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Assessing Impacts of Development-Induced and Climate Change Factors on Livelihood Strategies in Hau Giang Province, Vietnam

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[*Abstract*]

In response to climatic shocks and socio-economic changes, livelihood transitions have been undertaken across different agro-ecological regions of Vietnam's Mekong Delta. This article compares the transitional process in two areas with distinct external and intrinsic variables to examine how ecological and social forces affect farmers' livelihood strategies. Perceptions and attitudes of 307 households in Hau Giang were investigated against five aspects of vulnerability using factor analysis. Together with comparative analysis, regression models were used to determine factors driving livelihood transitions. The study found that drivers of transitions varied depending on

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specific contexts in which land use, financial capital, and labor advantages play the leading role. Urbanization impacts had a significant effect, but other aspects of market risks, institutional regulations, and cooperative networks were relatively important. Transitional policies that align with household interests, such as financial subsidies, cooperative incentives, and supportive entrepreneurs, will ensure that local farmers can embark upon sustainable livelihood pathways.

Keywords: Mekong Delta, climate change, sustainable livelihood, peasantry, transition

Ⅰ. Introduction

Changes in the physical landscape of the Mekong Delta have led to agricultural transformation at faster rates than residents can comprehend. The quantity of rice produced, for example, within a generation has quintupled, while cultivated land areas dedicated to three rice harvests per year have increased many times. In coastal provinces, aquaculture products have gradually replaced traditional crops, contributing to GDP per capita improvement (Hoanh et al. 2003; Poelma et al. 2021). At the same time, manufacturing facilities have been established thanks to new flows of direct foreign investments and national ventures. The introduction of industrialized activities has led to ripple effects with important implications for land-use patterns and employment structures in adjacent areas. These transformations have improved the living conditions of Mekong Delta residents, as reflected in the growth of incomes and consumption, together with urbanization processes that aim to accommodate the needs of new classes of consumers.

As land-use patterns have a strong linkage with livelihood strategies, it is expected that development-induced influences play a significant role in shaping the livelihoods in the Mekong Delta. However, urbanization is just one of many layers of external factors influencing Mekong Delta trajectories. Climate change

adaptations and long-term regional development plans have set developmental pathways and strategies that affect local livelihoods (Le et al. 2018; Minkman et al. 2022). The dynamic of these top-down plans and their interactions with locals' priorities present another layer of complexity to livelihood decisions. Within three decades, from the late 1990s to the early 2020s, several development plans were set in place with various adjustments in objectives and developmental approaches, leading to a shift from initial targets of poverty eradication and prioritization of export goods to climate change adaptation and sustainable development.

To what extent these plans and the issues they aim to address have led to livelihood transitions across the 900,000-hectare Mekong Delta is controversial, but differences in transitional paces and impacts can be broadly observed. Agricultural transitions are highly heterogeneous and patchy because the Mekong Delta's diversity in terms of hydrological patterns and soil characteristics tends to reject any uniform, top-down intervention (Tri 2012; Can et al. 2007). Questions on the policies' efficacy and consistency have been raised, but more importantly, drivers of agricultural transformations beyond the macro level have not been fully understood. Studies have stressed top-down policies and climate-related variables as triggers of livelihood decisions (Nguyen et al. 2019a; Hoan et al. 2019). Nonetheless, climate change alone, as a fixed and consistent factor, tends to be limited in explaining the diverse outcomes of livelihood strategies and associated individual lives. In fact, livelihood transitions have occurred at a rapid pace in places where climate impacts are hardly perceived or across communities adjacent to new industrial zones (Tran 2019). These contradictions suggest other factors, such as land-use changes or economic opportunities, might play a significant role.

At the household level, livelihood decisions are often determined by a wide range of factors and influenced by household characteristics and immediate concerns (Ellis 2000). Hence, climate-biased policies might end up failing in cases where factors shaping livelihood decisions are wrongly addressed. When barriers are falsely defined, livelihood sustainability cannot

be achieved because enabling conditions are overlooked, leading to ineffective adaptations. Previous studies on the Delta's livelihoods have factored in livelihood transitions, including land-use dynamics (Tran 2019), hydrological interventions (Le et al. 2018), and climatic conditions (Brown et al. 2018). These macro and meso-level drivers, however, were analyzed separately and failed to capture households' perceptions as well as socio-economic conditions. Hence, this article aims to address this imbalance by comparing factors that affect livelihood transitions at the household level embedded in specific contexts of Hau Giang province (*tỉnh Hậu Giang*) before the 2025 administrative reform and provincial merger.

In particular, the urbanized environment of Ward 4-Vi Thanh City *(phường 4, Thành phố Vị Thanh)* will be juxtaposed with the climate change-induced setting of Luong Nghia Ward-Long My District *(xã Lương Nghĩa, huyện Long Mỹ)* to examine the extent to which development-induced factors and climate-related factors influenced the locals' livelihood decisions. This comparative design allows us to control for other socio-economic factors, while simultaneously investigating the significance of targeted variables, hence empirically comparing the influence of climate change and urbanization on livelihood strategies.

Ⅱ. Analytical Framework and Transitional Livelihood Variables

2.1. Theoretical Framework

Livelihood as a concept is rather elusive and defined differently across time and space. In this study, we linked the definitions of Chambers & Conway (1992) with DFID and FAO frameworks (DFID 1999; FAO 2005) that analyze the nexus between livelihood and sustainability. A livelihood as "a means of gaining a living" and livelihood strategies often relate to a portfolio of different ways of production or earning incomes (Ellis 2000). Within the rural sphere, farmers undertake various kinds of activities to achieve a livelihood. Changes in livelihood

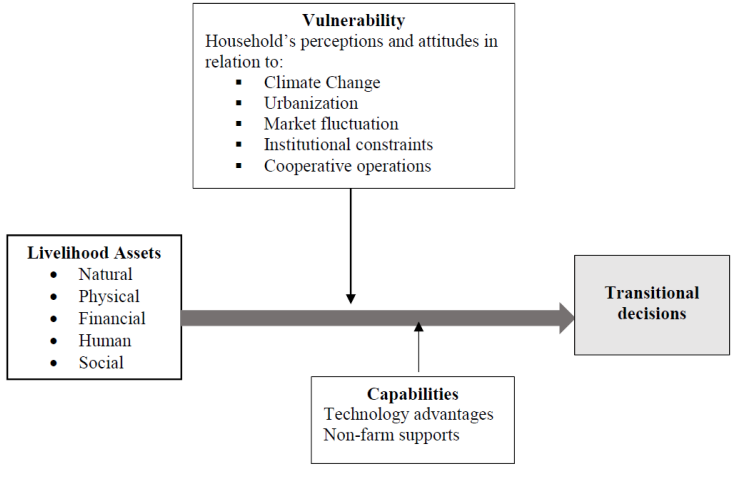
portfolio and livelihood transitions are often driven by socio-economic changes, technologies, and vulnerability. As a dynamic process, livelihood transitions are influenced by past cultivation strategies and household characteristics. While previous studies explored farmers' motivations and abilities (Hoan et al. 2019; Nguyen et al. 2019a), here we focused on transitional decisions that precede the transition process. A transitional decision refers to a specific choice of cultivation practices that conditions ways of organizing land, capital, and labor.

Historically, three dominant livelihood pathways in the Mekong Delta are agricultural intensification, income diversification, and migration. In freshwater alluvial zones, farming production methods have gradually transitioned toward intensification, in which inputs, including fertilizers, water access, and capital, are critical to crop outputs and farmers' welfare. In coastal regions, saline intrusion has had devastating impacts but also generated opportunities for new livelihood pathways. Diversification models focusing on shrimp and rice-shrimp cultivation gained success in Bac Lieu and Ca Mau provinces, and were later replicated by farmers in Soc Trang, Ben Tre and other coastal zones. Within Hau Giang, both freshwater and coastal production systems are commonly adopted due to the province's ecological variety. Across the two research sites, dominant livelihood strategies include two or three rice harvests per year, fruit tree cultivation, and aquaculture. Mixed shrimp-rice farming and intensive farming are also being piloted in sub-zones affected by salinity or brackish water. Non-farming strategies, like wage labor and migration were also significant.

Livelihood transitions, regardless of models and pathways, largely relied on farmers' assets and owned resources. In this study, we utilized the concepts of Scoones (1998; 2009) and Ellis (2000) to develop a theoretical framework for examining livelihood transitions at the household level (Figure 1). Specifically, livelihood assets refer to household-based resources that households have easy access in their everyday activities. Natural capital in the Hau Giang context relates to owned land areas, including rice fields and other types of land-use plots,

aquaculture areas, and homesteads. Physical capital includes farming tools, buildings, and supporting machines. Human capital measures individuals' skills and knowledge. This individual asset takes into account various characteristics like age, ethnicity, and level of education. Social capital links to social networks and relationships, capturing horizontal and vertical linkages among households. Financial capital is measured both at the household level and above, specifically in commune and district settings. This feature takes into account the heterogeneous characteristics of rural finance systems, where peer-to-peer loans tend to mix with long-term credit provided by institutional organizations.

Due to households' heterogeneous characteristics, it is expected that the structure, quality, and quantity of these five forms of capital vary across families and locations. In making transitional decisions, evidence suggests that endogenous factors also have significant impacts. In fact, actions of an individual household might be conditioned by the capabilities of the household's laborers (Sen 1999). Hence, household-level variables related to capabilities such as technology advantages and non-farming support were integrated into the framework.



<Figure 1> Transitional Decisions and Determining Factors. Source: based on Scoones (1998; 2009) and Ellis (2000)

However, the transition process tends not to occur in void settings but operates in a certain context, which is then shaped by different sources of vulnerability. In the Mekong Delta context, vulnerability might come via many layers of uncertainties, including weather shocks, changes in water patterns, and product output price fluctuations (Birkmann et al. 2012; Tuan & Chinvanno 2011). These unpredictable factors in most cases result from or relate to resource access (Ellis 2000). Further, institutional constraints might impact the readiness and accessibility of resource use. Land-use regulations, for example, might enable or limit certain types of livelihood. By combining asset-based, vulnerable, and institutional variables, the framework provides a comprehensive basis to identify the external and internal factors affecting livelihood decisions.

2.2. Variable Descriptions

2.2.1 Measure of Livelihood Transitions (Dependent Variables)
The survey confirmed the transition process by asking if a household had made a livelihood transition within the last five years. The validity of the response was cross-checked by investigating changes in rice field areas and land-use patterns. The scope and intensity of transitions were also classified into three categories, coding from none to partly transitioned to completely transitioned. However, this subjective evaluation of each household might be distorted due to memory loss. To better understand the scope of livelihood transitions, we recorded the actual land area in which the household carried out their agricultural transitions.

2.2.2 Measure of Capital
Nature capital in the Mekong Delta relates to ecological resource stocks that a farming household can easily assess and efficiently use. These stocks include rice fields, fruit tree gardens, shrimp farms, and fishing ponds. Communally-owned resources such as freshwater, canals, irrigation infrastructure, and environmental services are deemed important to farmers' production capabilities because their livelihoods are highly dependent on how other farmers use the shared resources. In this study, we tracked changes in land areas of rice fields, gardens, and ponds over a

ten-year period. The total area of land that a family can access and use for production is categorized under natural capital (LAND variable).

Physical resources include infrastructure and facilities that are essential for farming production (TOOL variable). Farmers located in close proximity to urban centers and markets have a number of advantages in terms of technologies and agricultural transformations. Physical capital also includes farming tools and machinery that contribute to productivity advancement. Considering Ward 4, advantages attributed to urban locations might be offset by pressures of urbanization and land-use constraints.

Financial capital measures the extent to which a household can mobilize resources to materialize a transition. The amount of an investment largely depends on the scope of the transition, but in most cases, such investments are significant and hence can only be covered with bank credits. Since the survey could not record a household's loans over time, we considered the presence of a loan in the last five years, regardless of sources, equivalent to financial sufficiency (LOAN variable). The accuracy of a household's debts was checked against annual debt payments. In addition, non-farm earnings and remittances of family members who worked out of the province were also recorded as financial capital (REMIT variable).

<Table 1> Description of Independent Variables Used in the Analysis

Categories	Variables	Descriptions
Capital and Asset		
- *Nature capital*	LAND	Total land areas, including rice fields, gardens, and ponds
- *Physical*	TOOL	The extent to which a family owned tools and machinery
- *Financial*	LOAN; REMIT	Existence of loans and bank credits; remittances sent by rural-to-urban migrants
- *Human*	LABOR; AGE; EDU	Number of available laborers and household head's characteristics
- *Social*	TIES; LINK	Network participations; direct/vertical linkages with government officials

Categories	Variables	Descriptions
Vulnerability		
- *Climate change*	CLIM	Perceptions of climate risks and environmental hazards
- *Urbanization*	URBAN	Perceived pressure due to the urbanization process and displacement
- *Market*	MARK	Concerns over market risks and agricultural output prices
- *Institution*	REGU	Attitudes and perceptions toward institutional and administrative factors
- *Cooperation*	COOP	Attitudes to cooperative models and practices
Capabilities and Others		
- *Technologies*	TECH	Self-evaluation of advantages in technologies access
- *Land appropriation*	COMPEN	Households that experienced displacements or had a part of their land appropriated
- *Housing conditions*	HOUSE	Area of residential land owned by the family
- *Non-farm support*	SUPP	Percentage of non-farm laborers
- *Female labor*	FEM	The percentage of female laborers in the household
- *Ethnicity*	ETHNIC	Households belonging to Khmer or Chinese ethnic groups

Following the British Department for International Development framework (DFID 1999), we considered human capital as the combination of labor, skills, knowledge, and health that enables households to pursue alternative livelihood strategies. Labor availability was once the key component of farming production in the Mekong Delta. With the advent of machinery and farming services, however, farmers are less dependent on the quantity of laborers. At the same time, new technologies and novel models of farming necessitate know-how as well as sufficient levels of education. Within a household, other variables such as the age and education of the household head and number of laborers have an important effect on livelihood decisions. Hence, these associated demographic variables were collected and placed within human capital (AGE, EDU, LABOR variables).

In terms of social capital, the DFID framework (DFID 1999) defines social capital as social resources upon which individuals might draw to achieve livelihood objectives. The quantity and quality of these resources are often measured by the number of networks and organizations to which an individual belongs. In the Mekong Delta, however, we suggest social capital reflects the position of individual households in the local socio-economic network. Therefore, participation in cooperative organizations (TIES variable) and owning vertical connections with local officials (LINK variable) were the two most important factors observed.

2.2.3 Measure of Vulnerability

In the framework, vulnerability affects transitional decisions via two pathways: direct exposure and indirect impacts perceived by farmers. To measure direct effects, past research utilized official data of regions and then aggregated values for each household. Few studies attempted to capture household attitudes and perceptions on a wide range of vulnerability aspects. Since perceived risks are closely associated with livelihood decisions, we argued that the latter approaches might better reflect the actual effects of vulnerability in the Mekong Delta. In this study, we analyzed a set of 17 questions and utilized factor analysis techniques to form 05 new constructs. Of these five latent variables, four are deemed to be associated with key sources of vulnerability, namely climate change (CLIM), urbanization (URBAN), market risks (MARK), and institutional constraints (REGU). The fifth construct capturing households' attitudes to cooperative models (COOP) was expected to play a mitigating role.

2.2.4 Measure of Capabilities and Other Variables

Apart from necessary resources, empirical evidence suggests that the transitional process requires a set of conditions to be sufficiently met, among them technology competence and daily support. We aimed to measure households' technology capacity in two dimensions: households' self-evaluation of their technology advantages and the presence of skilled laborers (TECH variable). Preliminary surveys revealed that family livelihoods were

commonly supported by those who chose to pursue non-farm jobs. Their skills and knowledge obtained beyond the rural spheres have important implications for adopting new farming models (SUPP variable). As farming production tends to be biased toward men's roles, the integration of the gender dimension allows us to measure the significance of women in livelihood decisions (FEM variable). Likewise, the ethnic status of the family was also included as a dummy variable to test if ethnicity has a significant influence on likelihood decision-making(ETHNIC variable).

In addition to the well-defined variables, we included another set of two variables to broaden the sustainable livelihood framework. Land appropriation often links to a sudden change in economic resources, such as a large compensation, and thus motivates households to carry out transitions (COMPEN variable). Under the influence of urbanization and demographic changes, households might decide to renovate or rebuild their houses. These modernized processes might be significant since the resulting outcomes, such as large investments, and might threaten the household's economic circumstances, thus inducing livelihood transitions (HOUSE variable).

Ⅲ. Methodology

3.1. Study Sites

To control for the influence of demographic and economic variables, this study selected households from two different areas based on the connections between their developmental trends and sources of impacts. Specifically, Ward 4 of Vi Thanh City is close to the political center of Hau Giang province and thus impacted by rapid urbanization and land-use changes. Although the majority of land in Ward 4 is categorized as rice land, the city's residential and recreational sites cover the whole ward. It is foreseen that a fierce transformation will occur, as all the 500 ha of rice fields have been turned into urban zones. On the contrary, Luong Nghia ward in Long My District is a rural zone

featuring two-crop rice and freshwater aquaculture. The impacts of climate change, namely saline intrusion in recent years, have generated opportunities for developing livelihoods that incorporate brackish conditions. The transition is happening at a small scale and slow pace, and farmers have adopted several models of farming with different levels of transitions.

Given the existing variations in terms of land use, access to urban infrastructure, and exposure to climate change, livelihood strategies of the two wards differ in a number of ways (Table 2). Demographically, there are few differences between the two areas. The Kinh ethnic groups maintain a dominant position in the populations, while the second largest ethnic group is Khmer. Literacy rates in both wards are roughly equal, at around 99% while the education level of Ward 4 is slightly higher. However, the dominant impact of each area is quite distinct, reflected through land-use patterns and livelihood typologies.

<Table 2> Compare Land-Use Areas, Ecological Systems, and Livelihood Strategies between Ward 4 and Luong Nghia

Aspects	**Ward 4**	**Luong Nghia Ward**
Total land-use area (ha)	796.61	3,019.72
Main livelihoods	Two-crop rice, fruit, vegetables, livestock, wage-labor, services	Two-crop rice, non-intensive shrimp, fish, fruit, vegetables, livestock, wage-labor
Saline intrusion	-	4 -5 ‰ (2022)
Poverty rate	5.6 %	32.3%

During the survey, farmers of each site were asked about their livelihood practices, current assets, and perceived difficulties in farming production. The survey also included questions about their transitional decisions and future preferences. Hence, the comparative design enabled us to identify issues that were significant across the areas as well as factors that specifically matter to each group of farmers. Comparing the convergence and divergence of the results helped to isolate the main drivers underlying households' decisions both within and across research sites. Also, the regression models quantitatively provided evidence

for the relative contributions of the concerned factors—climate change, urbanization, and other variables—to the transitional decision.

3.2. Data Collection and Analysis

3.2.1. Data Collection

In Ward 4, Area No. 4 was chosen after carefully consulting with the ward's leaders and representatives. Out of 07 administrative areas, Area No.4 is characterized by fast-paced urbanization coupled with large-scale livelihood transitions. A total of 610 households (1,817 persons) were in this selected area. Following preliminary surveys, a list of 500 families was established for sampling. Based on a set of selective criteria and on-set circumstances, 152 households were invited to join the survey. Ethnic minority households account for 4.1% of the total sample, suggesting a domination of the majority Kinh ethnic group. As shown in Figure 2, the majority of households (80%) employed rice cultivation as their main livelihood. Very few households (7%) adopted fruit as a means of living, whereas 13% of families relied on non-farm activities.

In Luong Nghia ward, two areas—Area No.6 and Area No.7—were chosen due to their geographical and livelihood representation. From the initial list of 2,387 households, a total of 155 families were selected for the survey. The proportion of diversified livelihoods, as reflected by 53.5% adopting rice-shrimp models, reflects a more diverse practice in the study area. Non-farm activities were underdeveloped in Luong Nghia as only 2.5% of the households worked in the service sector. Approximately 44% of the farmers chose two-crop rice as their main livelihood. In terms of sample size, we aimed to fulfill the general requirements of multiple regression and factor analysis. First, for the 15 main independent variables a sample size of 150 was required to achieve a conservative ratio of ten observations per regressor (Miller and Kunce 1973). Second, the sample size for factor analysis should be more than 100 observations (Bartlett et al. 2001; Hair et al. 1998). Thus, a total of 307 valid samples in the two wards was sufficient for data analysis.

Survey data in both wards was collected in June 2022 and complemented by various follow-up group discussions in September and October 2022. At the household level, face-to-face interviews were conducted with each family. Primary data included demographic characteristics, family structures, land and other assets, livelihood strategies, labor participation, changes in land-use, and livelihood transitions. Annual revenues and spending of each household were collected and triangulated with other economic variables, namely loans, debts, agricultural equipment, and self-evaluated social status. To capture households' perceptions and attitudes toward external impacts, a set of 17 Likert-scale questions was raised during the interview. Each household stated the extent to which they were concerned over various contextual questions, as measured on a 6-point scale from "0 = Not Worried" to "5 = Absolutely Worried." The head of each family was also asked about their outlook on livelihood transitions, living conditions, and means of living for their grandchildren.

During the fieldwork, we also collected additional sources of secondary data, including crop production time, crop prices, material distributions, and agent networks. Spatial information such as land-use development, locations of important buildings, irrigation infrastructure, and sources and directions of saline intrusion was obtained from key informants and officials working in district and provincial offices. Maps and GIS data were utilized to clarify and support field observations.

3.2.2. Data Analysis

Participants of each ward were considered as a homogeneous group of farm households, hence two compatible groups with accompanying data were generated. After scanning, valid data was analyzed by SPSS software (version 22). Firstly, factor analysis was conducted to examine the structural relationships among attitudinal statements. Kaiser-Meyer Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were used to assess the sampling's adequacy with cut-off points of 0.5 and $p < 0.05$, respectively. Maximum likelihood was utilized as the extraction method, whereas the extraction rules were based on Kaiser's criteria (eigenvalue > 1) and cumulative variance

percentages (Hair et al. 1998). Of the 17 items, five constructs were developed, each closely corresponding to a key area over which farmers were most concerned. Next, the constructs were inspected for internal consistency with the Cronbach Alpha test, then used to compare the impacts of climate change and urbanization on livelihood changes.

Secondly, to investigate the statistical relationship between different variables on the livelihood transition process, we ran ordinary least square (OLS) regression models under the assumption that the population distribution of collected values is approximately normal. For dependent variable, the area of land dedicated to new farming practices was regressed against other independent variables in two steps. First, all socio-economic and asset variables except the vulnerability constructs entered the 1st model. We tested the significance level of each variable and dropped out any insignificant regressors ($p > 0.05$). Second, variables with statistically significant results were entered into the 2nd regression model together with the five constructs of vulnerability. The final model with selected variables was reported and evaluated against several benchmarks, including significant levels, coefficient signs and p-values.

Ⅳ. Results

4.1. Household Characteristics

The majority of household heads in Ward 4 were male (74.3%) and 40% belonged to the 51-65-year-old age group. The average age was 60.7 while nearly one-tenth (9.2%) of the participants were below 42 years old. The household sizes, determined as those who shared economic resources, ranged from 1 to 11 persons, with a mean of 4.15, which is slightly larger than the figure for Luong Nghia (4.08). In comparison, the mean age of household heads in Luong Nghia was also younger, at 55.8 years old. These variations suggested a difference in family structures, in which the presence of young laborers in Luong Nghia is significantly larger than in Ward 4.

These differences indicate gradual changes in household structure and labor organization across the two sites. A large proportion of young laborers in Ward 4 who are experiencing significant changes attributed to the rapid urbanization process have migrated or sought non-farm jobs elsewhere. They no longer participate in the local farming practices, leading to a low level of young workforce. In contrast, Luong Nghia has maintained basic features of a rural ward in which rice and shrimp production play the leading role. New models of agricultural diversification have emerged, leading to increasing employment opportunities and supporting businesses. In fact, those who chose to stay could make a good living either from direct farming production or emerging wage-labor jobs thanks to new farming practices. As a result, the levels of young laborers and communal solidarity were higher in Luong Nghia.

A large proportion of respondents in Ward 4 had secondary education (38.2%) and higher (27%), while the figures for Luong Nghia were lower at just 34.2% and 15.5% respectively. This is partly explained by the high proportion of ethnic families in Luong Nghia (33.5% of respondents were Khmer), compared with just 10.5% of Khmer households in Ward 4. However, the average number of laborers was not significantly different, with a mean of 2.95 persons in Ward 4 and 2.92 adults in Luong Nghia.

4.2. Capital Assets and Household Resources

Across 152 households surveyed in Ward 4, the average amount of land used by farmers was 1.15 hectares, mostly rice fields and fruit land. Sixty-six percent of households cultivated below 10,000 square meters, which was equivalent to 0.24 ha per person. Motorbikes and water pumps were owned by most families, reflecting a medium level of physical resources. Only one-fifth of the households could access modern equipment, like tractors or computers. In terms of financial capital, the data suggested a relatively large proportion of loans from banks (77.6%). Just below twenty-six percent of respondents admitted that they borrowed from relatives or friends. Nevertheless, the combination of short and long-term loans reflected a high level of

indebtedness in Ward 4.

In Luong Nghia, the average land use was slightly larger, at 1.34 hectares per household. This is equivalent to an average amount of 0.37 ha per person, which is larger than the figure for Ward 4 households. In addition, land-use patterns for the 155 farmers were also more diversified, ranging from rice fields to fruit orchards to shrimp ponds. However, Luong Nghia was lower in equipment ranking, which was consistent with the ward's poverty rates. Just 8.4 percent of respondents owned tractors, electricity generators, or computers. On the other hand, the indebtedness of Luong Nghia households resembled their counterparts in Ward 4, with eight in ten households admitting they were paying loans to either relatives or banks.

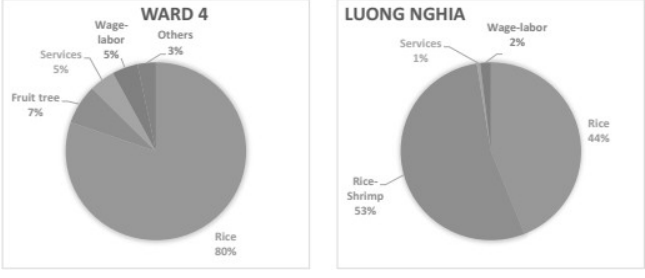
<Table 3> Descriptive Analysis (N= 307)

Measures	**Ward 4** *(n=152)*			**Luong Nghia Ward** *(n=155)*		
	Mean or %	**SD**	**Min- max**	**Mean or %**	**SD**	**Min-max**
Characteristics						
- Age (years)	60.7	12.9	*28 - 89*	55.8	13.9	*28 - 92*
- Male (%)	74.3	-		58.1	-	
- Family size (per.)	4.15	-	*1 - 11*	4.08	-	*1 - 10*
- No. of laborers (per.)	2.95	-	*1 - 6*	2.92	-	*0 - 6*
- Ethnicity (% Khmer)	10.5	-	-	33.5	-	-
- Female laborers (%)	49.2	-	-	47.1		-
Education (%)						
- Elementary	34.9	-	-	50.3	-	-
- Secondary	38.2	-	-	34.2	-	-
- High school	25.0	-	-	10.3	-	-
- College and above	1.9	-	-	5.2	-	-
Capital and Asset						
- Total land used (ha)	1.15	-	*0 – 8.5*	1.34	-	*0.004 – 10.5*
- Farm equipment (rank)	2.7	1.1	*1 - 5*	2.2	1.1	*1 - 5*
- Loans from banks (%)	77.6	-	-	79.4	-	-
- Vertical links (%)	18.0	-	-	12.3	-	-
- Cooperative members (%)	0	-	-	39.0	-	-
Capabilities						
- Technologies (rank)	1.92	-	*1 - 3*	-	1.84	*1 - 3*
- Non-farm support (%)	33.5	-	-	-	24.8	-

Across the two wards, the differences in social capital, particularly in cooperative participation and vertical links, were significant. Nearly forty percent of families in Luong Nghia belonged to a cooperative, but virtually none of the households in Ward 4 were cooperative members. In contrast, families in Ward 4 had strong vertical links, as nearly 20.0 percent had at least one laborer working in the government sector. Only 12.3 percent of households in Luong Nghia ward had such connections.

4.3. Household Capabilities and Livelihood Strategies

As shown in Table 3, households in both wards evaluated their technical capacities above the average level. This confidence (1.92 self-ranking in Ward 4) might be due to the diversity of livelihood strategies of Ward 4 farmers, but it could be partially explained by the impacts of the ongoing urbanization process. In fact, the proximity of Ward 4 to the province's economic hub provided Ward 4 with many advantages, among them information access and know-how techniques. In addition, households in Ward 4 benefited from remittances and support attributed to a larger proportion of migrant labor (33.5%). However, Luong Nghia greatly benefited from younger laborers and peer-to-peer assistance. The high proportion of cooperative members (39%) indicates the potential for capability improvement. In addition, the similarity between two modes of livelihoods, namely two-crop rice and shrimp-rice farming, might have made the transitional process more manageable.



<Figure 2> Livelihood Strategies across the Two Wards

Figure 2 presents differences in livelihood strategies of the two researched areas. About 10% of Ward 4 households relied on non-farm strategies while the figure for Luong Nghia was just 3%. This exhibited signs of a structural transition in Ward 4, in which more employment opportunities are emerging from services and manufacturing sectors. However, despite the fast-paced development of urban infrastructure, more than 80% of households in Ward 4 claimed that rice cultivation is their main livelihood. This suggested rice intensification continued to be the main strategy in Ward 4.

In contrast, the introduction of rice-shrimp farming models in Luong Nghia indicated an ongoing process of transitioning away from traditional modes of intense rice cultivation. The existence of shrimp ponds in long-established freshwater zones revealed a drastic change not only in farming outputs but also in labor structures. As aquaculture often requires fewer laborers, it is expected that the development of rice-shrimp models might lead to new markets for non-farming jobs. Nonetheless, the survey data implied that farming is still critical to livelihoods in both research areas for the foreseeable future.

4.4. Aspects of Vulnerability from Farmers' Perspectives

As noted in previous sections, household heads in both wards were asked to provide their opinions on 17 statements designed to obtain farmer attitudes towards vulnerability. Two sets of exploratory factor analyses were performed to categorize the information into a limited number of attitude dimensions. Principal component analysis was employed as the method of factor extraction while the two criteria of Kaiser's criteria and the cumulative percentage of variance were used to determine factor extraction. The Kaiser-Meyer-Olkin coefficient for the two dataset of Ward 4 and Luong Nghia was 0.75 and 0.74, respectively, and the Bartlett test of Sphericity was statistically significant ($p < 0.001$), suggesting the factor analysis was justified (Hair et al. 1998). The five factors were identified, based upon Kaiser's criteria (Eigenvalue > 1) and sufficient total variance percentages (60.6% for Ward 4 and 65.7% for Luong Nghia).

Out of 17 items, one item (C17) was removed because it did not uniquely load onto any of the five factors. In addition, this removal improved the total variance percentages and consistency across the two datasets. The two items C13 and C15 have a loading factor below 0.3 in the Ward 4 dataset, but their values are higher in the Luong Nghia dataset (0.55 and 0.75, respectively), hence they were retained. The C14 item, although has loading value below 0.3, was kept due to theoretical notions relating to institutional barriers. In sum, the data presented in Table 4, Table 5, and Table 6 refers to factor analysis outputs and test results of 16 items corresponding to five aspects of vulnerability perceived at the household level.

Explicitly, two statistical tests of KMO and Barlett confirmed the Ward 4's factor analysis results (KMO = 0.754 and $p < 0.001$). For Cronbach's Alpha statistic (Table 6), only two constructs of climate change and market risks passed the test of reliability and internal consistency (alpha > 0.7). The small values of URBAN, REGU, COOP variables implied that the impacts of the urbanization process, institutional regulations, and cooperative operations were perceived differently among local residents. Altogether, the five factors explained the 60.6 percent of the total variance in the dataset.

<Table 4> Five Aspects of Farmers' Concerns in Ward 4 (N= 152)

Propositions	**Components (Ward 4)**				
Households' concerns over	Climate Change	Urban Impacts	Market Risk	Institutional Regulations	Cooperative Models
C1. Saline intrusion	0.84				
C2. Excessive aluminum in soil	0.68				
C3. Water scarcity in farming	0.53				
C4. Impacts of Cai Lon – Cai Be infrastructure	0.21				
C5. Offspring don't like farming		0.51			
C6. Soil pollution due to urbanization & building		0.38			
C7. Land appropriation due to developments		0.36			

C8. Unstable agricultural markets and purchase			0.76		
C9. Agricultural products' low prices and losses			0.69		
C10. Distorting prices by traders and middlemen			0.60		
C11. Excessive use of fertilizers in soils				0.98	
C12. Excessive use of pesticides				0.62	
C13. Cannot catch up with new farming techniques				0.29	
C14. Lacks of financial resources				0.18	
C15. Effectiveness of cooperative models					0.15
C16. Effectiveness of OCOP programs[a]					0.97
C17. Household labor is no longer appropriate	Removed due to inconsistent loadings				

Note: [a] Acronym of a cooperative program, namely One Community One Product

Within Table 4, three items with small loading values include the impacts of irrigation infrastructure, a lack of financial capital, and attitude toward cooperatives. This might be explained by the location of Ward 4, which is situated deep inside the freshwater zone and does not gain any benefits from the newly built dam of Cai Lon - Cai Be *(cống ngăn mặn Cái Lớn-Cái Bé)*. Further, very few households in Ward 4 participated in a cooperative, and hence its role might not be important for farming transitions.

<Table 5> Five aspects of farmers' concerns in Luong Nghia (N= 155)

Propositions	**Components (Luong Nghia)**				
Households' concerns over	Climate Change	Urban Impacts	Market Risk	Institutional Regulations	Cooperative Models
C1. Saline intrusion	0.94				
C2. Excessive aluminum in soil	0.70				
C3. Water scarcity in farming	0.51				
C4. Impacts of Cái Lớn – Cái Bé infrastructure	0.32				
C5. Offspring don't like farming		0.49			

C6. Soil pollution due to urbanization & building		0.51			
C7. Land appropriation due to developments		0.57			
C8. Unstable agricultural markets and purchase			0.77		
C9. Agricultural products' low prices and losses			0.86		
C10. Distorting prices by traders and middlemen			0.56		
C11. Excessive use of fertilizers in soils				0.62	
C12. Excessive use of pesticides				0.73	
C13. Cannot catch up with new farming techniques				0.55	
C.14 Lack of financial resources				0.22	
C.15 Effectiveness of cooperative models					0.75
C16. Effectiveness of OCOP programs[a]					0.66
C17. Household labor is no longer appropriate	Removed due to inconsistent loadings				

Note: [a] Acronym of a cooperative program, namely One Community One Product

Similar to in Ward 4, both the statistical tests confirmed the factor analysis results in Luong Nghia ward (KMO = 0.749 and $p < 0.001$). Table 6 confirmed the reliability and internal consistency of four out of the five constructs (Cronbach's Alpha > 0.6). The small alpha values of the URBAN variable might be attributed to the rural setting of Luong Nghia, where the proportion of residential land is insignificant. Most factor loading values were relatively high and consistent. Taken together, the five-factor solution explained the 65.7 percent of the total variance in the dataset. Of the five dimensions, concerns over climate impacts and market risks were eminent, while urbanization had a moderate effect. In contrast to Ward 4's farmers, households in Luong Nghia expressed a high level of interest in the effectiveness of cooperative models.

Before comparing the five constructs, consistency values and

factor scores of each factor were computed, using Cronbach's Alpha and non-weighted sum scores. As suggested by DiStefano et al. (2009), the summed factor approach enables us to preserve the variation of the original data. It is also acceptable in exploratory cases such as the current study (Tabachnick et al. 2013). The final scores were compared between the two wards, and differences among factors were tested with one-way ANOVA. Detailed results were presented in a cross-tabulation (Table 6).

<Table 6> Compare Different Aspects of Vulnerability in the Two Research Sites

Aspects of Vulnerability	**Ward 4** (mean)	**Luong Nghia** (mean)	**Difference**	**Cronbach's Alpha** (Ward 4 ; LN)
- Climate Change	3.18	10.03	*- 6.85**	*0.73 ; 0.81*
- Urbanization Impacts	4.64	5.79	*- 1.15**	*0.47 ; 0.54*
- Market Risks	10.82	12.54	*- 1.72**	*0.74 ; 0.76*
- Institutional Regulations	7.77	11.89	*- 4.12**	*0.44 ; 0.66*
- Cooperative Models	0.30	0.60	*- 0.30**	*0.23 ; 0.63*

*Note: * p < 0.05, significant at the 5% level with one-way ANOVA F test*

Table 6 indicates a high level of variation in terms of vulnerability perceptions and perceived risks among farmers of the two wards. Households in Luong Nghia expressed a higher perception of vulnerability across the five aspects. Interestingly, Ward 4 respondents, despite the ongoing impact of development, ranked urbanization impacts at a moderate level (4.64), which was significantly lower than the figure for Luong Nghia (5.79). This reflects an incomplete transition of the urbanization process in Ward 4, where the non-farm and service industries have struggled to replace the long-established role of subsistence farming. Climate change and its related impacts greatly affected farmers in Luong Nghia (10.03), which is consistent with the high loading values noted previously. However, for Ward 4 households, climate change seemed not to be critical for farming and livelihood decisions (3.18).

Uncertainties and threats attributed to the market were the most concerning factor in both wards, reflecting the importance

of agricultural prices and the farmers' production output. Nonetheless, the perception of market risks by Luong Nghia farmers was significantly higher (12.54), showing the extent to which agricultural output prices affected their livelihood strategies. This also reflects the structural advantages of Ward 4, where credit access and better information on trades play a buffering role that mitigates the severe impacts of market fluctuations. Likewise, cooperatives and OCOP models tended to have limited impacts on Ward 4's farmers, but these peer-to-peer operations significantly affected transitional decisions of households in Luong Nghia. These observations will be linked to policy discussions in the next section, which emphasize the importance of credit access, price insurance and market uncertainty reduction.

Ⅴ. Discussion

5.1. Livelihood Transition Processes in the Two Wards

We aimed to measure the transitional process in two ways: the extent of transition and the area of land dedicated to transition. In the former, each farmer self-evaluated the extent to which their families carried out livelihood transitions in the last ten years, ranging from no transition to partial transition to complete transition. A partial transition involved limited changes in seed and cultivation techniques, whereas a complete transition involved significant changes or alternatives, including changing from rice land to fruit land or from two-crop rice to a rice-shrimp model. Alternative livelihoods often link to a new form of cultivation whose techniques and products were new to the household.

In contrast, the second approach refers to the area of farming land in which a household tried a new crop or transformed rice fields into shrimp ponds. This latter measurement captured the actual land area on which a household conducted its livelihood transitions. To some extent, this dependent variable—the total land area used for undertaking the transition—better reflects the intensity and scope of the

transition occurring in each household (Table 7).

<Table 7> Compare the Transition Process in Ward 4 and Luong Nghia

	Ward 4	**Luong Nghia**	**Difference**
Scope of the transition *(%)*			
- No transition	*8.0*	*27.7*	*-19.7**
- Partial transition	*82.4*	*48.4*	*-34.0**
- Complete transition	*9.6*	*23.9*	*-14.3**
Areas of land used for transition *(ha)*			
- Mean	*0.68*	*0.99*	*0.31**
- Min-max	*0 – 8.0*	*0 – 10.0*	*-*

Note: * $p < 0.05$, significant at the 5% level with one-way ANOVA F test

Over the last 10 years, households in Ward 4 were less likely to carry out livelihood transitions compared to their counterparts in Luong Nghia. Very few Ward 4 farmers (9.6%) conducted a complete transition, while nearly one-fourth of Luong Nghia farmers (23.9%) chose alternative cultivations. As shown in Figure 2, a transition from intensive rice to rice-shrimp models was commonplace in Luong Nghia ward. In contrast, a large proportion of households in Ward 4 (82.4%) adopted new seeds or techniques, while only half of families in Luong Nghia followed similar approaches. Together with the actual areas of land dedicated for transition, the data suggest the transition process occurred more completely and intensively in Luong Nghia than in Ward 4.

In comparison with the theoretical framework, significant differences in the transitional process in the two wards—both in terms of transition levels and livelihood portfolios—not only reflect the distinct agro-ecological characteristics but also exhibit the nexus between market incentives, institutional regulations, and climate change impacts.

5.2. Factors Shaping Livelihood Decisions

To explore the key factors that explain variations in livelihood

transition across the two wards, we ran several OLS regression models, using areas of transitional land as dependent variables. The independent variables included all variables in Table 1. As the distribution of some variables were non-normal, we used natural log transformations to improve their distributions. We ran the two-step model independently with the two datasets of Ward 4 and Luong Nghia and compared the OLS results (Table 8).

During the first step, variables pertaining to household characteristics and capital resources were entered simultaneously into the model. We then examined key parameters and checked if the p-value was below the significant threshold of 5%. The results showed that the age and educational level of the household head were not statistically significant in determining transitional decisions. Similarly, other variables of remittances, land appropriation, housing conditions, non-farm laborers, and ethnicity were found to be insignificant. Hence, the model was then simplified by removing the seven variables of AGE, EDU, REMIT, COMPEN, HOUSE, SUPP, and ETHNIC ($p > 0.05$). The variables of vertical linkages (LINK), technologies (TECH), and female laborers (FEM), although not significant, were kept for further discussion with regard to the network of social capital, technological advancements, and gender roles.

In the next step, the five attitudinal variables were considered together with the selected variables from step 1. Although all constructs, except URBAN variable, were not significant, we decided to retain them due to their theoretical importance. Hence, the final models combined a set of selected 13 variables corresponding to household assets and resources, family capabilities, and the five attitudinal factors (see Table 8). All of the models were statistically significant with a medium level of adjusted R^2 of 0.39 and 0.40 for Ward 4 and Luong Nghia, respectively. Both models had sufficient p-values ($p < 0.001$), indicating livelihood decisions can be partially explained by the defined variables. Significant estimates were marked with asterisks (*), while the coefficient signs of insignificant variables were recorded so as to examine against the theoretical frameworks.

<Table 8> Determinants of Livelihood Decisions in Ward 4 and Luong Nghia

Independent Variables	Abbreviation	Ward 4	Luong Nghia
Capital and Asset			
- Total land used (ha)	LAND	***(+)	***(+)
- Farm equipment (rank)	TOOL	**(+)	ns (+)
- Loans from banks (%)	LOAN	ns (+)	*(-)
- No. of laborers (per.)	LABOR	ns (+)	*(+)
- Vertical links (%)	LINK	ns (-)	ns (-)
- Cooperative members (%)	TIES	ns (+)	*(-)
Aspects of Vulnerability			
- Climate Change	CLIM	ns (+)	ns (-)
- Urbanization impacts	URBAN	**(-)	ns (-)
- Market risks	MARK	ns (-)	ns (+)
- Institutional Regulations	REGU	ns (+)	ns (+)
- Cooperative Models	COOP	ns (+)	ns (-)
Capabilities and others			
- Technologies (rank)	TECH	ns (+)	ns (-)
- Female laborers (%)	FEM	ns (-)	ns (+)
Model Summary			
- Adjusted R^2		0.39	0.40
- Significant		$p < 0.001$	$p < 0.001$

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; ns = not significant; OLS: Ordinary Least Square

As suggested by the framework (Figure 1), the total area of land (LAND variable) was the most important factor explaining households' decisions. The importance of this natural capital was consistent across the two wards. However, the results revealed that the influence of other capitals varied significantly between the two areas. Physical capital—represented by farm equipment—seemed less important in Luong Nghia yet played a principal role in shaping families' transitions in Ward 4. In contrast, financial capital and social resources were critical to farmers' decisions in Luong Nghia but had a rather marginalized position in Ward 4. Interestingly, credits (LOAN) and bonding networks (TIES) had opposite effects on farmers' decisions in the

two research areas. Specifically, having a bank loan or being a member of a cooperative reduced the likelihood of conducting a transition in Luong Nghia, but financial capital had positive impacts on Ward 4 farmers' transitions.

As noted earlier, household attributes such as education, age, and remittances had no significant effect on the livelihood transitions. Other variables relating to land appropriation, housing conditions, non-farm support, and ethnicity were also found to be insignificant ($p > 0.05$), indicating the fact that these factors were unimportant for livelihood decisions. Nonetheless, the number of laborers (LABOR) had a significant impact on the transition process of Luong Nghia farmers ($p < 0.05$). This might be explained as farming labor holding a leading role in the rural setting of Luong Nghia. Remarkably, the labor variable was found to be positive but not significant in Ward 4, which can be explained by the less important role of a young labor force in urbanization settings. This is also consistent with the positive sign of the technology variable (TECH) that shows farmers in Ward 4 are more likely to adopt new technologies during their transitional process, as opposed to Luong Nghia farmers who relied more on traditional practices utilizing the local workforce.

Among the five aspects of vulnerability, only urbanization (URBAN variable) had a significant effect on households, particularly in Ward 4, but not in Luong Nghia. This implies that farmers in Ward 4 directly experienced impacts of the ongoing urbanization process, namely land appropriation and soil pollution. Development-induced effects appeared to have negative correlations and were less likely to affect those residing in Luong Nghia. Likewise, market risks (MARK) were considered as positive factors contributing to the transition process in Luong Nghia. Farmers who perceived high levels of market risks were more likely to carry out livelihood transitions. In contrast, households in Ward 4 tended to cut down transitional areas if perceptions of market risks increased. Interestingly, the signs of the coefficients for institutional regulations (REGU) were positive, but not significant in both wards. A possible explanation for this finding is that the farming policies were consistently applied in the

whole province. Strict regulations appear to have facilitated the process of livelihood transition.

On the other hand, concerns over climate threats (CLIM variable) had inconsistent influences: positive in Ward 4 but negative in Luong Nghia. The insignificant values suggest that climate variables have limited impacts on the livelihood transition. These findings would go against previous studies that highlight the role of climate change as a key driver of livelihood transitions. This disparity might be explained by the advantageous location of Ward 4, which belongs to a rather stable freshwater ecosystem. A small part of Luong Nghia ward has been affected by saline intrusion, but these changes were mostly perceived as opportunities. Following the data analysis, we would not say that climate change had no impacts on the livelihood transition process as suggested by Brown et al. (2018) and Hoan et al. (2019). Here, the context matters, and we should move beyond the single climatic factor and take into account other common denominators.

In addition, due to the Delta's heterogeneous ecologies, the strength of each factor might vary significantly across agro-ecological zones. Salinity intrusion was seen as a main driver of livelihood transitions in Bac Lieu (Brown et al. 2018) and Ben Tre (Nguyen et al. 2019a) but farmers in Luong Nghia expressed more concerns over output prices. What happened in Ward 4, including the negative impacts of the rapid urbanization process, aligned well with land-use dynamics recorded earlier by Tran (2019). However, the regression outcomes for Luong Nghia revealed that urbanization impacts alone cannot explain households' transitions. Rather, the transitional decisions were mainly driven by a combination of market incentives and institutional regulations on which climate change had knock-on effects. With this study, we would emphasize other significant factors that underlie livelihood transitions.

Regarding the COOP variable, negative attitudes toward the cooperative models supported livelihood transitions in Ward 4, but the reverse was found in Luong Nghia. This might be due to

the fact that very few farmers joined cooperative models in Ward 4, hence, peer-to-peer support was not important. In contrast, nearly two-fifths of respondents in Luong Nghia were active members of a cooperative, so cooperative outcomes are critical to the transitional process. In terms of capability, confidence in cultivation techniques (TECH) played different roles in the two wards. Farmers in Ward 4 would expand their transition areas if they had a high trust in their capability, while farmers in Luong Nghia would do the opposite—mostly relying on peer-to-peer networks.

The FEM variable for female laborers in Luong Nghia had a positive, but not significant, effect on transitional processes. The positive coefficient suggests that in such an agricultural environment as Luong Nghia, women play a central role in household management, resource allocation, and labor organization. Field observations and interview data confirmed this notion as female laborers were responsible for livelihood security, cash income as well as transitional processes. These findings echo recent studies on gendered adaptation, which depict rural women as mediators between traditional practices and emerging non-farm activities in the Mekong Delta (FES 2024; Lovell et al. 2021).

In contrast, women in Ward 4 seemed to have a less important role in farming practices and transitional decisions. This might be explained by the significant proportion of male-headed households (74.3%) in the Ward 4 dataset. In addition, the high percentages of non-farm businesses also indicate that a significant proportion of female laborers have moved to service or industrial sectors in tandem with the ongoing urbanization process. As a result, the transitional process and livelihood strategies in Ward 4 tended to be controlled by men who have more opportunities to access new technologies and know-how. Nonetheless, women still have an active role in everyday agricultural production, particularly in taking care of the family, financial management, and risk mitigation.

Ⅵ. Conclusion

Across the Mekong Delta, natural landscapes and land-use patterns are changing fast, yet the pace and extent of change vary significantly among agro-ecological regions. These changes directly affect existing livelihoods, which in turn shape farmers' economic outputs and well-being. Hence, understanding livelihood structures and transitions is critical to understanding poverty in rural economies and how to reduce it. This article has compared the transitional processes in two areas with distinct sets of external and intrinsic variables so as to examine how natural forces and human forces affect livelihoods given different levels of farming intensification across regions. These research outcomes aimed to provide policy-makers with more evidence-based information and local perspectives grounded in theoretical and practical data. In doing so, transitional policies can be better aligned with farmers' interests, resulting in resource efficiency and successful livelihood pathways in the Mekong Delta.

In terms of farming structure and livelihood strategies, the data analysis confirmed a stark difference between the two research areas of Ward 4 and Luong Nghia. Clearly, farmers in Ward 4 adopted a wide range of livelihoods, including non-farming activities. Urbanization played a central role in shaping households' decisions, both as "push" and "pull" factors. On the one hand, land acquisition sped up the transitional process and facilitated the adoption of alternatives. The proportion of participants in the services and wage-labor sectors, although small, indicates that farmers in Ward 4 were on the transitional track toward diversification. On the other hand, changes in land-use patterns imply the emergence of employment opportunities that pull farmers out of farming sectors. This phenomenon was confirmed as agricultural production in Ward 4 was less dependent on labor in comparison to farming requirements in Luong Nghia. The high level of remittances and vertical links in Ward 4 are good indications of this trend of diversified labor. Despite these differences, rice cultivation remains the most important source of households' income and

well-being.

Looking into each ward's context, we found that locational and natural conditions significantly impacted farmers' perceptions of vulnerability. Specifically, Luong Nghia's respondents are largely concerned about climate change and institutional regulations. Farmers in Ward 4 do not share those concerns. This might be explained by the geographical advantages of Ward 4, which provide farmers with certain benefits relating to irrigation infrastructure and information access. In contrast, market fluctuation was of equal concern to farmers in both wards, indicating the importance of stable output prices. Urbanized impacts were of relative significance in Ward 4, but farmers in Luong Nghia had a higher level of anxiety. In fact, urbanization effects are not only attributed to infrastructure developments but also to the transition itself, especially due to an increase in farmland prices. Qualitative data obtained during the fieldwork confirmed these notions, as high profits from rice-shrimp models triggered a sharp demand in fields adjacent to brackish zones.

Together with factor analysis, regression models were employed in this study to examine determinants of livelihood transitions. Not surprisingly, natural resources, including land owned, are factors that consistently explain livelihood decisions. The findings are consistent with previous studies that underscore land as a critical asset (Winters et al. 2009; Tran 2019). Physical resources were found to be important for the transition process, particularly in Ward 4. Interestingly, other types of capital, including financial and social capital, had significant effects in Luong Nghia but not in Ward 4. This indicates the potential impacts of urbanization and non-farm activities in Ward 4, which provide better sources of financing and technologies. In addition, the significance of labor size in Luong Nghia suggests that the transition process might still largely rely on the capacity of a family's laborers.

Of the five aspects of vulnerability, urbanization had a significant impact in Ward 4. The results were expected, but this sole significance underscores the fact that involuntary transitions

due to land acquisition and soil pollution might destabilize local livelihoods. The models did not confirm significant impacts of climate change and other human forces on farmers' transitions, which is somewhat against the conclusions of previous research. While these variables did not have significant impacts, the variation in coefficient signs confirmed that the Mekong Delta's conditions vary significantly among sub-regions, and uniform policies might bring about unexpected consequences.

Given that the transition process was significantly affected by many factors whose significance varied between ecological zones, development pathways need to be tailored according to local characteristics. Within the rapidly urbanizing zones of Ward 4, for instance, rice-based cultivation is still a critical source of income, and thus development approaches should avoid disrupting farmers' assets, especially their farming land. Urbanization can provide off-farm alternatives, yet observations show that this transformation can often take decades to complete. As such, to address the devastating consequences of land acquisition, it is necessary to provide households with sufficient and appropriate resources so that they can gradually adopt alternative means of living. In rice-dominated regions like Luong Nghia, evidence indicates that when controlling for other factors, credit support and improvements in cooperative activities are the two most vital determinants for transitions. Thus, a farming policy centering on climate mitigation and adaptation might not be appropriate for Luong Nghia farmers.

Ⅶ. Policy implications

Compared with other findings (Nguyen et al. 2019b; Minkman et al. 2022), our key arguments are: natural forces, including climate variations, water scarcity, and soil pollution, are important for livelihood transition, but man-made impacts attributed to markets, institutional regulations, and cooperative actions are also significant. As a result, farming policies must simultaneously address all aspects of the transitional process; otherwise resources

cannot be efficiently allocated. As proven in the models, beyond assets owned, a transition occurs only when it is compatible with a household's capability. Thus, government funds and stimulus packages must be tailored to local conditions. More importantly, a key lesson from the findings is that uniform policies are unlikely to work in the Mekong Delta, where differences in natural settings are closely intertwined with heterogeneous groups of farmers, with varying preferences, capabilities, and interests. This emphasizes the importance of complete and inclusive developmental policies that provide the right resources and incentives in areas where the farmers fall short.

The transition of rural households from subsistence farming to cooperative business models necessitates a coherent and long-term institutional framework from the Hau Giang provincial government. For livelihood transformation initiatives to be effective, a coordinated governance mechanism is required that ensures collaboration between local enterprises and farming households. Only through such partnerships can ecological rice and shrimp products be developed into sustainable brands that enhance market value and secure long-term benefits for farmers (Domon and Lam 2025). Additionally, science and technology policies also play an indispensable role during the transition process. Hence, training programs for management skills, digital commerce, and corporate governance should be systematically provided to transitioning enterprises and young farmers. Parallel to capacity building, provincial agents should assist farmers with registration of brands and geographical indications in order to safeguard and promote local products in competitive markets.

A key pillar of this transformation lies in financial and credit policy. Thus, it is increasingly urgent for the provincial government to subsidize bank interest rates for cooperatives and cooperative unions. This initiative should be further institutionalized and expanded to strengthen emerging livelihood models. In addition, tax exemptions or reductions for newly established enterprises during their formative years should be considered. Such fiscal incentives would create vital resources for investments in value-added processing, reduce dependence on

raw material exports, and encourage product diversification. Trade promotion policies should complement these measures by raising awareness of the socioeconomic value of local enterprise development. The active involvement of professional associations and civic organizations will be critical in creating a supportive environment. Beyond the local sphere, government-led initiatives to integrate branded local products into conferences, training programs, and official events will further reinforce consumer confidence and stimulate enterprise participation.

Given the limited resources of local firms, such measures can be instrumental in building brand visibility and resilience. Provincial authorities should also establish preferential policies for supermarkets to prioritize locally produced goods. The current national emphasis on private-sector development provides a timely opportunity for Hau Giang to strengthen community-based linkages and accelerate livelihood transformation. Successful implementation in Luong Nghia and Ward 4 could generate wider spillover effects, elevating the province's leadership role and serving as a replicable model for rural economic transformation. However, this outcome will require stronger political will, broad-based social participation, and rigorous monitoring mechanisms to ensure product quality, market competitiveness, and the effective distribution of goods. Only through such comprehensive and sustained efforts can livelihood transformation be consolidated as a cornerstone of local economic development.

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