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Land rental markets as a poverty reduction strategy: evidence from Southeast Asia

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Abstract

Purpose – This study aims to investigate whether the participation in land rental markets helps to mitigate impacts by climate change on multidimensional poverty in Thailand and Vietnam.
Design/methodology/approach – The authors use precipitation data from the National Aeronautics and Space Administration (NASA) and self-reported shocks from the Thailand Vietnam Socio-Economic Panel (TVSEP) project to estimate climate change. Data from the TVSEP are also used to calculate a multidimensional poverty index (MPI). Fixed-effect logit panel regressions with interaction terms are implemented to analyze the above mentioned.
Findings – The results show that land rental markets are used as mitigation strategies to climate change in Thailand and Vietnam. The participation in land rental markets also reduces multidimensional poverty. However, as a mitigation strategy, land rental markets are only successful in certain circumstances.
Research limitations/implications – The results show that there is potential in using land rental markets as mitigation strategies to climate change. Further research is needed to better understand which adaptation strategies, besides land rental market participation, and which combinations of different adaptation strategies are successful to mitigate negative effects induced by climate change.
Practical implications – The results show that there is potential in using land rental markets as mitigation strategies to climate change. Therefore, education in the participation in land rental markets and how to use them as a mitigation strategy can be a way to increase households' resilience to negative effects induced by climate change. Households make better decisions regarding their land when they are better informed on the functionality of land rental markets. Additionally, being better informed increases self-confidence to participate in land-rental markets.
Originality/value – Land rental markets as a mitigation strategy to climate change rarely have been studied, and if so, mainly the effect of leasing land has been studied. Additionally, the authors implement new measures of poverty – a multidimensional view on poverty which provides new insights into who are the poor and how they can be lift out of poverty.

Keywords Climate change mitigation, Land rental markets, Multidimensional poverty, Panel regression
Paper type Research paper

1. Introduction

Climate change continuously impacts households worldwide. Since climate plays a key role in determining agricultural productivity, households dependent on agriculture are especially vulnerable to climate change (Hallegatte *et al.*, 2016; World Bank, 2020). They see the negative impacts of climate change on their crop yield (Aydinalp and Cresser, 2008; Tubiello and Fischer, 2006; Okonya *et al.*, 2013) and are forced to employ adaptation strategies to mitigate its impacts (Hallegatte *et al.*, 2016; World Bank, 2020; EEA, 2022). Several adaptation strategies exist, including crop rotation, an adjustment in water and farm management, utilizing disease and

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pest-resistant crops or hybrid seeds and income diversification (Okonya *et al.*, 2013; Howden *et al.*, 2007; Nguyen *et al.*, 2021a; Abid *et al.*, 2016; Yang *et al.*, 2016). Another coping strategy is using land rental markets to rent in or rent out land (Eskander and Barbier, 2017; Zhang *et al.*, 2018; Gebregziabher and Holden, 2011). Vietnam and Thailand are among the top 20 countries most at risk for severe impacts of climate change, and both have a high proportion of households dependent on agriculture (UNESCAP, 2021; Eckstein *et al.*, 2021). This, combined with the different land rental market situations in Thailand and Vietnam, makes it interesting to study to what extent land rental markets are used as adaption strategies and whether this is a successful strategy to mitigate the impacts of climate change.

Additionally, existing evidence on both countries is scarce. In contrast to most other studies, this study considers renting in and renting out land as adaptation strategies, giving a more comprehensive picture of the functioning of land rental markets as households may want to increase land holdings to increase agricultural production when climate change is unfortunate. Furthermore, precipitation data from the National Aeronautics and Space Administration (NASA) are used to control for the endogeneity of self-reported shocks. A multidimensional poverty index is constructed using a large and unique household panel dataset from Thailand and Vietnam to get a more detailed picture of poverty.

The empirical analysis first investigates land rental market participation in response to extreme weather events. Afterward, the impact of land rental market participation in combination with extreme weather events on poverty is examined. Results show that land rental market participation reduces the likelihood of being multidimensionally poor; however, participation needs promotion as most farmers tend to decrease participation in the face of extreme weather events.

The following sections are structured as follows. Section 2 provides context into country-specific land markets and reviews relevant literature, while Section 3 describes the data. Section 4 introduces the methodology, and Section 5 discusses econometric results. Finally, Section 6 concludes the paper.

2. Literature review

2.1 Climate change and land rental markets

Huong *et al.* (2019) propose that, without adaptation measures, farms' net revenue is set to reduce significantly by 2050. However, with continued adaptation strategies, this loss would be reduced. Studies find that major adaptation strategies on the farm and household levels include changing crop varieties or species, an adjustment in water management, differing use of fertilizers or pesticides, soil management, improving pest or disease management, change in land use and more (Howden *et al.*, 2007; Nguyen *et al.*, 2021a; Abid *et al.*, 2016; Yang *et al.*, 2016). Coping mechanisms in the area of land use practices include fallowing, changing farming or land area and the use of land rental markets (Bryan *et al.*, 2013; Nguyen *et al.*, 2021a; Yang *et al.*, 2016; Gebregziabher and Holden, 2011; Zhang *et al.*, 2018; Eskander and Barbier, 2017). Yang *et al.* (2016) and Esfandiari *et al.* (2020) found that farmers changed the land area cultivated in drought scenarios.

Current literature defines land rental markets as an adaptation strategy that allows households to adjust their farm's operational size by renting in or renting out the land (Eskander and Barbier, 2017; Ward and Shively, 2015). In response to climate change, households may rent out land to decrease their farm's operational size, gain additional income from the rent, reduce operating costs or avoid the additional risk of climate change impacts (Gebregziabher and Holden, 2011; Abid *et al.*, 2016). Households may also rent additional land to increase their operational land size (Eskander and Barbier, 2017).

This study builds on the framework developed by Eskander and Barbier (2017) under the assumption that land rental markets always clear, even in extreme weather events, allowing

households to always choose the optimal amount of land rented in or rented out. Households' participation in land rental markets is dependent on household-specific characteristics toward renting in, φ^i, and toward renting out, φ^o, as well as on the exposure to extreme weather events, σ, with $\sigma = 1$ if the household experienced a shock and 0 otherwise. Therefore, a representative household chooses the optimal amount of land rented in (Eqn. 1a) or out (Eqn. 2b) according to

$$l^i = l^i(\sigma, \varphi^i) \tag{1a}$$

$$l^o = l^o(\sigma, \varphi^o) \tag{1b}$$

Household and time subscripts are left out to make the equations easier to read. Representative households are endowed with a given amount of land l and a given set of crops. Household labor supply to agriculture can be seen as inelastic due to the lack of labor opportunities even though household members can be engaged in off-farm labor, for example, during the lean season (Deininger and Jin, 2005; Bryan *et al.*, 2014). Households tend to maximize profits as a function of agricultural land by choosing land rental amounts:

$$\pi = p(1 - \alpha\sigma)q\left(l + l^i - l^o\right) - c\left(l + l^i - l^o\right) - I\left(r + t^i\right) + O(r - t^o) \tag{2}$$

with p representing farm-gate prices of agricultural outputs, α representing the loss due to extreme weather event exposure and $l + l^i - l^o, \forall l^i, l^o \geq 0$ representing the total operational farm size. I and O are indicators for whether the household rents in (I) or rents out O land, while r represents land rent and t^i, t^o represents transaction costs associated with renting in (t^i) or renting out (t^o). Extreme weather events influence households' decisions on the amount of land rented in or out and output. Therefore, profits change due to extreme weather events, and we need to distinguish between three different scenarios: households in autarky who do not participate in land rental markets (3), households renting in the land (4a) and households renting out land (4b). We exclude households renting in and renting out land.

$$\pi_1(\sigma = 1) - \pi_0(\sigma = 0) = -\alpha pq(l) \tag{3}$$

Households in autarky cannot mitigate the losses induced by extreme weather events if $\alpha > 0$. However, they can break even if $\alpha = 0$.

$$\pi_1(\sigma = 1) - \pi_0(\sigma = 0) = p\Delta q^I - \Delta c^I - \left(r + t^1\right)\Delta l^I, \tag{4a}$$

with

$$\Delta q^I = (1 - \alpha)q\left(l + l_1^I\right) - q\left(l + l_0^I\right)$$

$$\Delta c^I = c\left(l + l_1^I\right) - c\left(l + l_0^I\right)$$

$$\Delta l^I = l_1^I - l_0^I$$

$$\pi_1(\sigma = 1) - \pi_0(\sigma = 0) = p\Delta q^O - \Delta c^O + \left(r - t^0\right)\Delta l^O, \tag{4b}$$

with

$$\Delta q^O = (1 - \alpha)q\left(l + l_1^O\right) - q\left(l + l_0^O\right)$$

$$\Delta c^O = c\left(l + l_1^O\right) - c\left(l + l_0^O\right)$$

$$\Delta l^O = l_1^O - l_0^O$$

The superscripts I and O denote renting in and renting out decisions, respectively, while the subscripts 0 and 1 denote exposure to extreme weather events and nonexposure, respectively. The direct effect of exposure to extreme weather events is determined by $\alpha > 0$. At the same time, the difference between the amounts of land rented in and rented out in exposure to extreme weather events and non-exposure determines the indirect effect.

Eskander and Barbier (2017) find that participating in land rental markets may be valuable in reducing the impact of natural disasters in Bangladesh. Zhang *et al.* (2018) expand upon Eskander and Barbier's (2017) research by employing precipitation and temperature data as climate variables. They find that renting out land is a potential adaptation strategy to future climate change and that less land will be rented in in the future due to increased climate change in the Pacific Northwest of the United States.

Studies across South Asia, East Asia and Africa identify renting out land as an adaptation strategy to climate change (Abid *et al.*, 2016; Yang *et al.*, 2016; Pandey *et al.*, 2016; Gebregziabher and Holden, 2011). Yang *et al.* (2016) found that, in drought scenarios, 13% of households surveyed chose to rent out farmland as a coping strategy in China. In India, 18–28% of farming households studied enacted land leasing as an adaptation strategy (Pandey *et al.*, 2016). Several studies in Pakistan also mention renting out as an adaptation option (Abid *et al.*, 2016; Amir *et al.*, 2020; Bakhsh and Kamran, 2019). Gebregziabher and Holden (2011) examined the use of distress rentals as a coping strategy for shocks in Ethiopia. They find that renting out land is a valid short-term strategy to aid food security issues.

Accordingly, we hypothesize that households participate in land rental markets by reacting to extreme weather events. In particular, we hypothesize that they are more likely to rent out land while the effect of renting in land remains unclear.

2.2 Poverty and land rental markets

A general review from the World Bank concludes that having land as an asset can also aid in increasing the overall household wealth and reduce the poor's vulnerability to shocks (Deininger, 2003). By renting, additional land households have the ability to increase their operational size and consequently increase their production capabilities in Vietnam and Kenya (Nguyen *et al.*, 2021b; Jin and Jayne, 2013). Alternatively, renting out land allows less efficient farms or households with more significant opportunities for off-farm employment to increase their income without permanently losing their land in Vietnam and the USA (Zhang *et al.*, 2018; Nguyen *et al.*, 2021b). Land rental markets offer land transactions without transferring ownership and, therefore, relatively lower transaction costs and smaller flexible payments. This leads to reduced barriers to entry into land markets for the poor in Ethiopia and Kenya (Ghebru and Holden, 2019; Jin and Jayne, 2013).

Jin and Jayne (2013) find that utilizing land rental markets encourages agricultural productivity and raises household incomes for those land constrained in Kenya. Renting in land contributes to agricultural productivity while positively affecting household income per capita in Malawi and Zambia (Chamberlin and Ricker-Gilbert, 2016). In contrast, households renting out land are more likely to escape poverty in Ethiopia and positively impact overall household welfare in China (Ghebru and Holden, 2019; Jin and Deininger, 2009). Findings from Vietnam show that farm efficiency and household income increase when households participate in land rental markets (Nguyen *et al.*, 2021b).

Research looking at the effect of multidimensional poverty instead of monetary poverty in China shows that land transfer from the elderly significantly alleviates rural elder poverty (Wang *et al.*, 2021) and decreases multidimensional household poverty in poverty-stricken rural China (Li *et al.*, 2021).

Accordingly, we hypothesize that participation in land rental markets reduces the likelihood of being multidimensionally poor. We also hypothesize that participation in land

rental markets can mitigate the negative effects of extreme weather events leaving households equally or better off.

This study contributes to the existing literature by expanding upon using land rental markets as an adaptation strategy for climate change. Instead of using either precipitation or self-reported shocks to measure climate change, we use both. This allows us to use the advantages of both data sources. Precipitation data help to reduce endogeneity introduced by self-reported shocks, while self-reported shocks help to measure microclimate effects where the resolution of precipitation is not high enough. Second, established literature also focuses on renting out land, neglecting the renting-in function of land rental markets (Abid *et al.*, 2016; Yang *et al.*, 2016; Pandey *et al.*, 2016; Gebregziabher and Holden, 2011), while we use both strategies. Third, we build upon current literature examining land rental market participation impacts on poverty using a study-specific constructed multidimensional poverty index (MPI). The use of multidimensional poverty measures allows for the comprehensive assessment of poverty in the study region by including monetary and nonmonetary poverty indicators such as health, education and quality of life (OPHI and UNDP, 2021). Fourth, we utilize data from Thailand and Vietnam, countries not previously explored deeply in this area of research.

3. Data

3.1 Land market characteristics

Vietnam passed The Land Law in 1993, permitting transferable land use rights (To *et al.*, 2019). This law allowed private land usage rights to households with land use certificates while the land remained the property of the entire people, with the State acting as a representative and manager of the land (Ayala-Cantu and Morando, 2020). The 2013 amendments continued to increase households' farmland rights (To *et al.*, 2019). In contrast, Thailand has recognized private land property rights since 1872, and in 1901, a land titling system and Thailand's Department of Land were established (Burns, 2004). Thailand faced a major adjustment within the Land Tilting Program in 1984, making the land transfer more secure (Gine, 2005; Burns, 2004). In the context of this study, both countries allow for transferring land. However, Vietnam's land market is central to the government, not allowing private land ownership but enabling agricultural land rentals, exchange, mortgages and leasing. In contrast, Thailand's land rental markets allow for transferring land property rights directly.

Table 1 displays land rental market decisions with household shares of participation and land areas by country in 2007 and 2017 from the Thailand Vietnam Socio Economic Panel (TVSEP). In Vietnam, renting in and renting out land have increased from approximately 11% in 2007 to 16% in 2017 and from 4% to 15%, respectively. In contrast, renting in and renting out land have decreased in Thailand from 25% to 16% and from 6% to 4%,

	Vietnam		Thailand	
	2007	2017	2007	2017
Percentage of sample renting in	10.8%	15.5%	25.4%	15.5%
Percentage of sample renting out	3.9%	15.3%	5.9%	4.1%
Percentage of sample renting in and renting out	0.2%	0.9%	0.7%	0.2%
Percentage of sample not renting in or renting out	85.4%	70.1%	69.5%	80.7%
Average area rented in (hectares)	0.04	0.05	0.54	0.33
Average area rented out (hectares)	0.01	0.03	0.18	0.15
Average land area owned (hectares)	0.81	0.93	2.68	2.92

Source(s): Own calculation

Table 1.
Land rental market participation

respectively. Households participating in both activities have increased by 0.7% points in Vietnam between 2007 and 2017 and decreased by 0.5% points in Thailand. The share of households participating in neither has decreased in Vietnam from 85% in 2007 to 70% in 2017, while it has increased in Thailand from 13% in 2007 to 18% in 2017. In general, land area owned is much lower in Vietnam than in Thailand. Therefore, land areas rented in or out are also much lower in Vietnam. Especially the results for land holdings are according to what could be expected due to the different land rental market situations in the two countries.

3.2 Thailand Vietnam Socio-Economic Panel

Data from the TVSEP project's household questionnaires offer information on household characteristics, shocks and risks experienced and include further sections on agriculture, assets and other income sources such as land use, among others. The TVSEP project started in 2007 and aims to provide a long-term panel (www.tvsep.de) financed by the Deutsche Forschungsgemeinschaft until 2024. Data are collected on 4,400 households, 2,200 in each country. The target population of households surveyed included rural households living at or near the poverty line and households with conditions suggesting they could move toward the poverty line in the future (Hardeweg *et al.*, 2013). The households surveyed fell within Northeast Thailand provinces Buriram, Ubon Ratchathani and Nakhon Phanom and Vietnam provinces Ha Tinh, Thua Thien Hue and Dak Lak (see Figure 1). These provinces met the criteria for low average per capita income, high dependence on agriculture, poor infrastructure and risk factors based on a remote location (Hardeweg *et al.*, 2013). To identify households, the sampling procedure comprised a three-stage cluster design (Hardeweg *et al.*, 2013; Nguyen *et al.*, 2021b). This analysis uses six waves of data comprising 4,247 households, covering the years 2007, 2008, 2010, 2013, 2016 and 2017. All monetary values have been converted to 2005 purchasing power parity (PPP) USD.

Source(s): Own Presentation

Figure 1.
Map of study area provinces in Vietnam and Thailand

3.3 Determining multidimensional poverty

International standards for poverty comprehension suggest a dynamic concept that involves more than insufficient income but also deals with other deprivations in the areas of food, education, infrastructure and other basic services (United Nations, 2022). Utilizing a multidimensional poverty measurement as an MPI instead of monetary poverty measures has several advantages. MPIs are transparent and effective in identifying the poor, allowing the introduction of effective policies and cross-regional comparisons (UNECE, 2017). Calculations of MPIs are also flexible in construction per region, and research focuses as they are adapted (Ayuya *et al.*, 2015; Ogutu and Qaim, 2019; Oshio and Kan, 2014). We build upon this to construct a Thailand and Vietnam Socio Economic Panel specific multidimensional poverty index (TVSEP-MPI) with appropriate dimensions and indicators. Within the TVSEP-MPI, we choose four dimensions of poverty: health, education, the standard of living/basic infrastructure and monetary poverty, according to UNDP and OPHI (2019).

Following the selection of dimensions and indicators, we define the cutoff below which a household is considered deprived in the respective dimension and the weight for weighting each dimension (Alkire and Foster, 2011b). In line with common practice, we assign the same weight to all dimensions, and indicators are weighted equally within dimensions. The cutoff points and weights are presented in Table 2 and Figure 2. In the next step, we sum the weighted values of experienced deprivations (Alkire and Foster, 2011b). Lastly, we define a poverty cutoff k that defines a household as poor if its MPI lies on or above k (Alkire and Foster, 2011b). This procedure is known as the dual-cutoff method (Alkire and Foster, 2011a,b). We define households as poor if $k \geq 0.25$. This is a lower threshold than those of other MPIs, but it sticks to defining households as poor when deprived in one dimension.

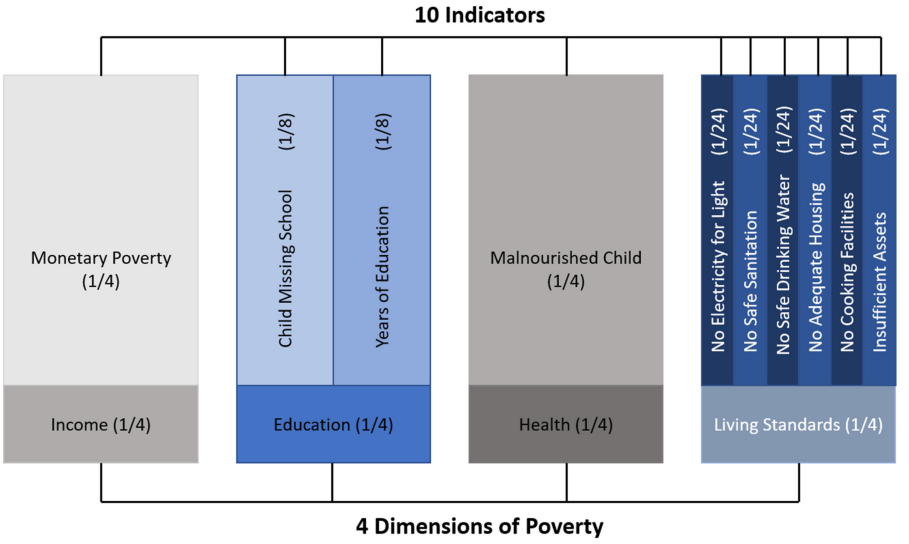
3.4 Identifying climate change

The Precipitation Processing System (PPS) from the NASA provides location-based information on surface precipitation with a 0.1-degree spatial resolution. These precipitation

Dimension and indicators	Deprivation cutoff points
Monetary poverty	
Income	Daily income less than US$1.90 per capita
Education	
Child missing school	At least one school-aged child (5–14 years) up to the age of grade 8 is not enrolled
Years of schooling	No household (HH) member (aged 10 or older) has completed six years of schooling
Health	
Child malnutrition	Any child in the HH with nutritional information is malnourished (z-score of height-for-age or weight-for-age below minus two standard deviations from the medium of the reference population)
Living standards	
Electricity	The HH has no electricity for light
Sanitation	The HH's sanitation facility is not improved, or it is shared with other HHs
Drinking water	The HH does not have access to safe drinking water
Housing	The floor is of natural materials or the roof or walls are of rudimentary materials
Cooking	HH cooks with wood, charcoal, kerosene, or leaves
Assets	The HH does not own more than one of the following: radio, TV, telephone, computer, bike, motorbike or refrigerator and does not own a car or truck

Source(s): Own calculation

Table 2. Dimensions and indicators for the TVSEP-MPI



Source(s): Adapted from UNDP and OPHI (2019)

Figure 2. Dimensions and Indicators of the TVSEP-MPI

data offer improved forecasting abilities for natural disasters such as floods, droughts and landslides, creates new insights into storm structures, enhances weather predicting and improves knowledge of Earth's water cycle and links to climate change (NASA Goddard, 2022). The provided data use an Integrated Multi-satellitE Retrieval (IMERG) algorithm for the global precipitation measurement (GPM) to measure surface precipitation as accurately as possible. With a Geographic Information Systems translation of the IMERG output, the PPS provides monthly precipitation data by latitude and longitude that can, therefore, be merged with household data from the TVSEP project. Precipitation data are aggregated to get historical averages and according to TVSEP wavelength (12 months from May until April). Merging took place on the village level, where the four nearest precipitation measures to each village were weighted with the inverse of their distance to the TVSEP village. We measure a shock to standard precipitation levels by using the standard deviation from historical monthly averages. The number of deviations was summed up over the TVSEP period to measure how often a shock appeared.

Households' perceptions of climate change shocks and risks are also used with self-selected responses recorded in TVSEP's household questionnaire sections for shocks and risks. Climate shocks and risks identified within TVSEP data consist of flooding, droughts, unusually heavy rainfall, crop pests and landslides or erosion.

3.5 Descriptives

Table 3 presents descriptive statistics of household characteristics by (non-)participation in land rental markets. The first five columns show household characteristics for Vietnam, while the last five show them for Thailand. The first and sixth columns show households not participating in land rental markets, while columns two and seven show households renting in land and columns four and nine show households renting out land. Finally, columns three and eight compare households renting in with nonparticipants, and five and ten compare renting out land with nonparticipants. We exclude households renting in and

Table 3.
Descriptive statistics of climate and household characteristics

	Vietnam					Thailand				
	Nonparticipants	Rent in	*t*-test	Rent out	*t*-test	Nonparticipants	Rent in	*t*-test	Rent out	*t*-test
Climate characteristics										
Flood Occurrence (0/1)	0.98 (0.15)	0.96 (0.19)	10.21^{b***}	0.95 (0.22)	21.01^{b***}	0.98 (0.15)	0.98 (0.15)	0.02^{b}	0.97 (0.16)	0.29^{b}
Drought Occurrence (0/1)	0.74 (0.44)	0.71 (0.45)	4.13^{b**}	0.61 (0.49)	57.62^{b***}	0.83 (0.37)	0.77 (0.42)	43.98^{b***}	0.8 (0.4)	5.15^{b**}
Perceived Climate Shock (0/1)	0.37 (0.48)	0.44 (0.5)	23.18^{b***}	0.23 (0.42)	58.21^{b***}	0.29 (0.45)	0.34 (0.47)	19.82^{b***}	0.24 (0.43)	6.34^{b**}
Households' socioeconomic characteristics										
Employed Off-Farm (0/1)	0.54 (0.5)	0.64 (0.48)	54.31^{b***}	0.41 (0.49)	49.89^{b***}	0.49 (0.5)	0.59 (0.49)	75.77^{b***}	0.4 (0.49)	16.21^{b***}
Total Value Assets (PPP$)	1,929 (4,383)	1,962 (3,349)	-5.69^{a***}	2,304 (4,243)	-2.25^{a**}	6,182 (12,160)	5,446 (11,616)	5.12^{a***}	7,113 (13,126)	0.61^{a}
Access to Credit (0/1)	0.17 (0.37)	0.18 (0.39)	2.72^{b*}	0.16 (0.37)	0.36^{b}	0.17 (0.37)	0.19 (0.39)	6.36^{b**}	0.19 (0.4)	3.36^{b*}
Household Size (persons)	4.11 (1.77)	4.42 (1.53)	-7.87^{a***}	3.16 (1.71)	14.62^{a***}	4.03 (1.71)	4.12 (1.59)	-2.8^{a***}	3.59 (1.66)	6.61^{a***}
Household Head Age (years)	51.81 (13.68)	48.01 (11.49)	10.74^{a***}	60.26 (14.79)	-15.06^{a***}	58.65 (12.43)	52.76 (12.48)	20.0^{a***}	60.97 (11.76)	-4.91^{a***}
Household Head Gender (female = 1)	0.18 (0.39)	0.13 (0.34)	25.61^{b***}	0.29 (0.45)	50.06^{b***}	0.28 (0.45)	0.23 (0.42)	20.32^{b***}	0.32 (0.47)	5.59^{b**}
Household Head Education (deprived = 1)	0.11 (0.31)	0.12 (0.32)	0.35^{b}	0.06 (0.25)	15.51^{b***}	0.44 (0.5)	0.45 (0.5)	0.88^{b}	0.4 (0.49)	3.24^{b*}
Dependency Ratio	0.34 (0.28)	0.34 (0.24)	-1.81^{a*}	0.43 (0.37)	-5.65^{a***}	0.33 (0.26)	0.3 (0.23)	3.58^{a***}	0.37 (0.31)	-2.62^{a***}
No. of Observations	9,664	1,573		742		7,498	2,207		618	

Note(s): Standard deviations in parentheses. A *t*-test compares households not participating in land rental markets with households renting in or renting out land. [a] Wilcoxon rank sum test, [b] χ^2-test, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$
Source(s): Own calculation

renting out at the same time. We see that households renting in or out land significantly differ from households not participating in land rental markets for most variables. It is noted that households report fewer environmental shocks in general than reported by precipitation data. Between 95 and 98% of the households face increased rainfall, while the picture is more diverse for droughts. In general, households not participating in land rental markets are more likely to face floods or droughts when precipitation data are used. At the same time, households renting in land are more likely to report environmental shocks themselves than nonparticipants. Households renting out land are least likely to report shocks.

Additionally, most patterns are similar for both countries. Households renting in are more likely to be involved in off-farm labor, while renting-out households are less likely to do so than nonparticipants. Households renting in are larger, younger and less likely to have a female household head than nonparticipants, while we see the reverse for households renting out. Households renting out are less likely to be educationally deprived but have higher dependency ratios than nonparticipants. Renting-out households have higher overall asset value than nonparticipants, while renting-in households have less total asset value. Generally, households renting out are better off, while those renting in are more similar to nonparticipants or even worse off.

To investigate the evolution of poverty, Figure 3 displays both Vietnam's and Thailand's percentages of households considered multidimensionally poor. The graph shows a decline in poverty over the years for both countries. However, Vietnam has a higher poverty rate than Thailand. In both countries, poverty rates among households renting in are higher than for households renting out.

4. Methodology

4.1 Evaluating land rental market participation in response to climate change

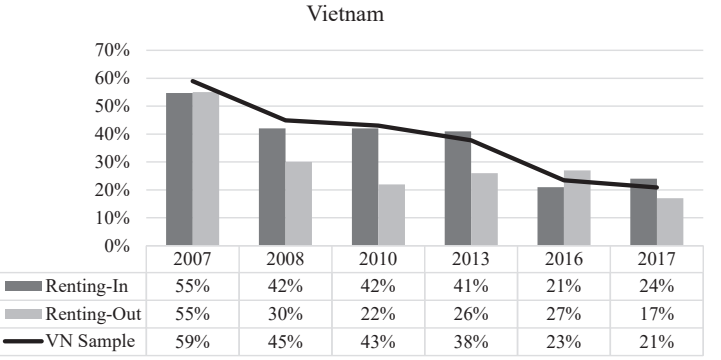
We use a multinomial fixed-effects logit panel regression at household level to examine the influence of climate change effects on households' decision to participate in land rental markets. According to the conceptual framework in chapter 2, households maximize agricultural profits by optimizing the size of land. They, thus, have three choices: not participating in land rental markets, renting out land or renting in land where

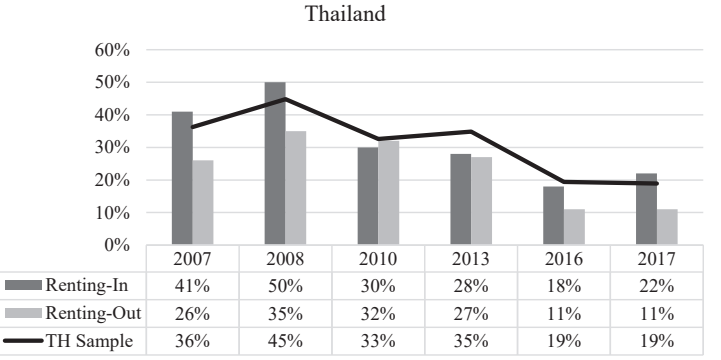
$$land\ rental\ market\ participation\ (LRMP) = \begin{cases} 0\ if\ household\ does\ not\ participate \\ 1\ if\ household\ rents-out\ land \\ 2\ if\ households\ rents-in\ land \end{cases}$$

Which option is chosen depends on household-specific characteristics, X_{it}, and exposure to environmental shocks, σ_{it}. Subscripts i denotes households, while t denotes the year. The probability of each option, j, is given by the multinomial logit function in equation (5).

$$P(LRMP_t = j|X_{it}, \sigma_{it}) = \frac{exp\left(X'_{it}\beta_j + \sigma'_{it}\gamma_j\right)}{1 + \sum_l^J exp\left(X'_{it}\beta_l + \sigma'_{it}\gamma_l\right)}, J = 2 \tag{5}$$

Household characteristics comprise information on off-farm employment, total household assets, size of agricultural land, access to credit, household size-to-dependency ratio, education, age and gender of the household head. Environmental shocks comprise flood or drought occurrences or the report of environmental shocks by the household itself. The detailed information on the variables is displayed in Table 4. Households engaged in both activities are excluded from the analysis.





Source(s): Own Calculation

Figure 3.
Percentage of households in poverty

Variables	Definition
Flood Occurrence	Household experienced a flood (1 = yes)
Drought Occurrence	Household experienced a drought (1 = yes)
Climate Shock	Household reported unusual heavy rainfall, flooding, drought, landslides or crop pests in the last 5 years (1 = yes)
Land Area	Logarithm of land area owned (ha)
Off-Farm Employment	Household receives income from off-farm employment (1 = yes)
Household Asset Value	Logarithm of value of total assets the household possesses in 2005 PPP$
Household Access to Credit	Household has access to credit (1 = yes)
Household Size	Number of members in household
Dependency Ratio	Share of household not working
Household Head Age	Age of the household head
Household Head Gender	Household head is male or female (0 = male, 1 = female)
Household Head Deprived of Education	Household head received less than 6 years of education (1 = yes)
Ethnic Minority	Household belongs to an ethnic minority (1 = yes)

Source(s): Own calculation

Table 4.
Independent variables used in regressions

4.2 Identifying poverty impacts from land rental market participation in response to climate change

To identify the impact of land rental market participation in response to climate change on multidimensional poverty, we use a panel logit fixed-effects model as presented in (6a) and (6b).

$$P\left(MPI_{it}^{0.25}=1\left|R_{it}^{in},\sigma_{it},X_{it}\right.\right)=\frac{exp\left(\beta_0+\beta_1R_{it}^{in}+\sigma'_{it}\beta+X'_{it}\beta\right)}{1+exp\left(\beta_0+\beta_1R_{it}^{in}+\sigma'_{it}\beta+X'_{it}\beta\right)} \quad (6a)$$

$$P\left(MPI_{it}^{0.25}=1\left|R_{it}^{out},\sigma_{it},X_{it}\right.\right)=\frac{exp\left(\beta_0+\beta_1R_{it}^{out}+\sigma'_{it}\beta+X'_{it}\beta\right)}{1+exp\left(\beta_0+\beta_1R_{it}^{out}+\sigma'_{it}\beta+X'_{it}\beta\right)} \quad (6b)$$

The probability of being multidimensionally poor depends on participation in land rental markets, shock exposure and household-specific characteristics. The dependent variable $MPI_{it}^{0.25}$ indicates if household i in year t is multidimensionally poor (1 = multidimensional poor). Variables R_{it}^{in} and R_{it}^{out} determine land rental market participation as binary variables, X_{it} is a vector of household characteristics and σ_{it} is a vector of environmental shocks. X_{it} contains the same control variables as in (5).

5. Results

5.1 Land rental market participation and climate change adaptation

Table 5 shows the results from (5) as odds ratios. For both countries, households experiencing floods or droughts are less likely to rent in or out land than not to participate in land rental markets as the odds ratios are below 1. Households self-reporting shocks are more likely to rent in land than not to participate in land rental markets, while they are less likely to rent out land. The results indicate that land rental markets are not used as an adaptation strategy to shocks derived from precipitation data except for droughts in Vietnam. This also aligns with the concept that households' behavior is influenced by and based on their recognized circumstances (Bryan *et al.*, 2013). Although high, the resolution of the precipitation PPS dataset may still be too large to detect microclimates and, therefore, might not be able to identify precipitation shocks completely. When households self-report environmental shocks, they use land rental markets for renting in land as an adaptation strategy. However, renting out land is not used as an adaptation strategy for self-reported environmental shocks. This supports that households use land rental markets to increase the operational size and optimize land use, as in Eskander and Barbier (2017). As in this analysis, Eskander and Barbier (2017) find that environmental shocks positively affect rent-in decisions and negatively affect rent-out decisions in Bangladesh. The results regarding renting out land oppose Gebregziabher and Holden (2011) and Abid *et al.* (2016) that households may rent out to reduce future climate risk, counteract climate impacts with additional rental income or reduce operating costs.

Additionally, Yang *et al.* (2016) find that Chinese households rent out land as a reaction to droughts. Instead, households rent out less, potentially choosing to optimize land already possessed in the face of climate change and extreme weather events. These results are a potential outcome from the specific land markets in Vietnam and Thailand, as discussed in Chapter 3. Households' land holdings are still relatively small, which makes them reluctant renting out land, which makes it a less attractive adaptation strategy to shocks and renting in land a more attractive adaptation strategy.

	Vietnam		Thailand	
	Rent in	Rent out	Rent in	Rent out
Flood Occurrence	0.653	0.776	0.999	0.82
	(0.177)	(0.266)	(0.226)	(0.33)
Drought Occurrence	0.759***	0.346***	0.87	1.17
	(0.066)	(0.042)	(0.096)	(0.241)
Climate Shock	1.314***	0.786*	1.269***	0.851
	(0.113)	(0.11)	(0.114)	(0.153)
Agricultural Land	1.622***	1.079	4.812***	0.567***
	(0.132)	(0.073)	(0.725)	(0.055)
Off-Farm Employment	1.239**	1.018	1.296**	0.892
	(0.134)	(0.17)	(0.129)	(0.171)
Asset Value	1.037**	1.063**	0.945***	0.97
	(0.016)	(0.032)	(0.013)	(0.023)
Access to Credit	1.092	1.061	1.129	1.229
	(0.106)	(0.158)	(0.114)	(0.227)
Household Size	1.055	0.822***	0.985	0.793***
	(0.044)	(0.057)	(0.044)	(0.053)
Dependency Ratio	0.568**	1.34	1.763*	1.023
	(0.152)	(0.424)	(0.512)	(0.424)
Household Head Age	1.014	1.076***	0.964***	1.002
	(0.009)	(0.022)	(0.008)	(0.013)
Household Head Gender	0.875	1.649	1.142	0.687
	(0.231)	(0.521)	(0.294)	(0.336)
Household Head Deprived of Schooling	1.251	1.44	1.109	0.716
	(0.296)	(0.578)	(0.185)	(0.186)
Household Head Ethnic Minority	1.499	1.79	1.067	0.381
	(0.725)	(1.706)	(0.785)	(0.506)
Number of Observations	5,277		4,436	

Note(s): ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; odds ratios from multinomial regression with standard errors in parentheses, base category: nonparticipants in land rental markets
Source(s): Own calculation

Table 5.
Land rental market participation as an adaptation strategy to climate change

5.2 Poverty impacts of land rental market participation as an adaptation to climate change

Table 6 shows the impact of land rental market participation decisions as an adaptation strategy to environmental shocks on multidimensional poverty explained in (6a) and (6b). Results indicate that renting in land significantly reduces households' likelihood of being multidimensional poor by 18% in Vietnam, while it increases the likelihood by 2% in Thailand. Renting out land reduces the likelihood of being multidimensionally poor in both countries, although the results are insignificant. The results regarding renting out are in line with the literature finding that poverty is reduced, or households have a chance of escaping poverty by renting out (Jin and Deininger, 2009; Ghebru and Holden, 2019; Wang *et al.*, 2021; Li *et al.*, 2021). At the same time, renting in land has not been associated with poverty reduction (Ghebru and Holden, 2019; Nguyen *et al.*, 2021b). In accordance with this analysis, Chamberlin and Ricker-Gilbert (2016) find that renting in land positively affects household welfare gains. Our findings, again, might be driven by the land market characteristics of Thailand and Vietnam. Renting might be profitable in Vietnam as households can increase their small land holdings, leaving them better off paying rent, while it might be the opposite in Thailand. Land holdings in Thailand are already big enough, so the costs for renting in additional land might not be so profitable anymore. Renting out land represents an additional source of income, reducing the likelihood of being multidimensional poor.

	Vietnam MPI		Thailand MPI	
Rent In	−0.18*		0.022*	
	(0.103)		(0.013)	
Rent Out		−0.17		−0.034
		(0.182)		(0.03)
Flood Occurrence	0.171	0.176	−0.068***	−0.065**
	(0.213)	(0.187)	(0.026)	(0.028)
Drought Occurrence	0.264***	0.259***	−0.041***	−0.04**
	(0.072)	(0.057)	(0.014)	(0.016)
Climate Shock	0.271***	0.265***	0.026**	0.025**
	(0.062)	(0.057)	(0.01)	(0.012)
Agricultural Land	−0.191***	−0.195***	−0.011*	−0.009
	(0.039)	(0.042)	(0.006)	(0.006)
Off-Farm Employment	−0.707***	−0.711***	−0.092***	−0.087***
	(0.065)	(0.076)	(0.025)	(0.026)
Assets Value	−0.175***	−0.175***	−0.002	−0.002
	(0.011)	(0.011)	(0.001)	(0.001)
Access to Credit	0.033	0.031	0.006	0.006
	(0.071)	(0.073)	(0.01)	(0.011)
Household Size	0.341***	0.339***	0.039***	0.037***
	(0.032)	(0.03)	(0.011)	(0.011)
Dependency Ratio	0.7***	0.713***	0.105**	0.101***
	(0.177)	(0.167)	(0.041)	(0.037)
Household Head Age	−0.038***	−0.038***	−0.005***	−0.005***
	(0.008)	(0.007)	(0.001)	(0.001)
Household Head Gender	0.114	0.123	0.003	0.002
	(0.185)	(0.165)	(0.028)	(0.024)
Household Head Deprived of Schooling	0.025	0.019	0.036	0.035
	(0.172)	(0.164)	(0.022)	(0.021)
Household Head Ethnic Minority	0.008	0.015	0.133**	0.125**
	(0.448)	(0.441)	(0.059)	(0.057)
Number of Observations	7,394	7,394	5,649	5,649

Note(s): ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; marginal effects, standard errors in parentheses
Source(s): Own calculation

Table 6.
Impact of land rental market participation as climate change adaptation on MPI

The findings in Table 6 also show that shocks in Vietnam increase the likelihood of being multidimensionally poor. While the coefficients are insignificant for floods, the results show an increase in the likelihood of being poor by 26% for droughts and 27% for self-reported shocks, independent of whether households rent in or out land. For Thailand, we see that droughts and floods decrease the likelihood of being multidimensionally poor by 7% and 4%, respectively. In contrast, self-reported shocks increase the likelihood of being poor by approximately 3%. As in Vietnam, the results are the same for renting in and out. The results in Vietnam are according to our hypotheses that shock increases the likelihood of being poor. Floods might have positive effects if seeds and crops are not washed away, especially in Thailand, as the provinces of the TVSEP are rice-heavy provinces. The decreasing effect of droughts on poverty in Thailand, however, is surprising and might be due to the inability of precipitation data to detect microclimates.

The results indicate, by looking at the size of the coefficients, that the use of land rental markets can help to mitigate the negative impact of environmental shocks on the likelihood of being multidimensionally poor in Vietnam. However, the effect is not significant enough to offset the negative climate change effects. Households should combine different mitigation strategies, such as renting land and crop diversification, to mitigate climate

change–induced shocks. Research so far has focused on renting out, while our results show that renting in land can also be a useful adaptation strategy in the presence of a land market as present in Vietnam. Renting in land as an adaptation strategy was also suggested by Eskander and Barbier (2017). Renting out as an adaptation strategy is mentioned across several studies in Pakistan (Abid *et al.*, 2016; Amir *et al.*, 2020; Bakhsh and Kamran, 2019) and is a valid strategy to mitigate food insecurities caused by shocks in Ethiopia (Gebregziabher and Holden, 2011).

6. Conclusion

Agricultural households and the rural poor are particularly vulnerable to extreme weather events, especially in countries vulnerable to climate change, such as Thailand and Vietnam. Households use different strategies to mitigate the risk imposed by extreme weather events. One of these strategies is optimizing agricultural land size via renting in or out land. Therefore, this paper examines the interlinkage between using land rental markets to adapt to climate change on multidimensional poverty in Thailand and Vietnam.

In contrast to our hypothesis, the results show that households are reluctant to participate in land rental markets as a reaction to environmental shocks such as droughts and floods. In Vietnam, households tend to rent in land in the face of droughts to increase agricultural land. Furthermore, the results show that renting in land reduces the likelihood of being multidimensionally poor in Vietnam while it increases the likelihood in Thailand. The different land markets drive this result. While land size in Vietnam is very small, it is larger in Thailand, making renting in more profitable in Vietnam while it may be an extra expenditure in Thailand. Renting out can reduce the likelihood of being multidimensionally poor, as suggested by several studies before. In general, it can be concluded that the positive effect of participating in land rental markets as a reaction to environmental shock is not large enough to offset the negative impact imposed by those shocks. This may be because land rental market participation alone cannot offset climate change's effects and impacts or provide enough beneficial gains to reduce poverty incidence. Households should, therefore, combine land rental market participation with other adaptation strategies, such as crop diversification. However, as households are reluctant to participate in land rental markets even though they can help to mitigate the negative effects of extreme weather events, policies should aim to improve the land rental market functioning in Vietnam and Thailand.

Furthermore, policies should promote land rental market participation as an adaptation strategy and enable households to participate by informing them better about the land rental market functioning. This is true, especially for the case of Vietnam, where land markets should be further liberalized, and participation in land rental markets has positive effects on agricultural households (Schulte *et al.*, 2022). Future research should focus on the interlinkages of different adaptation strategies and the role of farming efficiency that could play a role in deciding whether to rent in or out land.

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