

# Singapore in Efforts to Increase the Air Pollution Index

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## Abstract

According to the theory of environmentalism, human civilization has a negative impact on the environment because of industrialization. It means that it cannot be separated from the perspective of the green movement that underlies environmentalism. Environmental issues are an implicative issue because it creates a chain reaction for many parties. In general, cities in the Southeast Asia region are facing the same issue, such as air pollution obtained from factories and motorized vehicles. Within the regional scope, ASEAN has taken the initiative to create regional cooperation that specifically addresses cross-border haze and other environmental issues within the framework of ASEAN cooperation. One of the ASEAN member countries, Singapore was able to hold down the Air Pollution Standard Index and become the 5th ranked country in Asia Pacific with the best air quality. Thus, Singapore experience better air quality than most other countries in Southeast Asia. The achievement of Singapore also involves government policies that pay great attention to environmental issues. The results of this paper provide views and alternatives that can be applied by other countries' governments, related to environmental issues.

## I. INTRODUCTION

Living environment is an implicative issue to many parties. It is because environmental issue results in chain reaction to many them. It is unsurprising that international forum often raises environmental issue as the one deserving special attention and handling. Similarly, the author assumes that environmental issue has a distinctive attraction to discuss. In this case, environmentalism plays an important role in contributing its thought. Environmentalism, according to *Cambridge Dictionary*, is a study on environment and a belief that environment should be protected from damage due to human activities [1]. In contrast to *green politics*, environmentalist believes in the existence of structure that can repair environmental damage. Environmentalist believes that international institution can solve environmental problem. Generally,

a state's environmental damage level will be proportional to the state's economic growth. The higher the foreign investment in a state, the higher will be the state's economic growth, but it in turn will impact on the state's environmental damage level. World Health Organization (WHO) claimed that 9 out of 10 persons in the world inhale highly-polluted air. In addition, at least 7 millions people die annually due to air pollution [2]. Therefore, air pollution can be called a *silent killer*.

Living environmental problem becomes a common issue in nearly all states in the world, including those in South East Asia region. Singapore as a pro-investment state instead achieves proud achievement. This lion state successfully got a title as the state with the best air quality in South Asia following Philippine [3]. Singapore's area is only 721 squared kilometers wide, while Philippine's is 300,000 squared kilometers (721 km : 300.000 km).

Philippine area involves rural ones with broad green land. Meanwhile, all Singaporean areas are urban ones replete with motor vehicles and industrial plants. This ratio makes Singapore deserving a predicate as a state successfully dealing with air pollution problem. This phenomenon is in contradiction with a theory stating that a state's economic growth level is proportional to the state's environmental damage level. For that reason, the author argues that it is important to conduct a research on the phenomenon occurring in Singapore.

Image of developmental state is so inherent to this 721.5km-wide state. This image is of course inseparable from many Foreign Investment Companies investing in Singapore. Nevertheless, this state with 1001 rules (bans) successfully suppresses Pollution Standard Index (PSI) and becomes the 2<sup>nd</sup> best state in South East Asia, and the 5<sup>th</sup> one in Asia Pacific [4]. Thus, a question arises as to why the same way is not applied to other states, particularly Indonesia. Meanwhile, air pollution issue is so fundamental in our daily life. In this work, the author explores more in-depth the measures taken by Singapore to suppress PSI.

## I. ANALYSIS

### A. Air Quality in Singapore

Indonesian government has distinctive parameter to measure the air quality in Indonesian cities. Pollution Standard Index (PSI) is a report on air quality to the public to inform how clean or how polluted the quality of air is and the effect of the air inhalation for hours/days/months on health [5]. Meanwhile, international has different parameter called *Pollution Standard Index* (PSI). There are six categories of PSI: good, safe, potentially decreasing health level, less healthy, unhealthy, and hazardous to health. Since 1999, PSI is also called Air Quality Index (AQI) [6].

Here are the details of air quality categories, according to AQI:

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable, however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Fig. 1. Air Quality Categories  
(Source: AirNow [7])

Meanwhile, ASEAN Specialized Meteorological Centre (ASMC) has similar standard of air quality value:

TABLE I. AIR QUALITY VALUE	
PM <sup>10</sup>	Air Quality Description
≤ 50	Good
51 - 150	Moderate
151 - 350	Unhealthy
351 - 420	Very Unhealthy
< 420	Hazardous

(Source: ASEAN Specialised Meteorological Centre [8])

Speaking of air condition in Singapore is inseparable from the organization operating in Singaporean living environment field, National Environmental Agency (NEA). Since its inception in 2002, this organization kept attempting to create feasible environmental condition in Singapore. NEA is also committed to control air pollution in Singapore and organize cross-border pollution agreement with neighbor countries. The latest data on June 2, 2019 shows that Singapore belongs to safe category in PSI or AQI parameter [2].

The main source of air pollution in Singapore is emission coming from industry and motor vehicles. Transboundary haze pollution resulting from land and forest fires in neighbor countries also affects Singaporean air

quality, particularly during southwest monsoon period from August to October [10]. National Environmental Agency (NEA) stated that local government has used a good strategy of controlling development to minimize air pollution. Eventually, the local government policy can ensure that air quality remains to be good despite Singapore's population-dense and large industry-based urban landscape. Thus, it is unsurprising that Singapore can enjoy the better air quality than many other cities can in Asia, comparable to cities in United States and Europe. Singaporean Pollutant Standard Index (PSI) remains to range between "good" and "moderate" for most of the time in 2017 [9].

Here is the condition of air concentration in Singapore, according to ASEAN Specialized Meteorological Centre (ASMC), in the period of June 3-9, 2019:

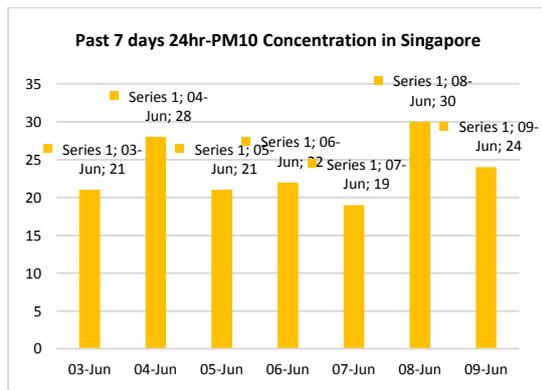


Fig. 2. The Condition of Air Concentration (Source: ASEAN Specialised Meteorological Centre [8])

Considering the graphic above, it can be concluded that Singapore has good air quality. The air quality value of Singapore is far below 50. During June 3-9, the highest air concentration in Singapore is 30 for the highest level. Compared with Jakarta or Hanoi as the *most polluted cities* in South East Asia, Singapore can be proud. Singapore belongs to 'Good' category, according to AQI parameter and ASMC. It means that air pollution in Singapore is on small-scale or with insignificant risk.

### B. Singaporean people's Socio-culture

Singapore is known as a country with 1001 rules. This name is, of course, inseparable from Singaporean society's culture that is disciplined and obedient to the rule. In relation to air pollution, a massive consciousness among local people is required to participate in reducing air pollution. On January 1, 2019, the Government enacted smoke-free area in 3-kilometer radius in the busiest shopping center, Orchard Road [10]. In contrast to Indonesia providing smoke-free areas in some places, Singapore instead provides 40 points only for the smokers. The smokers are banned from smoking but in the 40 points provided by the government. Although the substance contained in the cigarette is only one of so many pollutants, this policy of "assembling" the smokers at least affects the air quality significantly in Singapore.

Singaporean government seems to restrict cigarette consumption in its country. It can be seen in the price of cigarette rising dramatically, the cheapest price of cigarette is IDR 110,000.00 in 2018. In addition, people are not allowed to bring cigarette from outside Singapore or the officer is authorized to do confiscation against the one bringing more than one package of cigarette from abroad. Singaporean people do not object with those various bans, including the minority. Unlike in Indonesia, active smokers are found rarely along Singaporean streets. The image of disciplined people has been inherent to the people in this country with 1001 bans. It makes foreign tourists reluctantly breaking the regulations developed by local government. Thus, each regulation developed by local government will be surely obeyed by everyone living in Singapore.

Majority Singaporean people are public transportation users. They use bus, taxi, MRT and LRT as transportation

modes in their daily mobility. In 2016, nearly 4 millions people use bus and about 3 millions people use MRT everyday [11]. The massive use of public transportation, of course, reduces the production of air pollution coming from motor vehicle. Thus, the Singaporean people's high interest in using public transportation affects the Singapore's air quality.

### *C. Singaporean Government's Policy over air pollution.*

As a developed state, Singaporean government not only pays attention to political issue but is also concerned with living environment, one of which is the air cleanliness quality in its country. In dealing with this living environment issue, Singaporean government, through the Ministry of Living Environment and Water Resource, establishes National Environmental Agency (NEA) in charge of keeping Singapore clean and green by protecting Singaporean resource from pollution [12]. In addition, the establishment of National Environmental Agency (NEA) is intended to keep the people's health level high and to give meteorological information timely.

Meanwhile, Singaporean government takes additional measures to minimize air pollution by means of law, tight law enforcement program, and air quality monitoring. It is conducted as an attempt of helping ensure that Singapore's air quality remains to be good despite Singapore's population-dense and large industry-based urban areas [13]. Singapore monitors ambient air quality comprehensively to advise the community about the effect of public health related to a variety of pollution level and preventive measures to be taken. In the attempt of improving a clean air quality, Singapore contributes to and supports campaign for Breathe Life Global initiated by UN's environment [14].

The air quality of Singapore is better than that of cities in other Asian country, comparable to cities in United States and European. It is intended to Singaporean Pollution Standard Index (PSI) remaining to range between "Good" and "Moderate" in 2017. Singaporean Government has air quality target to its state corresponding to World Health Organization Air Quality Guidelines (WHO AQGs) and is attempting to achieve this air quality in 2020. Responding to the parameter of international air quality, World Health Organization Air Quality Guidelines (WHO AQGs) reviewed continuously, NEA establishes Advisor Committee for Ambient Air Quality on July 2010 to recommend the target of air quality for Singapore. This committee is headed by National Environmental Agency (NEA), with the representative of stakeholders from public sector and high education institution in Singapore [15].

The committee has completed its task on July 2011 and given recommendation based on an assessment that WHO AQG is recognized internationally and thorough as it is supported by scientific findings and health studies. The committee also recommends National Environmental Agency (NEA) to work in order to achieve WHO AQC for all air pollutant in long term. To achieve the target of air quality in 2010, National Environmental Agency (NEA) has developed road map with a series of mitigating attempts that will enable Singapore to achieve sustainable growth and development while maintaining the public health and economic competitiveness. Singapore Government develops a strategy as an attempt of managing air pollution, by means of prevention, monitoring, enforcement, and education [16].

- Prevention – All new industry proposals is referred to National Environmental Agency (NEA) to be evaluated, and to pass through

planning stage in order to ascertain the measures to be taken to control early the air pollution that will be generated.

- Monitoring – In addition to monitoring each pollutant, National Environmental Agency (NEA) also examines the quality of air surrounding for the signs of pollution so that quick action can be taken to prevent the escalating problem.
- Enforcement – National Environmental Agency (NEA) takes many enforcement actions such as inspecting industrial and trading center to ensure that the environmental regulation has been obeyed.
- Education – Improving the people's consciousness by means of educating the owners of vehicle about the appropriate maintenance of vehicle in order to prevent it from emitting more smoke.

#### *D. Air Pollution Regulation*

To ensure a good air quality, Singaporean Government establishes standard emission and encourages the adoption of cleaner fuel in industrial and transportation sector. This emission standard application is important to suppress the use of motor vehicle with more environment-friendly combustive gas emission. In addition, industrial fuel is also maximized to use cleaner fuel in order to minimize the emission of industrial gas waste so that it will not contaminate the air too much when it is disposed to the air. To reduce industrial emission, the state announce the tightening of emission standard in a series of pollutant (Mercury, cadmium, lead, ammonia, and hydrogen fluoride) for new and preexisting industrial plants from 2015 to 2018 [17].

##### *a) Motor Vehicle*

Motor vehicle is the main source of air pollution. To control the emission resulting from motor vehicle and to take care of the public health, National Environmental Agency (NEA) establishes the standard of disposed gas emission and the quality of fuel for all vehicles and organizes type and quality of fuel that can be used in Singapore. Since September 1, 2007, all new-gasoline vehicles should meet Euro VI emission standard [20]. This new standard applies to new motorcycle, new diesel vehicle aiming to tighten the fine particle emission from direct injection gasoline engine, in addition to other pollutants.

Since January 1, 2018, emission standard for all three-wheel vehicles (Cat L5e) and big motorcycle with engine capacity more than 200cc tightened into Euro IV standard, while the smaller motor vehicle with capacity of 200 cc or less will see the Euro IV emission standard to be effective on January 2020 [18]. This regulation also applies to former vehicle imported to Singapore that should comply with the emission standard enacted during the registration in Singapore. National Environmental Agency (NEA) also introduces Vehicle Emission Scheme (VES) to replace Carbon Emission-Based Vehicle Scheme (CEVS) for all new cars, taxis, and used cars imported effective since January 1, 2018.

##### *b) Smoky vehicles*

Under the Regulation of Environment Protection and Management (Vehicle Emission), is the driver of motor vehicle will be considered as committing violation if he lets his vehicle engine turning on when it does not move, because it can result in unnecessary pollution and waste fuel. The owner leaving his vehicle engine on idle mode can be fined up to \$2,000 for the first violation and \$5,000 for the next violation, when he is stated to be guilty before the court [18]. Diesel vehicle is

more vulnerable to smoke emission. To minimize the smoky diesel vehicle, the smoke opacity limit is tightened from 50 Hartridge Smoke Units (HSU) to 40 HSU per January 1, 2014. Furthermore, during compulsory periodical inspection of vehicle for road tax renewal, diesel vehicle is required to undertake and to pass through Chassis Dynamometer Smoke Test (CDST) measuring more tightly the vehicle smoke emitted under simulated road condition. National Environmental Agency (NEA) takes firm action against smoky vehicles on the road. The owner of smoky vehicles will be asked to send their vehicle for smoke emission inspection in official vehicle inspection center and the owner will be fined for the failed vehicle. In addition, the owners will required obligatorily to improve and to send their vehicle for repeated inspection before the vehicle is allowed on the road. The owner should ascertain that their vehicles are well-maintained in a good condition to be used on the road. The owner should also practice a good driving habit allowed (using gear appropriately) and. Failed for avoiding their excessive vehicle for to prevent smoke emission.

*c) Idling Engine*

Under the Regulation of Environment Protection and Management (Vehicle Emission), is the driver of motor vehicle will be considered as committing violation if he lets his vehicle engine turning on when it does not move, because it can result in unnecessary pollution and waste fuel. The owner leaving his vehicle engine on idle mode can be fined up to \$2,000 for the first violation and \$5,000 for the next violation, when he is stated to be guilty before the court [18].

National Environmental Agency (NEA) routinely involves such stakeholders as Singaporean School Bus and Personal Rental Owner Association, Singaporean

School Transportation Association, Public Transportation Operator (Bus/Taxi operator), and Singaporean Travel Agent National Association (NATAS) to educate and to warn their drivers to turn off their vehicle engine during stationary phase. while waiting for National Environmental Agency (NEA) also cooperates with school to distribute some material educating and warning parents, and private school transportation operator to turn off their vehicle engine while waiting for picking up the children at school.

*d) Off-road diesel engine*

Since July 1, 2012, all off-road diesel engines to be imported into and to be used in Singapore should meet the off-road diesel engine emission standard US Tier II, US or Japan Tier II [18]. Off-road diesel engine is any equipments or engines with diesel engine as primary or secondary activator (driver), unlisted in Land Transportation Authority (LTA) to be used on public road. Some examples are construction equipments such as crane, excavator, forklift, and electrical generator. Diesel engine used on ship, train, locomotive, and plane does not belong to this regulation. For the used off-road diesel engine, emission test report for each of and all units should be submitted to confirm its compatibility to emission standard specified before they are allowed to be used in Singapore.

*e) Transboundary Haze Pollution Management*

Singapore encounters haze pollution over times. The haze pollution induced by forest fire occurring in the region when the opened fire is conducted to open the land for farming purpose. Singapore takes some measures to ensure that its populations are equipped with knowledge on dealing with the haze pollution when it occurs. These measures include providing early haze pollution warning,

measuring and disseminating information on air quality, and guidelines to solve the haze pollution-related problem. In addition, National Environmental Agency (NEA) cooperates with ASEAN countries to fight against haze pollution. Along with Meteorological Service Singapore (MSS), National Environmental Agency (NEA) becomes the host of ASEAN Specialized Meteorological Centre (ASMC) – a collaborative program between national meteorological services from ASEAN member states – to solve haze pollution problem in this region. ASMC's main duty is to monitor and to assess cross-border forest fire and haze pollution affecting ASEAN region [19].

*f) Smoking Ban*

Singaporean government takes some measures to protect non-smoker's health through smoking ban as included in the preexisting law. In 2013, the smoking ban is expanded to include public areas in residence building (public corridor, empty deck, stairs, and multiuse room) including path/connector lane, zebra cross bridge for pedestrians, 5-meter radius from bus stop edge, and outer part of hospital. Since June 2016, the smoking ban is expanded to the following areas: reservoir, garden under JTC Corporation scope, and garden in public houses managed by individual Town Council and garden in personal plantation managed by NParks [20].

This regulation is developed, of course, based on the government's attempt of reducing air pollution in its state. In addition to the attempt of reducing air pollution, this regulation and expensive price of cigarette is also enacted in the attempt of safeguarding the public health from smoking hazard. However, unfortunately this regulation has not been able to apply to other states in ASEAN region because cigarette and cigarette industry can be stated as one of largest contributors to the state income.

For example, Indonesia get substantial APBN (State Income and Expense Budget) income from cigarette excise duty, and this society's culture that has been accustomed with smoking is difficult to remove.

*E. Air Pollution Threat against Regional Security*

ASEAN is a strategic region to be product and service market and production site. Substantial population and strategic geographical location can be utilized well. The large population with low human resource quality can be factor labor with *low-skilled labor quality*. However, the problem generated behind the advantage of large population and geographic location tends to have adverse effect, particularly on environment.

Haze pollution is one of issues always becoming hot topic annually in ASEAN. Singapore is the states mostly affected by haze pollution resulting from land fire in Indonesia [21]. Adapted from Republic of Indonesia Ministry of Living Environment and Forestry's website, the most severely burnt land can be found in 2015 with total width of 261,060.44(Ha) and this width decreases continuously [22]. Recalling that the this land fire affects not only Indonesia but also its neighbor states constituting the fellow ASEAN, this can one of threats against regional stability.

Land fire occurred in 1997/1998 in Sumatra region, Indonesia, impacting on Singapore. The fire in 1997/1998 produced PM10 constituting hazardous compound. PM10 is airborne solid or liquid particulates with median aerodynamic diameter less than 10  $\mu\text{m}$ . PM10 can be airborne easily and enter into upper respiratory tract and lung due to its very small size, and precipitate in long term. PM10 is also an indicator of polluted air, as it identifies the number of patients developing Acute Respiratory Infection (ARI).

Singapore's air had "moderate" status from August to early November 1997, and had "unhealthy" status for 2 weeks requiring the Singapore Ministry of Health to warn its people not to do activity outdoor, if unnecessary. It was reported that the highest PSI was 144 within 24 hour in that year. It very likely increased the number of patients with respiratory infection. Particle fraction PM2.5 is also found in cross-border haze pollution. PM2.5 can spread in light and harm vision distance. It is this that made vision distance limited and some flights cancelled during haze pollution period. Poor air quality also resulted in decrease in some business sectors, e.g. the decrease of tourist number and hotel business in Singapore during haze pollution. This problem will affect Singaporean economy. Unfortunately, the sufficiently severe land fire was repeated in 2014/2015 in Sumatera Region, Indonesia. Singapore becoming the state most severely affected protested against Indonesia [23].

This land fire is due to not only drought and high temperature, but also human factor deliberately burning the land for opening new factory or plantation land. This land firing deliberateness was conducted to minimize the cost needed to open new land. It of course results in adverse effect, because the haze pollution resulting from forest fire is very harmful and hazardous to human respiration. It of course encourages the authorized ones to improve the measures to fight against haze pollution and to protect their people from hazardous particles entering into human body. Today, haze pollution issue is no longer one state's problem in ASEAN region but it has been collective problem requiring collective effort to cope it with. In addition to government's attempt of fighting against toxic air pollution, such situation will likely persist because the states in the region find difficulty in

equilibrating economic growth and environment improvement.

Not only haze pollution resulting from forest fire but also sufficiently worrying factory waste smoke should be considered by the states in ASEAN region. Industrial cities in ASEAN have very poor air quality today. It results not only from factory smoke but also from motor vehicle contributing to worsening the quality of air in ASEAN region. A recent study conducted by Greenpeace found that Jakarta is the city with highest Air Pollution Index in ASEAN [24].

This air pollution will of course affect one state only, but can threat the state's regional area. For example, the first case concerns haze pollution, the source of which originates from Indonesia but the states affected most severely is Singapore. In the presence of such haze pollution, the mobilization of people and economic growth will be inhibited. The second one concerns air pollution due to motor vehicle and factory waste. It will, of course, be very hazardous to health.

Serious threat against health and air quality in ASEAN region forces the policy makers or those authorized to develop a regulation to mitigate the effect generated [23]. Therefore, the states in ASEAN region should discuss the way of coping with this effect of air pollution together immediately, because air pollution is no longer a state's problem but regional problem. The development of regulation should included standardization of factory air waste disposal, combustible land supervision, and renewable and environment-friendly energy use.

In addition to threat against health resulting in some health disorders, air pollution can also impact seriously the economy. Economic wheel can be inhibited sue to air pollution inhibiting mobility and product (goods) transportation. It of course can affect the trade that in turn can impact on the state's economy. It is this that should be

considered by policy makers at regional level in ensuring the performance of economic wheel by reducing air pollution that can inhibit transportation mobility rate and product trade.

Of course not only the development of regulation is promoted by each government in minimizing this effect of pollution, but also the character of consciousness of environmental preservation should be developed by government. Building and education to the people about the importance of reforestation and environmental preservation are accomplished the government through both public service poster in mass media and socialization. It is because basically creating a good environmental condition is not only the government's responsibility, but community or people also contribute considerably to maintaining environmental preservation.

#### *F. Cooperation in Living Environment Issue in ASEAN*

Air pollution in this ASEAN region cannot be dealt with by a state only because the region affected not consisting of one state only, but having passed through state borders and it becomes mutual responsibility to deal with it [26]. Therefore, in dealing this problem collectively, regional cooperation becomes important. Since a long time ago, ASEAN countries have actually long been aware of the hazard of air pollution. Therefore, the states in this region have established cooperation by making collective policy since along time ago.

In dealing with living environment including the handling of air pollution in ASEAN region there have actually been some instrument of mutual agreement. *ASEAN Agreement on Transboundary Haze Pollution (AATHP)* is a cooperation specifically discussing cross-border haze pollution issue in the frame of ASEAN cooperation [25]. AATHP agreement was

ratified in Kuala Lumpur, Malaysia on June 2002 and prevailed since November 25, 2003, corresponding to Article 29 containing AATHP that would be effective 60 days after the sixth state ratified and submitted *Instrument of Ratification* to ASEAN secretariat. Article 3 clause (3) of *ASEAN Agreement on Transboundary Haze Pollution (AATHP) 2002* stated that the parties should take preventive measures to anticipate, to prevent, and to supervise smoke pollution as the result of forest and land fire that should be mitigated to minimize its side effect. Whether or not serious threat and whether or not the damage due to cross-border smoke pollution can be repaired and even without scientific certainty, preventive measures should remain to be taken by the corresponding parties.

This consequence of AATHP is the establishment of *ASEAN Coordinating Centre (ACC) for Transboundary Haze Pollution Control* that will run the coordination functions from prevention, monitoring, and handling through mitigation of land and forest fires generating haze pollution. ASEAN cooperation in living environment has begun since 1978, as characterized with the establishment of *ASEAN Experts Group on the Environment (AEGE)* under *Committee on Science and Technology (COST)*. The establishment of such institutions is intended to reinforce the cooperation that has been initiated since 1971 through Permanent Committee on Science and Technology. At that time, AEGE was mandated to prepare ASEAN Environmental Programme (ASEP), the ASEAN activity program in living environment field.

As the coverage of living environment cooperation in ASEAN region expands, *ASEAN Senior Officials on the Environment (ASOEN)* was established in 1990, consisting of six work groups:

- a. Cross-order pollution handling
- b. Natural conservation

- c. Living Environment
- d. Living Environment management
- e. Environmental economics
- f. Environmental Information, improving the public's knowledge and consciousness

Therefore on July 2013, Ministry of Foreign Affairs (MFA), Ministry of Law (MinLaw), and Ministry of The Environment and Water Resources (MEWR) embarked on a legislative structured research corresponding to the reformation need to prevent and to act on opposing those responsible for cross-border haze pollution issue.

Singapore devised to establish International Advisory Panel (IAP), a legal advisor team for cross-border pollution, consisting of legal experts and headed by Prof. S. Jayakumar and Prof. Tommy Koh. IAP was intended to study and to give input to Singaporean government concerning the development of international law in relation to the effect of cross-border haze pollution. Public space was also opened to give contribution to draft Transboundary Haze Pollution, lasting for four weeks from February 19, 2014 and March 19, 2014, held by MEWR [28].

ASEAN cooperation in living environment can also be seen in the 19<sup>th</sup> ASEAN Summit in Bali on November 16-19, 2011, where 10 ASEAN's heads of state (government) saw 8 partner states to dialogue focusing on discussing living environment issue in ASEAN region.

The ratification of AATHP by Singaporean Government is also a political respond to Singaporean Government's consciousness of the need for a firmly binding political agreement in handling cross-border haze pollution issue in South East Asia [29]. The ratification of AATHP by Singaporean government is the manifestation of Singaporean people's consciousness of maintaining economic and ecological balances. The presence of AATHP is

expected to change economic system or regime for the sake of getting benefit and satisfaction. There should be economic and natural balance, so that economic development unnecessarily damages the environment.

#### *G. Comparison of Air Pollution Index between Singapore and other ASEAN States*

Seeing in more detail and comparing the data of air pollution index between Singapore and other ASEAN states, it can be seen that Singapore still belongs to the state with good air quality. Compared with Indonesia's capital (Jakarta) and Vietnam's (Hanoi), Singapore is still better because the two cities are the most polluted ones in South East Asia. Meanwhile, Samut Sakhon, a province near Bangkok is on the third rank. With Beijing's better air quality, Jakarta is risky of following some Chinese big cities that are known polluted, because the pollution rate in Jakarta is only 12% lower than that in Beijing in 2018. Three out five most polluted places are located in Thailand [30].

In a report on world air quality released by IQ Air Visual, Singapore is stated to be the state in South East Asian region with the best air quality [31]. Meanwhile, Jakarta, Indonesia occupies the first rank as the most polluted city in ASEAN region. This achievement that can be achieved by Singapore is of course a product of policy applied by Singaporean government in dealing or suppressing air pollution occurring in its state by applying a variety of regulations tightly to minimize the air pollution.

It of course can be accomplished not only with Singaporean government's hard work as the policy maker but also with the participation of public (community) and business performers who comply with rules contributing to suppressing the air pollution in Singapore. As mentioned in the discussion section,

Singaporean people's socio-culture is very aware of environmental preservation. Business performers, including company and factory, follow the rule or policy made by Singaporean government in processing their factory waste, including liquid or gas wastes that can contaminate the air. The processing of air waste as a main factor causing air pollution can minimize the effect generated. Before the waste is disposed to the air, it should have been processed first so that it becomes more environment-friendly. The policy should also be applied to other ASEAN countries. Some other countries in ASEAN region have actually issued similar policy, but they have weak supervision over the implementation of it.

Through the supervision over the implementation of regulation developed, including domestic and regional regulations, the environmental preservation can be better, either regionally or domestically, and environmental pollution can be minimized. It of course needed cooperation established well and consistently.

## **II. CONCLUSION**

Living environmental issue is considered as an implicative issue as it results in chain reaction from many parties. Generally, foreign investment triggering a state's economic growth is proportional to the environmental damage yielded, including air pollution. However, Singapore successfully proves otherwise. As a developing state getting many foreign investments, Singaporean people instead enjoy better air quality than other Asian countries. Pollution Standard Index (PSI) or Air Quality Index (AQI) mentioned that Singapore belongs to "good" and "moderate" categories in 2017. It is of course affected by Singaporean people's socio-culture life

and Singaporean government in making policy related to environment.

In dealing with this living environment issue, Singaporean government established National Environment Agency (NEA) in charge of keeping Singapore clean and green by protecting its resource from pollution. In addition, Singaporean government uses an integrated city and industrial planning strategy, along with development control to minimize air pollution. In addition, Singaporean government also has taken additional measures to minimize air pollution through law, tight law enforcement program, and air quality monitoring. It is intended to ensure that Singapore's air quality remains to be good despite Singapore's dense and large industry-based urban areas.

Singaporean government also specifies the standard emission and encourages the adoption of clean fuel in industrial and transportation sectors, in motor vehicles, smoky vehicles, idling engine, off-road diesel engine, haze pollution management and smoking ban.

The threat appearing almost annually and becoming regional issue is transboundary haze pollution. Singapore is the most affected stated in this event. The haze pollution affects economic, health, and living environment areas. Considering the wide distribution of area and effect generated by this haze pollution issue, it should be considered as regional issue needing collective problem solving. Some regional agreements have been entered into, for example, ASEAN Agreement on Transboundary Haze Pollution (AATHP). Although Singapore often receives smog delivery due to forest and land fires in Indonesia, compared with some other big cities in ASEAN region like Jakarta and Hanoi, it still has good air quality.

Thus, it can be concluded that Singapore's good air quality results from the policy made by Singaporean

government affected by  
environmentalism approach as its  
guidelines.

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