

Farmers' Awareness on Land Degradation and Conservation Measure Adoption in Vietnam

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Abstract: *This study aims to investigate farmers' awareness on land degradation and conservation measure adoption in Vietnam where land degradation is regarded as one of the country's most pressing issue. In addition to the secondary data, primary data were gathered through the direct interviews of 826 farm households in three selected regions of the country. The study shows that most of the survey farmers reported observing degradation of their agricultural land. Decline in land fertility was considered a key indicator of land degradation while inappropriate agricultural practice was seen as the foremost cause of land degradation. For preventing the land degradation, farmers in different regions adopted different sustainable land management practices such as agroforestry model, crop rotation, and use of compost and organic fertilizers. The factors influencing the adoption of sustainable land management include genders of household heads, number of land plots in the farm households, household income, extension accessibility and credit accessibility of the farm households. For enhancing the adoption of sustainable land management, it is crucial to improve the awareness of farmers on land degradation and advantages of conservation measures. In addition, extension services and financial supports for farm households through credit program should be improved.*

Key words: Awareness, land degradation, sustainable land management , farm households

JEL Code: Q01, Q15, Q56

1. Introduction

Land degradation is a significant worldwide problem affecting both ecological systems and development (Bai *et al.*, 2008). It involves several processes that lower land productivity such as decreased soil biological diversity and activities, erosion by water, loss of soil structure, acidification, salinization, waterlogging, nutrient depletion and contamination (World Bank, 2006). These consequences impede agricultural progress, escalate vulnerability and poverty, and generate social tensions due to increased demand on scarce natural resources from growing populations. Land degradation is driven by natural factors such as high annual precipitation and steep landscapes, and poor land management practices (Etter, 2015). Farmers' responses to land degradation, including the adoption of Sustainable Land Management (SLM) practices, are influenced by their awareness and various other factors. The concept of "awareness" can cover two interconnected facets: it can denote the understanding gained through personal experiences and perception, and it can also equate to cognizance, which involves acknowledging something perceived or felt (Ziadat, 2010). Awareness of land degradation refers to the understanding and recognition of the processes and impacts associated with the deterioration of the land's productive capacity and its ecosystems. This includes knowledge about the causes, such as deforestation, overgrazing, improper agricultural practices, and climate change, as well

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as the consequences, which can include soil erosion, loss of biodiversity, reduced agricultural productivity, and disruption of water cycle (Alemayehu, 2017).

Vietnam is located in the center of the Southeast Asian region and agriculture is considered as a key sector of the country. However, land degradation is regarded one of the nation's most pressing issues (Vu *et al.*, 2014). According to the Vietnam National Action Program to Combat Desertification for 2006-2010 period and orientation to 2020, around 9.3 million hectares are impacted by desertification. This land area supports the livelihoods of about 22 million people, constituting roughly a quarter of the country's total population. Despite the Vietnamese government's recommendations for implementing SLM practices, non-SLM practices or inappropriate land management practices such as erosive farming techniques, monoculture and excessive use of chemical fertilizers and pesticides remain widespread in many locations (Pham Manh Cuong, 2005; Pham Van Toan, 2011; Tran Thi Hien & Vo Quang Minh, 2014). Increasing the adoption rate of SLM or conservation farming measures is therefore crucial for preventing land degradation. According to numerous global scholars, inadequate awareness of land degradation among farmers and other constraint factors affect farmers' willingness to adopt SLM practices. However, in Vietnam, there are very few researches examining farmers' awareness of land degradation, their responses of adopting SLM and the contributing factors. This study is therefore designed with the aim to explore Vietnamese farmers' current awareness of land degradation, their responses to adopting SLM practices, the influencing factors, and then propose measures to enhance the SLM adoption of the farm households in the coming time.

2. Methodology

Land degradation poses a significant challenge across the country of Vietnam with certain regions experiencing significantly severe impacts. The Northwest mountainous area, the Central coastal region, the Mekong Delta, and the Central Highland are particularly affected (UNCCD NAP, 2007). For exploring the awareness of farmers on land degradation and their response of adopting SLM, one representative district was selected from each region based on consultation with land management experts to ensure the representativeness of the study sites. As the result, Dabac district in Hoabinh province was chosen for the Northwest region. This district features diverse terrain, including the high mountains (some exceeding 1000 meters high), hill, rivers and streams with slopes averaging 35 degree and an average elevation of 560 meters above the sea (Dabac DPC – District People Committee, 2023). In the Mekong Delta, Codo district in Cantho province was selected, known for its flat fields primarily dedicated to rice cultivation (Codo DPC , 2023). The Central coastal region is represented by Hailang district in Quangtri province, characterized by sandy soil with low fertility and prone to severe drought during the dried season (Hailang DPC, 2023). By selecting these representative districts, the study aims to capture farmers' awareness and response to land degradation in these diverse regional contexts.

In each district, consultations were conducted with district officials to identify communes for interviews, ensuring representation of various land management practices, including both SLM and non-SLM approaches. Between 239 and 300 farm households per district were chosen for face-to-face interviews for face-to-face interviews, using a stratified sampling method that initially categorized households into SLM adopters and non-SLM adopters. Sample households were then randomly selected from each category. The research team worked very closely with local staff of the districts and communes to get the insights into SLM adoption trends and identify suitable households for interviews across the selected districts and communes. The household survey was conducted in 2017 and details on numbers of SLM adopter and non-SLM adopter households per

study sites were presented in table 1. Subsequently, both primary data and secondary data were gathered, organized and categorized for analytical purposes.

Table 1. Number of interview farm households in study sites

District	Adoption rate estimation (%)	SLM adoption households	Non-SLM adoption households	Total survey households
1. Dabac district – Hoabinh province	30-40	181	119	300
2. Hailang district - Quangtri province	20-30	110	129	239
3. Codo district - Cantho province	10-15	123	164	287
Total	10-40	414	412	826

Descriptive statistics and comparative analyses are main methods for describing the farmers' awareness on land degradation and their responses of adopting SLM or non-SLM practices. Meanwhile, the binary logistic model is used to identify the effects of various factors on the SLM adoption of the farm households. The model consist of dependent and independent variables:

$$\text{Log}[\text{Pi}/(1-\text{Pi})] = \beta_0 + \beta_1 X_1 + \dots + \beta_{12} X_{12} + \varepsilon_i$$

where the dependent variable takes the value of 1 if the farm households adopt the SLM practice and value of 0 if the farm household do not do so. The definitions and measurement of the independent variables are presented in table 2.

Table 2. Variable definition and measurements

Variable	Definition and measurement
Education	Number of the years in school of the household heads
Gender	Gender of the farm household head (1 for male and 0 for female)
Plot	Number of agricultural land plots of the farm households
Income	Household income in the survey year (in million VND)
Extension access	Do the farm households receive technical guidance through extension training or visit by extension workers (Yes = 1, and No = 0)
Age	Age of the farm household heads (in year)
Credit access	Do the farms receive the loan in the survey year (Yes = 1, and No = 0)
Agri_labor	Number of the agricultural laborers in the households.
Poverty	Is the farm household is poor or not (Yes = 1, No = 0)
Plot Area	The area of the farming plot (in squared meters)
Dabac district	If the farm households is in Dabac district, Hoabinh province (Yes = 1, No = 0)
Codo district	If the farm households is in Codo district, Cantho province (Yes = 1, No = 0)

3. Study results

3.1. Demographic information of the survey households

As mentioned above, 826 farm households encompassing both those practicing sustainable methods and those not, were chosen for in-person interviews. The demographic details of the respondents and the households

surveyed are summarized in Table 3. The average age of the respondents was 47.7 year, with a majority having completed the secondary school. Each surveyed household averaged 4.7 members, with 4.1 members aged 12 and above. Additionally, the average number of agricultural workers per household was 2,2.

Table 3. Demographic information of survey farmers and households

	N	Age	Educational level	Family size (persons)	Members over 12 years old	Agri-labor
1. Dabac district	300	45.7	1.7	4.4	3.6	2.4
- Adopters	181	46.0	1.7	4.5	3.6	2.4
- Non-Adopters	119	45.2	1.7	4.3	3.6	2.4
2. Hailang district	239	49.7	1.9	4.9	4.3	1.8
- Adopters	110	48.7	2.0	4.7	4.3	2.0
- Non-Adopters	129	50.6	1.9	5.0	4.4	1.7
3. Codo district	287	48.2	2.1	5.0	4.4	2.3
- Adopters	123	48.4	2.1	4.8	4.0	2.0
- Non-Adopters	164	48.0	2.2	5.0	4.6	2.5
4. Total	826	47.7	1.9	4.7	4.1	2.2
- Adopters	414	47.4	1.9	4.6	3.9	2.2
- Non-Adopters	412	48.0	2.0	4.8	4.2	2.2

(Note for *educational level*: Primary school = 1; Secondary school = 2; High school = 3; College/ University = 4)

(Source: Household survey, 2017)

There was little variation in household size, and agricultural workforce between the groups practicing sustainable methods and those not, as statistical tests did not reveal significant differences in these areas. However, noticeable disparities in age and educational background were apparent across the regions. Respondents in coastal region (Hailang district) were four years older than those in mountainous region (Dabac district) and 1.5 years older than those in Mekong delta (Codo district). with these age differences proving statistical significance at $p < 0.1$. Furthermore, survey farmers in Codo district had higher levels of education in comparing to those in Dabac and Hailang districts with the educational differences between districts statistically significant at $p < 0.01$. While surveyed households in Codo district had more family members and individuals aged 12 and above, those in Dabac district had the highest number of agricultural workers per households. This disparity could be attributed to Dabac district's focus on agricultural activities due to limited non-agricultural job opportunities, whereas residents in Hailang district had relatively better access to non-agricultural employment opportunities.

3.2. Farmers' awareness on land degradation

- Awareness on land degradation occurrence**

According to the survey findings, a significant majority of respondents (over 82.7%) reported observing degradation of their agricultural land. However, awareness of land degradation varied significantly across different regions. In coastal and mountainous areas, nearly all farmers (100% and 82.7%, respectively) acknowledged experiencing land degradation on their farms. In contrast, only a minority of farmers (30%) in the Mekong Delta region believed they were witnessing land degradation. This difference in awareness among farmers can be attributed to the visibility of the land degradation in each region. In coastal and mountainous

region, issues such as reduced crop yields and soil erosion make the degradation more apparent to farmers, enabling them to observe these tangible signs firsthand. Conversely, in the Mekong Delta where signs of land degradation may be less pronounced, farmers may find it more challenging to identify and acknowledge its presence on their agricultural land.

Table 4. Respondents' awareness of land degradation occurrence (%)

District	Where is land degradation occurring?	SLM adopters	Non-SLM adopters	All survey households
1. Dabac	In my agricultural land	82.9	82.4	82.7
	In agricultural land of others	97.8	95	96.7
2. Hailang	In my agricultural land	100	100	100
	In agricultural land of others	100	100	100
3. Codo	In my agricultural land	4.9	44.5	27.5
	In agricultural land of others	8.1	44.5	28.9
Total	In my agricultural land	64.3	72.8	68.5
	In agricultural land of others	71.7	76.5	74.1

(Source: Household Survey, 2017)

The proportion of the survey farmers who reported experiencing land degradation on their agricultural land was similar between SLM adopters and non-adopters in both the coastal and mountainous region. However, a significant difference was observed between adopter and non-adopter groups in the Mekong delta region (table 4). Among adopters, only 4.9% reported encountering land degradation on their agricultural land whereas this figure was significantly higher at 44.5% among non-adopters. This highlights the effectiveness of adopting SLM practices in mitigating or preventing the land degradation specifically in the Mekong Delta. The clear contrast in reported occurrences of agricultural land degradation between SLM-adopters and non-adopter households emphasized the crucial role of SLM practices in preserving the health and productivity of agricultural land in this region.

• Awareness on indicators reflecting land degradation

The majority of respondents (81.7%) identified the decline in land fertility as a key indicator of agricultural land degradation, followed closely by reduced crop yield (around 80%), stunted crop growth (56.3%), and salinity (48.7%). Only around 47% of the respondents considered weed proliferation and bare land as indicators of land degradation while just 35% seen land erosion as the indicator. Interestingly, a small percentage (7.2%) of respondents viewed declining land fertility as the most critical indicator (Table 5). In contrast, 17.9% of respondents identified soil erosion as the primary indicator. Regional topography significantly influenced respondents' awareness of land degradation indicators. In mountainous area, around 87% of survey farmers recognized soil erosion as an indicator, with nearly half of them considering it as the most significant. However, survey farmers in the Mekong Delta and coastal regions did not share this perspective, likely due to the flat terrain where soil erosion is less visibly apparent.

There was a notable difference in how SLM-adopters and non-adopters perceived indicators of agricultural land degradation. While more than 87% of the adopters recognized the reduction in crop yields as indicator, this view was held by only around 72% of the non-adopters. Similarly, adopters showed higher awareness of other indicators such as soil erosion, weed growth and decline in land fertility compared to non-adopters. This

suggests that adopters of SLM practices demonstrated a more comprehensive understanding of agricultural land degradation indicators than their non-adopting counterparts.

Table 5. Indicators of agricultural land degradation by respondents

	Yes, this is an indicator			Yes, this is the most important indicator		
1. Decline in land fertility	88.6	74.8	81.7	10.2	4.2	7.2
2. Reduction in crop yield	87.4	72.3	79.9	19.8	5.8	12.8
3. Stunted crop	58	54.7	56.3	4.1	1	2.6
4. Salinity	55.9	41.4	48.7	3	3	3
5. Bare land	71.7	22.6	47.3	2.2	0	1.1
6. Weed growth	60.7	33.3	47	8.3	1.2	4.8
7. Inadequate water absorption	64.7	26.5	45.7	1.2	0.5	0.9
8. Rocky land	43.6	27.4	35.6	4.4	2	3.2
9. Soil erosion	40	30	35	19.3	16.6	17.9

(Source: Household Survey, 2017)

• The reason for land degradation

The vast majority of survey participants (more than 80%) recognized inappropriate agricultural practices as the foremost cause of agricultural land degradation, closely followed by excessive chemical use (around 80%) and knowledge gaps (over 70%). Policies and deforestation were cited as significant contributors to agricultural land degradation by only around one-fourth and one-third of survey farmers, respectively (Table 6). Noticeably, in the mountainous area, nearly 95% of respondents pinpointed deforestation as the primary driver of agricultural land degradation, with around 37% considering it as the most critical factor. Substantial differences in awareness regarding the main causes of land degradation were observed between adopters and non-adopters. SLM-adopters appeared to emphasize these reasons more than non-SLM adopters. For example, more than 87% of SLM adopters highlighted the overuse of chemical fertilizers and pesticides as a primary cause of agricultural land degradation, whereas this figure among non-adopter group was only 70%. This trend was similarly observed for other reasons such as knowledge gaps and inappropriate farming practices.

Table 6. Primary cause of agricultural land degradation by respondents' assessment (%)

	Yes, this is an indicator			Yes, this is the most important indicator		
1. Inappropriate farming practices	87.2	73.4	80.3	23.7	10.5	17.1
2. Overuse of agro-chemical	87.6	70.2	78.9	16.6	6.6	11.6
3. Lack of knowledge	80	60.4	70.3	9.5	1.2	5.4
4. Deforestation	41	30.1	35.5	14.4	12.5	13.4
5. Related policies	30.2	18.7	24.5	0.8	0.5	0.6

(Source: Household Survey, 2017)

When questioned about the main cause driving agricultural land degradation, SLM adopted farmers showed a notably apparent understanding in comparison to non-SLM adopters. More than two-third of SLM adopters provided a response whereas only one-third of non-adopters managed to do so. Among those who did respond, the majority pointed to inappropriate agricultural practices as the major cause of agricultural land degradation.

3.3. Farmers' response to land degradation

- **Farmers' understanding on land conservation measures**

To gauge respondents' awareness of land improvement techniques, a series of inquiries were made. The responses indicated a generally robust understanding of the concepts (Fig. 1). Approximately 93% of participants acknowledged that adopting organic practices could enhance soil quality. Moreover, 85.7% of the surveyed farmers recognized that implementing the crop rotation with legumes could help to improve land fertility. Additionally, more than 80% of survey farmers understood that overuse of agro-chemicals could degrade soil fertility. However, around 50% of the survey farmers agreed with the notion that SLM practice should only applied reactively in response to the apparent signs of the agricultural land degradation, even if the soil remains productive. This reveals some knowledge gaps and suggests a tendency to apply conservation measures reactively rather than taking proactive steps to prevent degradation..

The feedback from SLM adopted farmers indicated a clearer recognitions of agricultural land degradation and methods for improved land, particularly concerning no-tillage cultivation, crop rotation with legumes, mulching and the timing of soil conservation measures. A significant majority of adopters (over 90%) acknowledged the benefits of mulching for enhancing soil quality while only around half of non-SLM adopted households shared this perspective. Likewise, 33.8% of the adopted households believed in implementing conservation measures regardless of current soil productivity, contrasting with 55.2% among non-adopters. These findings underscore persistent knowledge gaps among respondents in general. Moreover, SLM adopters demonstrated a more nuanced understanding of conservation practices aimed at improving land than non_SLM adopters.

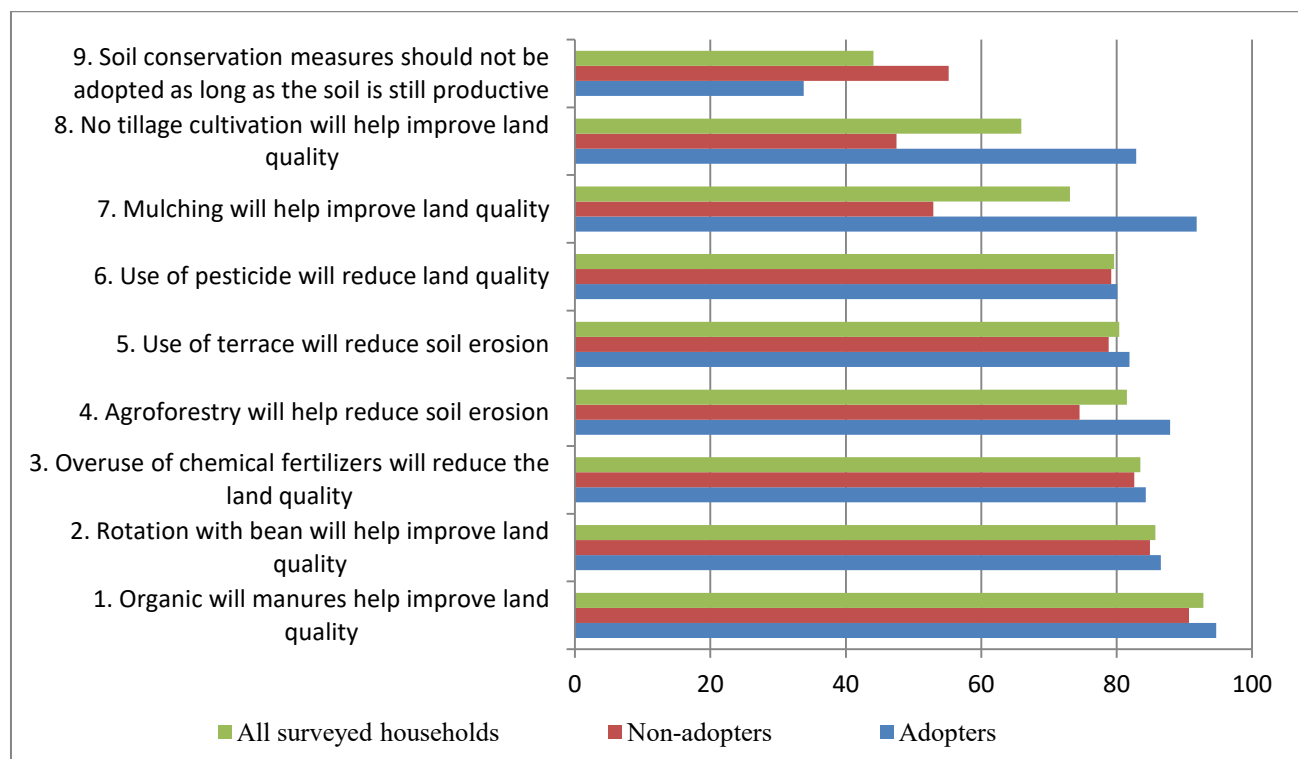


Fig 1. The rate of respondents agreed with the statement

• Farmers' responses to agricultural land degradation

Farmers' responses to land degradation include adopting measures such as agroforestry, contour plowing, terracing, and crop rotation. The implementation of these conservation practices, or SLM practices, varies significantly across regions due to socio-economic context and natural conditions. Even within the same region, diverse soil conservation measures are observed (Bui & Nguyen, 2022). This variability may stem from differing levels of farmers' awareness on agricultural land degradation and the unique characteristics of individual farmers and their households.

In the rugged terrain of Dabac district, SLM practices encompass a variety of approaches such as crop rotation and agroforestry models involving legumes and maize (Do & Bui, 2023; Nikolic *et al.*, 2008). In contrast, non-SLM practices are characterized by the monoculture of crops like dual maize crops, dual rice crops, sugarcane and cassava. Another prevalent non-SLM method involves crop rotations featuring edible canna or cassava such as cassava-maize or edible canna-maize which often result in the depletion of soil organic matter and nutrients in the region. Essential features of soil conservation measures or SLM practices in the area include maintaining robust land cover and enhancing soil quality. The findings from survey show a significant rate of SLM-adopted farm households (65.2%) adopt agroforestry models with combinations like acacia integrated with upland crops being the most common (Table 7). Other notable SLM practices include styrax with cash crops (around 13%) and Meliaceae with cash crop (around 10%). Conversely, non-SLM practices

consist of maize monoculture (around 32%), intercropping cassava with maize (around 20%), single cassava plantation (nearly a quarter), and various other practices (more than 10%)

Table 7. Rate of survey households by SLM and non-SLM adoption

Region	SLM practice		Non-SLM practice	
	Type of SLM practice	Rate of adopted households (%)	Type of non - SLM practice	Rate of households (%)
Mountainous region (Dabac district)	Styrax with cash crops	13.3	Maize – maize	31.9
	Acacia with cash crop	65.2	Cassava	24.4
	Meliaceae with cash crop	9.9	Maize and cassava (intercrops)	29.4
	Others	11.6	Others	14.3
	Total	100.0	Total	100.0
Coastal region (Hailang district)	Maize+peanut - Maize+bean	9.1	Rice - rice	54.6
	Chives + bean + cassava	22.7	Cassava	21.8
	Chives + cassava	27.3	Sweet potato	19.3
	Cococynth + bean	21.8	Others	4.2
	Cassava + bean -melon	19.1	Total	100.0
	Total	100.0		
Mekong Delta (Codo district)	Rice rotation with sesame	73.2	3 rice	94.5
	Rice rotation with melon	3.3	2 rice	2.5
	Rice rotation with bean	11.4	Others	3.0
	Rice rotation with maize	12.2	Total	100.0
	Total	100.0		

(Source: Survey data, 2017)

In Hailang district in Quangtri province (Coastal region), non-SLM practices predominantly involve the cultivation of single crops such as rice, cassava or sweet potato. These approaches often lead to reduction of soil nutrients and organic matters, exacerbated by overuse of agro-chemicals and exposure of soil during dry seasons. The household survey reveals that rice monoculture is the most predominant practice among non-SLM households, making up 54.6%. Single cassava plantation constitutes 21.8% while sweet potato monoculture accounts for 19.3% (Table 6). Conversely, SLM practices in Hailang district encompass intercropping models featuring legumes like mung beans, peanuts, or soybeans, alongside chives. These practices are designed to maintain soil nutrient balance, leveraging the nitrogen-fixing properties of legumes. Additionally, local farmers frequently employ mulching techniques by returning crop residues post-harvest and applying organic fertilizers and compost which supports soil moisture retention, enhances organic matter levels, and reduces surface degradation. The primary SLM models observed among surveyed households involves intercropping chives with cassava (more than a quarter). Other significant soil conservative measures include combinations such as chives with beans and cassava (22.7%), colocynth with beans (21.8%), and cassava with beans and melons (19.1%).

In the Mekong delta region, the practice of continuous rice monoculture – whether with three crops annually or two crop per year, is classified as a non-SLM practice. This extended cultivation in paddy fields leads to soil degradation due to persistent submergence and overuse of chemical fertilizers (Soong, 2006). Over time, continuous rice farming has been observed to rapidly deplete soil nutrients, cause soil compaction and disrupt soil structure and aeration under flooded condition (Vu *et al.*, 2023). According to the survey of non-SLM households, the predominant practice involves cultivating rice with three crops annually, accounting for 94.5%, while those with two rice crops per year constitute only 2.4%. In contrast, an SLM approach in the delta involves implementing a crop rotation system that incorporates upland crops, particularly legumes to improve soil fertility and nitrogen levels through biomass return and nitrogen fixation. Among surveyed households, a significant SLM practice observed is rice rotation with sesame, comprising the majority at 73.2%. Conversely, rice rotation with beans or maize shows smaller shares, approximately 11-12%.

3.4. Factors affecting the adoption of SLM practices

For analyzing the effects of the multiple variables on the probability of SLM adoption by individual farm households, the binary logistic regression is used. The dependent variable in the model is the adoption status of the survey households (dependent variable get value of 1 if farms adopted SLM and get value of 0 for otherwise). Omnibus tests of Model Coefficients with Chi-square of 142.62 confirm the statistical significance of the model (The Pseudo R-Square of the model is 0.125).

Table 8. Results of binary logistic model on the SLM adoption

Variable	Coeff.	Z	P> z
Education	-0.0862	-0.67	0.500
Gender	0.5075	2.43	0.015**
Plot	-0.3104	-2.63	0.008***
Income	8.53E-06	3.85	0.000***
Extension visit	1.1553	6.31	0.000***
Age	-0.0087	-1.00	0.319
Loan	-0.8902	-4.94	0.000***
Agri_labor	-0.0959	-1.07	0.284
Poverty	0.0471	0.20	0.839
Plot Area	-6.48E-06	-0.99	0.320
Da_Bac district	0.778	3.18	0.001***
Can_Tho District	-1.2341	-3.83	0.000***
cons	0.4387	0.59	0.554
Log Likelihood = -499.14366		Number of Obs.= 826	
		LR Chi2 = 142.62	
		Prob > Chi2 = 0.0000	
		Pseudo = 0.125	

The results of the logistic regression show that independent variables of gender of the household heads, number of land plots in the households, household income, visit of extension, loan of the households and the

region are statistically significant on the probability of SLM adoption. Meanwhile education level and age number of agricultural labor in the households are not statistically significant (table 8).

Gender of household heads statistically places significant impacts on the SLM adoption in the farm households. If the household head are male, the probability of SLM adoption is higher. Households with more plots tend less to adopt SLM.

The income of the households has positive effects on the SLM adoption at statistical significance of $p < 0.01$, however the effect is very little since the coefficient is very small. This finding is similar to the study by Okyoe (1998) in Nigeria and Gensa & Tebeje (2020) in Ethiopia.

Typically, the adoption rate would be high if farmers receive regular guidance from skilled extension agents and are supplied with adequate support materials in an organized manner (Andesina *et al.*, 2000; Akudugu *et al.*, 2012). In Vietnam, agricultural extension play important role in adopting the advanced agricultural practices as well as SLM as agricultural extension system in Vietnam is quite developed and useful. As variable of extension services has positive coefficient at statistical significance of $p < 0.01$ so that if the extension workers come to visit farm households more, the households have higher probability of SLM adoption. Farmers in mountainous region have higher probability to adopt SLM than farmers in other regions.

4. Conclusion and implications

Agriculture is vital to Vietnam's economy, but the sector is currently challenged by severe land degradation, affecting around 9.3 million hectares of agricultural land. Due to difference in topography, the appearance of agricultural land degradation varies by regions such as soil erosion in mountainous area and crop yield reduction in coastal region and Mekong Delta. More than 80% of respondents reported observing degradation of their agricultural land. Decline in land fertility was considered a key indicator of land degradation while inappropriate agricultural practice was seen as the foremost cause of land degradation. For preventing the land degradation, farmers in different regions adopted different sustainable land management practices such as agroforestry model, crop rotation, and use of compost and organic fertilizers. It is noted that SLM adopters tend to have better awareness on land degradation and measures for land improvement in comparison to non-SLM adopters. The results of binary logistic regression show that the factors affecting the farmers' adoption of sustainable land management includes genders of household heads, number of land plots in the farm households, household income, extension accessibility and credit accessibility of the farm households.

Given the crucial role of mass and local media in enhancing farmers' awareness of land degradation and the advantages of SLM, it is essential to design more radio bulletins and TV news segments that introduce SLM practices and their specific benefits for each specific region . These broadcasts should be distributed through mass media and local outlets, such as provincial TV channels and newspapers, to ensure local farmers can easily access them. The broadcasts should include clear evidence of SLM benefits to improve persuasiveness for local farmers.

Since the confirmation of the significant role extension services play in SLM adoption, there is a critical need for enhanced extension services, especially in providing technical guidance for SLM adoption. As a result, it is imperative for governments and policymakers to prioritize improving the expertise of extension staff, increasing their numbers, and ensuring their availability for the organized and effective dissemination of SLM technologies across all regions, thereby benefiting farmers directly. Furthermore, training programs should be

implemented for farmers to learn and apply SLM practices effectively. Additionally, establishing SLM demonstration sites would enable farmers to visit and learn practical, viable application methods. It is also recommended to consider implementing credit programs or financial support for SLM farmers, offering loans at low interest rates or with simplified procedures. This is crucial given the high costs associated with adopting SLM practices and the positive impact observed on SLM adoption through improved access to credit. Priority should be given to providing these supports to low-income households and those residing in mountainous regions.

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