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An Assessments of the Impact of Natural Disasters on the Economy and Society in Yen Bai Province- A Review Paper

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Abstract: Globally, the increasing frequency and intensity of natural disasters pose a significant threat to the economic, social, and environmental development. As a result of these disasters, livelihoods are disrupted, critical infrastructure is damaged, and long-term sustainability is impaired, making disaster resilience and climate adaptation essential priorities for nations. The primary economic sectors of Yen Bai, located in the midland and mountainous area of northern Vietnam, are agriculture and forestry. Because of its rugged terrain, and frequent storms circulation, the province is highly susceptible to natural hazards such as floods, landslides, and storms. The disasters have resulted in thousands of deaths, displacement and significant damage to crops, homes, and critical infrastructure. Soil erosion and unpredictable weather patterns have particularly affected the agricultural sector, which is highly vulnerable to economic impacts. Moreover, infrastructure damage further undermines local economic stability development. In this paper, we examine the socioeconomic impacts of natural disasters in Yen Bai using local statistics and secondary data. By strengthening early warning systems, investing in climate-resilient infrastructure, promoting sustainable agricultural practices, and raising public awareness, it aims to mitigate the effects of climate change. To ensure long-term sustainable development, these strategies are essential for enhancing Yen Bai's resilience to climate change.

Keywords: Yen Bai; Natural hazards; Climate Change; Socioeconomic impacts; Sustainable development

1. Introduction

There has been an increase in the number of deaths due to various types of natural disasters around the world over 1.6 million people have died from natural disaster worldwide since 1990 [1], resulting in an estimated economic loss of US$260–310 billion in economic losses. EM-DAT recorded 389 natural disasters in 2020, which resulted in 15,080 deaths, affected 98.4 million people, and caused US$171.3 billion in economic losses [2]. Vietnam is also highly susceptible to natural disasters, which cause significant socio-economic losses. In the period 1989-2016, the country was affected by an average of six major natural disasters annually, resulting in approximately 486 deaths and US$420 million in property damage [3]. Increased natural disasters and climate change have a direct impact on economic growth, particularly in the agricultural sector. It is estimated that agricultural productivity will be reduced by 2% to 15% by climate change [4]. Every year, more than 340,000 hectares of rice fields are damaged by natural disasters, with nearly 1 million hectares of rice destroyed by storms and floods [5]. The agricultural sector is clearly affected by natural disasters, which not only destroy crops and infrastructure, but also lead to food shortages, which exacerbate vulnerability and socioeconomic instability.

The northern mountainous regions of Vietnam are more prone to flash floods and landslides, which are among the most severe natural disasters. Yen Bai is one of the northern provinces most affected by flash floods and landslides. As a mountainous province in the North of Vietnam, Yen Bai, is prone to unusual fluctuations in the weather due to its mountainous terrain and tropical monsoon climate. In recent years, the province has experienced a growing number of such disasters, posing significant economic challenges. A major economic sector in Yen Bai is agriculture, which is highly susceptible to natural disasters [6]. Additionally, the province also becomes inaccessible and isolated after such events because of its rugged terrain and poor infrastructure. People who live in Such isolation are more vulnerable, as they face many problems such as food shortage, lack of health care services, and no external support [7]. The purpose of This article is to access some of the main impacts of natural disasters on the economy and society of Yen Bai province over the past few years. Furthermore, the article will examine the response and mitigation solutions that local authorities and communities have implemented, making recommendations for future disaster prevention. In the context of increasingly complex climate change, the goal is to respond to natural disasters as well as awareness and promote sustainable strategies.

To examine the impact of natural disasters on Yen Bai province's economy and society in recent years, in order to provide a comprehensive picture of the extent of damage and the challenges the province faces. The

article analyzes economic, social, and environmental damage in Yen Bai in order to assess the effectiveness of disaster prevention measures that have been implemented in Yen Bai. In addition, the article will propose appropriate some solutions to enhance resilience to natural disasters and climate change.

As a result of the article Yen Bai province will be more aware of the importance of disaster prevention for inhabitants, which will promote sustainable development policies and strategies.

2. Study Site

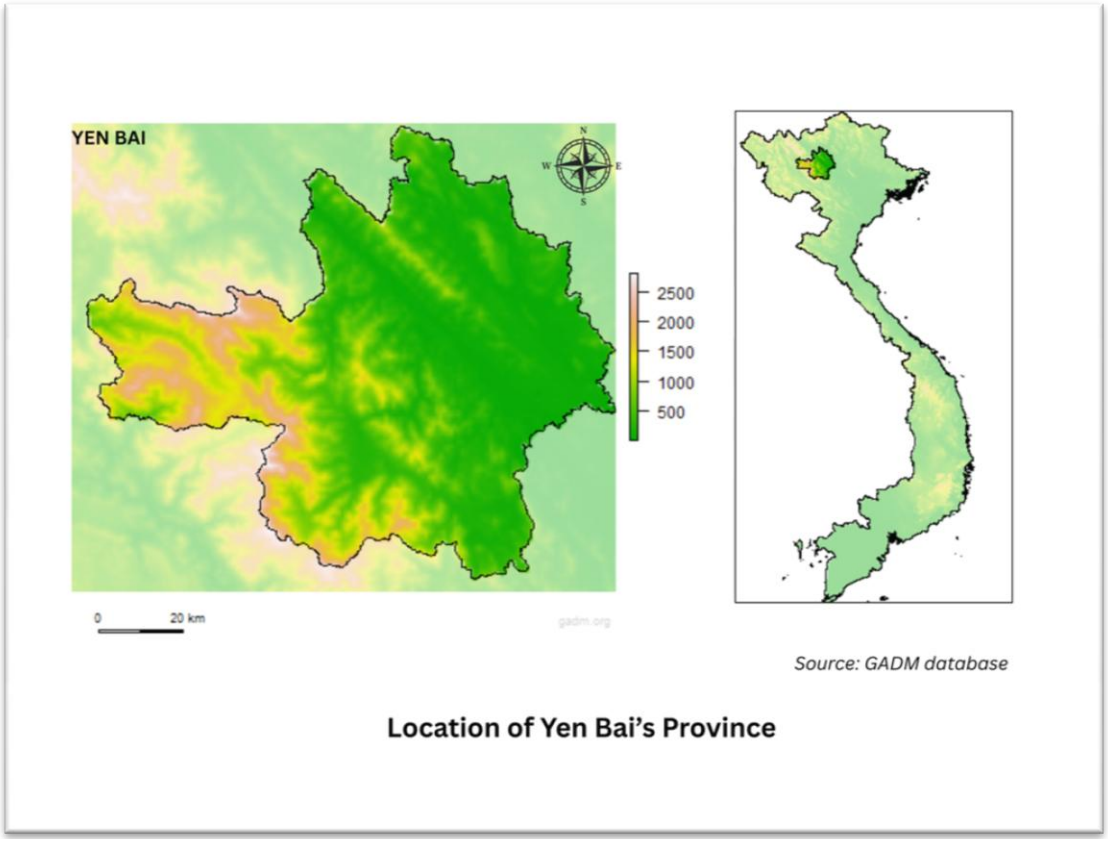

Figure 1: Geographical location of Yen Bai Province, Vietnam. Source: GADM database

In northern Vietnam, Yen Bai borders Lao Cai, PhuTho, Tuyen Quang, and Son La provinces. Its terrain is mainly mountainous, with high mountain ranges and rivers flowing through it, especially the Red River and Chay River systems. Its area is 6,883 km², and its population is about 850,000 people, most of whom live in mountainous districts and rural areas. The reason of Yen Bai is regularly hit by natural disasters such as floods, landslides, storms, and droughts. Through this provinces, Natural disasters have become increasingly severe in recent years, causing severe damage to people and property and negatively affecting socio-economic development. Areas such as Van Chan, Tran Yen, Mu Cang Chai, and Luc Yen are heavily affected by natural disasters, especially during the rainy season. In this paper, we will focus on the impacts of natural disasters on the economy and society of Yen Bai province.

3. Natural Hazard Impacts on Economy and Society

3.1. Natural hazard impacts on Economy

Economic growth has been examined in many empirical studies. First, a natural disaster is defined as a natural event that causes catastrophic consequences for living organisms in its vicinity [8]. Natural disasters disrupt the functioning of the economic system, leading to significant negative impact on assets, factors of production, output, employment, and consumption [9]. According to Cavallo & Noy (2013) natural disasters have a negative impact on short-term economic growth on average [10]. However, the extent of this impact varies. It has been suggested by Toya and Skidmore (2005)that countries with higher incomes, better education, and well-developed economic and financial systems are less prone to natural disasters [11]. It has been argued by Loayza et al., (2012) natural disasters affect economic growth, in various of ways, but not always negative [12]. Different type of disasters and the economic sectors have different effects. It is possible

for moderate disasters to even contribute to growth in some sectors, but severe disasters usually have a largely negative impact. Moreover, many of the key economic sector in developing countries are highly vulnerable to natural disasters. The economics of Yen Bai, one of the poorest provinces in the country, largely based on the agriculture and forestry. Due to their negative impact on agriculture [8], natural disasters also negatively affect economic growth. Therefore, it is not surprising that Yen Bai is severely affected by rain and storms during the rainy seasons.

According to Yen Bai natural disaster situation report, in 2018 alone, Yen Bai province experienced 15 natural disasters, including two severe cold spells, 11 instances of heavy rain accompanied by thunderstorms, and two flooding event, flash floods, and landslides, primarily the result of storms No. 3 and No. 4. The province was impacted by three major storms:

Storm No. 2 (EWINIAR): Made landfall in southern Guangdong province, China, triggering a widespread heatwave.

Storm No. 3 (SON-TINH - Tropical Storm Henry): Made landfall in Thanh Hoa and NgheAn provinces, causing widespread heavy rainfall in Yen Bai.

Storm No. 4 (BEBINCA): Made landfall in Thanh Hoa province, leading to heavy rainfall in the Tram Tau - Nghia Lo area.

The province suffered a total economic loss of 1,020 billion VND. Agricultural damage amounted to 4,450.75 hectares, with many crop areas completely submerged and unable to be farmed. Numerous nurseries and seedlings were destroyed, and livestock, poultry, and aquaculture sectors suffered severe losses.

Additionally, the province suffered significant damage to its infrastructure:

Transportation: Road surfaces along National Highways 32, 32C, 37, and 2D, as well as provincial roads, were damaged by landslides. Inter-commune and inter-village roads were severely eroded, with millions of cubic meters of soil and rock were displaced.

Irrigation systems: Many irrigation structures were damaged.

Industrial facilities: Several hydropower plants suffered damage. A broken power pole damaged 6,207 meters of electrical wiring, and 32 mobile stations lost communication due to broken cables.

In addition to agriculture, the industry, tourism, and trade sectors were also significantly affected. Local communities suffered severe economic losses due to power outages, shortages of raw materials, and damaged factories. Due to damaged landscapes and transportation disruptions, tourism, one of Yen Bai's key growth sectors, has been hindered, making travel to the province difficult.

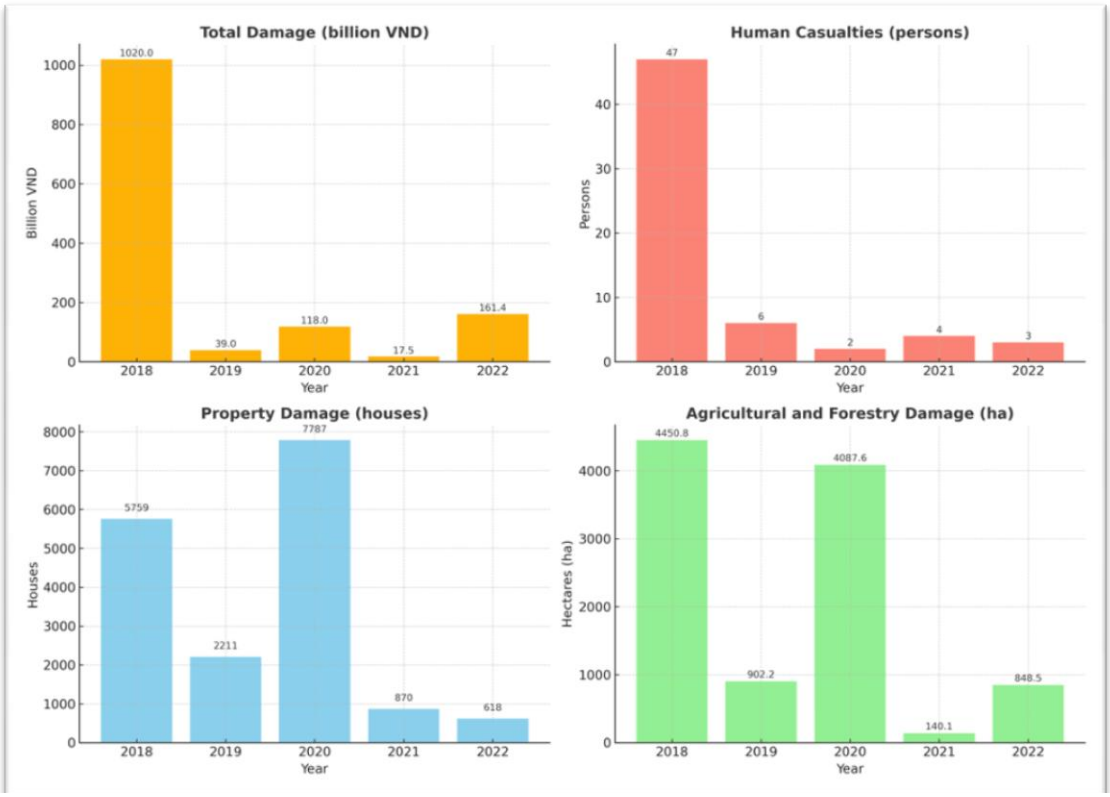

Figure 2: Disaster impacts (2018-2022)

3.2. Natural hazard impacts on Society

There are significant economic and social consequences associated with natural disasters. There are many ethnic minority groups living in Yen Bai, which is situated in a mountainous region in the northern part of the country. These people experience particularly difficult living conditions due to low incomes, limited access to healthcare services, and a lack of clean water. In addition to these challenges, natural disasters often cause food shortages and deteriorate food quality. In addition, the dispersed and remote nature of these mountain communities makes transportation to neighboring cities and major towns very difficult. A lack of access to essential services, such as education, markets, and healthcare, is a consequence of this isolation [7].

Every year, natural disasters in Yen Bai leave tens of thousands of people homeless and deep in poverty. In 2018, 5,759 houses were affected, including 161 houses that collapsed or were completely washed away, and 156 houses that needed immediate evacuation. Additionally, residents were forced to evacuate their homes along with their belongings due to flooding, landslides, and property damage (2018 Disaster Statistics Report).

Post-disaster recovery is particularly difficult in rural and mountainous areas, where economic conditions are already difficult. As a result of landslides and flash floods, families are often forced to relocate, causing further disruption to their lives and livelihoods.

A household's location influences its ability to prepare for and mitigate disaster risks [13]. Nevertheless, relocation and resettlement present significant challenges-in part due to the substantial financial resources required, but also to the fact that many ethnic minority communities build homes informally, without official documentation of land ownership. Despite cultivating the land since settlement, nearly half of the households in AnBinh commune, Yen Bai, have not been granted land use rights certificates [7]. In addition to complicating government management, this lack of legal recognition restricts residents' access to essential services such as healthcare, clean water, education, and government subsidies during natural disasters.

Furthermore, health issues become more severe after natural disasters, with increased risks of epidemics, water contamination, and malnutrition. In order to reduce household vulnerability, health insurance enrollment must be strengthened [14]. Nevertheless, the dispersed distribution of households presents significant challenges for government policies and support. Family members without health insurance face overwhelming medical costs-further compounded by the already high cost of healthcare-which places a heavy burden on their limited financial resources.

The availability of education is also affected by natural disasters. As a result of landslides that block roads and disrupt transportation networks, children are further prevented from attending school due to infrastructure damage, such as blown-off roofs or structural issues.

4. Conclusions and Recommendations

4.1. Conclusions

The role of leadership and direction in disaster management has been crucial. To ensure timely and appropriate response to natural disasters, the government consistently issues directive documents. In addition to enhancing forecasting, early warnings, and risk assessment, these directives help mitigate the impact of extreme weather events, such as flash floods and landslides. Consequently, disaster response efforts have been more coordinated, reducing potential losses and damages.

Whenever a natural disaster occurs, all available resources are mobilized to assist in the recovery process. An estimated 18,000 personnel, along with thousands of vehicles, machinery, and rescue equipment, are deployed for search and rescue operations and disaster relief each year. Coordinating this response is essential to addressing the immediate needs of affected communities and restoring normalcy as soon as possible.

Providing social security and well-being to those living in disaster-affected areas remains a top priority. Public health and sanitation are maintained, disease outbreaks are prevented, and storm- and flood-hit regions are secure and stable. Moreover, after disasters, efforts focus on restoring livelihoods, assisting with economic recovery, and repairing infrastructure like roads, irrigation systems, and public buildings.

4.2. Social Recommendations

In disaster preparedness and response, public communication and awareness efforts have been highly effective. Early warnings, accurate forecasts, and regular updates on extreme weather developments assist authorities and communities in taking necessary precautions. Furthermore, clear communication about leadership actions and post-disaster recovery initiatives ensures transparency and coordination, strengthening resilience against future disasters.

Because the terrain is highly fragmented and the population is dispersed, disseminating knowledge about natural disaster prevention, control, and search and rescue efforts presents significant challenges. There are many communities that work in remote fields for long periods of time, making it difficult to reach them with

essential information and training. Furthermore, residents and businesses remain unaware of their obligations and responsibilities under the Law on Natural Disaster Prevention, resulting in gaps in preparedness and response.

The relocation of households affected by natural disasters is a pressing issue. Choosing safe areas for resettlement remains a major challenge, especially in high-risk regions prone to landslides and floods. Due to their rugged terrain and limited land availability, highland districts like Mu Cang Chai, Tram Tau, Van Chan, and Nghia Lo town face particular difficulties. Many displaced households have identified potential rebuilding sites, but these areas are not designated as residential land, so land-use planning and legal permissions must be adjusted.

An effective early warning system for flash floods and landslides is a critical shortcoming in disaster preparedness. The current warning bulletins cover broad geographic areas rather than providing localized alerts at the commune, village, or hamlet level. When disasters strike, this lack of precision hinders timely evacuations and preventive measures. In order to respond effectively to natural hazards, warning systems need to become more accurate and reach a wider audience.

Additionally, disaster prevention and response forces are ineffectively organized and deployed in some sectors and organizations. There is often inconsistency in the implementation of provincial and sectoral directives at the grassroots level, especially in communes and wards. Authority officials sometimes fail to carry out awareness campaigns, mobilize communities, and ensure proper supervision. Therefore, despite efforts to mitigate risks, floods, flash floods, and landslides continue to cause casualties. It is crucial to improve coordination, accountability, and enforcement of disaster prevention measures in vulnerable areas to reduce the loss of life and property.

4.3. Economic Recommendations

In Yen Bai, a mountainous province with strong agriculture and forestry industries, climate change poses significant challenges. The government should implement targeted policies that promote climate resilience, sustainable farming practices, and infrastructure development in order to mitigate its impacts, particularly in the most affected sectors such as agriculture.

In order to allow for multiple crop cycles each year, one key strategy is to extend the growing season. Due to rising temperatures, a bifurcated growing season with a short summer break for fallow land could benefit short-term crops like wheat, barley, cereals, and vegetables. The feasibility of this approach will, however, depend on how precipitation trends evolve in tropical and subtropical areas [15]. In addition, crop resilience is essential to sustaining agricultural productivity. Developing and adopting crop varieties that are drought-resistant, insect-resistant, and salinity-tolerant can improve yields and product quality [16]. By introducing desirable traits into crops, genetic mapping and engineering offers promising solutions. The adoption of genetically modified (GM) varieties has been slow due to regulatory challenges, economic concerns, and consumer hesitancy [17][18]. To enhance food security and economic stability, policies should focus on promoting research and incentivizing climate-resilient crops.

The research and application of advanced agricultural techniques and machinery tailored to the specific conditions of Yen Bai Province are essential to enhancing agricultural productivity and resilience. The integration of modern farming technologies, including precision agriculture and efficient irrigation systems, can significantly optimize resource utilization, improve crop yields, and reduce vulnerability to climate-related disruptions. These technologies, when appropriately adapted to local geographical and socio-economic contexts, have the potential to address long-standing inefficiencies in agricultural practices and support the transition toward climate-smart farming systems. However, the widespread adoption of such innovations requires substantial investment in farmer training, capacity-building initiatives, and institutional support to overcome barriers such as limited technical knowledge, high initial costs, and fragmented land ownership structures.

In parallel, infrastructure development plays a critical role in fostering economic resilience and supporting rural livelihoods. Despite the clear need for investment in the repair and modernization of essential technical infrastructure-including transportation networks, irrigation systems, and energy supply-funding from central government sources remains insufficient. This financial shortfall underscores the necessity of diversifying funding streams through legally viable mechanisms such as public-private partnerships (PPPs), international development aid, and climate adaptation finance. Mobilizing these resources is imperative to close the infrastructure investment gap and enabling the province to implement long-term development strategies effectively.

Improved infrastructure not only facilitates agricultural development but also contributes to broader socio-economic goals, including enhanced market access, improved living standards, and increased economic stability. Furthermore, a coordinated strategy that aligns infrastructure upgrades with agricultural modernization

efforts can yield synergistic benefits. For instance, upgraded transportation systems enable the efficient distribution of agricultural inputs and products, while robust irrigation infrastructure mitigates the adverse effects of erratic weather patterns on crop production.

To maximize the benefits of these investments, it is crucial to strengthen local governance capacities, ensure transparency in fund allocation, and implement comprehensive monitoring and evaluation frameworks. These measures will help ensure that both technological and infrastructural advancements translate into inclusive and sustainable development outcomes for all communities in Yen Bai, particularly those in marginalized and remote areas.

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