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Agricultural Land Acquisition and Its Challenges to Household Livelihood Resources: Evidence from Thai Binh, Vietnam

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ABSTRACT

This study examines the socio-economic impacts of land acquisition driven by rapid infrastructure expansion and urbanization in Thai Binh province, Vietnam. The data were gathered from eight communes of four districts in Thai-Binh province (Dong-Hung, Tien-Hai, Hung-Ha, and Thai-Binh), where land acquisition occurred between 2015 and 2020. 372 households whose land had been recovered were randomly selected from the commune areas selected for the survey. Using the Livelihood Vulnerability Index (LVI) as an analytical framework, this study has combined upon index systems of Hahn (2009) and Huang et al. (2017) to develop a comprehensive index for assessing the livelihood vulnerability of households whose land has been partially acquired, taking into account the nature of the impact. A total of 26 indicators and 10 major components were included in the SLF framework for analysis to clarify regional vulnerabilities to land acquisition at the household level. The findings reveal that (1) compensation programs for land expropriation are insufficient in alleviating household vulnerabilities, (2) households must adopt diversified strategies for securing land by balancing customary institutions with state regulatory frameworks, (3) fostering strong social networks at both community and societal levels is essential for

sharing knowledge, experiences, and economic opportunities, and (4) policymakers should prioritize expanding non-agricultural employment and implementing vocational training programs tailored to the specific socio-economic conditions of affected communities.

Keywords: Land Acquisition; Livelihood Vulnerability Index; Landless; Thai Binh; Vietnam

1. Introduction

Land serves as a fundamental resource for agricultural production, with approximately 50% to 66% of a nation's wealth linked to it. However, as urban areas and cities contribute about 70% of a country's GDP [1], urban expansion has become a pivotal driver of socio-economic development. This expansion necessitates the conversion of agricultural land to non-agricultural purposes to support urbanization [2,3]. In many developing nations, the rapid pace of urbanization and industrialization has led to the acquisition of agricultural land, posing significant challenges for millions of people [4,5]. Research shows that such land acquisition can affect the livelihoods of 12 million individuals worldwide, with repercussions on food security [1], poverty rates [6], and employment levels [7]. Consequently, the process of acquiring land for urbanization and economic growth has profoundly transformed rural landscapes, livelihoods, and household well-being [8].

The loss of land due to acquisition presents numerous challenges for rural communities. On a positive note, land acquisition in agriculture can create a fund to support investments in industrial parks, communal facilities, transportation infrastructure, and other resources that foster economic growth and urban development [9]. This socio-economic development often leads to the creation of non-agricultural job opportunities for local residents [10]. Some studies suggest that the loss of arable land may actually represent a positive trend, as it encourages households to diversify their income sources and reduce their reliance on agriculture [11]. Due to the scarcity of farmland, families are compelled to seek alternative employment to sustain their livelihoods, which pushes rural households to explore a variety of income-generating activities [12]. Moreover, land acquisition addresses issues related to low land usage, land fragmentation, challenges in adopting new technologies, and the accumulation of livelihood capital [13]. While there are some positive outcomes, the vulnerabilities associated with this process have drawn scholarly attention. These include loss of income and employment opportunities-both in agriculture and other sectors-as well as loss of livelihood assets such as land and common resources, and reduced access to public services [14,15]. Many farming households remain engaged in agricultural production not out of choice or obligation, but because they are unable to find stable non-agricultural employment [16]. Consequently, the displacement of individuals whose farmland has been expropriated disrupts their traditional livelihoods, leading to significant costs associated with adaptation and relocation [17]. Despite this, the compensation provided has often been deemed inadequate, attracting considerable criticism. As a result, compulsory land acquisition frequently incites widespread social and political unrest, prompting further attention from researchers and authorities [18].

Since the late 1990s, Vietnam has been undergoing significant development and urbanization, prompting its authorities to conduct multiple rounds of agricultural land acquisition to support national defense and economic growth through infrastructure projects, state agencies, commercial centers, economic zones, industrial parks, and residential areas. By the end of 2020, the government had reclaimed approximately 2.1 million hectares of land, which includes about 1.59 million hectares of agricultural land, 0.59 million hectares of non-agricultural land, and 0.002 million hectares of unused land [18]. Numerous studies have analyzed the advantages and disadvantages of land acquisition, revealing that the outcomes are context-specific. For instance, farmers in peri-urban areas tend to have more opportunities to diversify their livelihoods compared to those in rural areas where agriculture is the sole source of income [4,8,19]. Additionally, the rapid growth of the indus-

trial and tourism sectors has created many job opportunities linked to land acquisition, which has facilitated successful livelihood adjustments for those surveyed [19,20]. Furthermore, households with partially acquired land are generally observed to have higher incomes and more diverse income sources than those whose entire agricultural land has been taken [21,22]. While land acquisition is usually viewed positively, several pressing issues remain that must be addressed for achieving fair and sustainable development [23].

Although farmers may have opportunities to increase their incomes by transitioning from agricultural to non-agricultural livelihoods [24], they often encounter significant challenges during this process. These challenges include difficulties in securing a sustainable livelihood [25], reduced access to food [26] and the need to adapt to non-agricultural activities [4,10]. Additionally, after land acquisition, many farmers struggle to find alternative employment [17] or end up spending compensation on purposes that do not generate or increase income [27].

Most studies on the impacts of land acquisition in Vietnam are conducted in peri-urban areas or cities. Consequently, the results and recommendations derived from these studies are applicable to regions with similar characteristics but may not fully align with purely agricultural areas. However, the "New Rural Development Program," initiated by the Prime Minister in 2022, mandates that each rural district establish an industrial park to meet the criteria of this program. As a result, districts are compelled to build and develop industrial parks and clusters, leading to increased demand for agricultural land acquisition. Moreover, there is a lack of research assessing the overall vulnerability of households affected by land acquisition on their livelihoods.

This study addresses this gap by employing a comprehensive assessment of significant components and index systems that combine sensitivity and adaptation levels to evaluate the vulnerability of households whose land is acquired in purely agricultural regions of Vietnam. As the negative impacts of agricultural land acquisition for industrial development and urbanization pose challenges for many countries, this research offers valuable insights for broader discussions. The findings of this study contribute a unique perspective to the ongoing discourse on land management in Vietnam.

The remaining of the article is structured as follows. Section 2 presents analytical data, and sample selection with a brief description. Section 3 reports methodology. Section 4 reports analytical results after screening data. Section 5 discusses the main results, and Section 6 concludes the paper.

2. Study Area and Data

2.1. Description of the Study Area

Thai-Binh is a coastal province located in the Red River Delta of Northern Vietnam. It shares borders with five provinces and cities: Hai-Duong, Hung-Yen, Hai-Phong, Ha-Nam, and Nam-Dinh. To the east, the province faces the East Sea (Gulf of Tonkin). Thai-Binh province experiences a humid subtropical climate with distinct wet and dry seasons. The hot, humid season, characterized by significant rainfall, lasts from April to October, while the dry season features minimal precipitation. The average temperature is around 23 degrees Celsius, with annual rainfall ranging between 1,500 and 1,900 mm, humidity levels between 70% and 90%, and approximately 1,600 to 1,800 hours of sunshine each year. Covering an area of about 1,586 km², Thai-Binh province has an estimated annual population of 1.9 million people. Notably, 67.9% of the land is designated for agriculture, and 88.2% of the population resides in rural areas, comprising 27% of the total workforce engaged in farming. The province has shown a relatively high economic growth rate compared to the national average, exceeding 7% per year and ranking 20th in the country [28]. Thai-Binh province serves as a market center along the Tra-Ly River and is connected by road to Ha-Noi, located 85 km to the northwest. The surrounding region is densely populated and intensely cultivated, with soil primarily derived from dunes and sandy beaches but predominantly alluvial, making it ideal for wet rice and vegetable cultivation. With its fertile land and favorable natural conditions, Thai-Binh province has a strong tradition of food production within the Red River Delta. The total rice-growing area in the province is approximately 160 hectares, making it one of the

country's key granaries, capable of producing two rice crops annually due to an extensive irrigation network. Other crops cultivated include sweet potatoes, corn, jute, mulberries, and rushes, and livestock such as hogs and poultry are also raised [29].

The province's stable geology makes it suitable for industrial development and high-rise construction. Thai-Binh province boasts relatively advanced infrastructure, including convenient seaports and roads, along with abundant water resources. It is also in proximity to major urban and industrial centers in the critical economic region of Ha-Noi, Hai-Phong, and Quang-Ninh, facilitating the transfer and receipt of scientific advancements and investment projects. This location provides advantages for the distribution and consumption of agricultural products, particularly fresh ones.

According to the land use plan approved by the government, the target area for paddy land in Thai-Binh province by 2020 was set at about 75 thousand hectares. During the final phase of the planning period (2016-2020), 5,5 thousand hectares of paddy land were slated for conversion to non-agricultural uses, while 434 hectares were designated for other agricultural

purposes, such as perennial crops and aquaculture. However, in reality, the area of farmland decreased significantly, from 1,255 km² in 2000 to 740 km² in 2020. In contrast, settled areas more than tripled over the same 20-year period.

Despite these developments, progress in land clearance for certain projects has been slow. Complaints and inquiries regarding land clearance persist for projects that have not been fully resolved, particularly concerning dissatisfaction among landowners-mainly farmers-over compensation and support policies in accordance with legal regulations. Data were collected from four districts in Thai-Binh province (Dong-Hung, Tien-Hai, Hung-Ha districts, and Thai-Binh city) (**Figure 1**), where land acquisition took place between 2015 and 2020. Most of the acquired land was used for growing rice or seedlings. The land was withdrawn primarily for the construction of industrial parks (47.0%), infrastructure development (26.3%), resettlement areas (26.1%), and other reasons. In the four villages studied, only a small number of households continued agricultural activities, while some transitioned to non-agricultural endeavors.
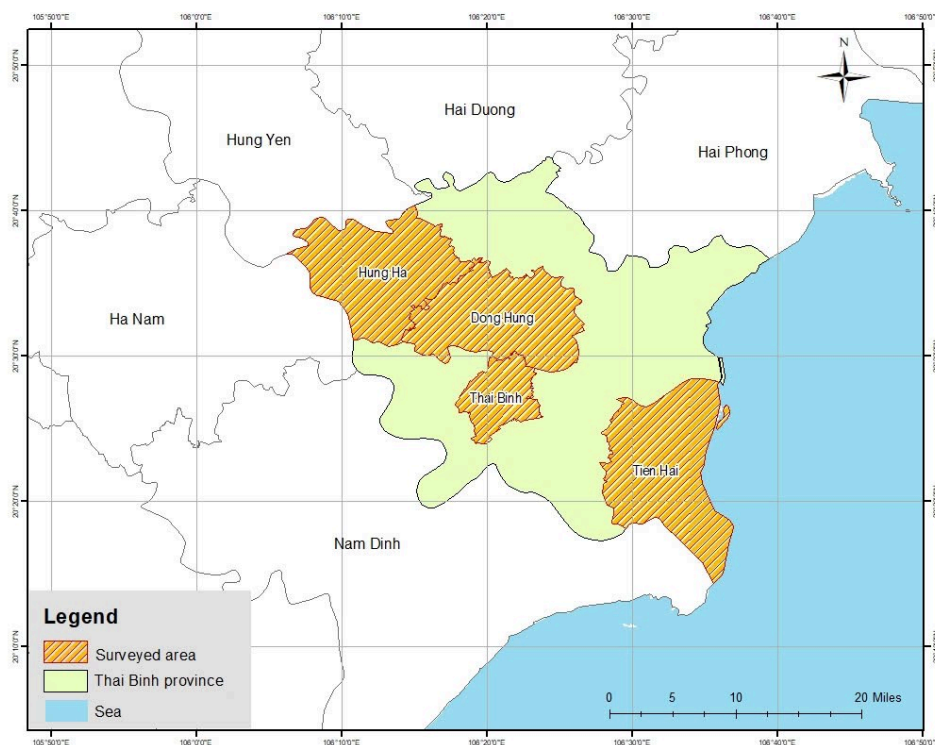

Figure 1. Study area.

2.2. Sampling and Data Collection

Multi-stage sampling method was applied. In the first step, four districts were selected based on the criteria that the districts represent geographical characteristics and economic development levels. In which, Hung-Ha and Dong-Hung districts are 2 districts representing economic regions with economic structure mainly being agriculture. Meanwhile, Tien-Hai and Thai-Binh city are places with large infrastructure development projects and mainly develop industry.

In the second step, a commune in each district was selected as a research site based on the criterion that the commune had the largest proportion of agricultural land recovered in the district. In this step, two communes in each district were selected as a research site based on the criterion of having the largest proportion of agricultural land recovered in the district. An initial list of communes with the highest rates of land recovery in the four districts was compiled. With assistance from district authorities, eight communes were selected from this list (two from each district) based on the criteria of having a high percentage of households affected by land loss and ongoing issues related to the acquisition process. The selected communes include: Phu-Chau and Trong-Quan commune (of Dong-Hung district); Hung-Nhan and Chi-Hoa commune (of Hung-Ha district); Vu-Chinh and Tran-Lam ward (of Thai Binh City) and Dong-Tra and Dong-Long commune (of Tien-Hai district).

Finally, households whose land was recovered were randomly selected in each commune for the survey. Based on the list of households whose land was recovered between 2016 and 2020 provided by the local authorities, 50 households in each commune were randomly selected for interviews. While 420 survey households were anticipated, travel restrictions during the Covid-19 pandemic resulted in a total of 372 survey households being collected.

Face-to-face surveys were conducted from May to August 2022. This approach helped establish a representative sample and minimize bias that could arise from surveying a small group of households. During each household interview, the interviewer utilized a questionnaire to gather information from the head or breadwinner of the household, with each interview lasting approximately 30 minutes to an hour. This method allowed for an overview of changes in household livelihoods over time. Other family members or neighbors were often present to provide additional information, although the head of the household confirmed all responses. The questionnaire aimed to assess the livelihood status of respondents, including sources of livelihood capital, reactions to land acquisition, vulnerability contexts, livelihood activities and strategies, future plans, and livelihood outcomes.

The questionnaire comprised nine key sections. The first section collected data on the demographic characteristics of the head of the household and their household composition before and after land acquisition. The next five sections gathered information on human, social, natural, physical, and financial capital before and after land acquisition. The seventh section examined detailed information regarding land acquisition (such as the area of land acquired, compensation received, and resettlement policies). The eighth section assessed the impact of COVID-19 on households in relation to their livelihoods and land acquisition experiences. The final section posed questions about the aspirations of individuals following land loss and their proposals to local authorities. This comprehensive approach allows the study to evaluate the effectiveness of local support policies and provide policy recommendations.

3. Methodology

3.1. Index System to Measure Livelihood Vulnerability to Land Acquisition

This study combines previous methodologies to create an index system designed to assess the varying impacts of land acquisition on households and their abilities to cope with these negative effects. Land acquisition refers to the State's decision to reclaim land use rights from either individual who have been granted such rights or from land users who violate land laws. The vulnerability of farming households to land acquisition reflects their susceptibility to its adverse effects, which can manifest as concerns or tensions resulting from land loss. The Livelihood Vulnerability Index

(LVI) was developed to assess, measure, and compare the level of livelihood vulnerability at both household and community levels. Hahn et al. [30] created an index system that evaluates households' exposure to external stress and shocks, as well as their sensitivity and capacity to respond to climate change. This system comprises seven key components, which include 30 sub-components. Building on this framework, Huang et al. [31] developed a new index system derived from Hahn et al.'s work, consisting of 15 indices that reflect two dimensions: sensitivity and response capacity. This revised system was used to analyze regional differences in household vulnerability to land loss. In this study, we have applied and expanded upon both index systems to develop a comprehensive index for assessing the livelihood vulnerability of households whose land has been partially acquired, taking into account the nature of the impact. As a result, this study will compare damage levels between different areas. Land is a critical natural resource that significantly affects the livelihoods of farming households. Land acquisition creates disparities in sensitivity levels among households due to variations in land characteristics and other livelihood resources. We identified seven major components related to sensitivity/exposure. The ratio of land area acquired indicates the extent to which a household is at risk of land requisition and rapid urbanization. Additionally, the purchase or rental of supplemental land illustrates the household's land shortage following acquisition. A family's agricultural income prior to land loss signifies the vulnerability of their livelihood strategies and reliance on agricultural land. Furthermore, sensitivity is assessed through components reflecting the quality of the living environment as influenced by the development of industrial parks in areas affected by land acquisition, since such developments can severely impact the local living conditions. A ten-point Likert scale (1 for very bad, 10 for very good) was employed to measure these environmental indicators. In our study context, socio demographic characteristics (such as education level) do not affect the ability of respondents to use each scale. Therefore, choosing a 10-point scale is more appropriate than a 5-point scale to increase the response effort of the interviewees [32]. This is also the difference in our study in measuring factors to assess livelihood vulnerability at the household level compared to previous studies.

Response capacity in managing risks is demonstrated through indicators that assess a household's ability to access resources, including institutional support. In our research, we analyze response capacities based on the capabilities of sustainable livelihood resources, which are categorized into five primary resources:

1. Human Capital: This includes three key components-health, knowledge and skills, and livelihood strategy.
2. Natural Capital: This encompasses two significant components-land and environment
3. Social Capital: This consists of two important components-socio-demographic factors and social connections.
4. Financial Capital: This includes two crucial components-financial resources and finances related to land loss.
5. Physical Capital: This comprises one major component, infrastructure, along with two additional indices.

In comparison to the index systems proposed by Hahn et al. [32], Huong et al. [33], and Huang et al. [31], we have introduced two new indices: road quality and electricity system quality. These additions aim to better capture households' adaptive capacities in the context of land acquisition. Land acquisition for industrial park development and urbanization often triggers infrastructure improvements in the areas affected. Ultimately, a total of ten major components represented by twenty-six indicators (see **Table 1**) collectively define response capacity.

Table 1. Major components and sub-components and information sources.

Capital	Major components	Code of Capital	Code of LVI	Sub-components (Indicator)	Units	Explanatory notes	References
Natural capital	1. Land	N1	SE1	1. Land-lost	Percent	Percentage of land area requisitioned by household	New main component. Questions extended by
		N2	SE2	2. Landless of HHs	Percent	Percentage of households with landless who have to buy or rent more land	Huang et al., (2017) [31]
	2. Environment	N3	SE3	3. Level of waste pollution		Degree of local waste pollution after acquisition, rated on a ten-point scale	New main components Questions extended by Huang et al., (2017) [31]
		N4	SE4	4. Noise pollution level		Degree of local noise pollution after acquisition, rated on a ten-point scale	
		N5	SE5	5. Air pollution level	Count	Degree of local air pollution after acquisition, rated on a ten-point scale	
		N6	SE6	6. Quality of local landscape	Count	Quality of local landscape after acquisition, rated on a ten-point scale	New main component
		N7	RC1	7. Access to clean water		Household's ability to access clean water, rated on a ten-point scale	Modified by Huong et al., (2019) [33]; Hahn et al., (2009) [30]
Human capital	3. Health	H1	RC2	8. Health of the head of household	Scale	Health status of the head of household, rated on a ten-point scale	Questions modified by Hahn et al., (2009) [30]; Huang et al., (2017) [31]
		H2	RC3	9. Labor in a HHs	Persons	Average labor in a household.	
	4. Knowledge and Skills	H3	RC4	10. Education level of HH head	Percent	Percentage of household heads who just passed high school	
		H4	RC5	11. Degree of policy awareness		Degree of awareness about the land acquisition policies, rated on a ten-point scale	Modified by Huang et al., (2017) [31]
	5. Livelihood strategy	H5	RC6	12. Working outside the community	Percent	Percent households without members working outside the community	Modified by Huong et al., (2019) [33]; Fahad et al., (2023) [34]
		H6	RC7	13. Dependent on agriculture/fishing/forestry as the major source of income	Percent	Percent of households dependent on agriculture/fishing/forestry as a major source of income	Modified by Hahn et al., (2009) [30]; Huong et al., (2019) [33]; Fahad et al., (2023) [34]
		H7	RC8	14. Households without non-agricultural livelihood income contribution	Percent	Percentage of households without non-agricultural livelihood income contribution	

Table 1. *Cont.*

Capital	Major components	Code of Capital	Code of LVI	Sub-components (Indicator)	Units	Explanatory notes	References
Social capital	6. Socio-demographic	S1	RC9	15. Percentage of poor and near-poor households	Percent	According to Vietnam's poverty standard, near-poor households have an income of less than 24 million VND (equivalent to 1000 USD) each year	Modified by Hahn et al., (2009) [30]; Huong et al., (2019) [33]; Fahad et al., (2023) [34]
		S2	RC10	16. Dependency ratio	Persons	Dependency ratio is the ratio of the population <15 years and > 60 years of age to the population between 19 and 64 years of age).	
	7. Social connection	S3	RC11	17. No association with any community	Percent	Percent of households that have not been members of any organizations	Extended by Huong et al. (2019) [33]
		S4	RC12	18. Access to information on household	Percent	Ability to access information after land acquisition (scale 10)	Extended by Huang et al. (2017) [31]
		S5	RC13	19. Changes in social connections after land acquisition	Percent	Percentage of households with have increasing social connections after land recovery	
Financial capital	8. Financial resource	F1	RC14	20. Debt to pay back to individual lender	Percent	Percent of households who have debt to pay back to individual lenders. Expressed through binarization: 0 = yes; 1 = no	Extended by Huang et al. (2017) [33]
		F2	RC14	21. Support financial from outside sources		Percentage of households with financial support from outside sources. Expressed through binarization: 0 = yes; 1 = no	
		F3	RC16	22. Saving	Percent	Percentage of households with savings	
	9. Finance relevant land lost	F4	S7	23. Income from the land before losing land	VND	Percentage of agricultural income from the land before losing land	New Main Component. Questions modified by Huang et al. (2017) [31]
		F5	RC17	24. Compensation payment for land expropriation	VND	Including the compensation payment for resettlement, green crops, and attachments on the land	
Physical capital	10. Infra-structure	F6	RC18	25. Road quality		Road quality after land acquisition, rated on a ten-point scale	25, 26 components are new main components
		F7	RC19	26. Electricity system quality		Quality of electricity system after land acquisition, rated on a ten-point scale	

3.2. Calculating the LVI

LVI indicates are calculated through three steps. After raw data were transformed into appropriate measurement units, each sub-component was standardized by the following equation:

$$A_i^{'} = \frac{A_i - A_{min}}{A_{max} - A_{min}} \qquad (1)$$

Where A_i is the original sub-component for the household; A_{max} and A_{min} are the maximum and minimum of each indicator, respectively; i is the number of the sample.

After each was standardized, the sub-components were averaged using Equation (2) to calculate the standardized scores of each main component:

$$H_d = \frac{\sum_{i=1}^{n} A_i^{'}}{n} \qquad (2)$$

Where H_d is one of the ten significant components of district d, A_i represents the sub-components, indexed by i, that make up each major component, and n is the number of sub-components in each major component.

Lastly, the LVI score was generated by combining the weighted averages of all the major components (Equation 3). To ensure that all main components contribute equally to the overall LVI, the weights of each main component are determined by the number of sub-components it comprises [35].

$$LVI_d = \frac{\sum_{i=1}^{10} \omega_i H_{di}}{\sum_{i=1}^{10} \omega_i} \qquad (3)$$

Where LVI_d is the vulnerability index for one of the districts, equals the weighted average of the ten major components; ω_i is the weight of each significant component, which are determined by the number of sub-components that make up each major component. The range of LVI lies between 0 (least vulnerable) to 0.5 (most vulnerable).

3.3. Calculating the LVI From the Sensitivity Index and Response Capacity Index

This study also adopted an alternative method for calculating LVI based on the two main dimensions: sensitivity/exposure to lost land and capacity to respond to negative impacts of land requisition. The LVI is calculated following Equation (4):

$$\text{LVI= Sensitivity index/Response capacity index} \qquad (4)$$

In which the sensitivity (SE) and response capacity (RC) index are understood as standardized values of the sensitivity/exposure indicator and RC indicator, respectively. In this study, the weight for each sensitivity/exposure index indicator or the RC is assumed to be equal. Our research has identified seven indicators that reflect sensitivity/exposure and nineteen indicators that reflect response capacity. So, the standardized values of the two indexes are calculated according to the following Equation (5) and (6):

$$SE = \frac{\sum_{j=1}^{7} X_{SEj}^{'}}{7} \qquad (5)$$

$$RC = \frac{\sum_{j=1}^{19} X_{RCj}^{'}}{19} \qquad (6)$$

Where SE and RC are sensitivity/exposure and RC index, respectively. X_{SEj} and X_{RCj} are indicators representing sensitivity/exposure and RC, respectively.

4. Results

4.1. Social Characteristics of Households

The social characteristics of the surveyed households are shown in **Table 2**. A significant majority of household heads are male (75%), which may indicate that land ownership and control are more likely to be in the hands of men, potentially influencing decisions around land acquisition and vulnerability. A smaller percentage of households have female heads (25%), which may imply that women could face additional challenges related to land acquisition, particularly in regions where land rights for women are limited. The educational level of household heads in the survey area is relatively low. 57.8% of household heads have secondary education, and only 11.56% of household heads graduated from high school. The number of household heads with a college or university degree is negligible (1.88%).

Table 2. Social characteristics of the surveyed households.

Household Characteristics	Freq.	Percent (%)	Household Characteristics	Freq.	Percent (%)
1. Status of household			**3. Education Level of Household head**		
Poor and near poor households	21	5.65	Did not go to school	1	0.27
Average households	331	88.98	Primary	106	28.49
Well-off and rich households	20	5.37	Secondary	215	57.80
2. Livelihood			High School	43	11.56
Off-farm	99	26.61	College or University	7	1.88
On-farm	220	59.14			
Worker	22	5.91	**4. Gender of household head**		
Small business	24	6.45	Male	279	75.00
Labor export	7	1.88	Female	93	25.00
Household characteristics		**Mean**	**Std. Dev**	**Min**	**Max**
Age of household head (year)		64.944	11.077	38	99
Farmland size (ha)		0.108	0.042	0.036	0.18

While the majority of households fall into the average category, only 5.65 percent of the surveyed households are considered poor or near poor. More than half of the surveyed households currently depend on agriculture for their livelihoods (59.14%). These households may be highly vulnerable to land acquisition since their income directly depends on access to land.

The average age of household heads suggests a relatively older population (64 years), which could be more vulnerable to the impacts of land acquisition, as older individuals may be less adaptable to change and have fewer opportunities to shift livelihoods. The average farmland size is relatively small, only 0.108ha per household, which could mean that any loss of land would have a significant impact on the household's livelihood. Smaller land holdings increase vulnerability, especially in the case of land acquisition for commercial or industrial purposes.

4.2. Livelihood Vulnerability Index (LVI)

Table 3 and **Figure 2** present the results of the LVI for four study districts: Thai-Binh city, Hung-Ha, Dong-Hung, and Tien-Hai districts. A total of ten major components were calculated from twenty-six sub-components. Overall, Dong-Hung has the highest LVI at 0.541, while the LVIs for Hung-Ha and Thai-Binh city are higher than those of Tien-Hai. The spider diagram clearly illustrates that Dong-Hung is more vulnerable in six out of ten major components, particularly in the areas of environment, knowledge and skills, socio-demographics, infrastructure, livelihood strategy, and social networks. In contrast, Thai-Binh city exhibits slightly higher vulnerability in health and financial resources, Hung-Ha shows increased vulnerability related to finance and land loss, and Tien-Hai is particularly vulnerable in terms of land. Notably, the environmental component has the highest level of vulnerability.

Table 3. Summary of the LVI results for ten components of the study area.

Contributing Factors	Major Components	Major Components Values				Number of Sub-components per Major Component	Contributing Factor Values			
		Dong-Hung	Hung-Ha	Thai-Binh city	Tien-Hai		Dong-Hung	Hung-Ha	Thai-Binh city	Tien-Hai
Human capital	Health	0.385	0.397	0.431	0.382	2	0.374	0.125	0.297	0.287
	Knowledge and skills	0.480	0.389	0.367	0.441	2				
	Livelihood strategy	0.297	0.188	0.162	0.122	3				

Table 3. *Cont.*

Contribut-ing Factors	Major Components	Major Components Values				Number of Sub-components per Major Component	Contributing Factor Values			
		Dong-Hung	Hung-Ha	Thai-Binh city	Tien-Hai		Dong-Hung	Hung-Ha	Thai-Binh city	Tien-Hai
Natural capital	Land	0.441	0.421	0.307	0.464	2	0.701	0.647	0.608	0.674
	Environment	0.806	0.737	0.728	0.759	5				
Social capital	Socio-demographic	0.303	0.256	0.299	0.282	2	0.253	0.184	0.230	0.223
	Social networks	0.219	0.137	0.185	0.183	3				
Financial capital	Finance resource	0.207	0.212	0.307	0.125	3	0.295	0.306	0.348	0.239
	Finance-relevant land lost	0.426	0.448	0.411	0.410	2				
Physical capital	Infrastructure	0.785	0.701	0.721	0.728	2	0.785	0.701	0.721	0.728

Notes: Overall livelihood vulnerability index. LVI: Dong-Hung 0.541, LVI: Hung-Ha 0.492, LVI: Thai-Binh city 0.486, LVI: Tien-Hai 0.404.
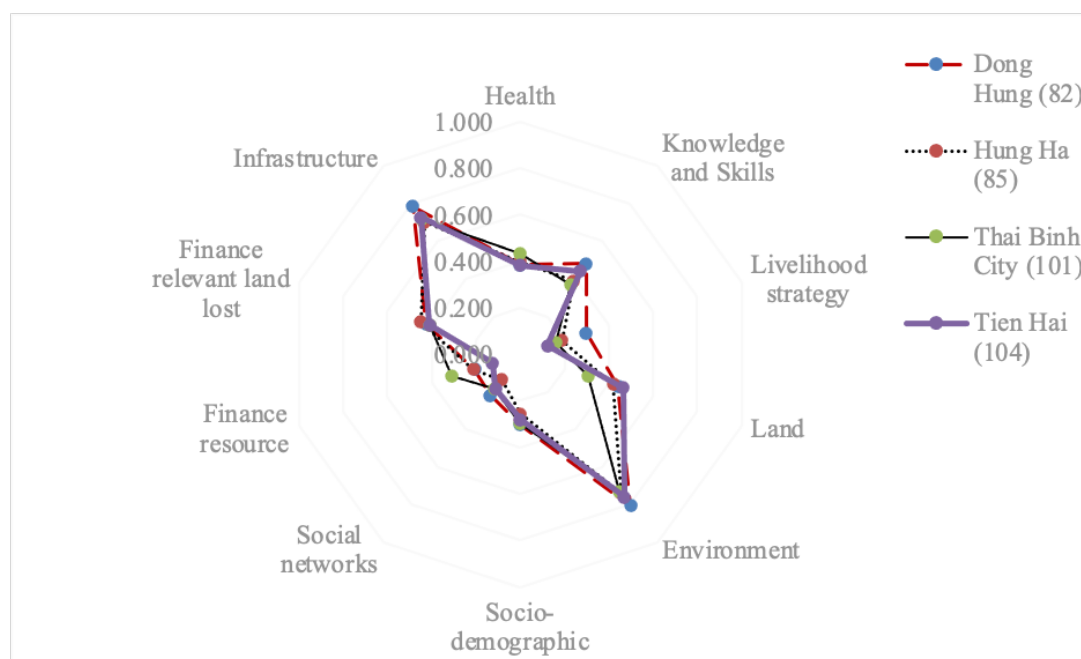

Figure 2. Vulnerability spider diagram of the ten principal components of the LVI of Thai-Binh province.

Table 4 provides a detailed overview of the indexed sub-components and significant components for the study areas. Dong-Hung exhibited the highest vulnerability in land loss (0.833), waste pollution (0.750), noise pollution (0.854), air pollution (0.823), and local landscape quality (0.843). In contrast, Hung-Ha showed the greatest vulnerability in terms of landless households (0.106) and agricultural income from land prior to acquisition (0.788). Thai-Binh city ranked highest in vulnerability concerning the health of the head of household (0.564), labor availability (0.298), and savings (0.416). Tien-Hai's most significant vulnerability indices were land loss (0.889), dependency ratio (0.535), lack of savings (0.952), and absence of external financial support (0.280).

Table 4. Indexed sub-components, significant components, and overall LVI for three districts and one city.

SLF	Sub-components (Indicator)	Dong-Hung (82)	Hung-Ha (85)	Thai-Binh City (101)	Tien-Hai (104)	Major Components	Dong-Hung (82)	Hung-Ha (85)	Thai-Binh City (101)	Tien-Hai (104)
Natural capital	1. Land-lost	0.833	0.736	0.565	0.889	1. Land	0.441	0.421	0.307	0.464
	2. Landless households	0.049	0.106	0.050	0.038					
	3. Level of waste pollution	0.750	0.722	0.678	0.762	2. Environment	0.806	0.737	0.728	0.759
	4. Noise pollution level	0.854	0.821	0.743	0.787					
	5. Air pollution level	0.823	0.719	0.722	0.758					
	6. Quality of local landscape	0.843	0.794	0.779	0.768					
	7. Access to clean water	0.759	0.627	0.720	0.719					
Human capital	8. Health of the head of household	0.531	0.515	0.564	0.505	3. Health	0.385	0.397	0.431	0.382
	9. Labor in a households	0.240	0.280	0.298	0.259					
	10. Education level of household head	0.220	0.118	0.050	0.163	4. Knowledge and skills	0.480	0.389	0.367	0.441
	11. Degree of policy awareness	0.740	0.661	0.685	0.718					
	12. Working outside the community	0.134	0.047	0.069	0.048	5. Livelihood strategy	0.297	0.188	0.162	0.122
	13. Dependent on agriculture/fishing/forestry as the major source of income	0.500	0.412	0.287	0.173					
	14. Households without non-agricultural livelihood income contribution	0.256	0.106	0.129	0.144					
Social capital	15. Percentage of poor and near-poor households	0.098	0.035	0.069	0.029	6. Socio-demographic	0.303	0.256	0.299	0.282
	16. Dependency ratio	0.508	0.476	0.528	0.535					
	17. No association with any community	0.244	0.153	0.327	0.452	7. Social connection	0.219	0.137	0.185	0.183
	18. Access to information on household	0.085	0.081	0.079	0.078					
	19. Changes in social connections after land acquisition	0.329	0.176	0.149	0.019					
Financial capital	20. Debt to pay back to individual lender	0.159	0.188	0.257	0.115	8. Financial resource	0.207	0.212	0.307	0.125
	21. Support Ffinances from outside sources	0.280	0.212	0.248	0.212					
	22. Saving	0.183	0.235	0.416	0.048					
	23. Income from the land before losing land	0.735	0.788	0.743	0.754	9. Finance relevant land lost	0.426	0.448	0.411	0.410
	24. Compensation payment for land expropriation	0.117	0.107	0.078	0.066					

Table 4. *Cont.*

SLF	Sub-components (Indicator)	Dong-Hung (82)	Hung-Ha (85)	Thai-Binh City (101)	Tien-Hai (104)	Major Compo-nents	Dong-Hung (82)	Hung-Ha (85)	Thai-Binh City (101)	Tien-Hai (104)
Physical capital	25. Road quality	0.779	0.748	0.736	0.719	10. Infra-structure	0.785	0.701	0.721	0.728
	26. Electricity system quality	0.790	0.654	0.707	0.737					

The vulnerability results for the five capitals are illustrated in a spider diagram (**Figure 3**). In all four surveyed areas, natural capital and physical capital emerged as the most vulnerable. In contrast, human capital, social capital, and financial capital exhibited lower susceptibility. Dong-Hung showed vulnerability across most capitals, with the following vulnerability index values: human capital (LEI = 0.374), natural capital (LEI = 0.701), social capital (LEI = 0.253), and physical capital (LEI = 0.785). Thai-Binh city demonstrated the highest vulnerability in financial capital, with an LEI of 0.348. Overall, natural and physical capital were significant contributors to vulnerability across all surveyed areas.
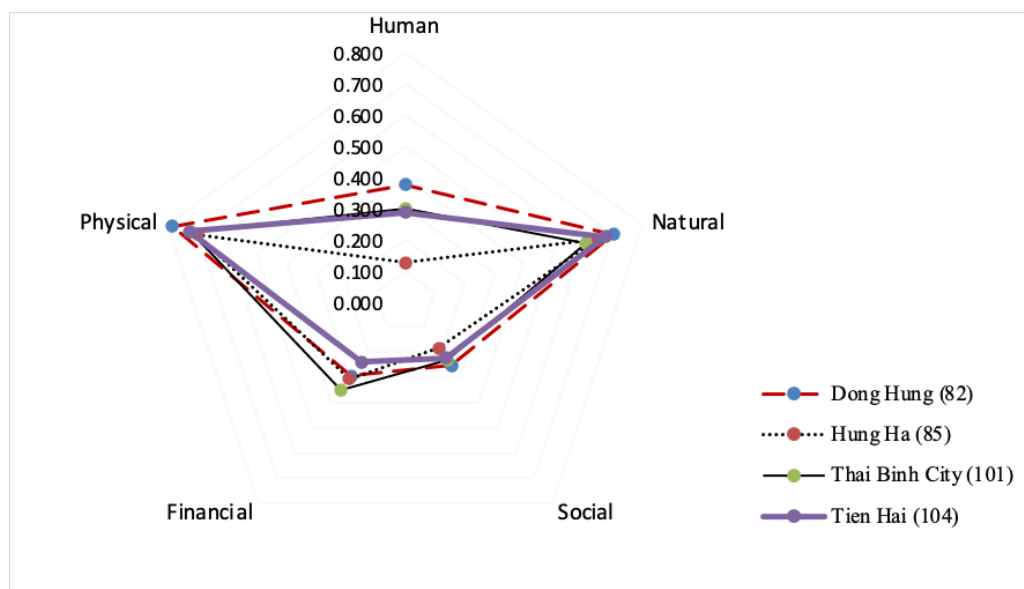

Figure 3. Vulnerability diagram of five capitals of Thai-Binh province.

In this study, we adopted an alternative method for calculating the LVI using the SE and RC indexes. The arrangement of sub-indicators into SE and RC indicators utilized for calculating the LVI is detailed in **Table 1**. The overall indexed values are presented in **Table 5**. The most vulnerable area is Tien-Hai, with an LVI of 2.249, while the least vulnerable area is Dong-Hung, with an LVI of 0.675.

Table 5. The sensitive and response capacity of study areas.

	Dong-Hung	Hung-Ha	Thai-Binh City	Tien-Hai
SE index	0.698	0.670	0.611	0.679
RC index	0.366	0.307	0.337	0.302
LVI	0.675	2.182	1.817	2.249

5. Discussion

According to the findings, natural capital is highly vulnerable across all regions, significantly contributing to overall livelihood vulnerability. This vulnerability is strongly influenced by sub-component indicators, such as land loss and environmental factors, which greatly affect the overall vulnerability level. Both Dong-Hung and Tien-Hai districts exhibit high rates of agricultural land acquisition. Additionally, the environmental indicator is notably high in all four surveyed areas. This is in contrast to the study by Tuan, N. T. [17], which found that land acquisition can lead to a decline in environmental and social quality.

The ongoing success of the "New Rural Development Program" in Vietnam and Thai-Binh province has positively impacted the environmental indicator, which, in turn, benefits livelihoods. Moreover, Thai-Binh's economic index stands out due to two key factors that attract investment: macroeconomic stability and economic growth, as well as competitive labor costs and productivity. These factors have played a significant role in attracting FDI, especially green FDI. The land acquisition policies, along with sustainable development strategies, have contributed positively to improving infrastructure and enhancing the quality of life for local residents [36].

Human capital vulnerability was found to be moderate. Key factors influencing human capital in the studied regions include the health of household heads, policy awareness, and primary income sources. The results indicate that Dong-Hung has more vulnerable livelihoods compared to other areas, primarily because it is a purely agricultural district. The population in Dong-Hung relies heavily on agriculture, with 50% of household's dependent on agriculture, fishing, or forestry as a significant source of income. In contrast, this rate is only 17.3% in Tien-Hai and 28.7% in Thai-Binh city. Furthermore, Dong-Hung has the highest percentage of households without any non-agricultural income contributions (25.61%), followed by Tien-Hai (14.42%) and Hung-Ha (10%). Consequently, households in Dong-Hung have a weaker ability to adapt their livelihoods when land is lost due to acquisition. This finding confirms many previous studies by Huang et al. [31]

that households with higher agricultural income may face greater livelihood risks due to their heavy reliance on agriculture, making their vulnerability more pronounced when they lose land.

In contrast, Tien-Hai benefits from 23 kilometers of coastline and the National Highway 37B, which connects eight provinces and an ancient gas mine. This geographical advantage has led to a diverse economy encompassing agriculture, industry, trade, services, tourism, and marine exploitation. Tien-Hai has greater potential for transforming livelihood strategies post-land acquisition, thanks to its diverse livelihood sources reliant on the sea, such as fishing and clam farming. Despite Tien-Hai having the highest rate of agricultural land recovery (88.94%), only 3.846% of farming households lack land and need to buy or rent additional land, which is the lowest rate among the study areas. There is a notable disparity in the percentage of households with net annual incomes below $1,500 across the localities, with Dong-Hung having the highest rate and Tien-Hai the lowest. This difference is a contributing factor to the highest vulnerability in Dong-Hung and the lowest in Tien-Hai. The acquisition of agricultural land is one of the causes of the explosion of non-agricultural activities. Therefore, for areas with diversified livelihoods, the acquisition of agricultural land can become a driving force for the transformation of farmer's livelihoods [19].

Overall, human capital vulnerability is moderate. Key determinants include household health, policy awareness, and primary income sources, which significantly influence access to human capital in the studied regions. Although policy awareness and the health of household heads contribute positively to human capital, the variations between the surveyed areas are minimal. Surprisingly, only 5.00% of household's head in Thai-Binh City have completed high school, despite being the economic and cultural center of the province. This educational factor hinders the adaptability of farming households in Thai-Binh city as they attempt to transition to non-agricultural livelihoods.

The moderate vulnerability level of social capital can be attributed to factors such as the dependency ratio, community membership, and changes in social connections following land acquisition. When households

become members of social organizations or establish more connections after land acquisition, they gain access to valuable knowledge, experiences, and information, which helps mitigate the negative impacts of this process. However, Tien-Hai stands out with the highest vulnerability levels in these two indicators, as well as in the dependency ratio. A significant proportion of households in Tien-Hai are not members of any organizations, resulting in limited access to information after land acquisition, and the rate of households experiencing increased social connections post-land recovery is the lowest in the area. This indicates that the acquisition of agricultural land does not enhance opportunities for households in Tien-Hai to participate in social organizations. One contributing factor to this situation is that Tien-Hai has the largest Catholic population in the province, accounting for one-third of the province's Catholic community. Members of this community often maintain social connections primarily within their own group, limiting their interactions with other communities. A social network analysis also shed light on how community ties influence access to information, economic opportunities, and resilience in the face of land loss.

The medium level of financial capital vulnerability also affects the overall livelihoods of the population, though variations exist among different regions. Notably, while compensation for land acquisition in Dong-Hung and Hung-Ha is more substantial compared to other areas, the overall vulnerability in these locations remains high. This suggests that the level of compensation does not significantly enhance the adaptive capacity or reduce the vulnerability of households in areas affected by land acquisition. This situation has also been seen in many other countries such as China [31,37]. Moreover, the way compensation funds are currently used by households has not been effective. Many households allocate the compensation for non-productive purposes such as building new homes, buying vehicles, or acquiring other luxury items. In some cases, individuals even invest the funds in illegal activities like fundraising schemes and gambling. Only a minority of people use their compensation money for productive investments or business activities that could sustain their livelihoods. In Vietnam, land ownership is considered universal, with the State acting as the representative owner. The State retains the authority to reclaim land for economic, social, and political purposes, compensating for agricultural land at rates significantly lower than market value [18]. This creates conflicts of interest among stakeholders involved in land recovery and conversion [19]. Furthermore, the current use of compensation for households has proven ineffective. Consequently, the government should consider revising the approaches to land acquisition compensation support. Providing compensation or financial aid may yield better results if implemented concurrently with additional measures such as offering training, facilitating job placement, or investing in infrastructure to promote alternative livelihoods. In addition, transparency of information and data on land acquisition should be promoted to reduce conflicts among stakeholders.

The susceptibility of physical assets was the primary factor contributing to the overall vulnerability of livelihoods, with minimal disparities among regions. The quality of roads and electricity across all areas is highly rated, reflecting the infrastructure improvements that have delighted residents. Significant support for infrastructure development has created additional opportunities for regional advancement. By July 2024, Thai-Binh province plans to implement numerous projects, including roads, highways, bridges, and two thermal power plants, while also developing wind and gas power sources to generate clean energy and balance future emissions.

The study compares vulnerability levels among regions using the second method, which approaches the LVI through five livelihood groups. Results from this method are detailed in **Table 4**, where the LVI is calculated using the SE and RC indices. Although Tien-Hai exhibits a higher overall sensitivity to land acquisition, its overall vulnerability is lower. Dong Hung is the second most vulnerable area, primarily due to high landlessness, a lack of community members with jobs outside agriculture, dependency on agricultural livelihoods, and a significant poverty rate. To address land shortages resulting from land acquisition, households may navigate between customary institutions and state policies to acquire land independently. This approach is encouraged by the Vietnamese government and is

viewed as an opportunity for farmers to consolidate production land on a larger scale [38]. Tien-Hai ranks as the second highest in overall vulnerability. Factors contributing to this include limited social connections among residents and a high rate of landlessness due to extensive land acquisitions, which heightens sensitivity in the area. To improve resilience, leveraging existing social groups can facilitate networking, promote cooperation, enhance knowledge exchange, and foster entrepreneurship within the community. This strategy would provide households with better access to information and strengthen farmers' ability to cope with land acquisition challenges.

The overall indexed values of LVI showed that the sensitivity and response of households in the study areas did not differ significantly. Our analysis reveals that it is challenging to identify distinct indicators of household vulnerability or exposure across different study areas. This implies that the effects of external shocks or risks on households are generally similar, particularly in the case of natural disasters. For instance, within the same community, it is hard to pinpoint which households experience the most severe effects of flooding. We suggest that a comparable pattern can be observed with land seizures in our study.

6. Conclusions

This study integrates multiple indicators to evaluate household vulnerability to agricultural land acquisition, focusing on livelihood resources, sensitivity, and adaptive capacity among farming households in Vietnam's Red River Delta. Among the assessed areas, Dong-Hung district emerges as the most vulnerable, followed by Hung-Ha, Thai-Binh, and Tien-Hai districts, with variations in vulnerability influenced by differing levels of sensitivity and adaptive capacity within each community. Compensation payments for land expropriation are generally inadequate in mitigating household vulnerabilities. However, Tien-Hai district demonstrates greater resilience due to its coastal location, which facilitates a smoother transition to alternative livelihoods. To reduce vulnerability among affected households, farmers should proactively consolidate land for agricultural production or explore new livelihood opportunities. Ad-

ditionally, the government should diversify its support mechanisms by promoting non-agricultural employment and implementing vocational training programs tailored to local socio-economic contexts. Strengthening social connectivity through existing local socio-political organizations can also enhance community resilience and adaptive capacity.

Although the study analyzed many factors such as human resources, finance, and environment, factors beyond the scope of the study area, such as the impact of national policies, macroeconomic fluctuations, or climate change, may not have been fully assessed. These factors may have a major impact on the adaptive capacity and livelihoods of households that lost land. Future studies could integrate more macro and objective factors into the analysis. In addition, the study did not assess in detail the alternative livelihood strategies, opportunities and challenges of shifting from agriculture to non-agriculture, and the success of these strategies in each specific area. Further research on employment opportunities, training, and support networks for households would help to better understand the sustainability of these strategies.

Author Contributions

N.N.-T.-K., L.N.-T.-T., N.T.-T., A.D.-M., A.A.S., and H.N.-T.-L. contributed to the study conception and design. Material preparation, data collection, and analysis were performed by N.T.-T., N.N.-T.-K. and H.N.-T.-L. The first draft of the manuscript was written by L.N.-T.-T., N.N.-T.-K. and A.D.-M. All authors have read and approved the final manuscript.

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Conflicts of Interest

The authors disclosed no conflict of interest.

References

[1] Mechiche-Alami, A., Yagoubi, J., Nicholas, K.A., 2021. Agricultural land acquisitions unlikely to address the food security needs of African countries. World Development. 141, 105384. DOI: https://doi.org/10.1016/j.worlddev.2020.105384

[2] Li, C., Wang, M., Song, Y., 2018. Vulnerability and livelihood restoration of landless households after land acquisition: Evidence from peri-urban China. Habitat International. 79, 109–115. DOI: https://doi.org/10.1016/j.habitatint.2018.08.003

[3] Liu, M., Lo, K., 2022. The territorial politics of urban expansion: Administrative annexation and land acquisition. Cities. 126, 103704. DOI: https://doi.org/10.1016/j.cities.2022.103704

[4] Pham Thi, N., Kappas, M., Faust, H., 2021. Impacts of agricultural land acquisition for urbanization on agricultural activities of affected households: a case study in Huong Thuy Town, Thua Thien Hue province, Vietnam. Sustainability. 13(15), 8559. DOI: https://doi.org/10.3390/su13158559

[5] Whiting, S.H., 2022. Land rights, industrialization, and urbanization: China in comparative context. Journal of Chinese Political Science. 27(2), 399–414. DOI: https://doi.org/10.1007/s11366-022-09786-3.

[6] Porsani, J., Caretta, M.A., Lehtilä, K., 2019. Large-scale land acquisitions aggravate the feminization of poverty: Findings from a case study in Mozambique. GeoJournal. 84, 215–236. DOI: https://doi.org/10.1007/s10708-017-9836-1

[7] Heurlin, C., 2019. Unemployment among land-losing farmers in China: Evidence from the 2010 census. Journal of Contemporary China, 28(117), 434–452. DOI: https://doi.org/10.1080/10670564.2018.1542223

[8] Nguyen, P., van Westen, A., Zoomers, A. 2017. Compulsory land acquisition for urban expansion: Livelihood reconstruction after land loss in Hue's peri-urban areas, Central Vietnam. International Development Planning Review. 39(2), 99–121. DOI: https://doi.org/10.3828/idpr.2016.32

[9] Karmakar, P., 2017. Politics of development: Land acquisition and economic development in India. Journal of Land and Rural Studies. 5(2), 164–182. DOI: https://doi.org/10.1177/2321024917703848

[10] Ju, Q., Ni, J., Ni, D., et al., 2016. Land acquisition, labor allocation, and income growth of farm households. Emerging Markets Finance and Trade. 52(8), 1744–1761. DOI: https://doi.org/10.1080/1540496X.2016.1181860

[11] Quansah, C., Ansah, W.O., Mensah, R.O., 2020. Effects of large-scale land acquisition on livelihood assets in the Pru East district of Ghana. Journal of Environment and Earth Science. 10(2), 72–83. DOI: https://doi.org/10.7176/JEES/10-2-08

[12] Sullivan, J., Brown, D., Moyo, F., et al., 2022. Impacts of large-scale land acquisitions on smallholder agriculture and livelihoods in Tanzania. Environmental Research Letters. 17(8), 084019. DOI: https://doi.org/10.1088/1748-9326/ac8067

[13] Yang, H., Huang, Z., Fu, Z., et al., 2023. Does land transfer enhance the sustainable livelihood of rural households? Evidence from China. Agriculture. 13(9), 1667. DOI: https://doi.org/10.3390/agriculture13091667

[14] Mabe, F.N., Nashiru, S., Mummuni, E., et al., 2019. The nexus between land acquisition and household livelihoods in the Northern region of Ghana. Land Use Policy. 85, 357–367. DOI: https://doi.org/10.1016/j.landusepol.2019.03.043

[15] Nanhthavong, V., Oberlack, C., Hett, C., et al., 2021. Pathways to human well-being in the context of land acquisitions in Lao PDR. Global Environmental Change. 68, 102252. DOI: https://doi.

org/10.1016/j.gloenvcha.2021.102252

[16] Le, K., Nguyen, M., 2020. The impacts of farmland expropriation on Vietnam's rural households. Review of Development Economics. 24(4), 1560–1582. DOI: https://doi.org/10.1111/rode.12702

[17] Tuan, N.T., 2021. Shrinking agricultural land and changing livelihoods after land acquisition in Vietnam. Bulletin of Geography. Socio-Economic Series. (53), 17–32. DOI: https://doi.org/10.2478/bog-2021-0020

[18] Tuan, N.T., 2023. Land tenure and land acquisition enforcement in Vietnam. SAGE Open. 13(1), 21582440231163102. DOI: https://doi.org/10.1177/21582440231163102

[19] Nguyen, Q., Kim, D.-C., 2020. Reconsidering rural land use and livelihood transition under the pressure of urbanization in Vietnam: A case study of Hanoi. Land Use Policy. 99, 104896. DOI: https://doi.org/10.1016/j.landusepol.2020.104896

[20] Nguyen, T.H.T, Bui, Q.T., Man, Q.H., et al., 2016. Socio-economic effects of agricultural land conversion for urban development: Case study of Hanoi, Vietnam. Land Use Policy, 54, 583–592. DOI: https://doi.org/10.1016/j.landusepol.2016.02.032

[21] Li, C., Wu, K., Wu, J., 2018. Urban land use change and its socio-economic driving forces in China: A case study in Beijing, Tianjin and Hebei region. Environment, Development and Sustainability. 20, 1405–1419. DOI: https://doi.org/10.1007/s10668-017-9928-6

[22] Nkansah-Dwamena, E., 2021. Can large-scale land acquisition deals improve livelihoods and lift people out of poverty in sub-Saharan Africa? Empirical evidence from Tanzania. Journal of Agriculture, Food Systems, and Community Development. 10(3), 243–264. DOI: https://doi.org/10.5304/jafscd.2021.103.013

[23] Kebede, D., Tesfay, G., Emana, B., 2021. Impact of land acquisition for large-scale agricultural investments on income and asset possession of displaced households in Ethiopia. Heliyon. 7(12). DOI: https://doi.org/10.1016/j.heliyon.2021.e08557

[24] Tuyen, T.Q., 2014. The impact of farmland loss on income distribution of households in Hanoi's peri-urban areas, Vietnam. Hitotsubashi Journal of Economics. 189–206. DOI: https://doi.org/10.15057/26972

[25] Nguyen, T.T., Hegedűs, G., Nguyen, T.L., 2019. Effect of land acquisition and compensation on the livelihoods of people in Quang-Ninh district, Quang-Binh province: Labor and income. Land. 8(6), 91.

DOI: https://doi.org/10.3390/land8060091

[26] Kebede, D., Emana, B., Tesfay, G., 2023. Impact of land acquisition for large-scale agricultural investments on food security status of displaced households: The case of Ethiopia. Land Use Policy. 126, 106507. DOI: https://doi.org/10.1016/j.landusepol.2022.106507

[27] Wang, D., Qian, W., Guo, X., 2019. Gains and losses: Does farmland acquisition harm farmers' welfare? Land Use Policy. 86, 78–90. DOI: https://doi.org/10.1016/j.landusepol.2019.04.037

[28] GSO, 2022. General Statistics Organization of Vietnam 2022. General Statistics Office of Vietnam: Hanoi, Vietnam.

[29] Tiep, N.C., Van Song, N., Anh, N.T.Q., et al., 2020. Agricultural cooperative development in Thai-Binh province, Vietnam: Situation and solutions. Modern Economy. 11(07), 1376. DOI: https://doi.org/10.4236/me.2020.117098

[30] Hahn, M.B., Riederer, A.M., Foster, S.O., 2009. The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change: A case study in Mozambique. Global Environmental Change. 19(1), 74–88. DOI: https://doi.org/10.1016/j.gloenvcha.2008.11.002

[31] Huang, X., Huang, X., He, Y., et al., 2017. Assessment of livelihood vulnerability of land-lost farmers in urban fringes: A case study of Xi'an, China. Habitat International, 59, 1–9. DOI: https://doi.org/10.1016/j.habitatint.2016.11.001

[32] Coelho, P.S., Esteves, S.P., 2007. The choice between a fivepoint and a ten-point scale in the framework of customer satisfaction measurement. International Journal of Market Research. 49(3), 313–339. DOI: https://doi.org/10.1177/147078530704900305

[33] Huong, N.T.L., Yao, S., Fahad, S., 2019. Assessing household livelihood vulnerability to climate change: The case of Northwest Vietnam. Human and Ecological Risk Assessment: An International Journal. 25(5), 1157–1175. https://doi.org/10.1080/10807039.2018.1460801

[34] Fahad, S., Hossain, M.S., Huong, N.T.L., et al., 2023. An assessment of rural household vulnerability and resilience in natural hazards: Evidence from flood prone areas. Environment, Development and Sustainability. 25(6), 5561–5577. DOI: https://doi.org/10.1007/s10668-022-02280-z

[35] Sullivan, C., 2002. Calculating a water poverty index. World Development. 30(7), 1195–1210. DOI: https://doi.org/10.1016/S0305-750X(02)00035-9

[36] Anh, V.T.K., Ha, H.T.V., Ha, D.T., et al., 2019. The impacts of industrial parks to socio-economic de-

velopment experimental research in Thai-Binh province, Vietnam. Academy of Accounting and Financial Studies Journal. 23(4), 1–19.

[37] Shackleton, R.T., 2020. Loss of land and livelihoods from mining operations: A case in the Limpopo Province, South Africa. Land use policy. 99, 104825. DOI: https://doi.org/10.1016/j.landusepol.2020.104825

[38] Nguyen, V.H.T., Kull, C.A., 2023. Land acquisition through Bricolage? Politics of smallholder acacia plantation expansion in upland Central Vietnam. The Journal of Peasant Studies. 50(4), 1501–1528. DOI: https://doi.org/10.1080/03066150.2022.2029849