The importance of green infrastructure for improving the air quality of Ho Chi Minh city

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Abstract. Ho Chi Minh City is becoming one of the cities which has the highest level of air pollution in Vietnam. The Urban Air Quality Index (AQI) sometimes hits an alarming threshold that shows how contaminated the air is. Air pollution has been set as a major concern for the people of Ho Chi Minh City for more than 20 years after the promulgation of the city developing resolution by the government, by which managing urban is still a challengeable burdensome. Investigating 100 city dwellers upon the issue came uploads of comments of urban citizens towards concerning about alarming polluted air, lacking green spaces, seeking for improvable environmental policies and developing social infrastructures in medication, transport, eco-system, etc. There are some typical solutions like planting more trees, using fewer polluting means of transport, prioritizing the use of clean fuels, using the public transport system, and raising public awareness. Furthermore, generally, citizens can improve their living standards, also enhance their awareness to stop behaving badly to the environment due to ameliorate community consciousness and perform the main role in investing in friendly environmental goods. The research is completed by combining, analysing journal documents and uses methods of an interview as well as a survey to come up with the most effective solutions. To manage the urban environment well, limit pollution, and improve the environment, we need to have long-term strategies. In order to have a good environmental protection strategy, it requires the participation of urban residents. This strategy should be linked to the visions and resolutions in developing industrial planning, transportation, etc. The research initiates multiple solutions for improving the quality of the air in urban places, social medication, and a better environment in the future.

Keywords: Air quality, environment, city dwellers, effective solutions

1. Introduction

By the first month of 2020, Vietnam has about 3.76 million cars, and the number of cars increases to 3.79 million, an average of 30,000 cars a month nationwide, and about 45% of cars and motorbikes are concentrated in HCMC. Before that, by the Ministry of Transport calculation about ground transportation vehicles in the middle period of 2019, Ho Chi Minh City has approximately 8.94 million private vehicles, an increase of 6.98% over the same period in 2018. Since 2010, Ho Chi Minh City has increased by more than 4 million vehicles, and on average, each person has a motorbike or car. This figure does not include the number of cars and motorbikes from the surrounding provinces to this city to serve the needs of transporting goods and travelling of the people [1]. This calculation also showed how great the transportation industry grew, likewise, affect directly to other industries such as fuel when a large number of vehicles using a cumulative proportion of fossil fuels, Accommodation when a figure of residents, labours coming from surrounding areas to the centre of the city moves up promptly [2].

It can be said that exhaust gas from a large number of vehicles in traffic, especially overcrowded old motorcycles, expired cars, and others that containing inferior qualities appear in cities of Vietnam nowadays [2]. This huge number of vehicles also emit into the air. The emissions increase even more when the traffic infrastructure is limited, causing traffic jams in many places, many times.

Moreover, concerning the continuous occurrence of deforestation cases, much of it was illegal, which causes serious lowering of rain forests and forest environment, have been spreading out over Saigonese for
decades [3]. Exceeded deforestation is destroying surrounding area environments in Ho Chi Minh City in particular and affecting to the Northwest landscapes, hills where suffered supposedly by the weather at Southern areas that after exceeding deforestation, shortage of trees somehow cannot regulate the atmosphere, take care of the lower ground to impregnate contaminated solid and keep the ground-surface stick together [4].

In addition, dust from construction activities, emissions from industrial establishments, emissions from incinerators using fossil materials such as coal-fired thermal power, calcination, chemicals, and non-organic fertilizers, etc. in Ho Chi Minh City and surrounding areas are making urban air pollution damaged seriously.

This research will give readers a full vision of the main sources which causing air pollution, unhealthy influences, the improvement strategy, and the strategy related benefits that will have for residents and the economy at Ho Chi Minh City.

2. The content of the research

2.1. The alarming air condition in Ho Chi Minh city

Vietnam is grappling with alarming air pollution. Two major cities Hanoi and Ho Chi Minh City are currently on the list of the 15 most polluted cities in Southeast Asia, of which the most worrying air pollutant is PM2.5 fine dust [4]. This statement represents lots of meaning relating to the diversity of Ho Chi Minh City and Ha Noi economic industries. In other words, the research knows it can be displayed as the environment has not been protected properly, as opposed to the rapidly changing of an economic system, and so on with exceed deforestation, industry activities and exhale CO₂ to the air, global warming dries the air and the surface [2]. This means that when the land surface dried, the toxic elements in the air will react strongly to each other to produce new harmful elements as PM2.5.

In 2019, Hanoi had 8 days with PM2.5 concentrations lower than the national standard (50 µg / m3). Ho Chi Minh City was not much better, with only 36 days below the standard. For the rest of the year, more than 10 million people are exposed to heavily polluted air [5].

Fine dust is especially harmful to human health because they have the ability to penetrate deeply into the lungs and cardiovascular system, causing many diseases such as stroke, cardiovascular disease, lung cancer, chronic obstructive pulmonary disease, and sugar infection [2]. WHO estimates indicate that there were 60,000 air pollution-related deaths in Vietnam in 2016.

Meanwhile, according to the AQI index, the quality of community life is affected by air pollution. In 2016, the air below the standards of the World Health Organization (10 µg / m3) reduced the 1-year life expectancy of people. The World Bank also calculates that air pollution costs the country 5% of total GDP each year [4]. In this case, the research claims that the extremely high effection to economic due to air pollution just outlines a serious picture about expenditures have to spend for medical supports and environmental protection campaign enormously [4].

2.2. Main sources of pollution

One of the main causes of air pollution is transportation. Vietnam currently has 3.6 million cars and 58 million motorbikes, mainly concentrated in big cities. Many of them are old vehicles with poor emissions control technology are possessing a high proportion within. Vehicles cause daily traffic jams, and at the same time, emit large amounts of pollutants. A huge number of old buses and motorbikes emit black smoke on the road [5]. As the problem of the transportation infrastructures is worsening over time because of lacking intensive care such as roads and people awareness about environmental conservation, more or less, lacking naturally conservative consciousnesses. So that, Vietnamese have to attach special importance to perform a major role in conserving the common breathing atmosphere [3].

Vietnam transportation problems are exacerbated by poor urban planning [4]. Tall buildings mushroomed in the heart of the city, where thousands of people live, putting enormous pressure on the already overcrowded road infrastructure. There is no public transport system here except for buses - and its not very convenient either. In many major cities in Vietnam, having green and open spaces is seemed
to be luxurious [7]. This has greatly created a grave global warming situation in the city centre which expands a lot of meanings and sources of Air Quality through core issue is Vietnam’s massively accelerated economic development policies. Since 2018, Ho Chi Minh City had approximately 540 million square meters of trees in total divided into two areas where urban, which included 5.5 million square meters of trees, holding 1% and suburb which had the rest of the figure and so on, the total green covering still modestly at the percentage of 31.7%. The motivation for green buildings and plantations has just started slowly from the near end of 2018 to 2020. In contrast, cities in developed countries such as Singapore City (Singapore) or Milan (Italy) have been doing this policy for more than 20 years. Also, Singaporeans want their developed cities covered by 30% of the total amount of trees, and they are striving by the year 2030, 80% of buildings will be eco-buildings.

Another problem comes from residential and commercial construction dust. Thousands of sites are full of trucks carrying sand and construction materials, creating a continuous layer of dust. In the heart of the city, there are still old industrial zones [8]. Many facilities causing air pollution, such as coal power plants, cement manufacturers, steel plants located around the city, also make the air quality worse [9].

2.3. Affecting the economy:
Vietnam major cities are affected seriously due to a wide reduction in air quality. Department of Nature Resources and Environment informs that every year, Vietnam suffers 10 billion dollars in the economy because of air pollution (occupying 5 to 7% of total GDP). [12] For instance, air pollution causes economy-wide reductions in market economic activity based on data for Europe. The analysis combines satellite-based measures of air pollution with statistics on regional economic activity at the NUTS-3 level throughout the European Union over the period 2000-15. An instrumental variable approach based on thermal inversions is used to identify the causal impact of air pollution on economic activity. The estimates show that a 1μg/m³ increase in PM2.5 concentration (or a 10% increase of the sample mean) causes a 0.8% reduction in real GDP that same year [3].

Furthermore, the Ministry of Health Portal reports that the amount of PM2.5 dust appearing in the air fluctuates between 30 to 100 micrograms per cubic meter. This statement means each person living in Ho Chi Minh City is breathing polluted air as smoking 1 to 5 cigarettes per day. Reducing directly to Vietnamese longevity, continuously limiting Vietnamese economic efficiency and weakening whole Vietnamese generations for ages [3].

Meanwhile, because of the increase in the price of industrial crops and plants, glasshouses are expanding their impact on every section of areas, causing “pollutant inflation” for planting areas. Meaning as plants too many crops, but is not having a proper managing system to control the air quality in Ho Chi Minh City suburbs [6].

Moreover, suburbs citizens are not highly educated, they do not have any additional financial planning except for planning crops in the field, which means low incomes, but they must carry on their shoulders heavy taxes relating to agriculture and “pay” for environmental protection policies. Indirectly lengthening the extent of richness and poverty hinder overall improvement living standards of urban residents, especially, Vietnam has to face financial harmfulness when interpreting the core issue is to change Vietnam educational system in order to revolute consciousnesses upon the environment and apply progressive technologies in Vietnam industry at once [8].

3. Methodology, Results, and Discussion
This article presents the survey results of 100 students opinions about which air pollution mitigation measures they would like to prioritize implementation [4]. Research results show that the majority of people choose the solutions with the desire to: (1) Increasing the number of trees, (2) Changing using fuel with less air pollution, and (3) Developing public transport system (see Table 1).
Table 1. Solutions to improve the air quality of the people

| No | Solutions                                         | Ratio |
|----|--------------------------------------------------|-------|
| 1  | Planting more trees                              | 51%   |
| 2  | Using clean fuel                                 | 20%   |
| 3  | Developing public transport system               | 13%   |
| 4  | Applying strict emissions standards for vehicles | 9%    |
| 5  | Developing modern air quality monitoring systems | 7%    |

It can be seen that the solution most favoured by the people of Ho Chi Minh City is also consistent with international experience in the implementation and benefits of measures to reduce urban air pollution [2]. Korea capital Seoul has recently built more than 2,000 gardens; Australia city of Melbourne plans to nearly double green acreage to 40% by 2040; and Milan, Italy have planned to expand their green spaces with 3 million trees to be planted.

Urban forestry “does not deal entirely with city trees or with single tree management, but rather with tree management in the entire area influenced by and utilized by the urban population”. [14] (The Urban Forestry: An Introduction, Chapter 1, 8) The provisions of the above statement help the research knows the importance of planting trees inside every building and saving ground fund, supports the 31.7% rate of green covering in the urban area in Ho Chi Minh City at current increases to more than 50% with the urgent regulation of the government.

With less air-polluting fuels, the switch to low-carbon fuels and electric vehicles is also a popular choice in dealing with air pollution [6]. Brazil made a significant change to the low carbon fuel of ethanol produced from sugarcane in 1975. Today, Brazil has a large fleet of vehicles that use ethanol produced from sugar cane to replace fossil fuels. Meanwhile, France is expected to reach the same goal by 2040; and China aims to electrify 20% of its new vehicles by 2025. Switching to compressed natural gas (CNG) is commonplace in public transport. Los Angeles Metro completely switched to the CNG bus fleet in 2013, and New Delhi, India, has implemented a similar policy since 2001.

In Ho Chi Minh City, the air pollution situation is happening quite complicatedly, especially in recent times. The phenomenon of photochemical blindness, which obstructs the vision, affects the health of the people.

Accordingly, the 9-month air pollution monitoring results show that air quality pollution in Ho Chi Minh City is mainly caused by suspending dust and noise levels caused by traffic activities, with 50, 8% of suspended dust data and 93.9% of observed noise level data at 19 traffic locations exceeded the permitted standards [10].

According to research data from the Institute of Environment and Resources (National University of Ho Chi Minh City), the calculation results of synthetic emissions show that traffic activity accounts for the highest emissions, mostly for pollutants. Pollution, with a rate of 99% in the total CO emissions of the whole city, 46% dust, 64% CH4, etc. Industrial activities of the city account for 22% of total SO2 emissions, dust 21%, etc.

It is interesting to note that Vietnam parliament has promulgated full-force regulations to accumulated change the whole ecological environment with upgraded bioenvironmental engineering technologies and proper managing systems. Desiring for more than 20 years, Vietnam living environment can be equally compared with the worldwide living environment [7].

Regarding the cause of pollution, there are 3 sources including emissions from transport, industry, and construction. In particular, pollution from traffic is the largest because the city currently has about 10 million registered vehicles, not to mention 2 million vehicles travelling and about 37 points that frequently occur in traffic jams air pollution [11].
Sharing information about the harmful effects of air pollution from fine dust, CO₂, SO₂, so on., to human health with the VNA, prolonged air pollution will seriously affect human health. Specifically, through research and surveys of developed countries, if people are in long-term exposure to fine dust, CO₂, so on., in the long term, they will suffer from diseases such as chronic obstructive pulmonary disease, cardiovascular disease, chronic asthma, etc. For pregnant women, fine dust can penetrate the placenta and into the fetal body, affect the development of the fetus, increase the risk of low birth weight, premature birth, and the risk of miscarriage in pregnant women [8].

4. Recommendations

First of all, we need to improve and strengthen urban planning. Ho Chi Minh City has many high-rise buildings with dense density. Now, these cities need more green and airy spaces. It is possible to move out crowded.

The city urgently needs to improve the public transport system (bus, aerial tram), then set up new systems. The introduction of green building construction regulations and feed-in tariffs can promote the development of buildings using economic energy or using solar power [7].

Second, we need to adopt policies that encourage greener means. For example, we need to encourage the gradual reduction of polluting outdated vehicles by subsidizing used car dealers. This money can be collected from higher taxes on the purchase of a new vehicle [5]. The above approach solves the distributive effect concerns, as older vehicle owners are often low-income households.

The government could also issue policies to promote EV development, such as allowing electric cars to run in central areas only or reducing income taxes for electric vehicle manufacturers to make them affordable.

Third, we need to price pollution in accordance with the polluter pay principle. The regulator could amend the environmental protection tax regulations to better target polluting fuels such as diesel and coal [10].

Fourth, we need a flexible and efficient transition to a renewable electrical system. The activation of wind and solar policies, including grid-to-grid and reverse auction pricing, will maintain Vietnam recent solar boom and keep Vietnam in its position. A leader in renewable energy in Southeast Asia. Vietnam may set more ambitious targets for renewable energy thanks to its high potential for solar, wind, and small hydroelectricity on rivers [11].

Finally, we need fossil fuel subsidy reform that can reduce the use of dirty fuels and save on annual subsidy payments. This money can be used for other welfare activities such as health, education, and environmental protection.

5. Conclusion

In conclusion, air pollution is not a natural disaster. It has its circulation, which affected by the most polluted environment factors such as wasteful exhaust, exceeding deforestation, over-building plantation canopies. The research provided multiple viewpoints about Ho Chi Minh City’s current environmental situation and suggested a list of solutions to may limit the losses, improve consciousnesses. Through a simple survey with 100 city dwellers, we can judge how the city’s residents know and think about their serious issue when they chose to seek cultivation zones in order to cover the colour green to their living locations. As loads of efficiencies have been made to deal with the problem, but the variety of advantages Ho Chi Minh City has so only can perform a new face of the city.

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