

EE361 ECONOMICS OF CLMV COUNTRIES

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Rise in sea level and impacts on natural resources in Vietnam

Group 9

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Introduction

Global warming is a direct cause of rise in the global sea level. The sea level has risen approximately 210–240 millimeters (mm) since 1880, with about a third coming in just the last two and a half decades (The World Bank Group, 2021). There are two factors that cause the increase in sea level, which are mountain glaciers increasingly melting, adding water to the ocean, and the warming of the water in the oceans leading to an expansion and thus increased volume.

Vietnam has been strongly associated with the aquaculture and fishing industry for a long time due to its geography, which has an extensive area of coastal marine areas and islands, and the freshwater with abundant aquatic resources from the basins of the Red River and the Mekong Delta. The aquaculture sector is important in the northern, central, and southern regions, where people mainly conduct aquafarming for their livelihood and trade (Imarcgroup, 2023). Vietnam also entered into free trade agreements in 2015, especially with the EU countries, which enhanced the efficiency of the fairness and yield of Vietnamese exports. The free trade agreement raised the export volume of Vietnam and resulted in an increase in GDP.

Other factors that provide incentives to aquafarming are participation in ASEAN and AFTA. Being a member of those associations helped Vietnam forge import links between countries and create an advantage for people to do international trading, which include aquaculture products. The more international integration between countries also attracts more investment into Vietnam and leads to improvement in the innovation of aquafarming. In 2017, Vietnam became the world's fourth-largest aquaculture producer, with 3.84 million tonnes of aquaculture products, mainly shrimp and pangasius (Aquaculture Vietnam, 2020). Many Vietnamese, more than 5,000 households, rely on farming and marine products as a source of their livelihood and income. They mostly still need to use the traditional ways and old equipment to do farming, which are traditional and outdated. Improving aquaculture or other related factors will therefore help farmers improve their livelihood and increase Vietnam's food supplies. However, Vietnam is currently facing the remaining challenges from the rising sea level's natural disaster that directly impacts the aquaculture farming and livelihood of Vietnamese.

The rise of sea levels has seriously impacted countries with long coastlines, such as Vietnam - especially for the residents or industries in low-lying areas and coastal zones. The vulnerability of Vietnam is compounded by its tropical and temperate climate zone and experiences of the monsoons that bring heavy rainfall in the north and south from May to October.

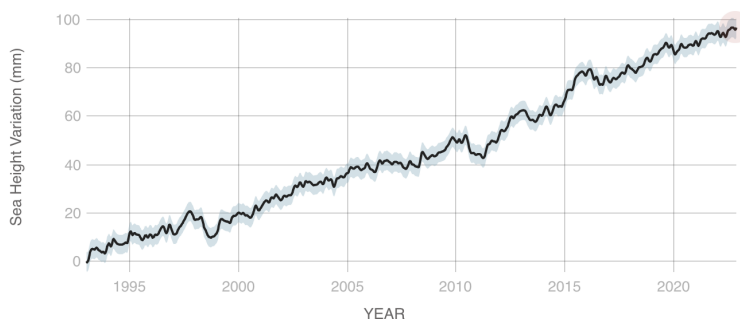


Figure 1. The height of global sea level in millimeters since 1993 until present.

Source: Global sea level, Satellite sea level observations.

According to NASA¹, between 1993 to 2022, the sea level had dramatically risen by around 96 millimeters (NASA's Goddard Space Flight Center, 2022). See Figure 1. This creates more inundated land along the coastline. The rise in sea level has a massive negative impact on the natural resources of Vietnam; if the sea level were to rise by 1 meter, approximately 20% of Ho Chi Minh city would be intruded along with almost 50% of the Mekong Delta zone. The effect is spread around many sectors of natural resources such as water, forest, land, and agricultural products, which not only cause the scarcity of food but also causes a decline in the amount of export from Vietnam - specifically in the aquaculture and fisheries industries that predominantly account for employment and the GDP.

In a study by the World Bank's, the rate of global mean sea level rising is predicted to keep increasing onwards to 2100; as a result, Vietnam should promptly adopt adaptation and mitigation measures to counteract the outcomes of global warming. The rise in sea level also caused the natural disaster of floods that directly harmed the Vietnamese. The floods also damage buildings and property and have a negative impact on the way people live since the owned properties are damaged by the flood leading people to suffer from shelter loss. In October 2017, Vietnam faced flash floods that killed 37 people, and many people are still missing who were swept away by water (BBC, 2017). So far, the government has implemented several mitigation policies, including reducing carbon emissions, building infrastructures to block flooding, alternating to new ways of living, and planning resource allocation. However the challenges still remain as loss of biodiversity, damage of natural resources, and people's health, which lead to more demands of natural disaster control and government intervention. These challenges include energy consumption, water management, and agriculture production and human health.

¹ Goddard Space Flight Center

Key issues and challenges on natural resources

Increased energy demand Vietnam has significant energy resources, including crude oil, natural gas, and coal, but increasing temperatures due to climate change will negatively affect labor productivity and household living standards. The optimum temperature range for safe heavy labor is 28°C, and any increase beyond that range will decrease outdoor thermal comfort and health. The phenomenon of Urban Heat Island exacerbates the effects of temperature rise in urban areas, leading to decreased labor productivity and increased costs of adaptation. Additionally, a one-degree increase in ambient temperature can result in a 0.5%–8.5% increase in electricity demand, which strains energy generation systems due to their own cooling requirements, reducing efficiency.

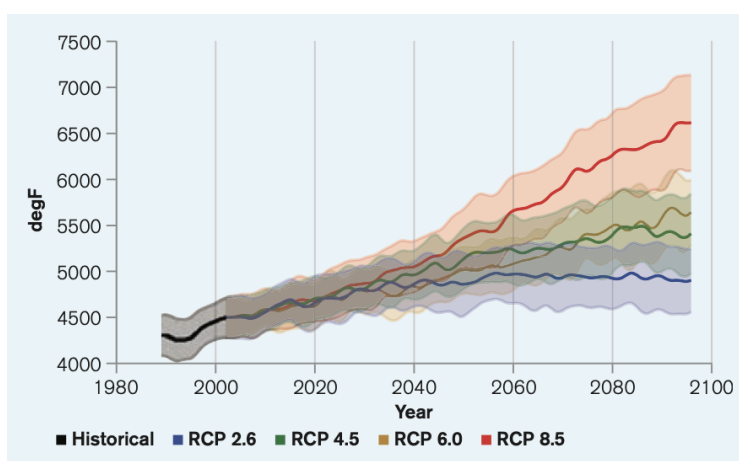


FIGURE 2: Annual cooling degree days (cumulative degrees above 65°F) in Vietnam under RCP2.6 (Blue) and RCP8.5 (Red). The values shown represent the median of 30+ GCM model ensembles with the shaded areas showing the 10th-90th percentiles.

The graph in Figure 2 shows potential monthly maximum temperature increases in Vietnam, exceeding 40°C under high emissions pathways, leading to extreme pressure on urban areas and amplified by the urban heat island effect. Cooling buildings will become more necessary, putting pressure on energy supply and penalizing marginalized groups. Flooding is also a major threat to urban areas in Vietnam, with potential losses of 1%-5% of GDP in Ho Chi Minh City and 0.5%-20% in Hai Phong, depending on the success of adaptation, and affecting the poorest and marginalized communities.

Increased pressure on water resources and collapse of the marine ecosystem The water resources in Vietnam are facing significant pressure due to human activities such as over-utilization of groundwater, land-use changes to aquaculture, and unplanned urban

development. The upstream damming of the Mekong River and intensive hydropower development have also had significant effects on water flow and quality, impacting agriculture, fisheries, industry, and biodiversity. In addition, the expansion of brackish aquaculture has led to the contamination of groundwater. Efficient water management, including wastewater reuse and improving water and irrigation use efficiency, is necessary to ensure water security.

Vietnam's coastal region is experiencing rapid economic development and high population density, which is damaging the delicate coastal environment. Coastal ecosystems, including coral reefs, mangroves, and seagrass beds, are particularly vulnerable to negative impacts from local human activities and external factors such as river runoff and unusual weather patterns. Climate change, which affects the entire planet, is causing rising sea levels due to global warming, typhoon turbulence, and more frequent coastal disasters. The rise in sea levels has severe consequences on coastal areas, potentially causing harm to farmlands and forcing millions of individuals residing near the coast to move elsewhere. The intrusion of saltwater into wetlands, including mangroves, can alter soil chemistry, make it less conducive to supporting mangroves and other wetland species, and ultimately result in habitat loss for wildlife and decreased productivity of the wetland ecosystem.

Lower agriculture productivity Vietnam's agriculture sector is dominated by rice production, which constitutes approximately 75% of the total national crop production value. Vietnam is also a significant producer of other crops such as coffee, tea, rubber, and cashews. The country is the world's second-largest rice exporter, and its export market is constrained by insufficient infrastructure, limited port capacity, and efficiency. Climate change is expected to influence food production through direct and indirect effects on crop growth processes. Direct impacts of warming have already resulted in a 10% drop in labor productivity during peak months, with the possibility of a 20% decline by 2050 under the highest emissions pathway. Climate change threatens multiple stressors on rice production, including high temperatures, saline intrusion, drought, and flood. However, some of these negative impacts may be partially offset by the benefits of increased atmospheric CO₂ concentrations.

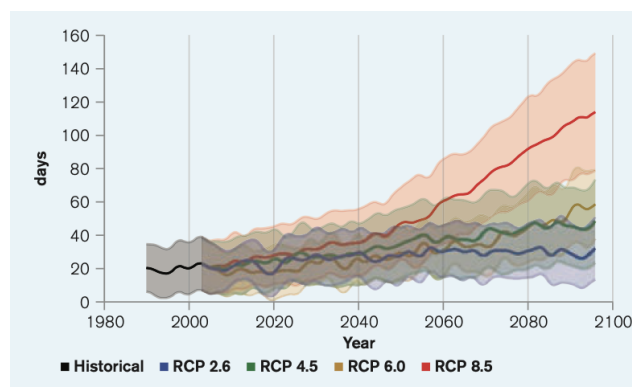


Figure 3: Annual average number of hot days ($T > 35^{\circ}\text{C}$) under RCP2.6 (Blue) and RCP8.5 (Red). The value shown represents the median of 30+ GCM ensemble with shaded areas showing the 10th-90th percentiles

The article states that maize is an important food crop and a primary source of feed for Vietnam's poultry and livestock industry. However, maize production is expected to decline due to its sensitivity to high temperatures. The article also raises concerns about potential future climate stressors affecting cash crops such as tea, coffee, pepper, and rubber in Vietnam's Central Highlands region. Specifically, a study in 2015 projects that many key coffee-growing areas in the region will become unsuitable for coffee production under the RCP6.0 emissions pathway.

Detriments to human health The impacts of climate change on human health in Vietnam include a range of issues such as malnutrition, micronutrient deficiencies, starvation, increased number of hot days, forest fires, and dust storms leading to health complications associated with high temperatures and respiratory diseases. Changes in temperature and rainfall patterns could lead to the occurrence and spread of vector-borne diseases. Sea-level rise and extreme weather events are also expected to increase climate-induced migration. Without adaptation, Vietnam could experience 125 climate-related deaths per million population linked to lack of food availability by 2050. Heat-related mortality is also a concern as temperatures rise. Finally, climate change may delay the eradication of infectious diseases, including malaria, dengue fever, and diarrheal disease.

Government/State Strategies, Policies and Legislation

Satisfy energy demand Currently, Vietnam is still proposing the plan for the development of renewable energy projects so there is not yet a national plan due to the low capability of the local government. The renewable energy project includes the regulations on power development plans, power purchaser and power purchase agreement (PPA), and approvals and consents from authorities (Hai & Ha, 2019b). Before the implementation of the project has to be included in the regional or national power development plan first along with the approval from the prime minister (MOIT).

As mentioned, there are more than one projects included in the plan for development of renewable energy, the first one is using solar power. It is the latest renewable source of energy promoted by legislation for the future usage. The solar power is used to generate electricity from sunlight and the project is installed in two ways, on the roof of houses or buildings and grid connection where the solar panel is set on the water surfaces. Next, is the use of wind power which in the Vietnam case there is a potential for growth in this project. Presently, there is a development in coastal cities and provinces on the wind power installation on land. The MOIT has already approved the plans for wind power developments in particular regions in Vietnam for instance the Ca Mau wind power installation is expected to increase the capacity by 2030. However, the construction of the wind power plants may have some consequences which are the owner of the wind power plants has to pass all the construction conditions of the laws, has to signed a PPA with power purchaser and a grid connection agreement with the power distribution, and the assessments from the wind measurement for at least one year.

Address pressures on water resources As mentioned in the issues and challenges section that there is a disturbance of human activities on the water management systems so there has to be solutions to improve water productivity in Vietnam. This leads to the use of Integrated Water Resources Management (IWRM) as the effective approach to achieve the successful and sustainable water management (Pham et al., 2012). Nonetheless, this approach may become an issue for Vietnam because of the difficulty due to climate change. Later when the IWRM was developed it was defined through the Technical Committee of the Global Water Partnership (GWP) as the process to promote the development and management of water land and related resources. The use of the approach is by applying the knowledge from stakeholders to find out the sustainable solutions for the water development problems. In 2001 had found that the IWRM can be used as means of changing water uses and demand and the IWRM appears to offer greater flexibility and capacity than conventional water resource management approaches. As a

result, GWP suggests that IWRM provides the best approach to manage the impact of water climate change.

Collapsing of marine ecosystems Moreover, the collapse in marine ecosystems is complex due to more than one issue associated with the collapse. The first policy that will be dealing with marine ecosystems is the coastal zone environmental protection. Vietnam has been putting effort on coastal protection through organizational structure and legal basis, development of national strategies and plans, capacity building, and implementation of coastal projects (Thanh, 2006). The associates are the Constitution of 1992, Ministry of natural resources and environment, and environmental protection laws. The policies and awareness of coastal protection has improved with the environmental management system has increased its capacity, the improvement shown by environmental protection strategy till 2010. The participation of mass organizations and communities become more active in this awareness along with the interaction with international support due to globalization and international conventions. Nevertheless, the protection also faced challenges such as the increase in population, unfocused pollutant sources, and high environmental costs.

Increase agricultural productivity The policy associated with agriculture restructure and development in Vietnam was the use of nanotechnology in agricultural systems (Ngoc et al., 2021). Nanotechnology is one of the significant tools that is used in modern agricultural architecture since it introduced new chemical agents and delivery mechanisms to improve crop yields. This can lead to an increase in agricultural production through applying the agrochemicals for fertilizers, crop protection, genetic manipulation of plants, and diagnosis of plant disease. Besides, there is an agricultural reform where it caused the development potential and brought positive changes to the agricultural industry.

Improvements in human health As Vietnam is a developing country, other countries might have a contribution in helping the development of the country. The Centers for Diseases Control and Prevention (CDC) in the US has helped Vietnam's government since 1998 (Ha et al., 2020) to prepare the foundation of a sustainable and effective public health care system. The CDC provides funding and technical support for the infrastructure and capacity of the health systems such as HIV, influenza, and the response to disease outbreaks. Besides, in 2015 the Ministry of Internal Affairs (MIA) and Ministry of Health (MOH) announced the policy on merging the existing prevention medicine agencies in the provincial level into one agency.

Conclusion

Global warming causes adverse effects on environmental conditions, and one of the evident occurrences is the rise of sea level. It prominently and regularly affects countries with long coastal areas, Vietnam. Ever since the 19th century, sea level has been increasing, creating harm to Ho Chi Minh city; it is predicted that if the sea level were to rise by 1 meter, the HMC city would be severely intruded. Hence, infrastructures and agricultural zones would be destroyed. Since Vietnam's main exports consist of fisheries and agricultural products, sea water inundation reduces the overall yields; in addition, the downside is that Vietnamese still use traditional ways of fishing which are vulnerable to natural disasters. Key challenges of Vietnam's environment include threats to marine ecosystems, natural resources, and human health; for instance, natural distresses such as forced displacement may arise. Furthermore, a periodic flood would negatively affect ecosystems, such as wetlands and mangroves, by reducing productivity and invading animal habitat. Finally, humans are more susceptible to heat-induced diseases because of the rising temperature, and malnutrition due to food instability. In this paper, issues are addressed accordingly. Firstly, because of sea water intrusion, rising demand for water is prioritized and managed through an integrated water management system. Though it is sustainable, the challenge still remains due to prolonged global warming. The next objective is to alleviate potential risks to marine ecosystems through policies and project implementation; for example, coastal zone environmental protection. Subsequently, with the enforcement of the constitution of 1992, the capacity of environmental management is enhanced; however, because of the importance of the fishery industry to Vietnam's GDP, the government has been subsidizing fisheries - leading to overfishing. This remains a substantial challenge for Vietnam's environmental conservation as the economic benefits are high. Finally, the last two aims are expected to avoid the negative impacts on natural resources and on human health. The Vietnamese government has implemented nanotechnology to ensure that the agricultural yields are resilient to changes in the environment. Moreover, the authority has also initiated health centers to improve healthcare capacity and to establish a constructive healthcare system. Both schemes are to address direct issues towards citizens' livelihoods; nevertheless, in order to achieve those objectives, the Vietnamese government may have to face higher costs in the beginning as well as persistent negotiations with the stakeholders.

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