

Storia e Futuro

RIVISTA DI STORIA E STORIOGRAFIA ON LINE

n. 56 dicembre 2022



Bologna
University Press

THE IMPACT OF CONSUMPTION-BASED ECONOMY ON THE VIETNAMESE ENVIRONMENT

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DOI: 10.30682/sef5622g

Abstract

A central question in today's environmental debate is how economic development and environmental protection interrelate, especially in middle-income countries with exponential economic growth. This article's focal point is to identify how the fast strong growth and change in consumption in Vietnam impacted on the environment during a 60-year period (1954-2018), in terms of climate change, air pollution, water pollution and waste disposal. Those issues would be thoroughly discussed and supported by the country's report on the number of emissions by different means (industrial activities, transportation, etc.), experts' analysis, forecasts and reliable databases from the World Bank, Euromonitor, Vietnam General Statistical Office, Statista. All data on this paper is taken from other various sources, ranging from government and companies reports to journals and articles worldwide.

1. The dynamics of Vietnamese economic growth from 1954 to the Present

1.1. The history of Vietnamese Economy

1.1.1. Pre-reunification period: 1954-1975

After the Geneva Agreement (July 1954), Vietnam was split into North and South with two different forms of government: the Democratic Republic of Vietnam and the Republic of Vietnam respectively. These regions were divided by the 17th parallel. Thereby, there were huge differences between the economic change in Northern and Southern Vietnam (Harvie Charles & Tran Hoa, 1977).

In Northern Vietnam, the communities returned to peaceful and completely independent life, not having to worry about fighting against the French. Nonetheless, they faced an awful lot of difficulties after 80 years of war. Landscape and infrastructures were drastically damaged as most large important plants and mines were destroyed, and there was a lack of labour workforce. Moreover, local bourgeois and foreign capitalists moved to the South, only 23 industrial engineers stayed in the North, making the situation even worse. In order to handle this scenario, the Democratic Republic of Vietnam government paid much attention to the recovery of agriculture and industrial production and built a number of industries for production and consumption needs. From 1954 to 1975, the component of the Northern economy was quite diverse, mixing between capitalist and socialist economies. It included private capitalist economy, individual economy, state-owned economy and collective economy. On the contrary, the Southern economic system followed the market economy, focusing on war support.

1.1.2. Reunification Period: 1976-1986

After 30 years of war and division, 1975 was a remarkable milestone in the development of Vietnamese history. This is the year the country was finally united under one government following Marxist-Leninist ideology. The state's responsibility was to unify and build the socialist economy for the whole united country. In particular, the socialist structure in the North would be maintained, while the South's capitalist structure would be transformed into a socialist one (Harvie Charles & Tran Hoa 1977).

During this period, there are many leverages to boost economic development. First of all, the unification and peaceful atmosphere created happiness among people in two regions. Consequently, people had the motivation and strong patriotism to cooperate and support each other with the aim to comprehensively develop the economy; at that time, they lived under the slogan of "Nam Bac mot nha", which stands for "South and North – we are one". The state communist party and the government implemented many policies that prioritised the heavy industry sector, enhanced the socialist production relations, and established the centralized economy structure. In the collective economy, private businesses were eliminated; consumer goods were distributed by the government under stamps; trading in the market was cut down; a limit was set on the goods distribution from one locality to others; and household registration system was established during this period with food distribution purpose, particularly the rice register book, which set the number and items allowed to be purchased.

However, the impacts of the policies from the state were not only ineffective but also left certain consequences that later led to the macroeconomic crisis in the late 1970s and early 1980s (Harvie Charles & Tran Hoa 1977). This 10-year period is one of the darkest periods in Vietnamese history. Regarding the economy, Vietnam was considered an agricultural country, and yet, the population had to suffer a severe shortage of rice and nutritional food source at that time (Bui Thang 2000).

1.1.3. Economic Transition Period: 1987-2000

In the middle of the 1980s there was a new global trend in economic management shifting towards capitalist countries. It was mainly due to the wide spread of the third new scientific and technological 17

revolution, based on the application of scientific and technological invention and the development of hi-tech industries, such as Information Technology (IT), Biotechnology, new materials technology and so on. Accordingly, countries that applied these management structures experienced impressive development in their economies. In addition, developing countries in East Asia and South-East Asia implemented economic reforms, becoming the world’s dynamic development areas. They applied new strategic governance and structural reforms to gain competitive advantages and attract foreign investment. Directly, all of these movements created an intangible pressure on many countries, including Vietnam. Furthermore, the third 5-year plan (1981-1985) left Vietnam with severe consequences on the agriculture sector in 1986, such as the un-effectiveness of the contract production program, unreasonable prices, monetary inflation, abuse of power and corruption. As the World Bank, the GDP fluctuated over the period 1986-1990 and bottomed out in 1989 (USD 6.293 billion in 2018 prices) declining by approximately 83% within 2 years, compared to 1987 GDP (USD 36.658 billion in 2018 prices). To cope with the economic crisis at that time, in November 1986, the Sixth National Congress of the Vietnamese Communist Party marked Vietnam’s first step to reform the economy. The congress introduced the policies to transform the socialist economy into a market-oriented system which combined with the multi-sectional economy development (Collins Ngan 2009). This period is called “Doi moi” which means “economic renovation” in English. In fact, in the early years of the “Doi Moi” period (the 1990s), Vietnam faced severe difficulties due to the collapse of some socialist countries that supported it (Soviet Union, Eastern European). Therefore, the country had to figure out how to reform the economy on its own. However, from 1991 to 1997, thanks to the emerging Asian market, the situation improved thanks to a huge Foreign Direct Investment (FDI) (Fig. 1). Moreover, after becoming a member of ASEAN (1995) and APEC (1998), Vietnam remarkably enhanced its worldwide relations.

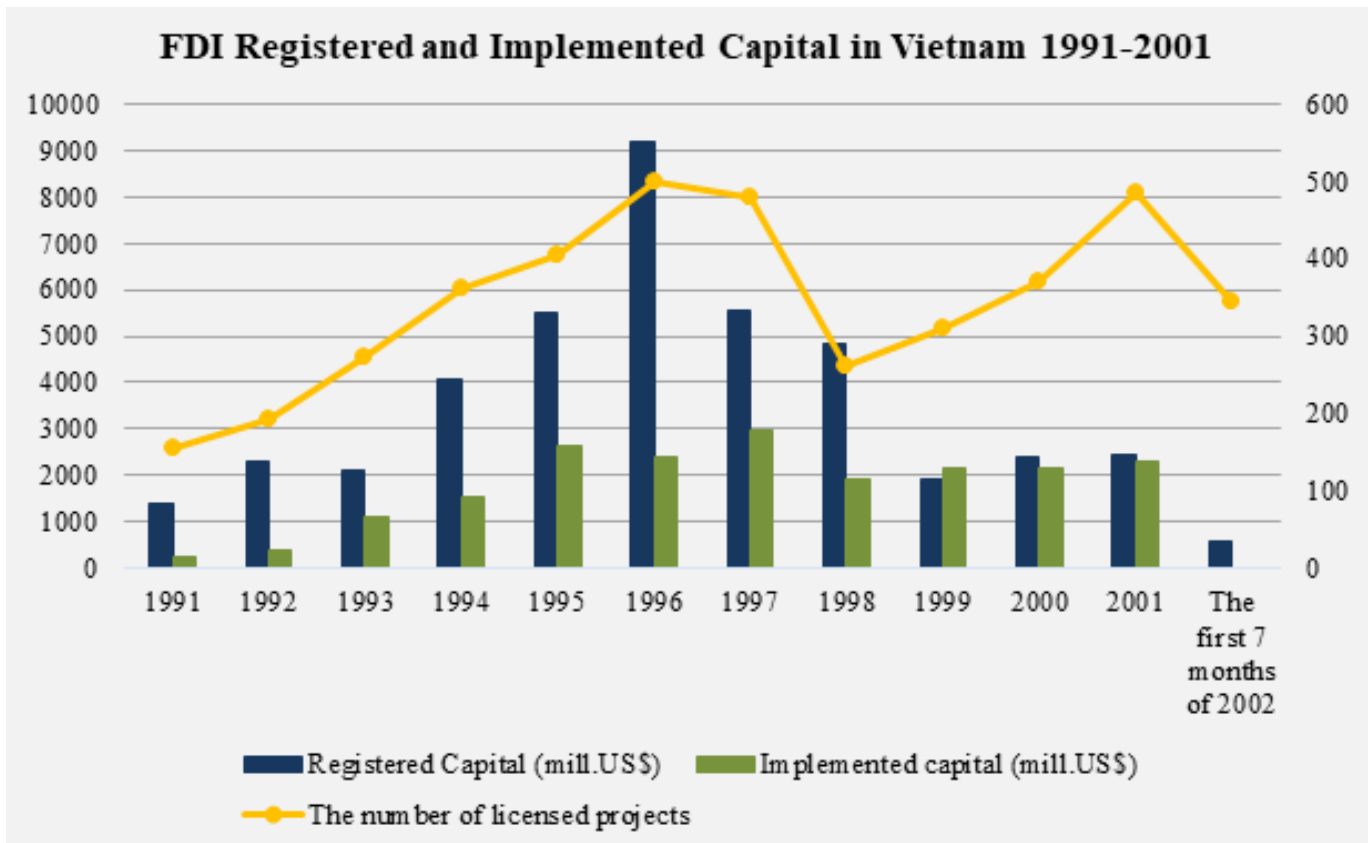


Fig. 1: FDI Registered and Implemented Capital 1991-2001. Source: Le Hoang Doanh 2002. Foreign Direct Investment in Vietnam: Results, Achievements, Challenges and Prospect.

1.1.4. Socio-economic consolidation and development Period: 2001-2018

Ten-year of Socio-economic Development (2001-2010)

Despite the effect of the Asian financial crisis in 1997 and the global financial crisis in 2008, Vietnam economy has experienced remarkable events during this period. When the 2001-2010 socio-economic development strategy was implemented, which was mainly aimed at industrializing and modernizing the country and emerging from under-development, Vietnam was heading to sign major agreements, including the BTA (2000) trade agreements and the WTO access negotiations (2007) (Gabriele 2005). The Bilateral Trade Agreement (BTA) was the most substantial and complete trade agreement signed by both Vietnam and the US. This is regarded as a paramount move that led to Vietnam officially becoming a member of the WTO. Vietnam’s export sector rate consequently increased significantly: the exports of manufactured goods grew by 500% and the total exports to the US market increased more than fourfold from 2001 to 2003 (from USD 1.05 billion to 4.05 billion) (Vo Thanh 2005).

In 2007, Vietnam became an official member of the World Trade Organization (WTO). This led to the reformation of trade policies towards transparency and liberalization, which reflected in multilateral and market-opening commitments. A reduced tariff was imposed on foreign goods import and a number of service policies was improved. In general, this helped the Vietnam economy to fully integrate into the regional and world economy. Total foreign trade in 2010 was estimated at nearly USD 157 billion, more than 5.2 times higher than 2000, of which exports increased more than fivefold, reaching USD 72.2 billion; while imports reached USD 84.8 billion, nearly 5.4 times higher (Tran Thuc 2011).

During the 2000-2010 decade, agriculture, forestry and fisheries industry had experienced a gradual increase with an average of 5.2% per year (Tran Thuc 2011). According to Sen Nag Oishimaya (2017), Vietnam maintained its high status as world rice exporter, tanking among the top three in the world.

In sum, the state has consistently achieved outstanding results and successfully fulfilled its planned objectives. Firstly, GDP per capita performance was surprisingly 3.5 times higher than the targeted plan (2 times), with a sharp increase from USD 31.17 billion in 2000 to USD 115.93 billion in 2010 (Fig. 2). Due

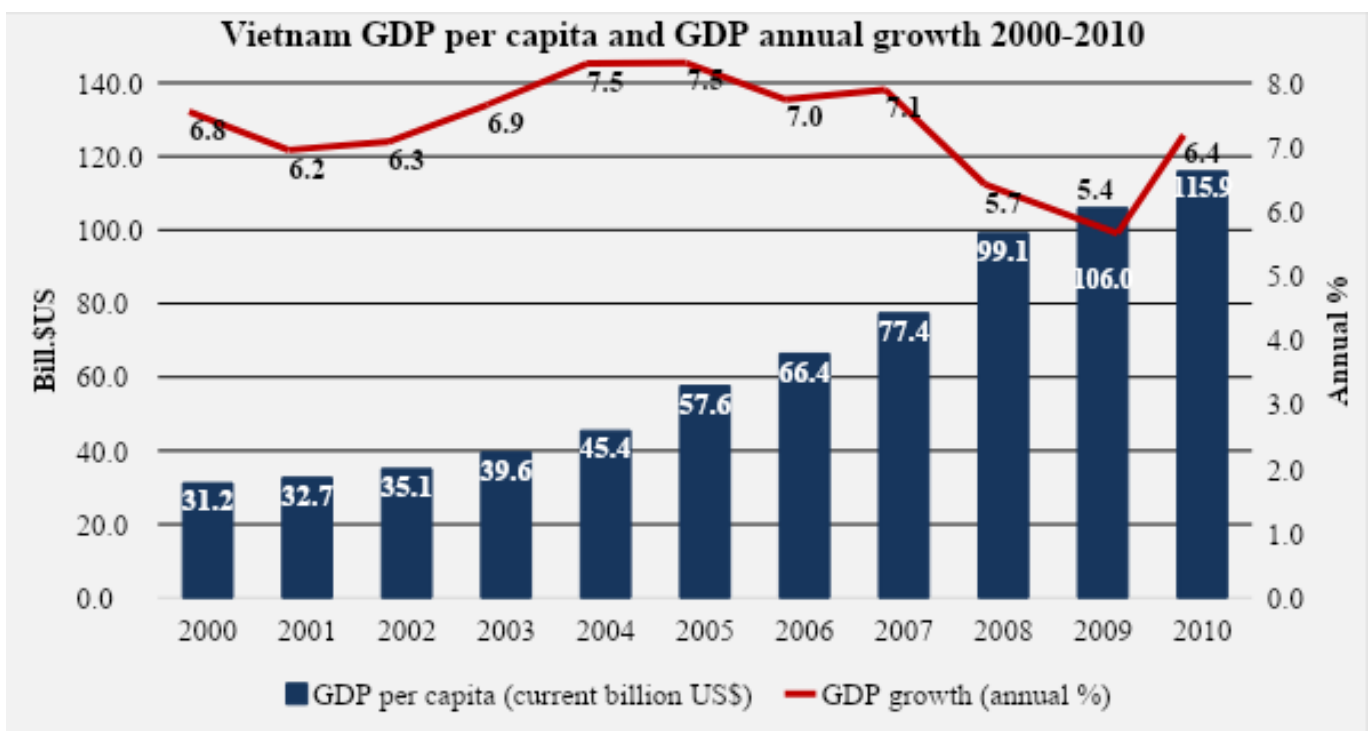


Fig. 2: Annual GDP per capita and GDP growth in Vietnam 2000-2010. Source: World Bank 2019.

to the effect of the regional and global financial crisis, the GDP growth rate in 2010 was slightly lower than in 2000. However, before the crisis, this period experienced a high GDP growth rate of over 7% each year from 2004 to 2007 (before the financial crisis in 2008) (Fig. 2). Secondly, Vietnam has not only emerged from its under-developed position, but has also entered the group of lower-middle-income countries (Dang Vinh, Do Trang, Nguyen Cuong, Phung Thu and Phung Tung 2013).

The robustness of domestic economy (2011-2019)

Following the 2008 global financial crisis, the trade balance have improved notably since 2012. As illustrated in Figure 3, from 2013 to 2018 Vietnam recorded a trade surplus, with the exception of 2015. This was a big movement of this period, compared to the trade deficit of the previous decade. In fact, Vietnam has strived to establish strong international relations, most importantly to facilitate export-import activities. In 5 years, from 2011 to 2015, Vietnam had established strategic partnerships with 8 nations (German, Italy, France, Indonesia, Thailand, Singapore, Malaysia, Philippine) and comprehensive partnerships with Ukraine, USA, and Denmark.

In the area of international economic integration and cooperation, in addition to its membership of the World Trade Organization, our country has signed several bilateral free trade agreements, including:

Year (launching)	Free Trade Agreements
2011	• Vietnam-Chile Free Trade Agreement (VCFTA)
2015	• Vietnam-Korea Free Trade Agreement (VKFTA)
2015	• Vietnam-Eurasian Economic Union Free Trade Agreement (VN-EAEU FTA)
2019	• EU-Vietnam Free Trade Agreement (EVFTA)

Furthermore, Vietnam joined 7 multilateral free trade agreements: ASEAN Free Trade Agreement; Free trade agreements between ASEAN and China, Korea, Japan, India, Australia, New Zealand and the Trans-Pacific Partnership Agreement. Hence, thus far, Vietnam has been a free trader with 55 economies, including 15 over 20 of the largest economies in the world; at the same time, the country established trading relations with 240 countries and territories.

The specific results of promoting foreign economic activities and international integration were primarily the import and export of goods and services. The period 2011-2018 was marked by positive results and a gradual increase in both goods import and export value. As Figure 3 reveals, in the first year (2011), the trend was importing goods rather than exporting. The value of exports in Vietnam was USD 96,257 billion while the value of imports was USD 106,75 billion. After 7 years, both export and import of goods has experienced a steady increase over the years, which explains the relatively dynamic trading activity of the country. Yet, exports have slightly exceeded imports in the last three years of the period (2016-2018).

In addition, another important result of foreign economic activities is the strong attraction of foreign direct investment. From 2011 to 2018 the number of licensed projects from the foreign investors has almost doubled; 1,186 projects were recorded in 2011 and 3,147 in 2018 (Fig. 4). The total registered capital over the period fluctuated and peaked at USD 37,100.60 million in 2017. Regarding the implemented capital, the graph shows that the number kept rising over the period and reached USD 19,100 million in 2018. Nevertheless, this number is relatively low compared to the huge FDI registered and demonstrates an inefficiency in the use of important investment sources. Therefore, a careful selection process of companies and projects, mainly in terms of science, technology, and market, should be prioritized. This would optimize the valuable flow of FDI received by the country.

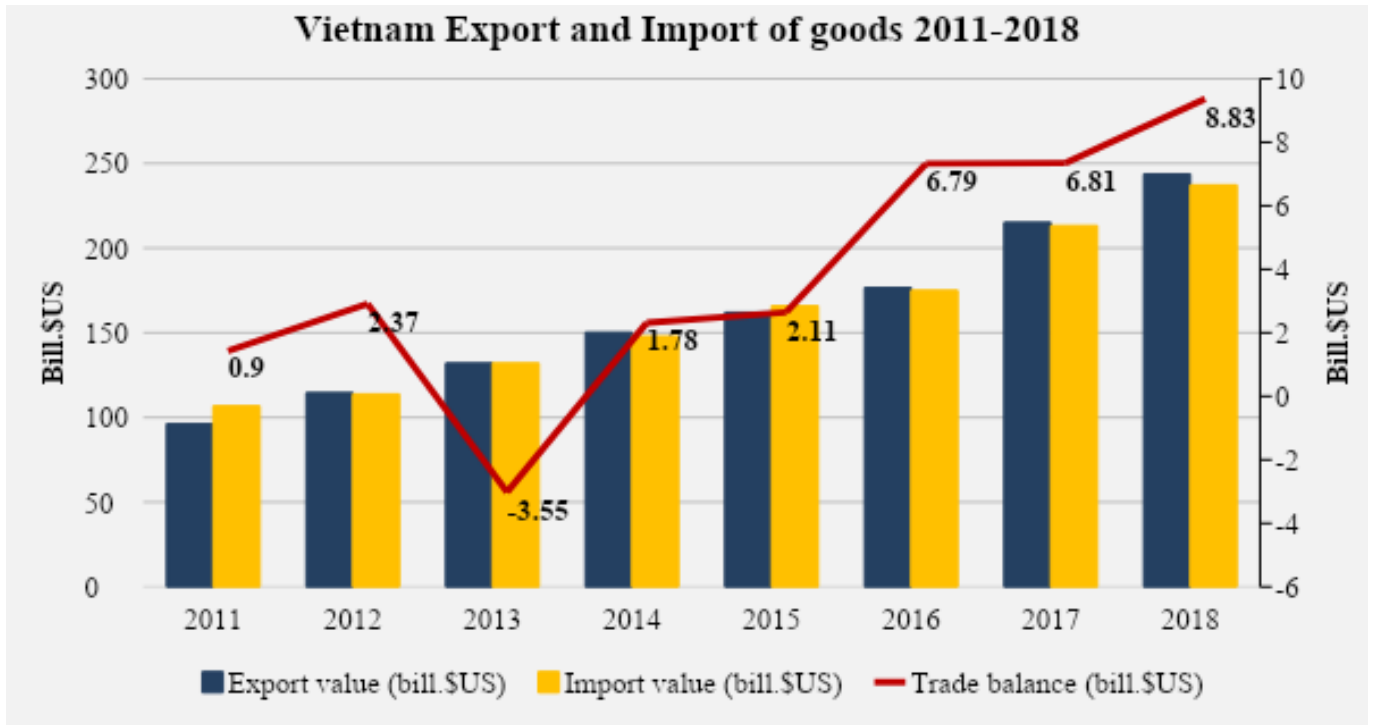


Fig. 3: Vietnam Export-Import growth and Trade Balance 2011-2018. Source: General Statistic Office of Vietnam 2019.

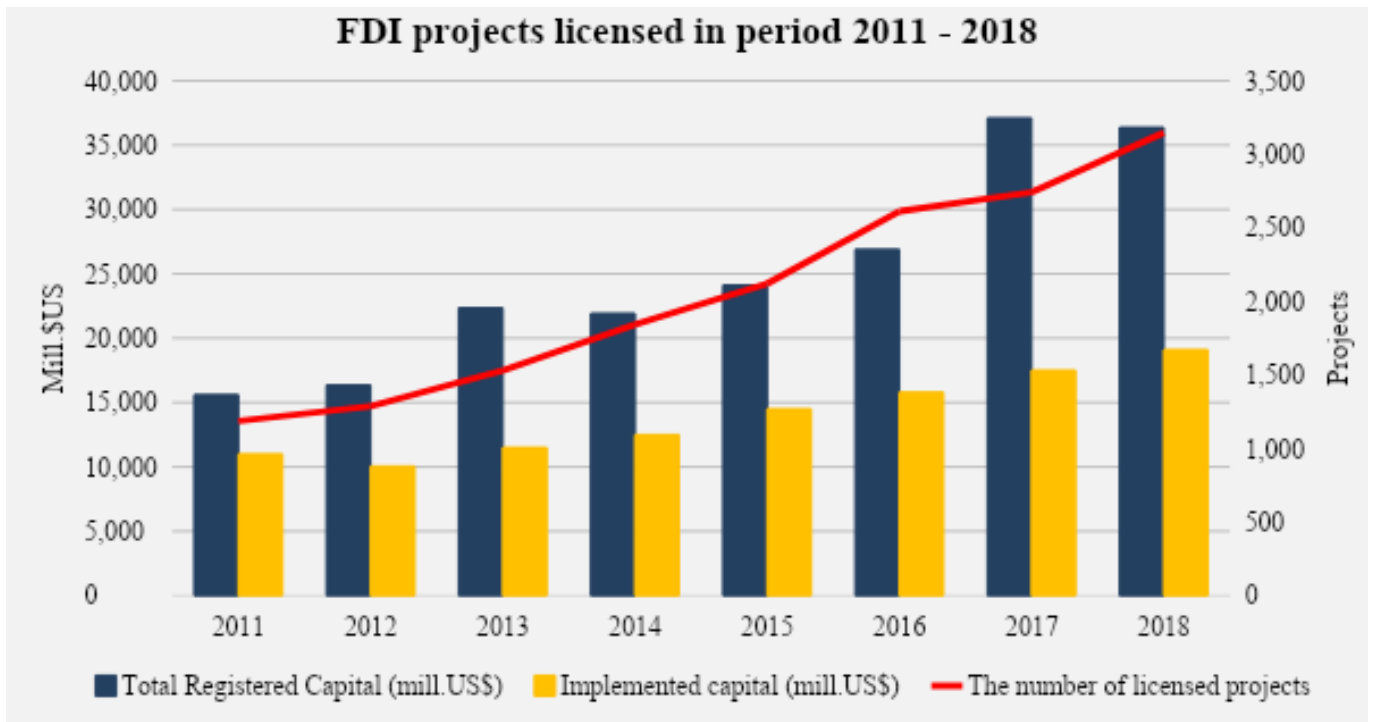


Fig. 4: FDI projects licensed in Vietnam 2011-2018. Source: General Statistic Office of Vietnam 2019.

In the process of industrialization, Vietnam’s transformation from agricultural to industrial and service-based country has been boosted. In other words, Vietnam puts more and more effort on the industrialization and modernization process. The positive result for this goal was mainly the large contribution of the industrial and service sector to the national GDP. Until 2017, the economic growth was led by the

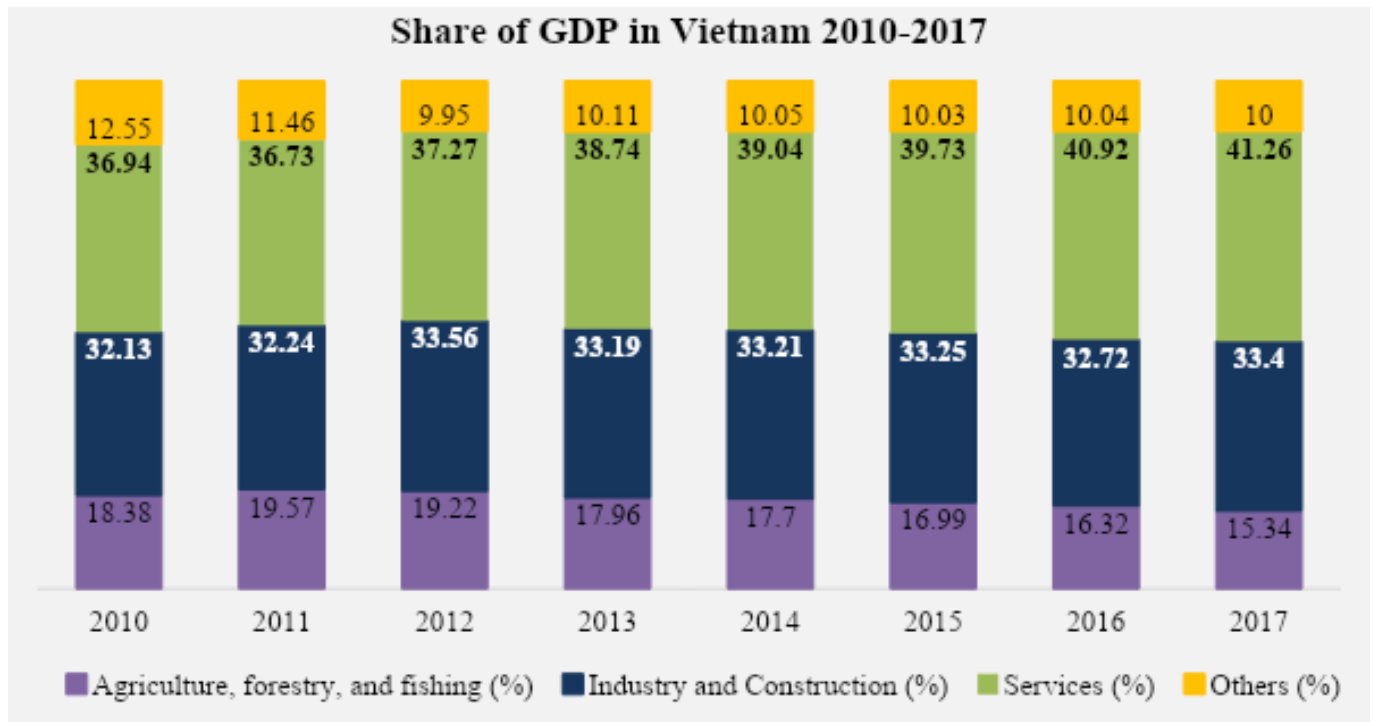


Fig. 5: Share of GDP by sectors in Vietnam 2010-2017. Source: Statista 2019.

Industry and Service sectors (33.4% and 41.3% respectively (Fig. 5.)), reflecting the sign of stabilization and sustainable development in these sectors.

Agriculture, forestry and fishery, however, are still well-developed and achieved the highest growth rate in the last year of the period (2018): agriculture grew by 2.89%, the fishery by 6.46% and forestry by 6.01% (Nguyen Tung 2018). The total production of three sectors – agriculture, forestry and fishery – developed steadily over the period of 2013-2018. The agricultural sector, in fact, contributed the most to the total production, followed by fishery and forestry. Thus, the annual growth rate over the years is obviously unstable.

With the stable growth, Vietnam still holds the third position in the world in terms of rice export. According to Statista (2019), Vietnam exported a total of 7 million tonnes of rice in 2018/2019, ranking behind India with 12,500 million tonnes and Thailand with 10,300 million tonnes. Furthermore, Vietnam was recognized as the fourth leading exporting country of fish and fishery products worldwide with USD 7.7 billion in export value in 2018/2019 (Statista 2019).

Accordingly, linking with the characteristics of the Vietnamese labour force, most of the employees are working in three major sectors: agriculture, forestry and fishing; manufacturing; and wholesale and retail trade, repair of motor vehicles and motorcycles.

In sum, between 2011 and 2018, the Vietnam average GDP growth rate was around 6.2%, lower than that of the 2001-2010 period (6.6% in average) (Fig. 6). Moreover, the projected GDP growth rate for the 2011-2015 period was not achieved, mainly due to the negative effect of the global financial crisis from 2008 to 2013. However, Vietnam has experienced rapid growth since 2014, presenting a positive sign in the GDP growth rate. The general trend has been upward, reaching 7.1% in 2018.

As a result, in the period 2017-2018, Vietnam ranked 55 over 137 countries in the global competitiveness. According to the Delegate of German Industry and Commerce in Vietnam (AHK Viet Nam 2018), the country reached this impressive achievement thanks to its competitive advantages in terms of market volume, the competitive labour market and better national education.

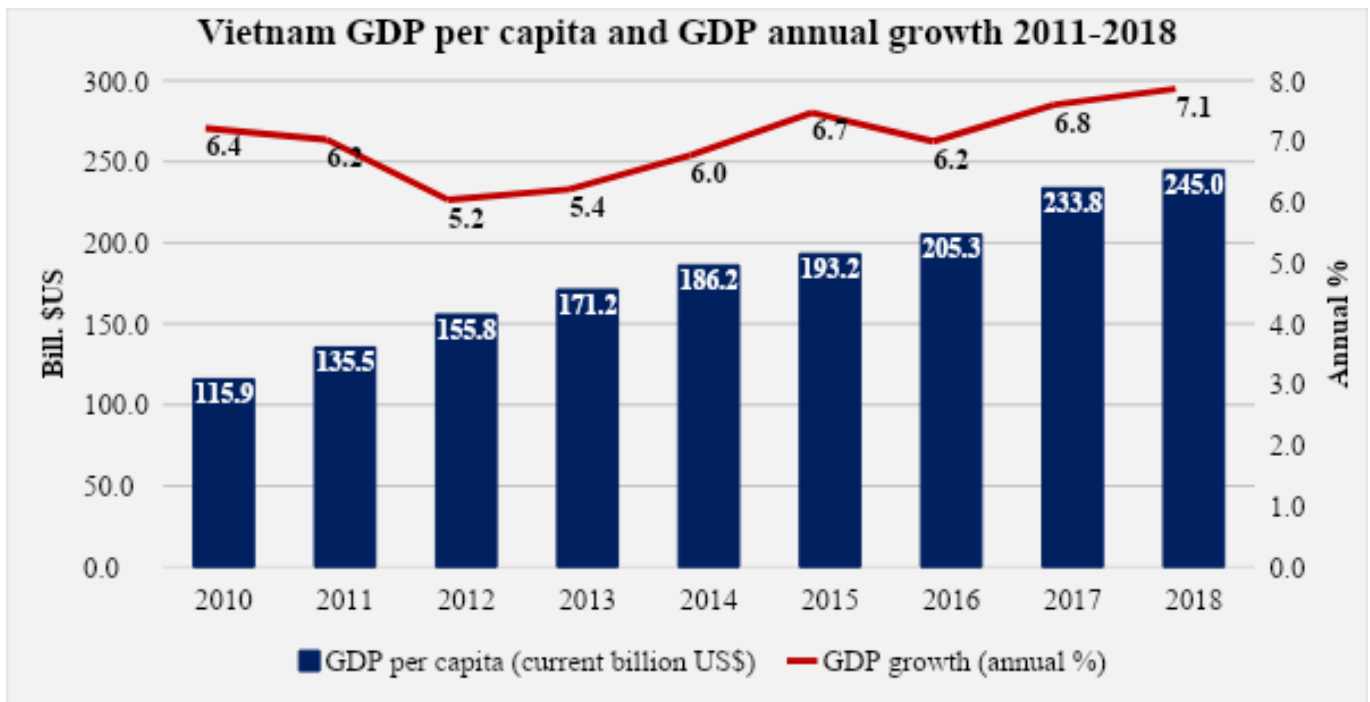


Fig. 6: Vietnam GDP per capita and GDP annual growth 2011-2018. Source: World Bank 2019.

1.2. The Vietnamese consumption changes according to the economic changes

1.2.1. Main consumption trends influenced by the service sector

Telecommunication

The number of telephone and Internet subscribers increased rapidly over the years due to the growing demand for contacts. In 2005, telephony (including mobile telephony) subscribers were about 15 million and 210 thousand were internet users. In 2018, the number has risen to 134 million and 12 million respectively (Fig. 7). These changes facilitated global integration and enhanced Vietnamese citizens' knowledge.

Transportation

Regarding private transportation usage, Vietnam is one of the countries where everyone is obsessed with owning private transportation individually. According to a national news channel report, Vietnam currently ranked first among Asian countries and fourth globally (VietnamNet News 2019) in terms of motorcycles ratio in the total number of road vehicles. Indeed, the number of motorbikes and scooters has increased by 48 times in 30 years (from more than 1,209,000 in 1990 to nearly 58,170,000 vehicles in 2018). In big cities like Hanoi there are around 2,500 motorbikes on the road for every kilometre.

The huge consumption of private vehicles certainly led to a rapid growth in energy consumption. In 2000, the energy consumption for transports was 4 million tonnes of oil equivalent; the number has since increased to 14 million tonnes of oil equivalent in 2018 (Fig. 8)

1.2.2. Increased energy demand due to the industrialization and modernization

The second dominant economic sector in Vietnam is industry and construction, which has developed significantly over the years. With the process of industrialization, the consumption of energy has grown dramatically. In 2000, the total energy consumption by industry reported in Vietnam was 7.9

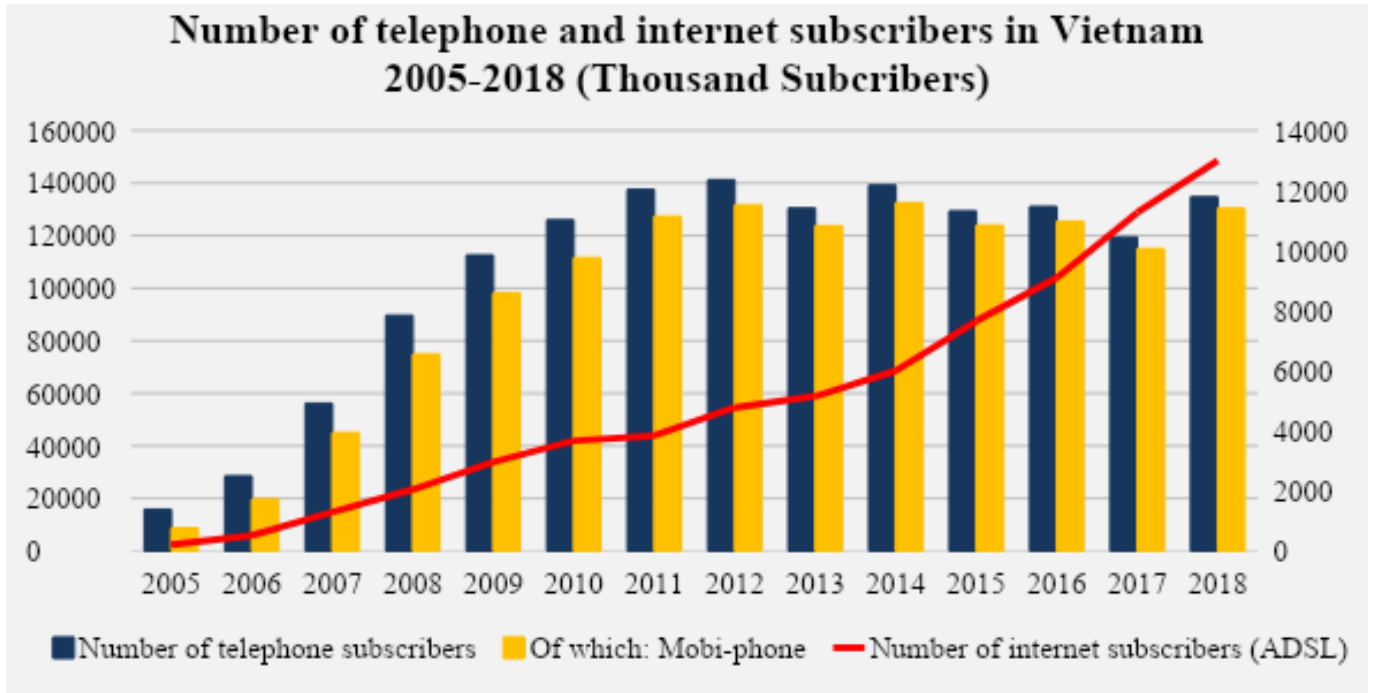


Fig. 7: Number of telephone and Internet subscribers in Vietnam 2005-2018. Source: General Statistic Office of Vietnam 2019.

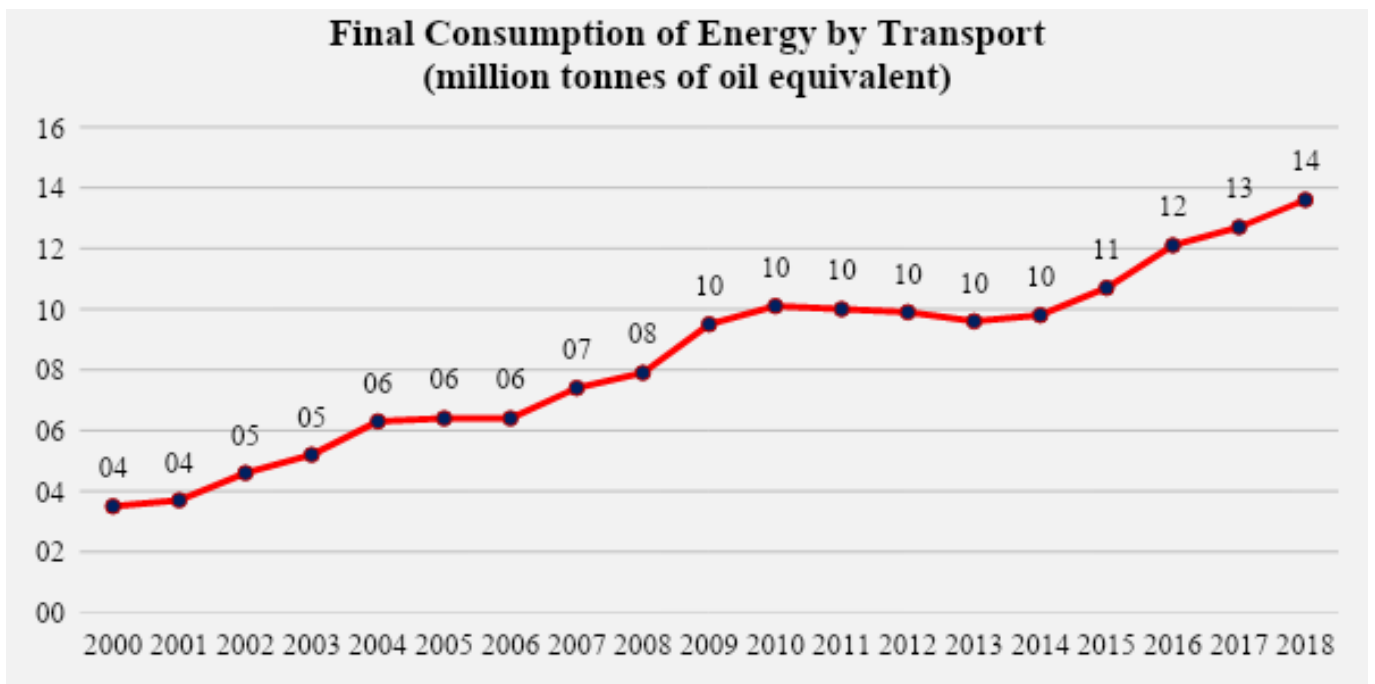


Fig. 8: Final consumption of energy by Transport in Vietnam 2000-2018. Source: Euromonitor 2019.

million tons of oil equivalent. This number has continued to grow over the years and in 2018 reached 39.2 million tons of oil equivalent (Euromonitor 2019). This means the consumption has increased fivefold within 18 years.

On the other hand, industrialization has always accompanied modernization, which is partly explained by a substantial rise in the number of accommodations. In 12 years, the demand for private houses increased by 12% while the apartment sector grew faster by approximately 19% (2005-2017) (Fig. 9).

With the fast pace of both industrialization and modernization, Vietnam experienced the urgent demand

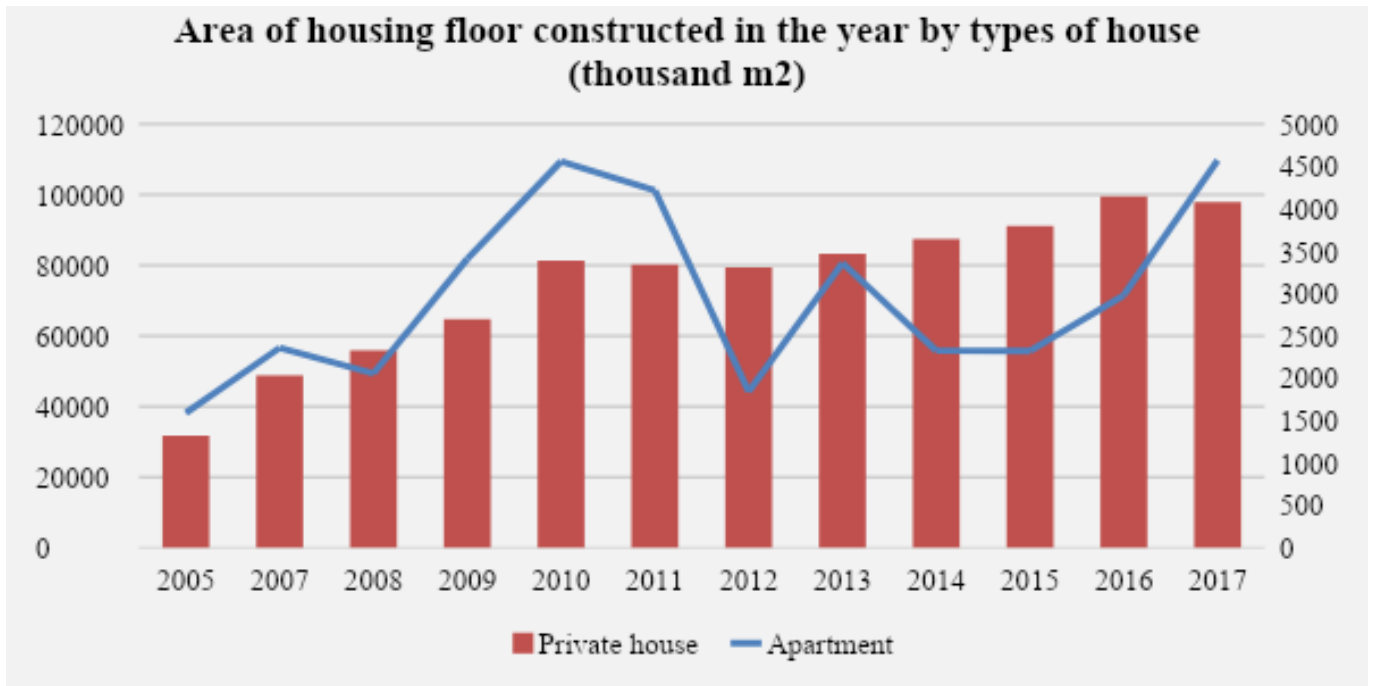


Fig. 9: Area of housing constructed by types of houses in Vietnam 2005-2017. Source: General Statistic Office of Vietnam 2019.

for more and more energy to run a huge number of companies, factories and households. However, industrial activities contributed the most to the total energy consumption at national level and consumption in this sector has gradually increased since 2008. In fact, the industry sector alone has accounted for 39% of energy consumption (Fig. 10). To be more precise, one of the most essential energy sources in every nation is electricity, which is needed for both population and operational demand. Every household consumes electricity for their activities all day long, including at night.

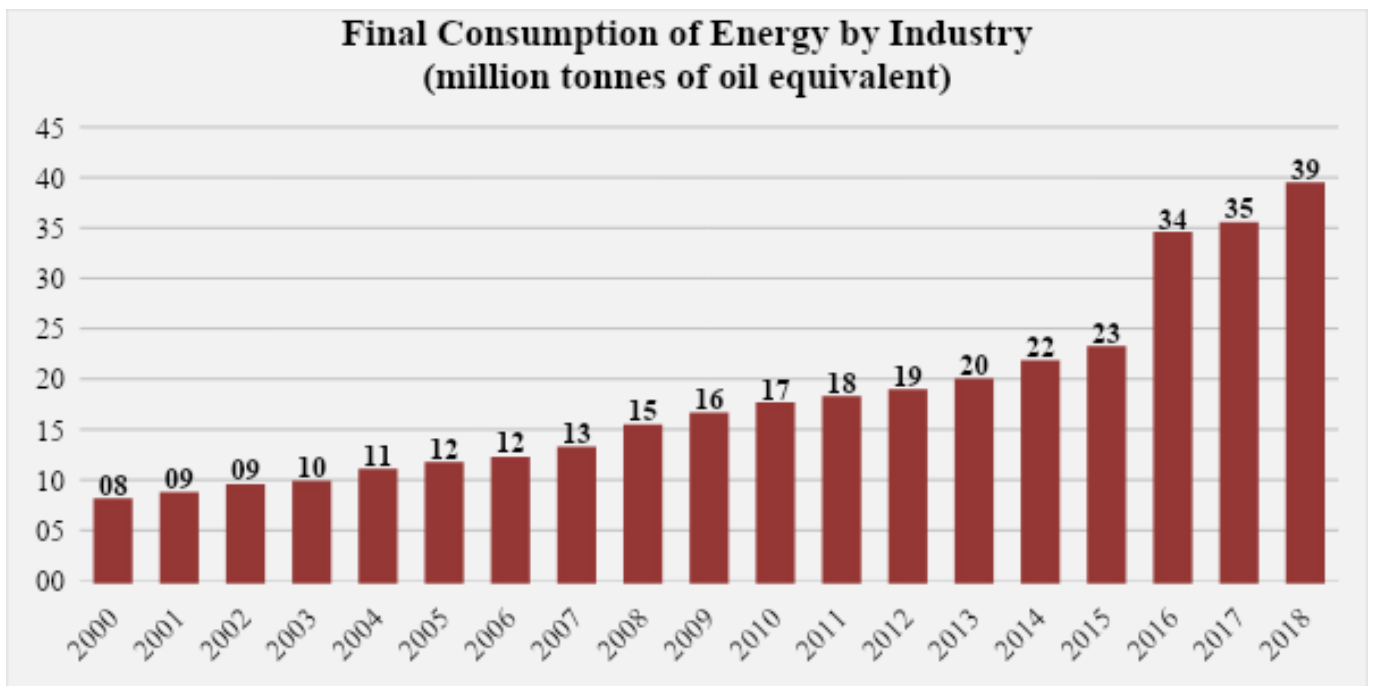


Fig. 10: Final consumption of energy by industry in Vietnam 2000-2018. Source: Euromonitor 2019.

Vietnam is a tropical country, well known for its high temperatures (30-35 degrees Celsius on average in the hottest month), thus air conditioning is massively used. Moreover, in manufacturing activities, electricity plays a key role in the functioning of the whole production process and in the operation of the plants. Consequently, the following statistics reflect the importance of electricity when the country started to enter the macroeconomic stabilization stage.

The total consumption of electricity in Vietnam increased sharply from 3.3 billion kWh in 1980 to 140.72 billion kWh in 2015. In 2014, 53.9% of the energy consumption in Vietnam was for the industrial sector and 35.6% was for residential use (Pham, Bui, and Duong 2018).

1.2.3. New trend of households spending

With the strong growth of Vietnam's economy, the average monthly income of Vietnamese has also gradually increased (Tab. 1). Thereby, the middle class became established and expanded, reaching the stage where more than 50% of the city inhabitants were considered middle class. Furthermore, the middle class and wealthy segments are expected to grow by 88% in the period 2010-2020.

Area	1999	2002	2004	2006	2008	2010	2012	2014	2016	2018
Whole country	295	356	484	636	995	1387	2000	2637	3098	3876
Urban	517	622	815	1058	1605	2130	2989	3964	4551	5623
Rural	225	275	378	506	762	1070	1579	2038	2423	2990

Tab. 1: Monthly average income per capita by residence and by region (Prices 2019, Thousand Dongs). Source: General Statistic Office of Vietnam 2019.

So far, the consumption habits of the Vietnamese have not only increased, but also changed considerably. The newly formed middle class is starting to look for things beyond their basic demand, shifting from a subsistence lifestyle to a consumer one (De Koning, Maria Crul, Wever, and Brezet 2015). People now are more inclined to purchase higher quality consumer goods, such as personal care products, instant coffee and tea bags, and more.

Whereas in the past the main concern in life was to have sufficient food, today consumers have increased their need to pamper themselves. According to Figure 11, in both rural and urban regions around 48% of the household expenditure would be on living costs, while 20-30% on eating, drinking and smoking habits. The huge expenditure on living includes the purchase of durable goods (cars, home appliances, consumer electronics, furniture, etc.) that provide households with more utilities and secure approaches in many aspects of modern life. The trend of purchasing durable goods is increasing rapidly and achieving remarkable results. As of 2002, 96.9% of households in the whole country owned durable goods in their accommodations; this rate has since increased up to 99.8% in 2018 (GSO 2019 *Tình hình kinh tế xã hội 2018*).

In addition, there is a new trend in the import sector towards modernization and industrialisation. The Delegate of German Industry and Commerce in Vietnam stated: "The production of export goods in Vietnam still depends on imported materials and inputs". In fact, the top three imported products in 2017 are machineries, computers and cell phones. The main reasons could be the revolution of new technologies and the impact of culture on consumption habits (Northern Vietnamese are into luxury and high-class brands).

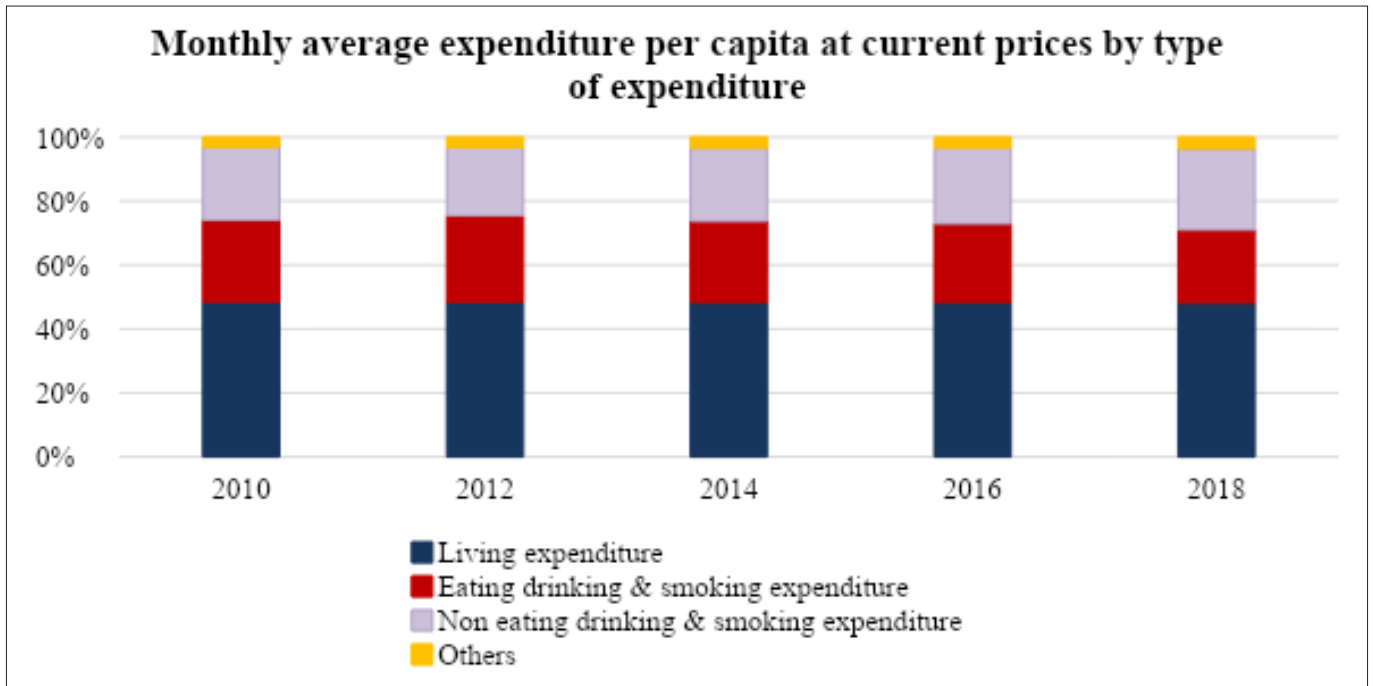


Fig. 11: Monthly average expenditure per capita by type of expenditure 2010-2018 (Prices 2019, Thousand *Dongs*). Source: General Statistic Office of Vietnam 2019.

2. The impact of the consumption-based economy on Vietnam’s environment

Compared to other Southeast Asian countries, Vietnam has a rather impressive growth rate. In fact, the country has shifted from agriculture to industry. This is the direct cause of the increase in energy consumption, including oil, coal, etc. Moreover, since 1990, Vietnam’s intensity of energy is estimated to have increased by 4% per year (Asian Development Bank 2013). As a result, the Greenhouse Gas (GHG) emissions has risen rapidly; according to some experts, the 177 tonnes of CO₂ in 2005 could triple by 2030. Furthermore, to sustain the progress of developing, Vietnam manages and seek to attract investments from foreign nations and allow foreign companies to easily enter the domestic market in order to improve the country’s industrial sector. An immediate measure to attract huge sources of FDI is to lower the environmental standards. It is a fact that Vietnam is likely to prioritize the value of FDI over quality. In fact, many foreign companies enter the Vietnam market with limited or poor technologies. As a result, the country faces serious environmental pollution and risks becoming a technology dumping ground.

As a leading country in the export of enormous quantities of rice, pepper, coffee, etc., the pressure on mass production demand has led to increasing consumption in terms of natural resources. It is evident that the natural land and forests have been overexploited for economic demand, which is proven by nature’s reactions such as soil erosion, soil fertility devastation and floods.

In addition, the urbanization in Vietnam has increased very rapidly over the years. In 2007, 28.5% of the total Vietnam’s population lived in urban areas and after 10 years, the rate has risen to 35.21% (World Bank – Population 2019), and is expected to reach 50% in 2030 (Asian Development Bank 2013). Therefore, more land is being exploited for accommodation and industry. Moreover, the economic development has accompanied the rise in the living standards of residents. For instance, as the number of members of the middle class is increasing significantly, the demand for goods and services consumption has also risen sharply. Thereby, more and more activities in the agricultural, industrial and services industry have to be carried out to meet the market needs and this directly causes pollution of the environment one way

or another. Likewise, the growing population and the activities of the individuals themselves certainly contribute to environmental damage. Enormous use of private vehicles and huge consumption of energy are two major examples.

In short, since recent activities on the national and individual scale are overabundant, environmental consequences like climate change, air pollution and water pollution are inevitable.

2.1. Climate Change

Being located in the tropical and temperate climate zone, the entire Vietnam territory has always been affected by the annual monsoon. Therefore, the rainy and sunny seasons vary according to the change of monsoon circulations. Usually, the rainy season lasts for 6 months from May to October, while the sunny season lasts from November to April (World Bank – Climate 2018). However, the climate in Vietnam has changed noticeably since the 1960s, mainly due to the negative impact of human activities aimed at high-speed development. Vietnam is a fast-growing country that has developed not only in economy but also in the quality of life and well-being of its inhabitants; the developing process, therefore, brings certain challenges along, especially with regard to the severe consequences for climate change in the country. It is a fact that Vietnam is among the top five countries that could be most affected by climate change. Therefore, as change in climate would be strongly perceived in the country, the government pays great attention to the issue, which will cause a reduction in the country's income by 2050 (3.5% estimated) (United Nation Vietnam 2012).

Temperature and rainfall

Since 1960, the average temperature in Vietnam has increased by 0.5-0.7 degrees Celsius per year; while the global warming rate over 40 years (1971-2010) is reported at 0.26 degrees Celsius. This means that Vietnam's temperature rate has doubled the global rate over the same period (World Bank – Climate 2018). The peak of average monthly temperature during the 2000s was 28.17 degrees Celsius, higher than in the 1990s (27.99 Celsius degrees). The highest peak was reached in 2015 with 28.54 degrees Celsius. (World Bank – Climate 2018)

The country also experienced a similar trend in the rise of the average monthly rainfall. The peak grew from 398.12mm in the 1990s to 416.59mm in 2000s, then reaching the highest level in 2012 with 454.3mm. In general, average annual rainfall has been unstable over the last century (1900-2016): precipitations continue to rise and fall over time and in different regions of the country.

“Hot” days have become quite frequent in recent years. According to Vietnam News, the country experienced greater numbers of hot days in 2015, which led to a huge change in climate. In Northern Vietnam, rainfall appears to be decreasing while in the South, it is the other way around. The change of temperature is predicted to increase every year (by 2.3 degrees Celsius by the end of the 21st century), and the same goes for average rainfall (which is increasing at a rate of 5% compared to 1980-1999 period) (Ministry of natural resources and environment 2016). These alarming numbers stand as environmental message for humans, and especially Vietnamese, who are most affected by global warming.

Sea levels rise

Vietnam is a coastal country with a coastline of 3,444 km (including islands), and thus could be dramatically affected by sea-level rise variations. In fact, the average trend of sea-level change along Vietnam's coast is about 2.8mm per year (Nguyen Vinh 2017).

The sea levels of the Central Coast and Southwest coastal areas tend to rise further. Satellite data from 1999-2014 show that the highest sea-level rise occurred at the southernmost point (the cape of Ca Mau), where it doubled the average rate (5.6mm each year). Inversely, the lowest rate was 2.5mm/year in Northern Vietnam (Tonkin Gulf area) (Ministry of Natural resources and Environment 2016).

Moreover, some experts have indicated that for the city of Can Tho could suffer severe floods and displacement of millions of citizens, as well as crops, due to rising sea levels. This is one of the major consequences of climate change. Can Tho is located in the Mekong delta, the largest rice-growing region in southern Vietnam. If sea level rises by 1m, more than seven million inhabitants of the Mekong delta would be displaced (United Nation Vietnam 2011).

It is forecasted that Vietnam could experience a sea-level rise of 30cm by mid-21st century and 75cm by the end of the 21st century (Ministry of natural resources and Environment 2016). The consequence would not only be the reduction of agricultural land, but also the salinization of various freshwater sources, with the most vulnerable area being the Mekong delta. As a result, the agricultural production might be negatively affected, and the lives of the inhabitants threatened. Consequently, around 45% of the Mekong delta is expected to suffer from salinization, causing serious damage to the agricultural industry by 2030, estimated at USD 17 billion. The water supply system in the low-lying areas of the South will be also severely affected (Nguyen Luan 2019).

Deforestation

Deforestation is a common phenomenon in Vietnam nowadays. According to statistics from the Vietnam General Statistics Office, in 2018, 1383.2 hectares of forest were damaged, of which 739.1 hectares were burned. This entails a significant increase of 41.7% compared to 2017. 544.2 hectares of forests were cut down, which is twice the number the planted forests. The area of natural forests throughout the country has been seriously reduced.

There are various causes that lead to deforestation in Vietnam. Firstly, the lack of financial status of residents in the fast development economy as well as social sectors, which pushes poor people cut down trees and woods, smuggling to make a living. Also, timber sales bring high returns. Secondly, the residents do not have adequate knowledge about forest land use planning. They continue to cut trees to build houses, sell woods, etc. arbitrarily and even burn forests to make room for crops and houses to cope with migration. Furthermore, there is no relevance and rationality in forest planning for the construction of hydroelectric power plants and farms.

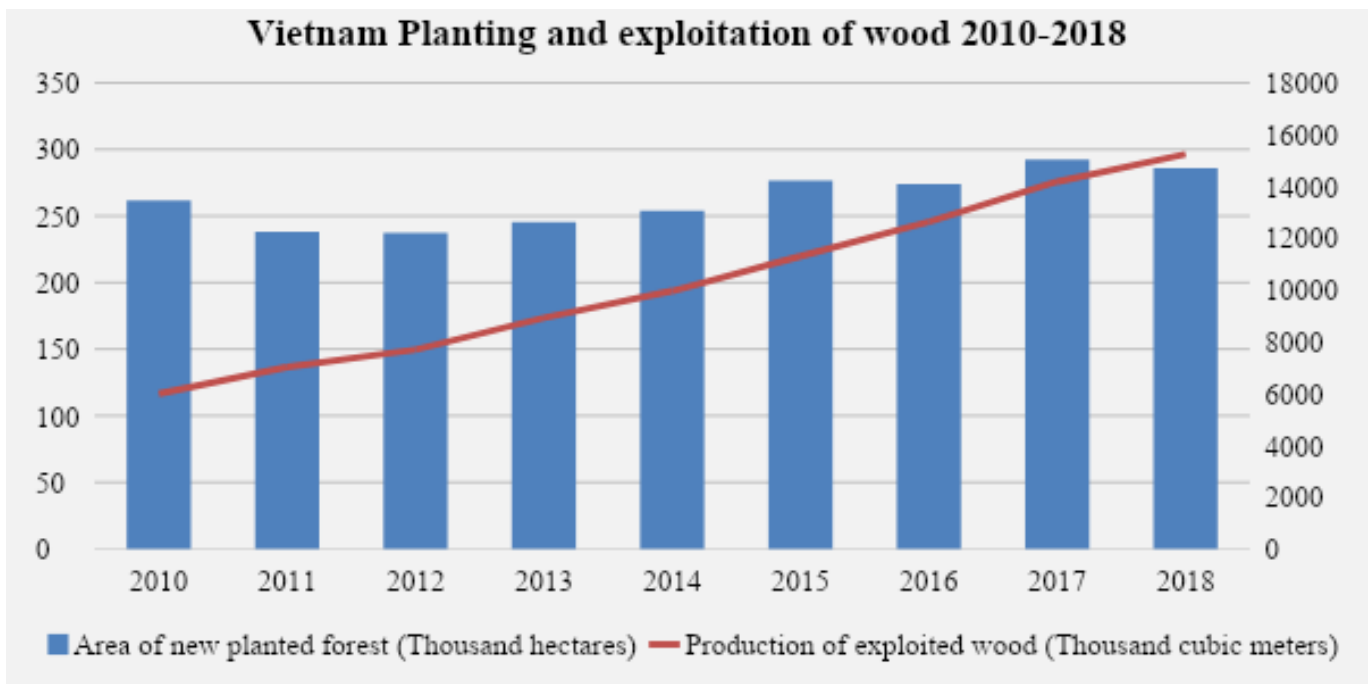


Fig. 12: Vietnam planting and exploitation of wood 2010-2018. Source: General Statistic Office of Vietnam 2019.

According to the Forest Protection Department's report, the burning of forests for cultivation purposes is becoming increasingly problematic and large-scale. Indeed, the citizens cut down a few square meters of forests at night when there is no management and detection by the authority. In a long run, many a little makes a mickle. The locals thus own a large area of vacant land, which could be used for economic purposes.

Moreover, while the production of exploited woods has increased dramatically (from 5988.1 thousand cubic meters in 2010 to 15241.2 thousand cubic meters in 2018), the area of planted forest has increased by only 25 thousand hectares over the last eight years (Figure 12.). The Vietnamese Government has developed several policies and laws to preserve the natural forest and promote planted forest. However, forestry problems like deforestation continue to occur uncontrolled.

Climate disasters

Due to climate change, several unusual natural disasters have occurred in Vietnam, the magnitude of which is particularly striking. Floods, droughts, typhoons are some major phenomena that cause considerable losses and property destruction; the damage was estimated to account for 1.5% of GDP. According to a 2017 report, storms, droughts and floods are three enormous disasters that caused the most economic damage during the 2006-2016 period. The level of storms' effect has increased in recent times. In fact, over 80% of Vietnam's population has been afflicted by nearly 138 storms including typhoons and tropical storms (Natural Disaster Risk in Vietnam in the period 2006-2016 and Forecasting and Warning system 2017). In addition, over the past 100 years, various unpredictable climatic disasters occurred, first and foremost, the massive flood that hit the northern and north central coast of Vietnam in 2018. This off-season heavy rain exceeded all the expectations and forecasting, causing a historic flood in Hanoi (the capital of Vietnam). The damage caused by the flooding was enormous: 17 deaths, nearly 13000 flooded houses, around VND 3000 billion loss. Secondly, increased deforestation led to the upsurge of El Nino phenomena of, leading to the historic drought in 2016. This drought is also assessed unprecedented in the last 100 years, causing huge damages on a national scale, both in terms of human lives and economy.

2.2. Air quality

Recently, a Yale University (US) report indicated that Vietnam is among the 10 worst global air polluters as of 2018 (Vietvision Travel). There are two major reasons that lead to severe pollution: the high use of private vehicles and the industrialization and modernization progress. In fact, pollution has spread across the country, with the air quality in the North being worse than in the Southern region.

In fact, the Vietnam Air Quality Indicator level is exceeding the healthy standard and reached the overall rate of 154 in 2019, which is considered a very harmful level (UN Environment Programme 2019). Indeed, public health and air quality are at serious risk.

Greenhouse Gas (GHG)

In Vietnam, the energy and agriculture sectors contributed the most to the country's GHG emissions (89%). Specifically, energy accounted for 66% of the country's annual GHG emissions while agriculture for 23%. The energy sector includes electricity/heat, manufacturing/construction, transports, other fuel combustion and fugitive emissions. The electricity/heat and the manufacturing/construction sectors are the major contributors (Fig. 13).

The Figure 14. illustrates the continuous increase of CO₂ emissions in Vietnam over the years. The World Bank (2019) reported that CO₂ emissions in Vietnam have augmented substantially since 1992, from 21,477.62 kt to 166,910.839 kt in 2014. Above all, liquid, solid, and gaseous fuel consumption are three main contributors to CO₂ emissions. These three sectors' contribution to the domestic carbon dioxide emission has increased in recent times.

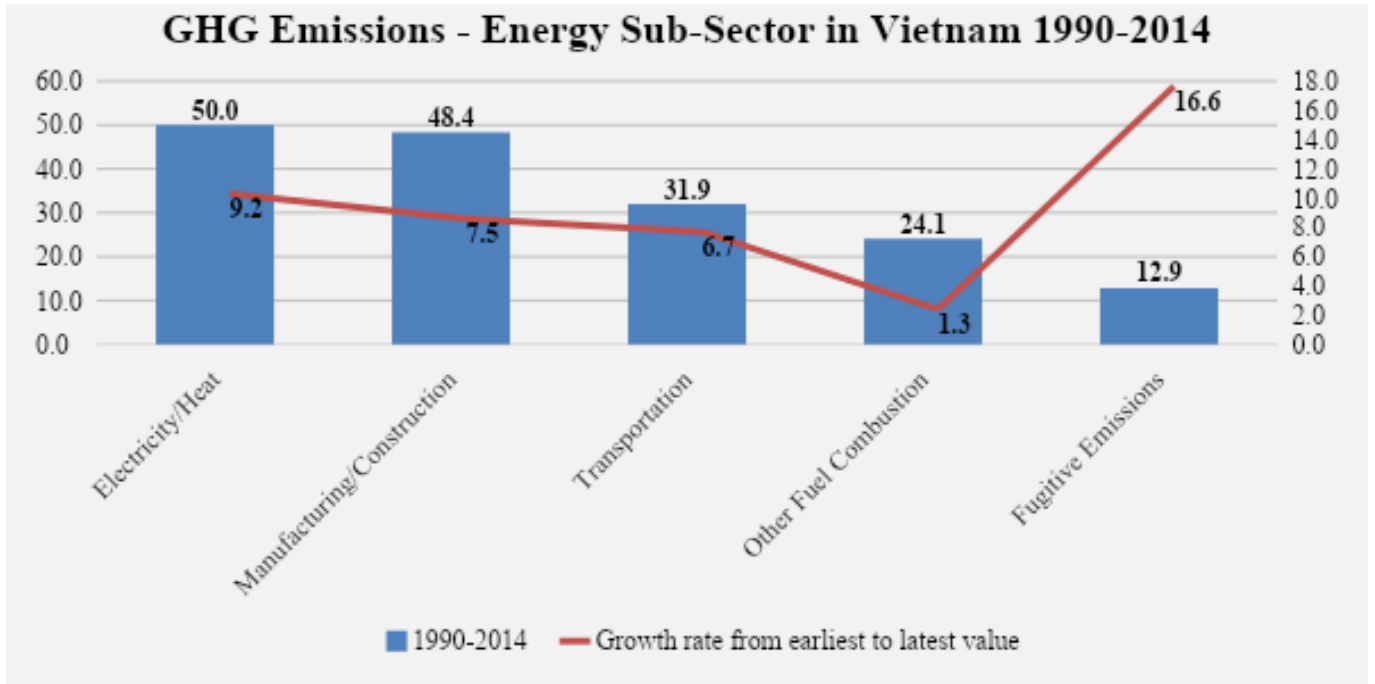


Fig. 13: GHG Emissions - Energy Sub-Sector in Vietnam 1990-2014. Source: General Statistic Office of Vietnam 2019.

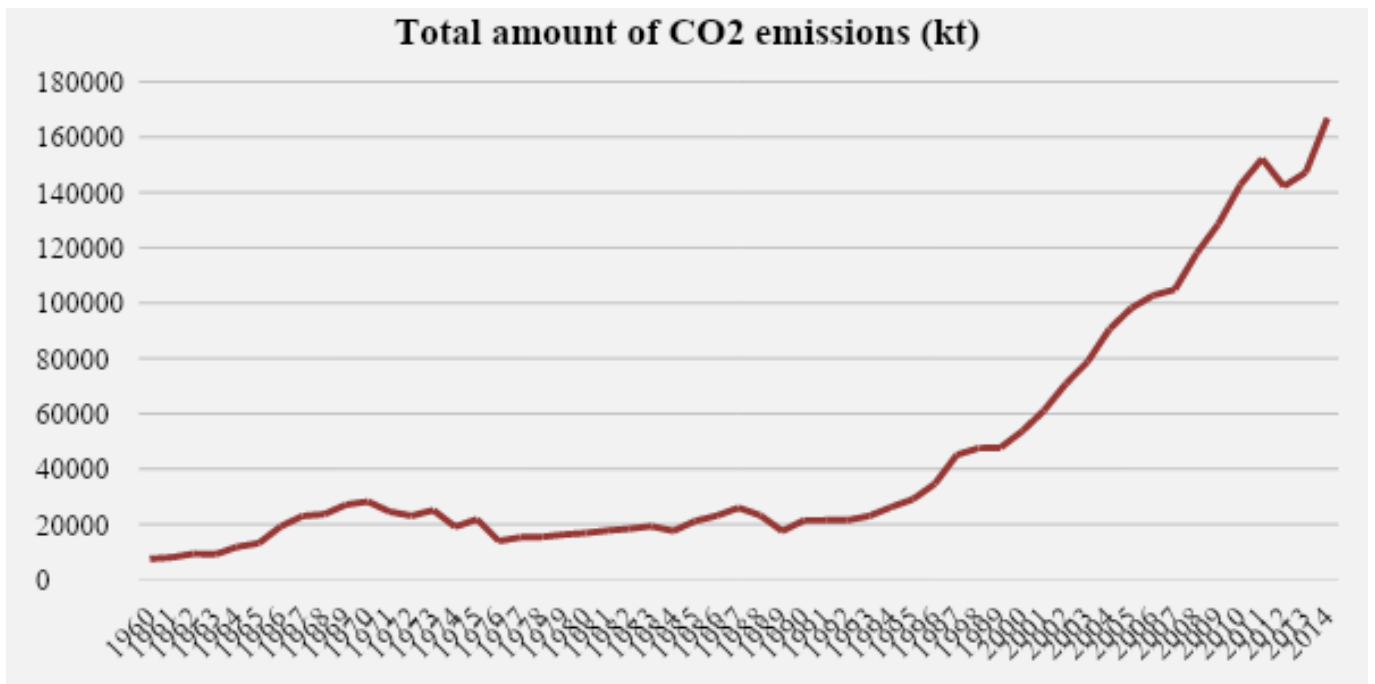


Fig. 14: Total amount of CO2 emissions in Vietnam 1960-2014. Source: Worldbank 2019.

Firstly, the liquid fuel was likely heavily consumed in Vietnam in the past. From 1960 to 1970, the consumption of liquid fuel contributing to CO2 emissions was considerable (the peak was 20,513.2 kt in 1970), and then declined rapidly. After 1975, however, it rose significantly, reaching 46,548.898 kt in 2014 (Fig. 15). Secondly, solid fuel consumption contributed to the CO2 emissions in Vietnam from an early stage and has shown a fluctuating trend over the years, with an overall increase from 5,493.2 kt in 1960 to 70,575 kt in 2014 (Fig. 15).

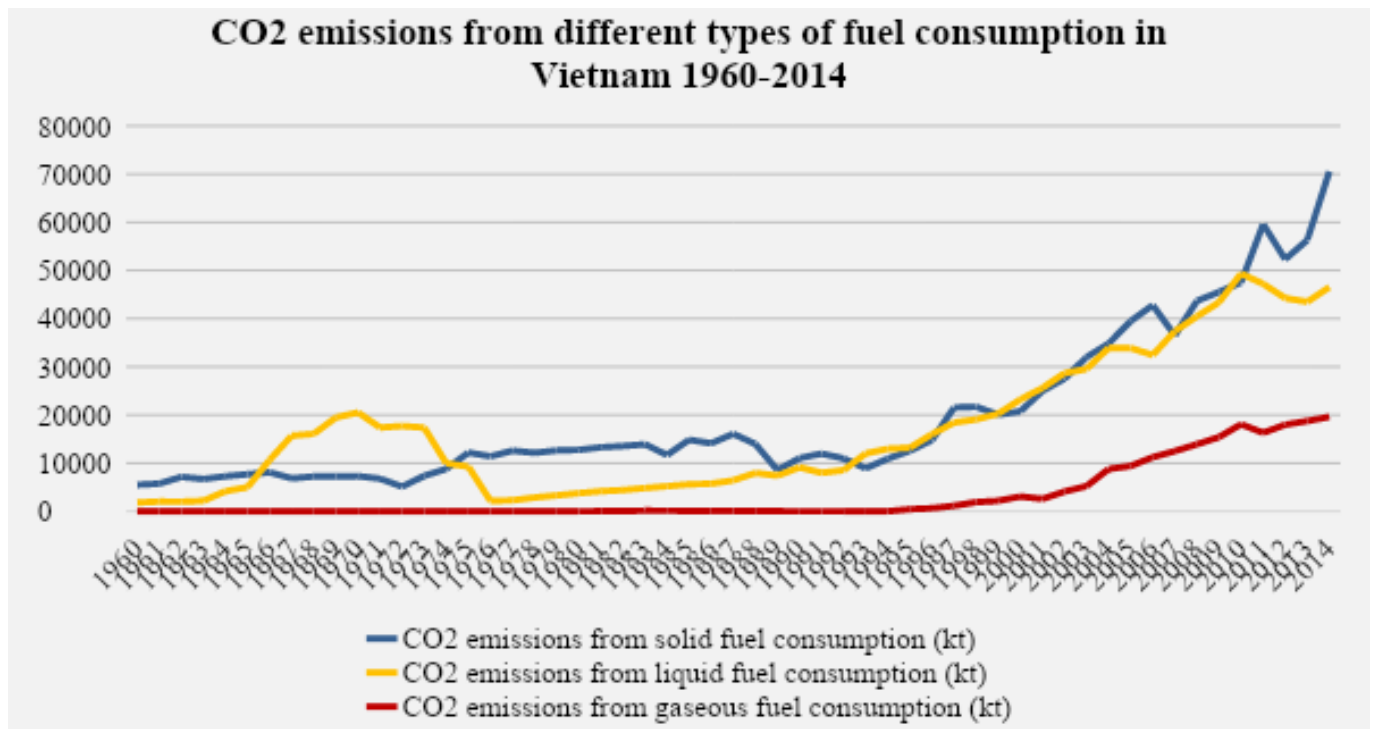


Fig. 15: CO2 emissions from different types of fuel consumption in Vietnam 1960-2014. Source: Worldbank 2019.

Regarding the gaseous fuel consumption, before 1995 people likely have not consumed much gas, since its contribution to the CO2 emission was even zero over the period 1960-1980. From 1981 to 1991, it slightly increased, reaching the highest point at 135.68 kt in 1983; then, from 1992 to 1994 the number went back to zero. However, after 1994, there was a significant increase in gas consumption, which peaked at 19,614 kt in 2014 (Fig. 15).

PM2.5

Besides GHG, P.M 2.5 is another dangerous factor that directly contributes to air pollution in Vietnam. Overall, PM 2.5 air pollution in Vietnam has increased annually over a twenty-five-year period, from 1990 to 2015 (Table 2.). PM2.5 is an ambient particulate matter and a cause of death worldwide. In 2016, it was reported that 4.1 million people died due to PM2.5, which was the 7th leading cause of death worldwide in that same year (World Bank – Climate 2018). Hanoi, the capital of Vietnam, was selected by the World Bank for the country's air quality management program.

Year	PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)
1990	26.76
1995	26.96
2000	27.10
2005	29.27
2010	26.74
2011	27.22
2012	27.4
2013	27.82
2014	27.98
2015	28.25

Tab. 2: PM2.5 Value in Vietnam 1990-2015. Source: Index Mundi 2019.

Such an increase in air pollution is mainly due to huge private vehicles use, and a surplus of construction and manufacturing. It is well known that Vietnam is the Southeast Asian country with the largest number of motorbikes (VietnamNet News 2019). The UNEP also stated that “Traffic is responsible for up to 70% of air pollution”. In addition, manufacturers in Vietnam are mostly equipped with out-of-date technologies that cause a serious damage to the environment. Moreover, the huge population means a higher demand for energy consumption (for cooking, cooling systems, etc.). Vietnam is the 14th most crowded nation in the world with a population of over 94 million people (Danso Vietnam 2019). Hence, this is one of the major reasons for national pollution. However, Vietnam is implementing several programs to reduce air pollution in both urban and rural areas. For instance, the Degree of air pollution charge, Vietnam national energy efficiency programme for the period of 2005-2015, and more (UN Environment Programme 2019).

2.3. Water quality

In recent years, despite Vietnam being one of the fastest urbanizing countries, its water disposal treatment system has many limitations. The lack of technical infrastructure for wastewater treatment as well as inadequate technological treatment systems have led to the point where untreated urban wastewater is released directly into the environment, threatening the habitat of many species. According to statistics from the Ministry of Construction, there are currently 43 municipal wastewater treatment plants in Vietnam, with a full capacity of over 926,000 m³ /day. However, only 13% of wastewater is collected and treated. In Hanoi, there are 6 wastewater treatment plants, which can treat only 22% of the daily amount of total wastewater, the remaining 78% is discharged into nearby lakes and rivers. (Pham Van 2019) This leads to increased water pollution, especially in big cities. It was mentioned in a report that in 2005 the amount of pollutants in rivers flowing in large cities (Hanoi and Ho Chi Minh) was 1.5 to 5 times higher than the approved standards. (Do Thang 2008)

Clean water is one of the most important sources in human daily life. However, in a low- and middle-income country like Vietnam, it is a challenge for both the government and the locals, as they have to deal with a large number of problems and difficult situations related to fresh water. Citizens do not have enough clean water for their daily use, since water pollution has recently surged in Vietnam. The decrease in water quality is caused by several reasons, including industrialization, urbanization and public’s lack of environmental awareness, but is mainly due to the industrial activities (Hoang Hai, Nguyen Minh, Nguyen Mai and Tran Lien 2012). A 2011 report from the U.S. Commercial Service Vietnam indicated that

while the number of intensive industries producing hazardous wastes in Vietnam is increasing, waste management methods are still relatively inadequate. As a result, downstream water is becoming alarmingly contaminated due to these socio-economic activities.

The main cause: Industrialization and FDI cases

Domestic companies are not the only ones to be held responsible for illegal water emissions, but so are FDI companies. The 2012 survey found that 26.47% of FDI companies illegally discharged wastewater in the territory of Vietnam, 44% of which were Taiwanese, 33% Korean while the rest were Japanese, British and Malaysian (Hoang Hai, Nguyen Minh, Nguyen Mai and TRAN Lien 2012). These are all companies from developed countries where Corporate Social Responsibility (CSR) is rather strict, especially regarding the environment. Therefore, they aimed for Vietnam - a country that had little awareness of environmental protection at the time. There are several cases of water pollution caused by the activities of FDI companies in Vietnam. In the past, the two major cases were caused by two big Taiwanese corporations, VEDAN and Formosa. The consequences of these tragic scandals on Vietnamese lives and environment are still linger today.

Ve Cheng Food (now VEDAN) is a Taiwan producer of monosodium glutamate established in 1954, which established its first advanced plant in Vietnam in 1991, in Phuoc Thai, Long Thanh, Dong Nai province. It is a 120 hectares plant and VEDAN Vietnam invested to expand widely across the country (Ha Noi, Binh Phuoc, Binh Thuan, Ha Tinh, and more). The company had a solid network of domestic distributor, and its products used to be largely consumed. While penetrating the Vietnamese market, they committed to enhancing Vietnam development in general and preserving the environment in particular, even though VEDAN's actual production activities were extremely harmful to the environment. In 2008, environmental police and inspectors found out that the company had a hidden system to dump untreated liquid waste into 30 km long Thi Vai River. With 2,300 m³ of untreated waste emission per day (105,600 m³/month), 2,700 hectares of seafood cultivation areas in Dong Nai and Ba Ria-Vung Tau provinces and Ho Chi Minh city were severely polluted (VietnamNews 2019). Waste that contained a high volume of chemicals and molasses was examined: heavy metals (zinc, lead, mercury) were found to be present and the coliform level (indicator of bacteria in food quality and water) was 100 times higher than the acceptable limit (Nguyen Hieu and Pham Huyen 2012). Once a rich source of aquatic life, Thi Vai river had now been terribly devastated and left with little chance to be recovered: eight years have passed but, the consequences of VEDAN's activities still remains. In 2016, residents along Thi Vai river in Dong Nai province protested that they were facing the scarcity of fish since then (VietnamNet News 2016). Many Long Thanh and Nhon Trach fisherman had to migrate to other provinces to make a better living. This irresponsibility of VEDAN has caused a huge damage to the jobs and daily lives of millions of people.

Secondly, one of the biggest environmental tragedies is the 2016 Vietnam marine life disaster or in other words the Formosa Environmental Disaster. This Taiwanese steel manufacturer from the Ha Tinh province caused extremely severe pollution on 125 miles (more than 200 kilometers) of coastline in 2016. Formosa Ha Tinh Steel's plant was held responsible for dumping a huge amount of industrial waste into the sea. The waste included noxious chemicals, including phenol, cyanide, and iron hydroxide (Tiezzi Shannon 2016). As a result, the seas of four provinces in central Vietnam (Ha Tinh, Quang Binh, Quang Tri, and Thua Thien-Hue) suffered mass fish deaths; more than 100 tonnes of fish were killed (Nguyen Luan 2019). 450 hectares of coral reefs were also negatively affected, half of which were completely destroyed (The Guardian 2017). Later on, Formosa had admitted its irresponsibility and paid VND 11.5 trillion (USD 500 million) to compensate for the economic losses of the inhabitants and assist them find new jobs and handle pollution (Thanh Nien News 2016). Nevertheless, the consequences were extremely serious and have lingered for years. 40,000 of Vietnamese people used to live on fishery and tourism (The Guardian 2017) and this tragedy, thereby, greatly disrupted the economies, environment and jobs of four provinces (Nguyen Luan 2019).

The lack of public knowledge

In order to have clean water in the Hanoi region, the water from the Đà River is treated through a special process by a local company, then distributed to households in the nearby area. In October 2019, the company that supplies clean water for over 250,000 households in Hanoi officially announced that the water was poisoned and advised citizens to use water only for bathing and washing, not for cooking or drinking. The citizens also reported a smell of burnt plastic. According to Vietnam News (2019 – Plastic waste), three individuals were followed by the management of a local ceramic company and caught illegally dumping a huge amount of oil (about 10 cubic meters) into the Đà river. It was in fact the ceramic company's untreated wastewater, which does not have adequate waste treatment. The main reason that leads to such severe consequences could be the action of three criminals. If they had even the slightest knowledge about the negative impact of releasing pollutants on water, they might have acted differently. After detection, the government implemented several measures. The initial stage of Đà River decontamination is finished, but pollutants are still there. Residents also reported that water still has a strong smell, and they now face a shortage of clean water. Water quality is still a controversial issue in Hanoi these days.

2.4. Waste

2.4.1. E-waste

E-waste flows from developed to underdeveloped and developing countries, including Vietnam. In fact, this flow occurs through both legal and illegal routes, to which Vietnam endogenous electronic waste is added, causing the amount of e-waste in Vietnam to increase at alarming rate. If the problem is not taken into consideration and addressed soon, Vietnam could risk becoming an e-waste landfill.

According to the United Nations Environment Program (UNEP), e-waste comprises more than 1,000 different substances, mainly heavy metal components, precious metals, and other high-molecular substances, which contain many toxic substances causing serious environmental pollution and affecting human health (Pham, Dinh, Nguyen, Dinh and Nguyen 2007). Besides, the toxins present in out-of-date electronic devices are difficult to identify once released into the environment. These chemicals pose a potential risk to both human health and the environment. People might run the risk of several diseases that are difficult to treat and have long-lasting effects such as cancer, respiratory diseases, cardiovascular and neurological diseases. The environment could also endure various severe pollution in all aspects: air, water, and soil. The impacts of e-waste on the surrounding habitat are as dangerous as those of climate change.

On the other hand, if treated with appropriate and correct disposal procedure, e-waste is a valuable resource since it contains several rare substances which could be recycle such as rare earth metals, copper and gold.

The result of high electric equipment consumption

Electronic machines, such as television, housing and industrial electric machines, and handy devices are undeniably becoming essential elements in people's lives these days. They bring huge advantages and conveniences that makes it easier for people to work and relax. People save a lot of time thanks to washing machines or dishwashers. They are more productive if they work with high-tech devices: computers, tablets or mobile phones. In an information age, people have to keep up to date every seconds. Therefore, the increasing consumption of e-devices is obvious.

However, there is a new rise of e-waste problems. The greater the electrical and electronic equipment consumption, the greater the release of e-wastes. As calculated from Hanoi University of Science and Technology, Vietnam's e-waste grows at a high rate, about 25% per year (2014 International E-Waste Management). Most of the electric waste comes from homes and offices, ranging from heavy to small equipment, hundreds of thousands of which are released into the surroundings every year (Vietnamnet News 2018).

Vietnam has only 15 facilities licensed to process e-waste. Due to limited technologies and background, they are only able to process common metals, like copper and aluminium (The Recycler 2017). In addition, there is no guidance or strict regulations on the disposal of industrial e-waste for companies to follow, even though the Decision 16 enacted in 2015 stated that it is the importers' responsibility to collect product waste (Vietnamnet News 2018).

The destination of developed countries' e-waste

The enormous volume of e-waste has led to the development of a global waste market, in which waste are collected, treated and recycled. The market is worth USD 410 billion per annum and creates significant jobs and incomes. However, this huge economic sector entails illegal acts along the waste chain. Manufacturers, producers usually only aim to generate profits, disregarding waste legislations. European Union (EU) and Organization for Economic Co-operation and Development (OECD) Member States have prohibited hazardous waste export to non-OECD members. Nevertheless, illegal activities continue to occur, on a small or large scale. Thousands of tonnes of e-waste are passed off as plastic, mixed metal scrap, etc. and dumped from developed to developing countries. They are transported in trucks and containers from Europe and North America to Africa and Asia. In Asia, Vietnam along with other nations (China, India, Bangladesh, etc.) are the main destinations of illegal e-waste flows (UN Environment 2015).

According to Parker Laura (2018) this phenomenon is worsening in Southeast Asia since China stopped importing any kind of waste, including e-waste. Hence, together with India, Pakistan, Nigeria, and Ghana, Vietnam is the next targeted destination due to less strict and controlled waste-import policies. Although the exact number is difficult to assess due to these illegal activities, this market's estimated worth is about USD 410 billion per year (The Guardian 2015). Furthermore, citizens, especially in rural areas, lack environmental knowledge. They do not fully understand the potential risk of such waste, thus accept to import it. This leads to Vietnam turning into one of the world's e-waste hubs.

2.4.2. Solid waste

Vietnam is among the five countries that generate the most solid waste in the world: it is estimated to dump 13 million tonnes of waste per year (Vietnamnet May 2019). This huge generation of waste is attributable to the progress of its fast-growing economy. The migration trend from rural to urban areas in Vietnam has surged. As a result, people are getting more career opportunities and making better living conditions in large cities, accompanied by an improvement in living standards. Due to the fast pace of urbanization and industrialization, more and more waste is generated, and cities are considered the main sources of solid waste (Truong Ngan 2018).

In general, solid waste varies from country to country, the main sources being medical centres, grocery shops, warehouses, markets and domestic areas. A distinction is also made based on the level of health impact: ordinary or hazardous.

In fact, in Vietnam, the solid waste collection process is enhanced only in urban areas but not in others, especially rural ones. In 2019, 80-85% of waste was collected in urban areas while the rate in rural region is only 40-55% (Vietnamnet May 2019). However, even in the urban areas, waste collection is very basic and does not include sorting steps. To be more precise about waste treatment methods, the majority of waste is landfilled, incinerated and partly recycled. Recently, 85% of waste in the country was landfilled without proper treatment, 80% of which was contaminated and directly polluted the environment (VIETNAM WASTE MANAGEMENT MARKET 2019). There are large 660 landfill sites covering an area of around 1 hectare, only 120 sites meet hygienic standards. In fact, landfills in cities are always overloaded, with the constant risk of water and air pollution. Another common method of handling waste in Vietnam is incineration without prior sorting. 28% of the total amount of solid waste are incinerated (National Assembly of Vietnam 2019), including plastic waste which releases a huge amount of toxic air pollutants into the environment.

It is a fact that 8-12% of households' solid waste is made of plastic (National Assembly of Vietnam 2019). One noteworthy aspect is that plastic bags are widely used in Vietnam. Along with this scenario, the country reportedly disposes of twice as much plastic waste as other low-income countries. According to Vietnam News (2019), Vietnam is among the top five countries in Asia and the 17th worldwide for the most ocean contaminants, dumping 13 million tonnes of waste into the sea each year. The amount of plastic waste has extremely increased over a period of 25 years, from only 3.8kg per year in 1990 to 41kg in 2015. The number keeps growing over the years and was recently estimated at 80 tonnes of plastic thrown away every day in the two largest cities, Hanoi and Ho Chi Minh.

Being a dangerous pollutant, plastic waste has massive impacts on the natural environment, including displacing several aquatic species and ecosystems. Furthermore, in terms of its impact on land, it also has seriously affected human health and life.

There are several players in solid waste management industry in Vietnam, mainly state-owned enterprises with the support of foreign technologies. Also, a number of big multinational enterprises and subsidiaries are located in Vietnam. The country indeed relies on foreign technology providers like Singapore, America, China and EU nations. Nevertheless, the ability to incorporate and synchronize those technologies to Vietnam's management system is still inadequate, because the country excessively depends on the physical function of the technology itself, but does not fully understand its mechanism of operation, and thus has not figure out how to optimize the use of the technologies yet. This shortcoming stems from national legislation, which is still unclear. Consequently, companies in this sector all tend to fully rely on foreign technology (VIETNAM WASTE MANAGEMENT MARKET 2019).

3. Conclusion

A number of negative impacts on the environment accompanied the development of the economy. The increased demand for consumption, not only of goods but also of services and energy, has caused global warming and other problems to appear more frequently. In recent years, air pollution, water crisis, natural disasters and "hot" days are regular occurrences on daily news and newspapers. First of all, air pollution is one of the most serious problems in Vietnam, with a large amount of fuel emissions and high PM2.5 levels. Secondly, Vietnam's temperature has been rapidly increasing over the past three decades. In addition, heavy rains last for longer periods and the sea level is rising at an alarming rate. Natural disasters occur more frequently and cause greater damage. All of these environmental phenomena are worse than experts predicted. The final concern relates to another important source of the earth: water. Unfortunately, Vietnam had to deal with many cases of deliberate water pollution and marine life crisis over the years. The absence of social responsibilities and business ethics on the part of corporations caused the situation to worsen. As a results, to the lives of billions of Vietnam citizens lives and the surrounding habitats of various species are jeopardized.

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