ASSESSMENT OF AIR QUALITY IN LONG THANH DISTRICT, DONG NAI PROVINCE 2017-2020 BY AQI

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Article Info

Abstract

Air pollution control in Vietnam, particularly in Dong Nai province, is an urgent issue, therefore measuring the degree of pollution is critical in developing solutions. The study aims to propose control solutions to improve air environment quality in three areas: Go Dau Industrial Park, Long Thanh Industrial Park, and Binh Son Commune, based on monitoring data from the Environmental Monitoring Centre of Long Thanh district, Dong Nai province, from 2017 to 2020, and using the AQI index (Air Quality Index) as an assessment method. Assessment results can also be utilized as a data source to produce air quality zoning maps, which provide environmental information to the community.

1. Introduction

Air pollution is a serious problem in the world and in Viet Nam. According to statistics from the World Health Organization (WHO), there are 92% of the population currently living in polluted air. That greatly affects human health and the natural environment. So, finding out the cause and proposing the solutions to overcome air pollution are very important meaning.

Air quality index (General Department of Environment, 2019) (AQI) is an index calculated from monitoring parameters of pollutants in the air, to indicate the state of air quality and the degree of impact on human health. people (QCVN05-2013/BTNMT 2013), and is expressed through a scale. Calculating environmental quality indicators mainly uses Excel software, setting up index calculation functions and using charting tools to do this. Currently assessing environmental quality.

There have been published results related to research fields such as:

In 2018, author Ying Li and his colleagues used a dynamic SBM model to analyze the energy efficiency and AQI efficiency of 31 cities in China from 2013 to 2016 (Ying Li, Yung -ho Chiu, Liang Chun Lu 2018). The results show that there are still 22 cities that need to significantly improve their overall performance. In 2021, author Abdelfettah Benchrif and his colleagues studied the Air Quality Index (AQI), PM2.5 dust parameters and NO2 concentration in the troposphere during three periods of COVID-19 blockade (before, during and later) between 21 cities around the world. The results show that the frequency distribution of NO2 changes more than that of PM2.5 dust, and the distribution is flatter from 2020 to the 2018-2019 baseline period (Abdelfettah Benchrif, Ali Wheida & cs, 2021). In 2020, author Zeeshan Fareed and his colleagues researched to determine the impact of climate on the level of deaths caused by COVID-19. The average air quality and humidity index

was selected from the panel of climate variables, to determine its impact on daily new deaths related to COVID-19 in Wuhan, China (Zeeshan Fareed, Najaf Iqbal & cs). In 2017, author Do Thi Khanh Huyen and her colleagues monitored suspended dust (TSP) at 41 points in Ninh Binh province during the period from April 2013 to November 2016, calculated the index. corresponding air quality number (AQI). The results show that the province's TSP dust pollution is at a very alarming level, with no air sample reaching the Good AQI level. Only a few samples reached the Average level. Most of the samples reached the Poor level (Do Thi Khanh Huyen, Le Thu Ha, Hoang Viet Hung, 2017). In 2021, author Nguyen Dinh Thuan and his colleagues applied the two-dimensional Long Short-Term Memory (BLSTM) model to predict the Air Quality Index (AQI) from PM 2.5 concentration. The model is implemented based on hourly PM2.5 concentration data collected from two major cities in Vietnam: Hanoi and Ho Chi Minh City. In 2019, author Nguyen Cong Nhat and his colleagues used TSP concentrations (one of the main causes of air pollution in large urban areas) at several monitoring stations in Da Nang city, using the method Cokriging interpolate to find a suitable model, thereby predicting TSP dust concentrations at some unmeasured stations in the city. On that basis, find good statistical models from a number of criteria, then adjust the models with high accuracy.

In this study, the author used air quality monitoring data in 03 areas: Long Khanh Industrial Park, Long Thanh Industrial Park and Bien Hoa city from 2017 to 2020, calculated the AQI index, and drew charts. to compare air quality in these three areas over the years, evaluate air quality and propose solutions to reduce pollution for polluted areas.

2. Method of studying

2.1. Methods of collecting and synthesizing data

The data are air quality parameters monitored from 2017 to 2020 provided by the Department of Natural Resources and Environment of Dong Nai province (Report on monitoring results in Long Thanh district, Dong Nai province, 2017, 2018, 2019, 2020).

2.2. Method for calculating AQI air quality index by the General Department of Environment.

The pollutants used for calculations in this study are: SO2, NOx, CO, and TPS. With the collected data, the author applies it to calculate the hourly AQI index.

The AQI^h value of the parameters SO2, CO, NO2, O3 is calculated according to formula 1, the AQI^h value of the parameters PM10, PM2.5 is calculated according to formula 2:

$$AQI_x = \frac{I_{i+1} - I_i}{BP_{i+1} - BP_i}(C_x - BP_i) + I_i \text{ (formula 1)}$$

$$AQI_x = \frac{I_{i+1} - I_i}{BP_{i+1} - BP_i}(Nowcast_x - BP_i) + I_i \text{ (formula 2)}$$

In there:

AQIx: AQI value of parameter x

BPi: The prescribed lower limit concentration of the monitoring parameter

in Table 2 corresponds to level i

BPi+1: The prescribed upper limit concentration of the monitoring parameter value is given in Table 2 corresponding to level i+1

Ii: The AQI value at level i corresponds to the BPi value given in the table

Ii+1: AQI value at level i+1 corresponds to the BPi+1 value given in the table

Cx: Average 1-hour monitoring value of parameter x.

Nowcastx: Nowcast value calculated in part a

Note: For PM10 parameter: because there is no 1-hour average standard, so take the 1-hour average TSP standard to replace PM10.

Select the largest AQIh value of 04 parameters in the same time (01 hour) to take it as the hourly AQI value.

$$AQIh = Max\ (AQIhx)$$

Calculating the AQI index to evaluate air environment quality in Long Khanh city from 2017-2020.

Use the table to compare AQI values corresponding to air quality warning levels and levels of impact on human health, shown in the following table:

TABLE 1. Air quality assessment based on AQI value range

AQI value range	Air quality	Health affects	Color
0 – 50	Good	Does not affect health	Green
51 – 100	Average	Mild effects on health	Yellow
101 – 150	Relatively bad	Sensitive groups should limit outdoor time	Orange
151 – 200	Bad	Highly sensitive groups, avoid going out	Red
201-300	Very bad	Avoid going out, should stay indoors	Violet
Trên 300	Dengoures	Everyone should stay indoors	Brown

2.3. Data processing methods

Based on all data collected from documentary sources to process by Excel software and synthesize into charts for the assessment of the environmental status in the research area.

3. Results and discussion

3.1. Calculation results of AQIh index in 2017 in 03 research areas

Table 2. AQIh in 2017 in 03 research areas

Monitoring stations	Monitoring Phases	AQI value				AQImax
		TPS	SO2	NOx	CO	
Go Dau Industrial Park	1st	117	18	33	6	**117**
	Phase 2	83	17	29	13	83
	Phase 3	41	30	40	25	41
	Phase 4	74	18	26	27	74
	Phase 5	21	16	17	25	25
	Phase 6	49	15	20	25	49
Long Thanh Industrial Park	1st	75	27	26	6	75
	Phase 2	76	10	17	12	76
	Phase 3	79	19	48	25	79
	Phase 4	116	15	30	25	**116**
	Phase 5	79	8	25	25	79
	Phase 6	66	13	32	25	66
Binh Son commune	1st	97	8	20	20	97
	Phase 2	58	11	20	25	58
	Phase 3	133	13	26	113	133
	Phase 4	60	9	21	16	60
	Phase 5	82	12	18	25	82
	Phase 6	134	15	24	25	**134**

Observations: From the above results table, it shows that the AQImax values of the 03 research areas of Go Dau Industrial Park, Long Thanh Industrial Park, Binh Son Commune in 2017 are alternately: 117 (phase 1), 116 (phase 4), 134 (phase 6). These values are all TPS dust parameters. The parameters (SO2, NOx, CO) are all good.

Comparing with the air environment quality table, we have the following assessment results:

TABLE 3. Results of air environment quality assessment of three research areas in 2017

Monitoring stations	Monitoring Phases	AQI$_{max}$	Comparison range	Environment air quality
Go Dau Industrial Park	1st	117	101<117<200	Relatively bad
	Phase 2	83	51<83<100	Average
	Phase 3	41	0<41<50	Good
	Phase 4	74	51<74<100	Average
	Phase 5	25	0<25<50	Good
	Phase 6	49	0<49<50	Good
Long Thanh Industrial Park	1st	75	51<75<100	Average
	Phase 2	76	51<76<100	Average
	Phase 3	79	51<79<100	Average
	Phase 4	116	101<116<150	Relatively bad
	Phase 5	79	51<79<100	Average
	Phase 6	66	51<66<100	Average
Binh Son commune	1st	74	51<74<100	Average
	Phase 2	58	51<58<100	Average
	Phase 3	133	101<133<150	Relatively bad
	Phase 4	60	51<60<100	Average
	Phase 5	82	51<82<100	Average
	Phase 6	134	101<134<150	Relatively bad

Observations : This result is explained by the increase in construction works in the areas at each monitoring time. The qualitty are all in the comparison range of relatively bad air quality

3.2. Calculation results of AQIh index in 2018 in 03 research areas

TABLE 4. AQIh in 2018 in 03 research areas

Monitoring stations	Monitoring Phases	AQI value				AQImax
		TPS	SO2	NOx	CO	
Go Dau Industrial Park	1st	48	23	21	25	48
	Phase 2	60	9	16	60	**60**
	Phase 3	59	7	18	25	59
	Phase 4	41	7	15	25	41
	Phase 5	33	4	10	25	33
	Phase 6	50	8	18	27	50
Long Thanh Industrial Park	1st	84	12	16	25	**84**
	Phase 2	53	11	9	25	53
	Phase 3	42	4	9	27	42
	Phase 4	70	12	17	25	70
	Phase 5	69	5	14	25	69
	Phase 6	27	29	18	25	29
Binh Son commune	1st	76	21	27	27	**76**
	Phase 2	64	16	14	25	64
	Phase 3	58	5	19	25	58
	Phase 4	47	16	11	25	47
	Phase 5	35	4	11	25	35
	Phase 6	68	27	18	25	68

Observations: From the above results table, it shows that the AQImax values of the 03 research areas of Go Dau Industrial Park, Long Thanh Industrial Park, Binh Son Commune in 2018 are alternately: 60 (phase 2), 84 (phase 1), 76 (phase 1). These values are all TPS dust parameters. The parameters (SO2, NOx, CO) are all good

Comparing with the air environment quality table, we have the following assessment results:

TABLE 5. Results of air environment quality assessment of three research areas in 2018

Monitoring stations	Monitoring Phases	AQI$_{max}$	Comparison range	Environment air quality
Go Dau Industrial Park	1st	21	0<48<50	Good
	Phase 2	23	51<60<100	Average
	Phase 3	23	51<59<100	Average
	Phase 4	17	0<41<50	Good
	Phase 5	17	0<33<50	Good
	Phase 6	18	0<50<50	Good
Long Thanh Industrial Park	1st	39	51<84<100	Average
	Phase 2	19	51<53<100	Average
	Phase 3	18	0<42<50	Good
	Phase 4	30	51<70<100	Average
	Phase 5	30	51<69<100	Average
	Phase 6	21	0<29<50	Good
Binh Son commune	1st	34	51<76<100	Average
	Phase 2	26	51<64<100	Average
	Phase 3	22	51<58<100	Average
	Phase 4	17	0<47<50	Good
	Phase 5	17	0<35<50	Good
	Phase 6	29	51<68<100	Average

Observations: The AQImax values of the 03 areas are all TPS dust parameters. These values are in the comparison range of average air quality. Compared to 2017, this quality has improved

3.3. Calculation results of AQIh index in 2019 in 03 research areas

TABLE 6. AQI^h in 2019 in 03 research areas

Monitoring stations	Monitoring Phases	AQI value				AQImax
		TPS	SO2	NOx	CO	
Go Dau Industrial Park	1st	84	11	17	25	84
	Phase 2	67	21	21	25	67
	Phase 3	19	8	12	25	25
	Phase 4	165	10	24	25	**165**
	Phase 5	95	8	24	25	95
	Phase 6	40	14	23	25	40
Long Thanh Industrial Park	1st	153	7	19	36	**153**
	Phase 2	104	12	17	25	104
	Phase 3	100	8	21	25	100
	Phase 4	141	4	16	25	141
	Phase 5	57	10	18	25	57
	Phase 6	79	14	22	33	79
Binh Son commune	1st	106	6	13	25	106
	Phase 2	60	8	19	25	60
	Phase 3	70	8	13	25	70
	Phase 4	151	5	18	25	**151**
	Phase 5	33	13	24	25	33
	Phase 6	56	17	22	25	56

Observations: From the above results table, it shows that the AQImax values of the 03 research areas of Go Dau Industrial Park, Long Thanh Industrial Park, Binh Son Commune in 2019 are alternately: 165 (phase 4), 153 (phase 1), 151 (phase 4). These values are all TPS dust parameters. The parameters (SO2, NOx, CO) are all good.

Comparing with the air environment quality table, we have the following assessment results:

TABLE 7. Results of air environment quality assessment of three research areas in 2019

Monitoring stations	Monitoring Phases	AQI$_{max}$	Comparison range	Environment air quality
Go Dau Industrial Park	1st	84	51<84<100	Average
	Phase 2	67	51<67<100	Average
	Phase 3	25	0<25<50	Good
	Phase 4	165	151<165<200	Bad
	Phase 5	95	51<95<100	Average
	Phase 6	40	0<40<50	Good
Long Thanh Industrial Park	1st	153	151<153<200	Bad
	Phase 2	104	101<104<150	Relatively bad
	Phase 3	100	50<100<101	Average
	Phase 4	141	101<141<200	Below medium
	Phase 5	57	51<57<100	Average
	Phase 6	79	51<79<100	Average
Binh Son commune	1st	106	101<106<150	Relatively bad
	Phase 2	60	51<60<100	Average
	Phase 3	70	51<70<100	Average
	Phase 4	151	151<200	Bad
	Phase 5	33	0<33<50	Good
	Phase 6	56	51<56<100	Average

Observations: The AQImax values of the 03 areas are all TPS dust parameters. These values are in the comparison range of bad air quality.

3.4. Calculation results of AQIh index in 2020 in 03 research areas

TABLE 8. AQI^h in 2020 in 03 research areas

Monitoring stations	Monitoring Phases	AQI value				AQImax
		TPS	SO2	NOx	CO	
Go Dau Industrial Park	1st	106	15	17	25	**106**
	Phase 2	57	16	19	25	57
	Phase 3	10	10	9	25	25
	Phase 4	22	10	8	25	25
	Phase 5	55	10	9	25	55
	Phase 6	41	12	8	25	41
Long Thanh Industrial Park	1st	113	12	14	25	113
	Phase 2	111	12	14	25	111
	Phase 3	60	8	13	41	60
	Phase 4	61	8	11	25	61
	Phase 5	49	9	8	25	49
	Phase 6	122	12	10	25	**122**
Binh Son commune	1st	52	9	12	25	52
	Phase 2	63	15	8	25	63
	Phase 3	68	9	13	25	68
	Phase 4	27	12	8	25	27
	Phase 5	3	10	8	25	25
	Phase 6	126	12	8	25	**126**

Observations: From the above results table, it shows that the AQImax values of the 03 research areas of Go Dau Industrial Park, Long Thanh Industrial Park, Binh Son Commune in 2020 are alternately: 106 (phase 1), 122 (phase 6), 126 (phase 6). These values are all TPS dust parameters. The parameters (SO2, NOx, CO) are all good.

Comparing with the air environment quality table, we have the following assessment results:

TABLE 9. Results of air environment quality assessment of three research areas in 2020

Monitoring stations	Monitoring Phases	AQI_{max}	Comparison range	Environment air quality
Go Dau Industrial Park	1st	106	101<106<200	Relatively bad
	Phase 2	57	51<57<100	Average
	Phase 3	25	0<25<50	Good
	Phase 4	25	0<25<50	Good
	Phase 5	55	51<55<100	Average
	Phase 6	41	0<41<50	Good
Long Thanh Industrial Park	1st	113	101<113<200	Relatively bad
	Phase 2	111	101<111<200	Relatively bad
	Phase 3	60	51<60<100	Average
	Phase 4	61	51<61<100	Average
	Phase 5	49	0<49<50	Good
	Phase 6	122	101<122<200	Relatively bad
Binh Son commune	1st	52	51<52<100	Average
	Phase 2	63	51<63<100	Average
	Phase 3	68	51<68<100	Average
	Phase 4	27	0<27<50	Good
	Phase 5	25	0<25<50	Good
	Phase 6	126	101<126<200	Relatively bad

Observations: The AQImax values of the 03 areas are all TPS dust parameters. These values are in the comparison range of Relatively bad air quality.

3.5. Summary results of AQI max of 03 research areas in Long Thanh district over the years from 2017 to 2020

TABLE 10. AQI max of 03 research areas in Long Thanh district over the years from 2017 to 2020.

Year	AQI_{max}		
	Go Dau Industrial Park	Long Thanh Industrial Park	Binh Son commune
2017	117	116	134
2018	60	84	76
2019	165	153	151
2020	106	122	126

Graph showing AQI values of 03 research areas in Long Thanh district over the years from 2017 to 2020
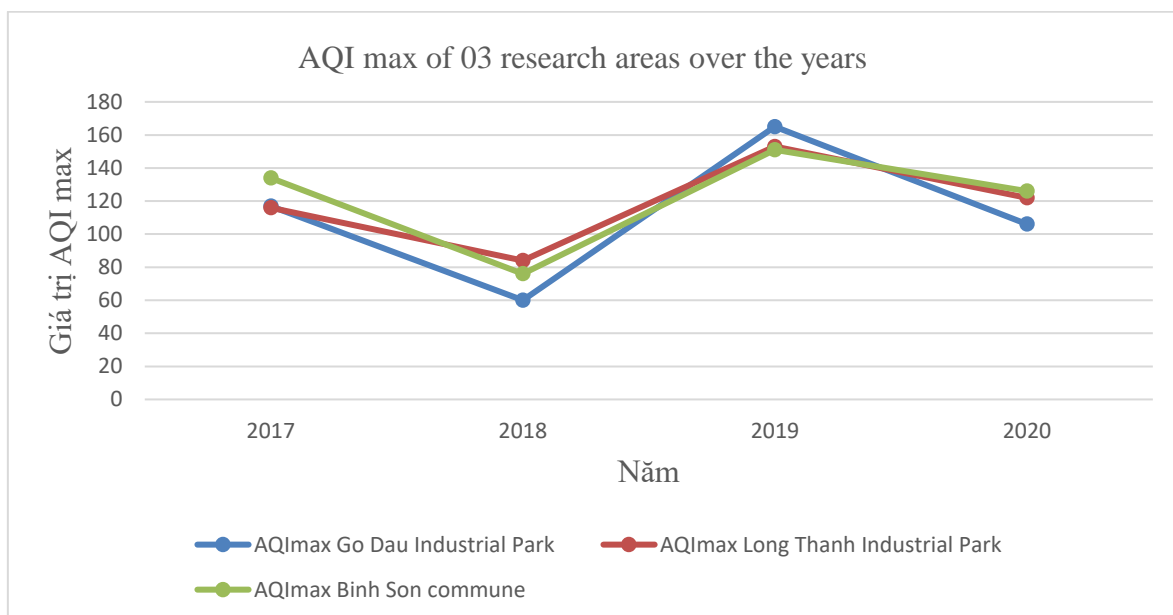

Figure 1. AQI max of 03 research areas in Long Thanh district over the years from 2017 to 2020

Observations: The AQImax of all these areas increased and decreased linearly over the years from 2017 to 2020. All these areas had the highest AQImax in 2019 and the lowest in 2018. By 2020, the amount of dust in the air decreased, so the AQImax of all these areas were lower than previous years.

4. Conclusion

From the research results shows that:

• AQImax of 03 research areas: Go Dau Industrial Park, Long Thanh Industrial Park, Binh Son Commune in the years from 2017 to 2020 all exceeded the allowed threshold (reached bad level). These values are all caused by the TPS dust parameter.

• Detailed AQI data of TPS, SO2, NOx, CO parameters are all within allowable limits. This proves that production activities in the industrial park, as well as emissions from daily vehicles in these research areas are stable and do not cause environmental pollution.

• The AQImax of all these areas increased and decreased linearly over the years from 2017 to 2020. All these areas had the highest AQImax value in 2019 and the lowest in 2018. Thus, it can be explained that in 2019, Long Thanh town was expanded (including Long Thanh town and part of communes: An Phuoc, Loc An, Long An, Long Duc) was a class IV urban area. Urban expansion entails the need to complete synchronous infrastructure, leading to the generation of a large amount of dust into the air environment throughout Long Thanh district. Therefore, the AQImax index caused by dust parameters increased.

• By 2020, the amount of dust in the air decreased, so the AQImax of all these areas were lower than previous years.

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