in this case study (introduced through the Prime Minister Decision No.196/QĐ-BTNMT on 18/02/2014). Documents and statistical data in this study were provided by the local authorities and companies located. The results showed that: (i) Viet Nam's general efforts in sustainable development is significant. They are planned specifically, followed by a clear pathway and detail objectives together with particular action in the Viet Nam's SDGs; (ii) With regards to Bac Ninh assessed results: Water indicators scored 400/500, atmospheric indicators scored 360/400, Solid Waste indicators, and Responding to Climate Change indicators are 260/300, and 240/400, correspondingly. Based on the assessment instructions, Bac Ninh city is ranked "Good" in relation to the Viet Nam's environmentally sustainable city criteria. The study could be otherwise adopted for other regions of Viet Nam given the similarity and homogeneity of Bac Ninh City to other developing urban areas. The set of criteria could possibly be used as an assessment tool with the intention of assessing the Viet Nam national action plan for implementing the 2030 Agenda for sustainable development.*

**Keywords:** Viet Nam, Bac Ninh, sustainable development, sustainable development goals, environmentally sustainable city, criteria, indicators.

## 1. Introduction

### 1.1. The term of sustainable development

"Sustainable development" was first introduced in the United "Nations Conference on the Human Environment. In most simple terms, "sustainable development" is achieved when all sectors within a country reached its sustainability. This comprises of the balance between worldwide economic development and ensuring the maintenance of core ecosystems. The significant growth of population size around the world leads to an

over-increase in human needs. Therefore, the key point, which needs to be concentrated on is ensuring the sustainability of economic, social, and environmental systems.

Since urban areas management is included, "environmentally sustainable cities" appeared. According to Richard Register, "environmentally sustainable cities" are those designed with many requirements related to environmental impacts, human demands on input resources, such as energy, water, foodstuffs and minimizing as least as possible in the amount of solid waste, which causes air pollution, soil pollution, and water pollution" [11]. In summary, the relationship among three of them is shown in Figure 1 below.

---

Corresponding author: Cung Hong Viet  
E-mail: hongviet97@gmail.com

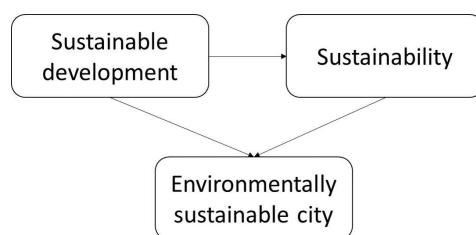


Figure 1. Formation history of the concept environmentally sustainable city

## 1.2. Orientation pathways to pursue sustainable development around the world and Viet Nam

The 2030 Agenda is considered as a final result - a combination of a long-period effort of finding a comprehensive direction that can lead the world to sustainable development. In detail, the 2030 agenda has been motivated from previous meetings including the United Nations Conference on Environment and Development at Rio de Janeiro, Brazil (1992); The World Summit on Sustainable Development at Johannesburg, South Africa (2002); and Brundtland report [21], the UN conference on environment and development [16], the Millennium Declaration [17], and the UN Conference on Sustainable Development [5]. The 2030 Agenda was agreed by The United assembly (leaders from 193 nations in the globe) in the 70<sup>th</sup> meeting took place from 25-27 September, 2015 in New York.

The release of the Sustainable Development Goals (SDGs) is a great endeavor of the United Nations Development Program (UNDP). They are a collection of 17 global goals (Figure 2), which are designed to be a “blueprint to achieve a better and more sustainable future for all” [19]. The SDGs are set in the year of 2015 and meant to be achieved by 2030.

The new 17 SDGs was associated with 169 targets. They are all linked to the three basic pillars of sustainable development system: the economic, social, and environment. Despite of being illustrated as 17 separate goals, they are systematically interrelated to each other. They can, in turn, affect each other whether positively or negatively.

The SDGs are assumed as a challenge but also opportunity for all countries. In order to

achieve those goals and objectives, nations have to reach the establishment of an advanced and determined system at a country level. By initiating rules and regulations with follow-up assessment and review of these goals at local, national, even global level, governments and their associated bodies dedicate their responsibility and compromise in sustainable development. Otherwise, because of those goals require many changes of the economic system, for instance reconstruction and completing economic structure towards environmentally friendly; encourage using energy and natural resources efficiently with high added value, etc.

Opportunities gained from those actions appear when it comes to analyze foreign direct investment (FDI). Although many previous studies have showed that FDI has a positive influence on the environment. Baek has examined that FDI deteriorates the environment [5]. On the other hand, Zarsky has concluded that FDI inflow brought higher environmental standards and state-of-the-arts technologies, which are found that beneficial to the environment of a country [22]. The research of Asghari (2013) has calculated that FDI inflow showed a weak statistically significant negative relationship with CO<sub>2</sub> emission, which meant that it actually does not related to the environmental degradation [1]. Furthermore, a study of Kim and Baek applied an auto-regressive distributed lag model, the result came out that FDI has little effect on environment in both developed and developing nations. In general, it is clear that implementing SDGs can bring more positive rather than negative effects on the long run [7].

With the help of the United Nations Development Program (UNDP), Viet Nam has

introduced its own National Action Plan for the Implementation of the 2030 Sustainable Development Agenda. Similar to the global SDGs, Viet Nam has introduced 17 SDGs with the consultation of ministries, provincial

agencies, civil society, and development partners. However, as regards to the indigenous situation, there were only 115 targets (54 targets less than that of national SDGs) [10].



Figure 2. Seventeen sustainable development goals [6]

**1.3. The appearance of environmentally sustainable cities around the globe and Viet Nam**

Alongside the development of urban areas worldwide, many models of environmentally friendly and sustainable cities have been created. This study is to take the definition of “environmentally sustainable cities” throughout the article. There have been many environmentally sustainable cities sets of criteria adopted which can be mentioned as The United Nations Urban Environmental Accords (UNUEAs) (2005), EU Catalogue of Criteria for Sustainable Settlements (EUCSSs) (Jaroslav Coplák, 2013), the ASEAN Green city index (AGC) (EIU), etc. All of the aforementioned criteria were created with an aim to set off objectives for an urban future of ecologically sustainable, economically dynamic, and socially equitable. Specifically, the UNUEAs has been signed by more than a hundred mayors who have been already started applying the accords for their own cities [15]. This was true to the EUCSSs which has been researched and aimed to put forward its own vision of a sustainable city and also indicated its rationality under the special condition of the seven selected model areas

in several European countries [6]. The AGC was supposed to measure and rate the environmental performances of a total of 22 cities in Asia. Those are similar as all of them are capital cities as well as certain leading business centers, which was chosen for their size and importance: Trnava (Slovakia), Bad Ischl (Austria), Barcelona, Győr (Hungary), Tampere (Finland), Tübingen (Germany) and Umbertide (Italy) [12].

In the area of Southeast Asia (SEA), the Working Group of Environmental Cities (AWGESC) was constituted in June 2003. The Group appeared in the circumstance that all 11 members of The Association of Southeast Asian Nations (ASEAN) were developing at distinctive levels, though, facing serious environmental-related issues such as environmental pollution, untreated solid waste, air pollution, water pollution, managing urban areas unsystematically, etc. After a whole host of working group conferences and meetings, in Brunei (2006), the 4<sup>th</sup> AWGESC meeting has met to an adoption of a comprehensive set of criteria related to environmental sustainability.

Viet Nam as a member of ASEAN, has already adopted a set of criteria of environmentally

sustainable cities. This particular set of criteria is based on Viet Nam’s National Environmental Protection Strategy to 2020 with the vision to 2030, Viet Nam’s National Green Growth Strategy in 2011-2020 with the vision to 2050, Viet Nam’s National Program on Urban Development in 2012-2020, Viet Nam’s National Strategy on Climate Change. Viet Nam’s environmentally sustainable city criteria (VNESC) are adopted by the Ministry of Natural Resources and Environment to serve as a comprehensive tool with the intention of providing raw information on assessing environmental sustainability and environmental challenges, which cities in Viet Nam are facing to both the authorities and residents. It is used to point out the problems, and the unmet requirements. Hence, those cities will have a broad perspective on what they have to put more effort into the pursuance of becoming environmentally sustainable cities [14].

This research provided a case study for the Bac Ninh City in Viet Nam. The effectiveness of developing toward environmental sustainability is thoroughly studied using the VNESC. Regards to this new global perspective and trend, it is now considered as critical to start evaluating and ranking cities throughout Viet Nam with those criteria. Furthermore, this study not only assesses the effect of evaluating a city using the VNESC but also provides valuable information for policymakers to both summarize, and also rank all potential environmental sustainable cities, which will be used to achieve the 11<sup>th</sup> goal

SDGs in general down the road.

**2. Study area**

Bac Ninh city is an administrative unit of Bac Ninh Province with the population of 56,663 people. This city located in the north-eastern of the province, and located close to Bac Giang Province. The distance from the Ha Noi to Bac Ninh city is roughly 35km southward. The total area of the city measured is approximately 82.60km<sup>2</sup>. Figure 3 below is a brief view of the study area in Bac Ninh city.

In particular, Bac Ninh city is divided into 19 hierarchy systems, including 16 sub-districts (Dap Cau, Thi Cau, Vu Ninh, Suoi Hoa, Ninh Xa, Tien An, Ve Anh, Van An, Kinh Bac, Dai Phuc, Vo Cuong, Van Duong, Hap Linh, Phong Khe, Khuc Xuyen, and Khac Niem) and 03 communes (Hoa Long, Kim Chan, and Nam Son). This city is the heart of the whole province, with developed economic and high-quality living standards. On account of this development, Bac Ninh city was awarded as Category-1 City in 2018. The development of a city shares a similar pattern of the increase of environmental pollution, such as untreated municipal solid waste or the growth of AQI index - which represents the level of air pollution in the area, etc. Therefore, in order to ensure the progress on track, the authorities need to redress the imbalance between economic, society, and environment. In other words, it means leading the city towards environmentally sustainable development in a long-term period.



Figure 3. Study area

### 3. Materials and research methodologies

This research flow is as described in Figure 4. Specifically, input data are statistical data and survey ones. The former is processed by applying the VNESC, while the latter is summarized from 101 samples. The comparison between the

outputs illustrated that the city’s reports are relatively detail, and citizens’ thoughts are with the authorities. Finally, the evaluating results of Bac Ninh city’ accuracy is to confirm by sociological investigation and conclude at the end of the article.

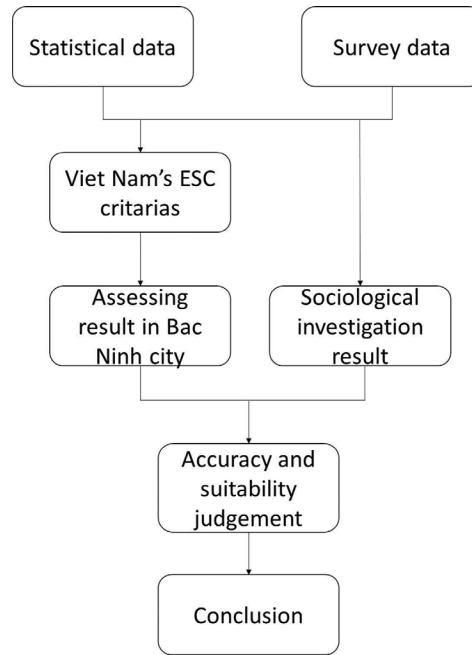


Figure 4. Research structure

In detail, those statistical data that needed and its sources are listed in Table 1.

Table 1. Sources of statistical data

No.	Name of Document	Source
1	Planning industrial clusters in Bac Ninh province to 2020, vision to 2030	People's Committee of Bac Ninh province
2	Statistical yearbook of Bac Ninh province in 2017	Bac Ninh Department of Statistic
3	Socio-Economic Situation Report 2018 in Bac Ninh Province	
4	Report on environmental protection in Bac Ninh province in 2018	Bac Ninh Department of Natural Resource and Environment
5	Regulation on drainage management of Bac Ninh city	
6	Project "Building a smart city model in Bac Ninh province in the period of 2017-2022 with a vision to 2030"	
7	Summary report on the implementation of the natural resources and environment monitoring network	Bac Ninh province Center for monitoring natural resources and environment
8	Bac Ninh Climate Change Action Plan period of 2021-2030, with vision to 2050	People's Committee of Bac Ninh city
9	Planning the network of passengers on fixed routes and bus stations in Bac Ninh province to 2025, orientation to 2030	

No.	Name of Document	Source
10	Report on the results of the implementation of socio-economic development tasks in 2018, directions for tasks in 2019 of Bac Ninh city	Bac Ninh city Natural Resources and Environment Department
11	Report on environmental protection in Bac Ninh city in 2018	
12	Summary report on the implementation of the network of natural resources and environment monitoring in 2018 of Bac Ninh province	
13	Report on current situation of water supply in Bac Ninh city	The Bac Ninh Water Supply and Sewerage Company Limited

Those statistical data above are collected and will be provided into the VNESC. After the calculation process, the result is indicated under a number (out of 100), which represents the environmental sustainability level of the city. Otherwise, there were a few surveys taken in-person with officials in Bac Ninh city Natural Resources and Environment Department to keep surveyed results neutral. It then will be compared with statistical data to ensure the correlation is rational. The final consequences will be a reference for decision-makers to find out the suitable management methodologies related to urban areas in light of sustainable development.

The total number of survey samples are calculated using the formulation of Yamane (1967)<sup>(1)</sup>, which are 101 samples needed to be asked. Surveyed locations are chosen based on areas that containing many production activities with a bunch of environmental pollution phenomena occurred. Details are shown in

Table 2.

Sociological questions in this study is constructed based on the pattern of the VNESC to reaffirm the reliability of statistical data provided by the authorities. A sample has 28 questions, divided into 05 main sections (i) Section 1: General information includes full name, age, gender, number of family members, and address (5 questions); (ii) Section 2: Safe water supply and collecting and treating wastewater assessment includes questions related to sources, quality, demands, supply systems and operating status of production facilities (7 questions); (iii) Section3: Air quality assessment includes questions related to air quality, air pollution and its impacts to human health (9 questions); (iv) Section 4: Collecting and treating solid waste includes questions related to solid waste and recycling (4 questions); (v) Questions related to urban areas includes questions related to green facilities, public transportation usages (3 questions).

Table 2. Numbers of samples (divided into areas)

No.	Surveyed areas	Numbers of samples
1	Centre areas (including sub-districts Suoi Hoa, Ninh Xa, Tien An, Ve An, Kinh Bac)	40
2	Sub-districts including Khac Niem, Phong Khe, and Vo Cuong	40
3	Hoa Long commune	21

<sup>(1)</sup> The total number of samples  $n = \frac{N}{1 + N \cdot e^2}$  (with N: Bac Ninh population; e: error in this situation is taken 0.1)

## 4. Results and discussion

### 4.1. Environmental sustainable development city assessing in Bac Ninh city

#### 4.1.1. Implementing Water indicators results

There are 05 indicators in the Water indicators. In this case study of Bac Ninh city, they are evaluated based on these legal documents (i) National strategy on water resources to 2020 (promulgated under the Prime Minister's Decision No. 81/2006/QĐ-TTg on April 14, 2006); (ii) Decision No. 605/QĐ-UBND of Bac Ninh City People's Committee on water supply planning for Bac Ninh province to 2030, vision to 2050, dated May 27, 2013; (iii) National target program on new rural construction of Bac Ninh province in 2015 and the period of 2016-2020 (issued under Decision No.1085/QĐ-UBND of Bac Ninh province People's Committee (October 16, 2014); (iv) Decree No. 80/2014/ND-CP on drainage and wastewater treatment with regulations on domestic wastewater of Bac Ninh province People's Committee (August 06, 2014).

- *The ratio of clean water accessing population:* Most of sub-districts and communes in Bac Ninh city have been actively implemented and invested in installing both systems of water supplying and treating for the good of residents [8]. Up to now, there have been 03 water supply plants built with the total average water supply capacity of up to 37,000 m<sup>3</sup>/day. Sources are mixed of surface water (Cau River, Duong river, and inland fields) and groundwater. According to reports from Bac Ninh authority, the percentage of households in Bac Ninh city has increased since 2017 and reached 95% [2].

- *The scope of service of the drainage system:* Bac Ninh city is currently using a pipeline sewer system, which was built over the different periods since the time the drainage system was formed. This system has 03 levels, drainage network level 1 to level 3. They are divided hierarchically, served with the objective of connecting the drainage system all the way from small towns to the city center. Hence, limiting flooding happens and draining water for a specific area, region, or inter-region. According

to the consultation results of ministries working at Bac Ninh Department of Environmental Protection, currently, the estimated service area of the drainage system in Bac Ninh city is about 80%.

- *The ratio of water loss in supplying:* The Bac Ninh Water Supply and Sewerage Company Limited (a state-owned enterprise) is handed in charge of managing, operating, and also exploiting water supply in Bac Ninh city, issued by Bac Ninh Department of Planning and Investment. Since 2008, this company has been synchronously installing new water meters and implementing a detailed anti-water loss plan with flow control devices, pressure remotes, and leaked water detectors all equipped, simultaneously. As results of these efforts, water loss has been controlled, witnessed a gradual reduction over years, from 21.84% (2008) to under 18% in 2012, envisaged to be maintained under 19% down the road [13]. Furthermore, with regards to a report in 2013, the water loss ratio of Bac Ninh city ranged from 12-18%, the objective is to maintain at 17% for the urban area by the year of 2020 and the target for the period of 2030-2050 is reduced to 15% [8]. In conclusion, to sum all the figures above up, the current ratio of water loss in Bac Ninh city is estimated at 17% [20].

- *The ratio of domestic wastewater is collected and treated up to standards:* According to the thesis of Viet H. C. (2019), this ratio is calculated based on the Decree No. 80/2014/ND-CP, which is 76% [20].

- *The rate of production and business establishments that treat wastewater up to standards:* There are a total of 06 main industry-related areas in Bac Ninh city, with 01 industrial areas (Que Vo) and 05 industrial clusters (Vo Cuong, Phong Khe I, Phong Khe II, Khac Niem, Khuc Xuyen) [9]. Recently, there are only two out of 06 facilities mentioned above have already built concentrated wastewater treatment plants. It is estimated that the ratio is approximately 33.3% [20].

#### 4.1.2. Implementing Atmosphere indicators results

There are 04 indicators in the Atmosphere

indicators. The action of natural resources and environment monitoring system in Bac Ninh province, and in Bac Ninh city particularly is based on these legal documents (i) The Law 55/2014/QH13: Environmental Protection promulgated by The National Assembly 13 on June 23, 2014; (ii) Decision No. 16/2007/QĐ-TTg of Prime Minister on Approving the master plan on the national monitoring network of natural resources and environment till 2020 (dated January 29, 2007); (iii) Decision No.1618/QĐ-UBND of People’s Committee of Bac Ninh province of Approving the project “Reviewing and evaluating the natural resources and environmental monitoring network in Bac Ninh province in the period of 2010 - 2015 and adjusting the natural resources and environmental monitoring network in the period of 2016-2020” (dated December 23, 2015); (iv) National Technical Regulation on Ambient Air Quality (QCVN 05:2013/BTNMT) promulgated by the Minister of Natural

Resource and Environment.

- *The frequency of monitoring ambient air quality each year:* Monitoring network of the natural resources and environment is one of the important tasks under the Master plan and strategies for natural resources and environment protection up to the year 2020. This task is assigned to Bac Ninh province Center for Natural Resources and Environment Monitoring cooperates with Viet Nam Academy of Science and Technology (VILAS 366, VIMCERT 079) and the Technical and Environmental Analysis Joint Stock Company (VIMCERT 006) [4]. Currently, there are a total of 12 ambient air quality monitoring locations around Bac Ninh city area (as described in Figure 5). They are distributed quite extensively, systematically, feasibly by socio-economic regions. In a specific year (2018), 06 monitoring rounds were done in February, April, June, August, October, and November, respectively.



Figure 5. Distribution of 12 ambient air quality monitoring locations in Bac Ninh city

- *The average concentration of PM<sub>10</sub> per year, compared with the standards:* Ambient air quality monitoring data on PM<sub>10</sub> for all 12 locations in Bac Ninh city (shown in Figure 6) are within the range prescribed by QCVN 05:2013/BTNMT (average of 24 hours). However, 02 of

the highest figures appeared in 02 industrial clusters Phong Khe I and Phong Khe II (101,9 µg/m<sup>3</sup> and 91,5 µg/m<sup>3</sup>, respectively). Furthermore, the monitoring round in April and November witnessed the highest PM<sub>10</sub> average concentrations throughout the year of 2018 [21].



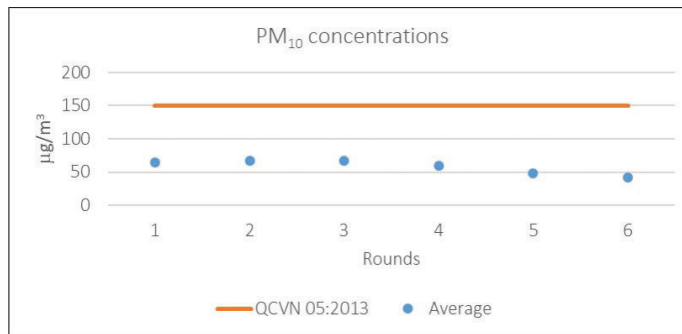


Figure 6. Average PM<sub>10</sub> concentration results in 6 rounds

- The average concentration of SO<sub>2</sub> per year, compared with the standards: Figure 7 describes SO<sub>2</sub> concentration monitoring results over 06 rounds of the year 2018 in Bac Ninh city. An unprecedented result came out at Phong Khe I in the February monitoring round. It was higher than other locations with 127 µg/m<sup>3</sup> (the limit is 125 µg/m<sup>3</sup>). In overall,

the average of air quality data related to SO<sub>2</sub> monitored in 12 locations within Bac Ninh city in 2018 was under the limit of QCVN 05:2013/BTNMT (average of 24 hours). As regards the average SO<sub>2</sub> monitoring data in 2018, the highest number was seen in February and the lowest was 6<sup>th</sup> round in November.

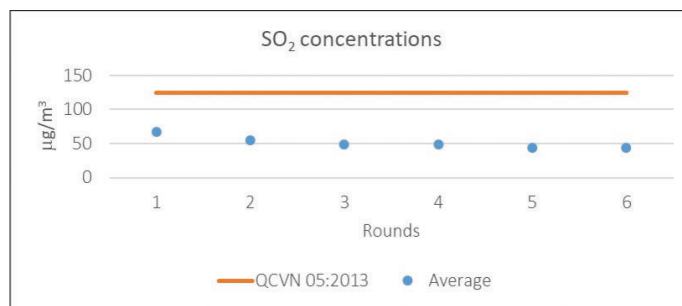


Figure 7. Average SO<sub>2</sub> concentration results in 6 rounds

- The average concentration of NO<sub>2</sub> per year, compared with the standards: The limit of NO<sub>2</sub> concentrations indicated in QCVN 05:2013/BTNMT is 100 µg/m<sup>3</sup> (average of 24 hours). In 2018, there were 6 rounds conducted in all 12 monitoring locations on NO<sub>2</sub> concentration within Bac Ninh city. As consequence, the average results of all

6 rounds satisfied the required range. In comparison, the first round of 2018 showed the highest number with 61.3 µg/m<sup>3</sup>. Nevertheless, this reduced gradually in each round later, ended up at 48.4 µg/m<sup>3</sup> in the round of November. Details are indicated in Figure 8 below.

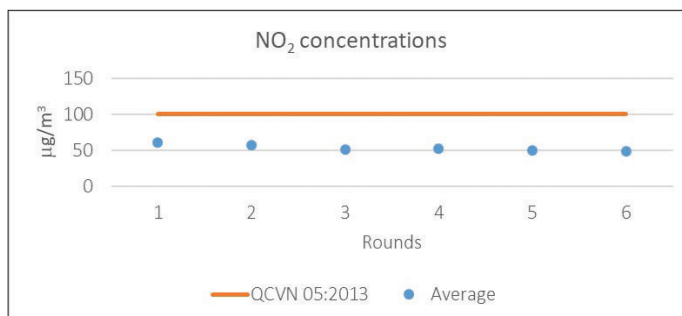


Figure 8. Average NO<sub>2</sub> concentration results in 6 rounds

#### 4.1.3. Implementing Solid Waste indicators results

There is a total of 03 indicators in the Solid Waste indicators. Daily-life solid waste in Bac Ninh city is collected and treated following the scheme “Solid waste treatment in Bac Ninh province” and other related legal documents.

- *The ratio of collected and treated solid waste:* Solid waste collecting and treating in the area of Bac Ninh city is handed into the Bac Ninh Environment and Urban Works Company Limited (under the management of Bac Ninh city People’s Committee). On average, the whole Bac Ninh city generated approximately 130-150 tons of solid waste/day [20]. With regards to the report of environmental protection in Bac Ninh city 2018, the rate of domestic waste solid has been collected and treated was about 91.5%.

- *The ratio of collected and treated hazardous solid waste up to standards:* There are 03 fundamental sources of hazardous solid waste generation in Bac Ninh city, they are daily-life solid waste generated from households; industrial solid waste generated from factories, industry-related areas, industrial clusters; and medical solid waste generated from medical care centers and hospitals of sub-districts and communes. According to the statistic reports from Bac Ninh Department of Natural Resources and Environment, the volume of treated domestic solid waste in Bac Ninh province is up to 90% (20% higher than that of 2017). The standardized treatment ratio of hazardous medical solid waste and hazardous industrial one was 100% and 95%, respectively. In summary, the ratio of collected and treated hazardous solid waste is about 95% averagely [3,20].

- *The ratio of solid waste has been reused, recycled, energy recovered, or produced fertilizer:* These days, it is still witnessed a relatively low ratio in the rate of solid waste has been reused, recycled and energy recovered. Although there have been a little number of families approached this environmentally friendly activity, it still has a bunch of things to do in order to spread out all over the city. Recently, most households choose to sell those kinds of waste rather than recycling. According

to a report from Bac Ninh Department of Natural Resources and Environment, the rate of recycling solid waste in the whole province in 2018 was 10% [3].

#### 4.1.4. Implementing Responding to Climate Change indicators results

This criterion is a combination of 04 major indicators, which focus on green urban areas, green energy using, public transportation, and adapting to climate change.

- *The total area of public greenery per capita:* The socio-economic development in Bac Ninh city is on its high speed of growing with a large majority of land area has been converted into buildings. Hence, this tendency inadvertently has put pressure on the environment, in particular lack of trees and green facilities. Nevertheless, governors in Bac Ninh city have considered this matter carefully, many parks and green spaces were built. In 2018, the total area of trees and water surface in the city was 1,740.731m<sup>2</sup>, which means approximately 7.4m<sup>2</sup> per capita.

- *The ratio of renewable energy in the total energy use structure:* The use of renewable energy in Viet Nam generally, and in Bac Ninh specifically is still assumed as a difficult and complex action. There is not yet much specific information, data to analyze the ability and potentiality of renewable energy in Viet Nam enough for related organizations to invest in. Currently, the city has not yet reported the proportion of renewable energy consumption in the total energy structure on account of lacking evaluation data [20].

- *The ratio of public passenger transport:* The main means of public transports in Bac Ninh city is bus and coach. In fact, the more the socio-economic developed, the more increase in citizens’ demand for transportation. Therefore, passenger transport by bus has become an indispensable necessity, especially in densely populated areas. According to the proposal of “Proposing Bac Ninh city as Class-1 city under Bac Ninh province”, the public passenger transport system was reported currently meets 53.47% of residents’ traveling demands within the city.

- *Promulgating Action Plan on Climate Change*: The Action Plan on Responding to Climate Change of Bac Ninh province in the period of 2021-2030, vision 2050 was promulgated in the Decision No.699/QD-UBND by People's Committee of Bac Ninh province (It was built followed The National Target Programme for Climate Change Respond). The overall objectives of the Plan include strengthening the province's capacity to cope with climate change in the period of 2010-2015, vision to 2020. In particular, it ensures the socio-economic development towards sustainability, protects the livelihoods of residents, and mitigates hazards of climate change. All of those are tasks, step by step to

be finished, and thereby contributing positively to Viet Nam's general efforts in climate change mitigation and adaptation.

#### 4.1.5. Final results

By summarizing assessed parts of 04 main criteria above and following the instructions of the VNESC, this study has initially and fundamentally figured out the level of the environmentally sustainable city oriented process of Bac Ninh city. Indicators related to solid, atmosphere, and water have been done relatively well with completed ratios of 90%, 86%, and 80%, respectively. The criterion of responding to climate change has a total point of 240 out of 400 (60% completed). Specific grading is illustrated in Table 3 below:

Table 3. Summary of assessed indicators

Criteria		Indicators	Level of completion	Point
Water	1	The ratio of clean water accessing population	95%	100
	2	The scope of service of the drainage system	80%	100
	3	The ratio of water loss in supplying	17%	60
	4	The ratio of domestic wastewater is collected and treated up to standards	76%	100
	5	The rate of production and business establishments that treat wastewater up to standards	33.3%	40
	<b>Total</b>			
Atmosphere	6	The frequency of monitoring ambient air quality each year	6 rounds/year	60
	7	The average concentration of PM <sub>10</sub> per year, compared with the standards	Required QCVN 05:2013/ BTNMT	100
	8	The average concentration of SO <sub>2</sub> per year, compared with the standards	Required QCVN 05:2013/ BTNMT	100
	9	The average concentration of NO <sub>2</sub> per year, compared with the standards	Required QCVN 05:2013/ BTNMT	100
	<b>Total</b>			
Solid waste	10	The ratio of collected and treated solid waste	91.5%	100
	11	The ratio of collected and treated hazardous solid waste up to standards	95%	100

Criteria		Indicators	Level of completion	Point
Solid waste	12	The ratio of solid waste has been reused, recycled, energy recovered or produced fertilizer	10%	60
	<b>Total</b>			<b>260/300</b>
Responding to climate change	13	The total area of public greenery per capita	7.4m <sup>2</sup> per capita	40
	14	The ratio of renewable energy in the total energy use structure	yet to record	0
	15	The ratio of public passenger transport	53.47%	100
	16	Promulgating Action Plan on Climate Change	Promulgated	100
	<b>Total</b>			<b>240/400</b>
<b>Final total point (converted into scale point of 100)</b>				<b>1260/1600 = 78.75</b>

The final total point (FTP) is represented for the level of environmental sustainability that Bac Ninh city is currently achieving. The scale points are divided into 04 different group: (i)  $FTP \leq 40$ : yet to achieve; (ii)  $41 \leq FTP \leq 60$ : achieved; (iii)  $61 \leq FTP \leq 80$ : good; (iv)  $81 \leq FTP \leq 100$ : very good. The FTP of this study conducted in Bac Ninh city is 78.75. Since it belongs to the range from 61 to 80, therefore based on VNESC's instructions, Bac Ninh city is evaluated as a good completed city.

**4.2. Sociological investigation outputs**

A total of 101 samples have been conducted in those determined districts and sub-districts in Bac Ninh city. Specifically, the ratio of genders between males and females are 51 samples

(50.5%) and 50 samples (49.5%), respectively. They were from a wide range of ages, from 18 to 65 years old. Averagely, those who were asked said that there are 02-04 people in their family, accounted for 74.3%. All 101 citizens shared that they had access to the source of treated water came through the plant, and the water volume also met their demands. There are 70 residents told that Bac Ninh city already had a water treating plant. In particular, there are 68% of the total samples show that residents have access to the final drainage that leads to treating plants. When it comes to efficiency, nearly half of participants interviewed share their thought that they are satisfied with the outputs of the treating process. Details are shown in Figure 9 and Figure 10.

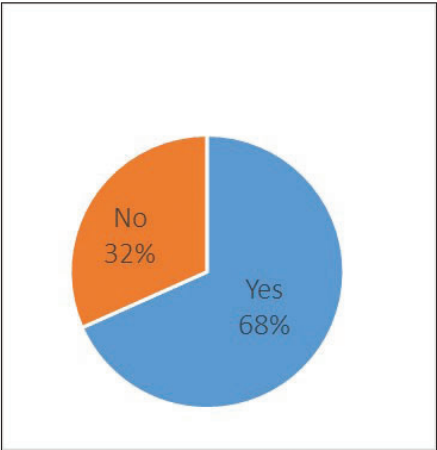


Figure 9. Ratio of having access to the drainage

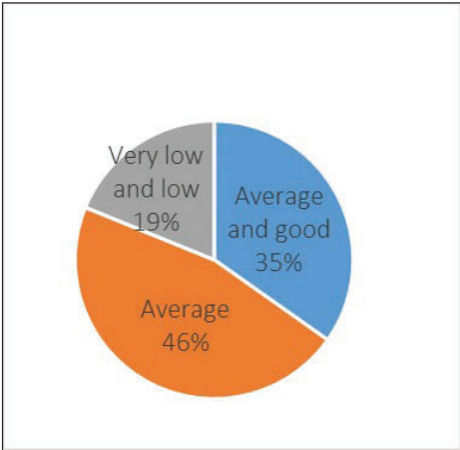


Figure 10. Ratio of households have waste water treated

Although the average monitored concentrations of 03 substances  $PM_{10}$ ,  $CO_2$ ,  $SO_2$  showed positive results, 52 people (51%) still presumed the air quality is polluted. These negative comments have a similar point, all come from citizens living in the areas near industrial areas and industrial clusters. The types of industry in Bac Ninh city are commonly producing paper and noodles, which release many smoke attached with hazardous contaminations.

In part of solid waste management, most people answered that waste is collected by the environmental company twice every day, however, they still do not treat garbage separately. The number of households did recycle accounted for 93% in total (94 samples), nevertheless, hazardous garbage such as old bulbs, batteries were not sorted out. Finally, the majority of respondents satisfied with the greenery with the city, stood at 86%. In the contrary, public transportations appeared uncommon in Bac Ninh city, there are just 37% of respondents have used this kind of transport, in particular, 25% of those were using it for everyday purposes.

The sociological survey provided the outcomes that are relatively comparable with analysis results. Nevertheless, some unprecedented points still occurred. Those differences are attributed to the uneven distribution of the environmental issues, majorly happened in the sectors of industrial areas, and industrial clusters. Hence, they polluted these areas and affected the livelihoods of citizens in surrounding neighborhoods. Others can be listed as the struggle in collecting solid waste, citizens within the city do not usually put their garbage at the right places; solid waste treating capacity is under pressure, garbage is still being buried in landfill side rather than using incinerator; hazardous waste has not been classified; public greenery is mostly located in the center, but sub-urban areas [20].

## 5. Conclusions

In the 1980s, a new pathway of developing the world has been considered and introduced. It was built based on the basis of development

that meets the needs of the present without compromising the ability of future generations to meet their own needs. In 2015, according to the environmental situation, and also the socio-economic status, nations of The United Assembly gathered in New York have determined that the world need a comprehensive plan, hence, the Agenda 2030 was adopted, attached with 17 major objectives that nations have to reach by the year of 2030. Viet Nam as a developing nation, has indicated its responsibility to the global prosperity by adopting the National Action Plan for the Implementation of the 2030 Sustainable Development Agenda with 17 national objectives with each related targets. This plan is adopted, and served as Viet Nam's highest hierarchical legal foundation, which shows Viet Nam's efforts for sustainable development. It is the result of a long term period of striving and consultation process with the strict collaboration of ministries, sectors, localities, international corporations as well as social organizations. To date, Viet Nam is proud to have achieved a number of SDG targets related to fields such as reducing the national multi-dimensional poverty rate; increasing the cover range of health insurance; gender equality; enhance the rate of households having access to safe water sources, and electricity; increasing forest cover; etc.

In particular, one of those objectives is developing sustainable and cities and communities with a relative balance between 3 main pillars of environment, economic, and social community, which is a similar interest that a lot of countries are sharing currently. Those kinds of cities have many models, however, the most ubiquitous is environmentally sustainable city. The first brick of the whole wall is built with the introduction of the VNESC, which allows authorities and policymakers to assess the current situation of an urban area, determining its potential opportunities towards improvements, evaluating the level of implementing the model of environmentally sustainable cities through a synchronic pointing system and releasing rational solutions for

later enhancements. The study conducted in Bac Ninh city has shown that the VNESC is suitable with Viet Nam's cities conditions. The implementation of each criterion in the VNECS in Bac Ninh city has been basically implemented relatively well. The construction of the environmentally sustainable city in Bac Ninh city is assessed at "very good" stage, detail order of implemented level is arranged from high to low: solid waste criteria, atmosphere criteria, water criteria, and responding to climate change criteria. Furthermore, the reliability and accuracy of the VNESC are approved throughout the results of sociological surveys for citizens living within Bac Ninh city. Specifically, they were asked about the performance of tasks associated with each criterion. The results show that people's assessments are quite similar to the city's reported data.

The study also pointed out that the VNESC

adopted by the Ministry of Natural Resources and Environment is applicable nationwide in Viet Nam for evaluating cities for their environmental sustainability. This set of criteria is to constitute progressive results for the process of enforcing the National Action Plan for the Implementation of the 2030 Sustainable Development Agenda. Moreover, there are a few actions need to be done for the improvement in Bac Ninh city in order to increase the level of implementing the environmental friendliness of the sustainable city. Specifically, these actions are: (i) Keep remaining tasks that are already done well; (ii) A clear renewable resources developing plan needs to be researched and released; (iii) Following the trend of developing sustainable cities around the world, encouraging research in this field and integrating the matter into development plans of the city, and province.

**Acknowledgements:** *The authors are deeply grateful to all of the authority's corporations in Bac Ninh province (mentioned above) for the kind permission of using the mass amounts of profiles and reported data in this research.*

## References

1. Asghari, M. (2013), *Does FDI promote MENA region's environment quality? Pollution halo or pollution haven hypothesis*, Int. J. Sci. Res. Environ. Sci., 1, pp. 92–100.
2. Bac Ninh City Natural Resources and Environment Department (2019), *Report on environmental protection in Bac Ninh city in 2018*.
3. Bac Ninh Department of Natural Resource and Environment (2018), *The Information and Indicators Update Task Report of Bac Ninh Environment*.
4. Bac Ninh province Center for monitoring natural resources and environment (2018), *Summary report on the implementation of the natural resources and environment monitoring network*.
5. Baek, J. (2016), *A new look at the FDI income–energy–environment nexus: dynamic panel data analysis of ASEAN*, Energy Policy, 91, pp. 22–27.
6. Coplák, J. (2003), *The Conceptual Framework of the EU Project ECOCITY*, ALFA-SPECTRA, 10.
7. Kim, H. S. and Baek, J. (2011), *The environmental consequences of economic growth revisited*, Econ. Bull., 31, pp. 1198–1211.
8. People's Committee of Bac Ninh province (2013), *Decision on water supply planning for Bac Ninh province to 2030, vision to 2050*.
9. People's Committee of Bac Ninh Province (2013), *Planning industrial clusters in Bac Ninh province to 2020, vision to 2030*.
10. Prime Minister of Viet Nam (2017), *Viet Nam National Action Plan for the Implementation of the 2030 Sustainable Development Agenda*.
11. Register, R. (1987), *Ecocity Berkeley*. North Atlantic Books.
12. Stelzner, K. (2011), *Asian Green City Index: Assessing the environmental performance of Asia's*

*major cities', Siemens AG.*

13. The Bac Ninh Water Supply and Sewerage Company Limited (2015), *Report on current situation of water supply in Bac Ninh city.*
14. The Minister of Natural Resources and Environment (2014), *Promulgating a set of environmentally sustainable city criterias.*
15. UNDP and UNEP (2005), *World Environment Day.*
16. United Nation-UN (1992), *United Nations-Sustainable development- Conference on Environment & development Rio de Janerio, Brazil, 3 to 14 June 1992.* Available at: <https://doi.org/10.1007/s11671-008-9208-3>.
17. United Nation-UN (2000), *United Nations millennium declaration: Resolution adopted by the general assembly.* Available at: <https://doi.org/0055951>.
18. United Nation-UN (2012), *The future we want: Resolution adopted by the General Assembly.* Available at: <https://doi.org/A/RES/66/288>\*
19. United Nation-UN (2015), *Sustainable Development Goals: Knowledge Platform.* Available at: [sustainabledevelopment.un.org/?menu=1300](https://sustainabledevelopment.un.org/?menu=1300).
20. Viet, C. H. (2019), *Researching and assessing the ability to achieve environmentally sustainable city criterias of Viet Nam: Case study of Bac Ninh city, Bac Ninh province.*
21. World Commission on Environmental and Development (1987), *Our Common Future*, Oxford University Press.
22. Zarsky, L. (1999), *Havens, halos and spaghetti: Untangling the evidence about foreign direct investment and the environment*, *Foreign Direct Invest. Environ.*, 13, pp. 47–74.