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Divergent Perspectives on Ecosystem-Based Adaptation: A Comparative Analysis of Government Officials and Farmers in Mountainous Communes of Thua Thien Hue Province, Vietnam

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Abstract: Ecosystem-based adaptation (EbA) has been widely recognized as the key strategy for supporting farmers in adapting to climate change. The success of EbA requires a cohesive alignment from the national level to community implementation. However, harmonized efforts from central governments to local farmers remain underexplored in the literature on climate change and adaptation, especially in the context of mountainous areas of Vietnam. This study applied multiple qualitative research methods, including 12 key informant interviews, six focus group discussions, and 18 in-depth interviews to explore the varying perspectives of EbA between government officials and farmers, and how these perspectives influence their involvement in governmental initiatives. Using matrix coding visualization in NVIVO, this study revealed notable differences in perceptions of EbA between government officials and farmers, which in turn impact EbA practices at the commune level. This study also found factors affecting EbA practices, including knowledge, economic priorities, institutional support, labor shortages, limited market access, and funding inadequacies. The policy implications drawn from this study are necessary for bridging top-down policy with local realities, to ensure the sustainability and effectiveness of EbA. Furthermore, this paper contributes to the EbA literature by highlighting the need for context-specific adaptation strategies to enhance the effectiveness and inclusivity of EbA practices in vulnerable communities.

Keywords: ecosystem-based adaptation; sustainability; smallholder farmers; perceptions; government officials; climate adaptation; mountainous areas

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1. Introduction

Climate change and environmental degradation heavily affect the agriculture, forestry, and fishing sectors, causing cumulative losses of USD 3.8 trillion between 1991 and 2021, with USD 123 billion in annual average losses [1]. Asian countries, which contribute up to 65% of global value-added in agriculture, forestry, and fishing, have experienced the highest absolute losses [1,2], which are caused by heightened exposure to climatic and environmental perturbations and low capacity for adaptation [3]. Moreover, many farmers encounter significant difficulties in adapting to climate change and environmental degradation, mainly due to limited accessibility of cultivated land, lack of technical and financial support, and limited education. Additionally, farmers often cultivate marginal lands, which are highly vulnerable to risks, such as landslides, floods, and droughts.

Consequently, farmers struggle to adapt to the escalating frequency and intensity of extreme weather events and gradual environmental degradation.

Various efforts have been made by governments, research institutions, and non-governmental organizations (NGOs) to increase the capacity of farmers to adapt to climate change and environmental degradation. These efforts include diversifying and modernizing agricultural techniques [4], providing government subsidies and assistance [5], developing credit schemes [6], and improving good farm management practices [7]. Although the effectiveness of these measures is recognized, they require a high level of investment and support, which often exceed farmers' capacities. Therefore, agroecological and ecosystem service-based agriculture management have been viewed as cost-effective and alternative practices for farmers to adapt to climate change and environmental degradation.

Ecosystem-based adaptation (EbA) encompasses measures that protect and enhance biodiversity and ecosystem services. These are used in farming to maintain and increase production, while also making farmers more resilient to extreme weather events [8]. Various EbA methods have been commonly practiced, especially in mountainous areas. These include agroforestry to reduce the negative impacts of rainfall and high temperatures on crops and livestock [9,10]; the establishment of windbreaks to reduce damage from strong winds [11]; the application of cover crops and terracing to protect soil fertility and erosion [12]; the design of live fences to prevent soil erosion and provide fodder for livestock; and the diversification of agricultural productions to mitigate the risk of productivity losses caused by extreme weather events, pests, and diseases [13]. In the forestry sector, different EbA practices, such as forest restoration and rehabilitation have been applied to reduce the risk of landslide and erosion [14], the conservation of riparian forests to regulate streamflow under varying rainfall conditions [15], and the protection of upland forests to prevent erosion and landslides, triggered by extreme weather events [16].

Although the consistency of government and local communities in the perception and implementation of EbA has been considered a critical factor for successful implementation, the issue remains underexplored in the literature. Amend [17] stated that successful climate change adaptation relies not only on governmental actions but also on collaboration with various stakeholders, including local communities. Similarly, Reid [18] emphasized that a consistent alignment between national and community-level policies ensures the contextual relevance and effective implementation of EbA initiatives.

Through a case study in the mountainous communes of Thua Thien Hue Province, Central Vietnam, this study examines the contrasting perspectives of government officials and farmers on EbA practices. Particularly, this paper aims to (1) understand EbA practices by smallholder farmers across three studied communes; (2) identify the divergence of perceptions on EbA between government officials and farmers; and (3) explore the factors influencing farmers' adoption of EbA practices.

2. Literature Review

2.1. Ecosystem-Based Adaptation for Smallholder Farmers in Mountainous Areas

Ecosystem-based adaptation (EbA) is a holistic approach that integrates ecosystem restoration with human livelihoods by leveraging biodiversity and ecosystem services to enhance human resilience to the impacts of climate change [8]. In mountainous areas, EbA has been recognized as an effective initiative to address the vulnerabilities of smallholder farmers who depend on fragile ecosystems for their livelihoods amid extreme weather conditions and environmental degradation [14]. Mountainous areas are particularly prone to a unique set of geographical, ecological, and socio-economic challenges, which make them susceptible to hazard conditions and highly exposed to extreme weather conditions, resulting in soil erosion, landslides, flooding, and droughts [19].

The EbA practices of farmers in mountainous areas are challenged by the topography of the region such as steep slopes and fragile soils and risks associated with environmental degradation [20]. Moreover, previous studies have highlighted barriers for farmers to practice EbA, such as a lack of financial resources, low technological capacity, and inadequate infrastructure to effectively cope with these challenges. These issues consequently make smallholder farmers especially vulnerable to climate-induced shocks [14]. Furthermore, the limitation of accessing external support, such as limited access to credit, and low accessibility of market information, further impedes their ability to adopt more resilient agricultural practices [12].

Since smallholder farmers' livelihoods are intricately linked to natural resources, they are often the forerunners of climate adaptation. Various practices of EbA conducted by smallholder farmers have been extensively reviewed, with studies highlighting the potential to improve productivity, mitigate vulnerability, and maintain ecosystem functions [14]. For instance, agroforestry systems in mountainous areas have contributed to soil stabilization and improvement in water retention, while also providing additional income for households [9]. Similarly, initiatives of soil conservation, including terracing and/or cover cropping, have proven effective in reducing erosion and improving soil fertility [12]. However, the practice of EbA by smallholder farmers in the context of mountainous areas is constrained by various challenges. The previous studies found that farmers often face limited access to finance, lack of know-how on agriculture production, and inadequate institutional support, which constrain the effective implementation of EbA [21]. Moreover, other relevant studies mentioned the socio-economic challenges of smallholder farming, including labor shortages and market uncertainties, which exacerbate these challenges [8].

2.2. The Misalignment of EbA Practices Between Government and Local Farmers

Different studies explored the alignment of government and local farmers, examining how effective this cooperation is in contributing to the success of EbA. Most of these studies confirmed that there is a lack of cooperation between these stakeholders in implementing and enforcement of EbA, due to policy misalignment [22,23], challenges of integrating local knowledge into national strategies [24], lack of institutional support [25], and insufficient communication between stakeholders [26]. These barriers create a disconnect between government and local communities in the design, implementation, and reinforcement of adaptation strategies. Moreover, the top-down approach in government initiatives may not align with local needs and priorities for EbA practices [27]. Tran and Nichols [28] stated that coordination among stakeholders is crucial for implementing and maintaining the effectiveness and sustainability of EbA by integrating knowledge into adaptation strategies. Similarly, Kissi et al. [29] confirmed that coordination between the government and farmers is significant for improving resilience against extreme weather conditions and enhancing the local people's livelihoods.

The government refers to a systemic approach to improve the resilience of ecosystems and human livelihoods in the long term. Therefore, the policy framework on EbA targets ecological priorities and addresses macro-scale environmental challenges [30,31], whereas local communities and farmers focus more on the short-term benefits of EbA practices to address the threats to their agriculture production and livelihoods [32]. To achieve the expected outcomes of EbA, the government launched relevant programs on forest restoration, biodiversity conservation, and agroforestry to obtain broader development goals [33]. Different governmental support initiatives to practice EbA include capacity-building programs, financial incentives, and regulatory frameworks aimed at promoting sustainable land management. Therefore, many studies underscore the importance of integrated approaches to EbA, in which institutional priorities are aligned with the localized

needs of farmers. Participatory planning and co-design of adaptation strategies have been considered as a measure to address this. By involving farmers in decision-making processes, the government can issue relevant policies on EbA, which are context-specific, inclusive, and match the local needs [34].

3. Methodology

3.1. Research Design

Different from other previous quantitative studies that relied on using questionnaires [14,35], this study applied a qualitative method design to explore the perceptions of governmental staff and farmers regarding ecosystem-based adaptations. This approach provides the opportunity to gain insight into the practice of EbA, the factors affecting EbA practices, and their consequences.

3.2. Study Area

This study was conducted in three communes: Phong My in Phong Dien district, Hong Thuong in A Luoi district, and Thuong Lo in Nam Dong district, which are all located in the mountainous region of Thua Thien Hue Province, Central Vietnam. These communes have different natural and socio-economic conditions and climate vulnerabilities, as well as different approaches to EbA practices. Phong My commune has a natural area of 40,000 hectares, with 75% covered by natural forest. Because the commune has a hilly terrain and moderate slopes, it has the potential to diversify agriculture production and other critical ecosystem services. However, extreme weather events such as storms, floods, and irregular landslides disrupt agriculture production and local livelihoods. To address these challenges, various EbA practices have been applied by local smallholder farmers, such as community forest management, the promotion of indigenous tree species and medicinal plants, and the conversion of low-productivity land into orchards.

In contrast, Hong Thuong commune faces significant challenges in agriculture production and local farmers' livelihoods due to its geography upstream of A Sap River and at the edge of a watershed. The commune is highly vulnerable to climate change and has experienced increased rainfall intensity, landslides, and soil erosion, which have reduced agriculture production. Because of poor land conditions, few EbA practices have been implemented, which primarily focus on sustainable forest management and the cultivation the medicinal plants under the canopy. A lack of market accessibility for agriculture products remains a challenge for farmers, especially the ethnic minority who rely on traditional agriculture production as their main livelihood sources.

Thuong Lo commune has favorable conditions for developing agriculture production and forestry activities, with the highest percentage of forest cover at 87% situated in the fertile valleys. However, the commune also faces erratic weather patterns including storms and heavy rains, which pose the risk of disruption of agriculture production and local people's livelihood. Different EbA practices have been adopted by smallholder farmers, such as developing resilient crops like pineapple and cinnamon, community forest management, diversifying orchards in gardens such as green pomelo and orange, and pursuing animal husbandry. Forestry remains a keystone of local people's livelihoods, in which restoring the indigenous species is being actively promoted in this commune.

3.3. Data Collection Methods

Contact with stakeholders was initially set up to provide an introduction to the research objectives. In this process, this study applied a nonprobability purposive method to select stakeholders from different groups such as government staff and farmers for interviewing. The selection of stakeholders from governmental organizations was based on

their functions related to climate change adaptation in agriculture and forestry. As a result, there were 12 stakeholders involved in this study from the Department of Agriculture and Rural Development, the Department for Forestry Management, the Department of Rural Development, the Forest Development and Protection Fund, the Division of Agriculture and Rural Development at the District Level, the Center for Agriculture Technique, and the Commune Authorities. There were 18 farmers involved in this study who practice typical agriculture production in communes. This study conducted in-depth interviews with 18 smallholder farmers (6 from each commune). The interviews explored the types of EbA practices adopted, the perceived impacts of climate change, and the factors influencing the adoption of EbA strategies. Moreover, 6 focus group discussions were held, with 4–6 participants in each group, consisting of farmers, local agricultural extension officers, and community leaders. The discussions provided additional insights into the collective experiences and community-level factors that influence EbA adoption.

To ensure reliability and minimize bias during face-to-face encounters, the researcher built rapport with informants and carefully explained the purpose of this study. Moreover, the researcher maintained neutrality and refrained from expressing personal opinions during the interview and discussion. The design of open-ended questions was used to allow interviewees to freely express their perspectives, without prompting or influencing their responses. The researcher also applied triangulation to check the data sources to ensure consistency and accuracy in the findings.

3.4. Data Analysis

This paper applied thematic content analysis as this method is suitable and relevant for providing policy implications [36,37]. Based on a priori themes, the themes identified in this study were climate change adaptation, EbA practices, economic considerations, livelihood strategies, infrastructure issues, and local initiatives. The collected data and information were then imported into Nvivo 14 for coding analysis. The coding process involved carefully reading through the data and identifying relevant information linked to each specific theme. However, during the analysis, new information and insights emerged, leading to the creation of emerging themes to incorporate these new findings.

This study aims to explore the different perspectives of government officials and farmers on ecosystem-based adaptation (EbA) that affect the practices at three communes in the mountainous districts of Thua Thien Hue Province, Central Vietnam. As such, the coding was grouped into two distinct groups, government officials and farmers. To analyze the data, word frequency analysis, coding comparison, and matrix coding queries were applied to examine how frequently government officials and farmers mentioned EbA-related topics. Additionally, a cross-tabulation of EbA-related strategies was conducted to identify the differences in perspectives between the two groups.

4. Findings

4.1. Climate Change Impacts and EbA Practices at Study Sites

Smallholder farmers, especially forest-dependent households, are highly vulnerable to climate change. Group discussions across three communes revealed that extreme weather events such as storms, floods, and droughts have severely impacted local livelihoods and destroyed the infrastructure (see Table 1). The specific negative effects of climate change on agriculture and livelihoods, as discussed by participants from the three communes, include land degradation, erosion exacerbating soil infertility, pest outbreaks, temperature extremes jeopardizing, food security, and decreased water availability. The discussions also highlighted that since most of the population consists of ethnic minorities and poor households, they face significant challenges in investing in climate resilience models and

establishing adaptive strategies for their households, thereby intensifying their exposure to climate risks.

Table 1. The EbA practices of households and their impacts on livelihood.

Climate Change Impacts	EbA Practices	Livelihood Benefits from EbA
Extreme weather events (e.g., storms, floods, and droughts)	Adopting climate-resilient crops and cropping patterns	Improved crop yields and income
Land degradation and erosion	Planting indigenous and drought-resistant tree species and medicinal plant cultivation	Enhanced ecosystem services (e.g., carbon sequestration)
Loss of crops and livestock	Promoting agroforestry and sustainable farming practices	Reduced vulnerability to climate impacts
Decreased water availability	Enhancing community forest management	Sustainable forest and resource management

Source: In-depth interviews and group discussions.

EbA practices across the three communes are seen as promising solutions to reduce the negative impacts of climate change through the integration of ecosystem services. Data from in-depth interviews with smallholder farmers indicated that various EbA practices have been adopted to ensure that agriculture and forestry activities can withstand climate variability. For crop production, climate-resilient crops and cropping patterns have been introduced to cope with abiotic stresses such as drought and flooding. Moreover, indigenous and drought-resistant tree species have been piloted and scaled up to maintain the ecosystem and mitigate exposure to diseases and extreme weather. Different techniques in agroforestry and sustainable farming such as soil erosion prevention and appropriate fertilization have been applied to enhance biodiversity, stabilize household income, and improve the resilience of the farming system. In forestry activities, community forest management plays an important role in ensuring the sustainability of forest resources while improving household income through ecotourism and medicinal plant cultivation. These practices are complemented by the development of alternative livelihoods that reduce dependence on climate-sensitive agricultural systems.

The benefits of these EbA practices are recognized by both local authorities and smallholder farmers. Group discussions and in-depth interviews highlighted improvements in crop yields and diversified income streams, which ensure stability for farmers even during adverse conditions. Moreover, enhanced ecosystem services, such as carbon sequestration and water regulation, benefit both local smallholders and the district at large. Vulnerability to climate risks is reduced as diversified livelihoods and improved natural resources provide a buffer against shocks. Moreover, government officials recognize that sustainable forest and resource management secures long-term ecological systems that provide critical services for the local community. This study found varying levels of EbA implementation across the three communes. Thuong Lo commune has demonstrated the most advantages to practicing EbA, while Phong My has shown moderate EbA implementation. By contrast, Hong Thuong has lagged behind (see Table 2).

In Thuong Lo, focus group discussions and in-depth interviews indicated that local farmers have a strong awareness of EbA and view these practices as a transformation of production to achieve both economic and environmental benefits. Consequently, local people have partly shifted production from acacia and rubber to various crops, such as cinnamon and pineapple, implemented FSC (Forest Stewardship Council) certification for forest plantations, and developed medicinal plants under the forest canopy.

Table 2. The varying levels of EbA at three studied communes.

	Thuong Lo	Phong My	Hong Thuong
Awareness and understanding of EbA	Strong awareness; active in community-based forest management; and sees EbA as an economic and environmental opportunity.	Moderate awareness; some discussions but not a major focus.	Low awareness; no direct mention of EbA initiatives.
Agricultural adaptation strategies	Shifting from acacia/rubber to cinnamon and pineapple; hesitant about FSC due to storm risks.	Major land use shifts (rubber to acacia, fruit trees, and medicinal plants) driven by economic opportunities.	No significant adaptation strategies focused on EbA.
Forest and community-based approaches	Active community forest management: households receive carbon credits; focus on non-timber forest products.	Community forest groups manage large areas; an interest in medicinal plants but lack market support.	Forest protection group contracted and paid by the commune.
Challenges in implementing EbA	Market instability for alternative crops; economic priorities over environmental concerns.	Lack of financial incentives; weak market for medicinal plants and agroforestry products.	Likely limited support from governance; low engagement in ecosystem-based solutions.

Source: Data analysis from group discussions and in-depth interviews with commune authorities.

In Phong My, local people have a moderate understanding of EbA, and various EbA practices have been implemented, such as land conversion into fruit trees and medicinal plants, along with community forest management. In contrast, Hong Thuong's population exhibited low awareness of EbA, and the term was not mentioned by residents during interviews. There has also been no agricultural transformation in the commune over the last ten years due to poor soil fertility and a lack of effective water supply. As a result, local people continue to rely on acacia for economic development.

4.2. Disaggregation Between Institutional Strategies and Local Realities Related to Climate Change and EbA Practices

Government officials at all levels and smallholder farmers have different understandings of climate change and its impacts, which can lead to varying perceptions of EbA (see Table 3). Government officials focus on issues such as floods, droughts, and deforestation, viewing them as province-wide challenges related to extreme weather conditions and natural resource degradation. For instance, the Deputy Director of the Thua Thien Hue Provincial Department of Agriculture and Rural Development noted the following:

> *"Over the past 10 years, local communities in mountainous areas have experienced floods and droughts with increased intensity and frequency, which are consequences of natural forest loss and the construction of hydroelectric power plants. Although the provincial government has made various efforts to support local populations in adapting to these extreme weather events, particularly in agricultural production, the outcomes have not fully met expectations. Thua Thien Hue province has less advantages in agriculture production compared to other regions because the average land size per hosueholds is small and fragmented. For this reason, farmers face difficulties in applying alternative cultivation methods to adapt to and mitigation to climate change. Moreover, the application of alternative cultivation entails higher production cost, while the small and fragmented*

area limits the potential for increased turnover. Besides, the limited provincial budget has resulted in inadequate infrastructure, which exacerbate climate vulnerabilities"

Table 3. The differences among interviewees regarding climate change impacts, ecosystem-based adaptation (EbA) measures, barriers, benefits, and awareness.

	Government Officials	Smallholder Farmers
Perceptions of climate change impacts	Discuss macro-level impacts such as drought, deforestation, floods, and infrastructure challenges.	Focus on localized impacts like rainfall intensity, landslides, and crop damage.
Proposed EbA practices	Advocate systemic, long-term strategies: agroforestry, indigenous species, and community forest management.	Prioritize immediate, practical measures: crop shifts, resilient species, and FSC acacia planting.
Barriers to implementation	Highlight structural issues: funding shortages, limited infrastructure, and technical expertise.	Cite practical challenges: labor shortages, immediate financial needs, and market access.
Emphasis on benefits	Focus on long-term ecological and socio-economic benefits: resilience, carbon sequestration, and soil health.	Prioritize short-term economic returns: quick income through crops like acacia and cassava.
Awareness and training	Emphasize training programs for forest management and ecological farming.	Mixed awareness: some actively participate in training, while others lack exposure.

Source: Synthesized from group discussions and in-depth interviews.

Similarly, officials from the Department of Forest Management focus on the degradation of natural forests, low investment in forest restoration, and the provision of ecosystem services at the provincial level as key climate-related issues. In contrast, smallholder farmers recognize climate change based on their perspectives and daily experiences. Mrs. X, a farmer in Hong Thuong commune, described the extreme weather events caused by increasing rainfall, which leads to landslides, while other farmers pointed to repeated storms that damage crops and livestock. These personal accounts highlight the immediate and visible consequences of climate change at the household level.

The divergence in perceptions of EbA between government officials and smallholder farmers has led to differences in the proposed and prioritized EbA measures. Government officials have prioritized broad, systemic strategies, such as promoting agroforestry, planting indigenous tree species, and improving community forest management. According to officials from the Forestry Management Department and the Department of Rural Development, the provincial government is focusing on long-term EbA strategies, including the rehabilitation of medicinal plants under the canopy and strengthening sustainable forest management. These EbA solutions aim to ensure biodiversity conservation, enhance ecosystem services, and provide access to carbon credits.

In contrast, in-depth interviews with smallholder farmers revealed the challenges in implementing these EbA measures at the commune level. These practices often require significant investment, which may exceed the farmers' capacity. Additionally, issues related to the availability of medicinal plant seedlings, the market for products, and the willingness of local households to engage in sustainable forest management hinder the adoption of these EbA strategies. Farmers are more inclined to adopt immediate and practical adaptations that mitigate daily production and livelihood challenges. Consequently, shifting cropping patterns, adopting resilient crops, and selecting economically viable options such as acacia are the most common EbA practices among smallholder farmers. Farmers' hesitancy to adopt new crops, such as cinnamon or medicinal plants, due to concerns over economic

viability and market uncertainties, further highlights the gap between long-term EbA goals and immediate livelihood needs.

Barriers to EbA practices are perceived differently by government officials and smallholder farmers. From the perspective of government officials, structural challenges include inadequate funding, lack of technical support, and low infrastructure capacity. The Head of the Division of Agriculture and Rural Development in Phong Dien noted the following:

> *"Although the district government has issued the plan for different ecosystem based measures to adapt to extreme weather conditions in agriculture production, we have been unable to effectively carry out these measures due to several challenges. The implementation of EbA practices requires expertise to provide the technical assistance for farmers, while the district lacks sufficient staff to support the farmers at 14 communes. Moreover, the district has not received a dedicated budget from provicial government to implement the EbA practices. As a result, the budget for implementation of EbA must be integrated into other programs such as new rural development programs or socio-economic development for ethnic minority. Additionally, the products from EbA models have not well accessed marker for consumption, which has led to limited interest from farmers in applying EbA practices to their agricultural production."*

On the other hand, farmers emphasize localized and practical constraints, such as labor shortages, immediate financial needs, and limited market access. These contrasting perspectives highlight the disparity in addressing systemic versus day-to-day challenges. Mr. H, a farmer in Phong My commune noted the following:

> *"I understand that applying FSC certification to acacia plantations is one of the EbA practices to adapt to climate change. However, I am unable to implement this method as it requires more labor to manage the plantation. Moreover, FSC certification entails a longer harvesting period of over six years, while I need quicker returns to cover my family's expenses. Additionally, applying FSC certification requires a higher investment to maintain the forest area, yet the selling price of FSC-certified timber is not significantly different from that of non-FSC timber."*

Data from in-depth interviews revealed notable differences between the priorities of government officials and smallholder farmers in implementing EbA practices. Government officials prioritize long-term benefits such as soil health, carbon sequestration, and resilience to climate change, viewing these as important ecological and socio-economic outcomes. As a result, government officials encourage farmers to shift from short-term survival strategies in agricultural production and forest management toward more sustainable practices. In contrast, smallholder farmers focus on short business cycles that provide quicker economic returns, underscoring the challenges of reconciling long-term adaptation strategies with the urgent economic realities faced by farmers.

The strategies for building capacity for EbA practices also differ between government officials and farmers. Government officials expect to design training curricula to increase local awareness of sustainable practices. Accordingly, various training programs on sustainable forest management and ecological farming have been conducted. However, the effectiveness of these training sessions has been limited, which has affected the awareness of smallholder farmers regarding EbA and its benefits. Smallholder farmers, in turn, are more interested in technical training related to agricultural production and market access to improve productivity and ensure better product consumption.

The level of engagement with training varies among farmers. For instance, Mr. Y, a farmer in Thuong Lo commune, actively participates in forest management due to his better understanding of EbA and its benefits. In contrast, Mrs. Z, with less exposure to key concepts like organic farming or sustainable forestry, has less awareness of EbA practices.

This variation reflects gaps in communication and resource distribution, which hinder the adoption of EbA.

4.3. Factors Affecting EbA

This study found multifaceted factors affecting EbA practices in mountainous areas, including awareness, social, cultural, economic, institutional, and technique. Moreover, these factors shape the involvement of both government officials and smallholder farmers in EbA initiatives.

In-depth interviews with government officials revealed a comprehensive understanding of EbA and its long-term benefits. Strategic measures, such as promoting agroforestry, planting indigenous trees, and advocating policies to support sustainable forestry management, have been prioritized by the government. As the vice chairman of the Forest Management Department noted, forestry restoration and sustainable forestry management are prerequisites for ecosystem resilience, biodiversity conservation, adaptation to climate change, and achieving sustainable economic outcomes. In contrast, smallholder farmers have a more localized and practical awareness of EbA. While some are familiar with EbA practices that directly impact their livelihoods, such as diversifying crops or participating in forest monitoring, many lack a broader understanding of the concept. Ms. T, a female farmer, mentioned that she is involved in community forest management because she receives payment for forestry patrolling, but she was unaware that forest conservation and restoration could help the community adapt to climate change by reducing landslides and environmental degradation.

In-depth interviews with government officials highlighted the lack of financial incentives, subsidies, and programs to support EbA implementation. Structural barriers include limited government funding, fragmented markets for product consumption, and high costs of implementing EbA practices such as FSC certification. Government officials also explored economic opportunities at the macro level, such as carbon credit systems and ecotourism, which are seen as market-based mechanisms to address the shortage of national budget allocation to the forestry sector. On the other hand, smallholder farmers focus on immediate financial needs and practical constraints. They prioritize changing crops to obtain quick economic returns, even if these crops are less sustainable or more vulnerable to climate impacts. Mr. P, a farmer in Thuong Lo commune, expressed hesitancy to apply for FSC certification for acacia production due to market price uncertainties and the high cost of certification. As a result, he continues to rely on the traditional acacia system, which offers quicker financial returns.

Social and cultural factors are significant to the implementation of EbA in these mountainous communes, where indigenous people make up a large percentage of the population. In-depth interviews with government officials revealed the importance of community engagement and social cohesion in EbA initiatives. They advocate for collective actions in all EbA practices at the commune level, such as community-based forest management and the development of indigenous tree species. Moreover, the relevant policies related to EbA emphasize the involvement of marginalized groups, such as ethnic minorities, and the inclusion of gender perspectives and equitable participation. However, the involvement of smallholder farmers in EbA initiatives at communes varies. Some farmers actively engage in community forest management and have benefited from collective efforts. Other farmers have faced the challenges of weak cohesion or low levels of trust, which have hindered their participation in collective EbA initiatives such as community forest restoration through medicinal plant development and forestry patrolling.

Government officials have targeted the objectives of large-scale environment for every EbA initiative such as forest restoration, soil conservation, and biodiversity protection.

Therefore, the EbA initiatives aim to restore the indigenous species and improve ecosystem health to enhance the resilience capacity to climate change. By contrast, farmers emphasized localized environmental issues, including poor soil fertility and lack of water availability, which directly affect crop productivity. The group discussion with farmers indicated that steep terrain and soil erosion are the barriers to practicing EbA on crop production.

Institutional factors, including relevant policies and coordination among stakeholders, play a key role in the implementation and enforcement of EbA practices. Policy gaps, such as inconsistencies between national or provincial climate change adaptation plans and local realities, hinder the effective practice of EbA. To address this, training initiatives and financial support mechanisms have been considered vital for building capacity among local communities to better implement EbA. Despite efforts to coordinate technical assistance and provide information to farmers, this study found that these initiatives have not met expectations due to inconsistencies in planning and monitoring the adoption of EbA practices at the community level. From a bottom-up perspective, smallholder farmers expressed concerns about the accessibility of government support, such as subsidies or training sessions. Mr. H, a farmer, noted that although local people recognize the benefits of FSC certification for forest plantations, they face constraints related to production costs and time requirements, while the market for FSC-certified timber remains unclear.

In interviews, government officials prioritized advanced tools and technologies, such as satellite monitoring for forests and improved irrigation systems, to support smallholder farmers in implementing EbA initiatives. Moreover, government officials discussed the need for technical capacity-building and infrastructure development for successful EbA implementation. Farmers, on the other hand, preferred tools and techniques that could immediately improve agricultural productivity. Group discussions revealed that limited technical knowledge and access to technology hindered the adoption of EbA practices at the commune level. Some farmers had limited access to training on technology use in production management and sustainable forestry. Furthermore, some farmers still rely on traditional agricultural practices, which limits their ability to effectively implement EbA measures.

5. Discussion and Conclusions

This study revealed significant differences in how government officials and smallholder farmers perceive and practice the EbA. While government officials prioritize long-term sustainability and restoration of the ecosystem, smallholder farmers focus on short-term survival and immediate economic needs. This divergence in perspectives is a critical challenge to effectively implement EbA practices because it creates a gap between ecological objectives and the practical realities of smallholder farmers.

The complex dynamic between institutional strategies and local realities was revealed in this study, which contributes to the literature on EbA. Government-led initiatives advocate for systemic strategies such as sustainable forest management and biodiversity conservation. These priorities are consistent with previous studies by Adhikari, Baral [38] and Sapkota, Keenan [39], who found that policymakers play an essential role in setting long-term strategies to achieve environmental benefits. Our study is in line with Colls, Ash [40], confirming that smallholder farmers often resist the adoption of long-term adaptation strategies due to economic pressure, emphasizing the need for short-term adaptation to secure livelihoods.

Risk perceptions regarding the negative impacts of climate change and environmental degradation differed between government officials and smallholder farmers, leading to the divergence of priorities. Deforestation and biodiversity loss are systemic risks that were emphasized by government officials, and as a result, they considered EbA as a long-

term solution to mitigate these large-scale risks, as noted by Quandt [27]. Smallholder farmers, conversely, emphasized the visible and immediate risks, such as loss of crops and low soil fertility, which reflect their immediate livelihood concerns. This study also addressed the economic uncertainties as barriers to practicing EbA, including market access and resource constraints, which tend to increase the focus of farmers on short-term concerns [21]. Different from previous studies, this research highlighted the role of social cohesion and labor dynamics in shaping farmers' decision-making, offering a more nuanced understanding.

The gaps in awareness and understanding of EbA between government officials and smallholder farmers underscores the necessity to conduct capacity-building initiatives to bridge knowledge disparities [41]. Our findings show the variability among smallholder farmers, as some smallholder farmers actively engage in sustainable practices, like forest monitoring and agroforestry, while others do not. This suggests that designed community-specific approaches could enhance awareness and participation in EbA programs.

The valuations of ecosystem services differed between government officials and farmers, emphasizing the need for context-sensitive and responsive approaches to the local realities related to EbA policy frameworks. Government officials prioritized values from ecosystem services, such as carbon sequestration, biodiversity, and water regulation, and the contribution of these services to climate adaptation [42]. Farmers, conversely, valued ecosystem services for their visible outputs, such as improved soil fertility and access to non-timber forest products, which is in line with Locatelli and Pramova [43], who noted that farmers often prioritize ecosystem services with tangible benefits. The integration of smallholder farmers' priorities into policy frameworks could be a way forward to improve the design of EbA strategies for ecological and socio-economic objectives.

Smallholder engagement emerged as a key factor in the success of EbA, with collective action contributing to sustainable adaptation, as noted by Tran, Brown [34]. However, our study found that challenges, including weak social cohesion and competing priorities, tend to limit participation in some communities. Unlike previous studies, financial incentives appear to be a critical driver for these solutions. We found that smallholders who received payments for ecosystem services, and other financial support, are more likely to engage in EbA initiatives, highlighting the importance of linking economic incentives to collective actions.

A more integrated approach, bridging the gap between institutional strategies and grassroots realities, is necessary for the effective design and implementation of EbA programs. Co-designing policies with smallholder farmers is crucial to ensuring that immediate needs, such as financial security and market access, align with long-term ecological goals. Moreover, capacity-building programs tailored to local contexts, combined with improved market access and financial incentives, can enhance EbA implementation. Social cohesion and community participation are also vital for the success of collective initiatives such as forest management.

This paper contributes to the growing literature on EbA by addressing the problematic interplay between government officials and smallholder farmers. While long-term adaptation and resilience have been prioritized by institutions, smallholder farmers emphasize immediate practicalities, creating gaps that affect the implementation of EbA strategies. Solutions to address this gap include participatory planning, tailored support, and enhanced communication. Future research should explore how these approaches can be scaled to diverse contexts to ensure that EbA strategies are both impactful and equitable.

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Institutional Review Board Statement: Ethical review and approval were waived for this study due to Legal Regulations foe the following reasons: The study focuses on non-sensitive data regarding the awareness of local farmers and government officials about Ecosystem-based Adaptation (EbA) and the factors influencing their understanding. This includes gathering information about their knowledge and perceptions of EbA practices, without delving into personal or sensitive topics, ensuring that the data collected remains within ethical boundaries. At the beginning of the research process, the research team made multiple intentional efforts to engage with stakeholders. These efforts involved presenting the study's objectives, conceptual framework, and research methodology. In parallel, this phase also served to obtain consent from stakeholders to participate in the interview process, ensuring their understanding and agreement with the study's goals and the role they would play in it. An informed consent process was thoroughly prepared and implemented during the interviews with stakeholders. This process ensured that all participants were fully informed about the study's purpose, how their data would be used, and their rights, including the right to withdraw at any time without penalty. The team took care to ensure that stakeholders understood the consent process and voluntarily agreed to participate in the interviews.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are contained within the article.

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