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Livelihoods Transformation and Climate Change Adaptation of the Ethnic Minorities: A Case Study of the Khmer People in Binh Phuoc Province, Vietnam

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ABSTRACT: Typhoons, floods, and droughts brought on by climate change in Vietnam have severely damaged the livelihoods of farmers, particularly those of the Khmer people in Binh Phuoc province. In the Khmer community, drought has resulted in widespread crop deaths and livestock without food sources for more than ten years. Using qualitative data sources from in-depth interviews and participant observations in the community at several times in 2020, 2021, 2022, and 2023, the study aims to examine the Khmer community's livelihood transformation to adapt to climate change. The findings show that, in response to extreme weather events, the community has changed crops from growing pepper and rice to drought-tolerant rubber, cashew, and fruit trees; they have also shifted their livestock from buffalo to goats and cows. Families with limited land for production have divided their resources to become workers and other secondary sources of income. This transformation shows how dynamically livelihoods are adapting to climate change while also helping the Khmer people become less vulnerable to weather-related shocks. The article also makes some suggestions for policy about the livelihoods of the Khmer people in relation to environmental challenges and climate change.

KEYWORDS: livelihood transformation, climate change adaptation, Binh Phuoc, Khmer people.

I.INTRODUCTION

Around the planet, severe weather events like tornadoes, droughts, floods, unstable rainfall cycles, rising sea levels, and rising temperatures are becoming more common. These events have had a significant impact on human existence and the economy, altering production procedures and placing a significant strain on agricultural output (Leclère et al., 2014; Murken & Gornott, 2022; Tran et al., 2022). Unusual weather affects farmers, particularly small-scale farmers, by reducing agricultural yield and income and opening doors for disease outbreaks (Ajetomobi et al., 2011; Tran et al., 2022). Since agriculture is the primary source of income for farmers, it is critical that the agricultural sector adapt to climate change in order to preserve livelihoods and guarantee food security for those living in rural areas of developing nations (Esham & Garforth, 2013; Tran, 2019; Aghapour Sabbaghi et al., 2020). Farmers are responding by trying to build new social networks with institutions, groups, and political and social organizations in order to learn how to innovate in technology and farming practices (Chhetri et al., 2012; Adolwa et al., 2017). They change crops, manage and enhance land, modernize irrigation, and increase the variety of their sources of income (Esham & Garforth, 2013; Tessier, 2023)Farmers as well have chosen to adapt to climate change by modernizing production and altering water use and allocation patterns (Aghapour Sabbaghi et al., 2020; Tessier, 2023).

Vietnam is among the five developing nations most badly impacted by climate change, with drought and rising sea levels being the main effects. One meter of sea level rise is expected to impact 12,300 km2 (or 31% of the Mekong Delta's total productive land area) by 2100, affecting 4.8 million people's lives and means of subsistence (Dasgupta et al,. 2007). Droughts endure three months and occur roughly 14–18 times every ten years, which translates to 1.1–1.5 droughts each year throughout the majority of Vietnam (Tran et al,. 2022). As such, climate change adaptation is a critical undertaking for Vietnam's present and future. The Vietnamese government studied and discovered suitable. Vietnamese farmers have been resisting natural calamities for a long time, but they usually only employ their skills within their own households. Planting new crop types that are more drought- and salinity-resistant, changing crops and seasons, and improving water resource management are some of these initiatives. However, a combination of family solutions and political organization support will increase effectiveness (Tessier, 2023).

Climate change has a significant effect on the lives and livelihoods of ethnic minorities, who are vulnerable groups. The article examines how the drought affects the Khmer people's livelihood and how they adjust to rebuild and expand it. What kind of

adaptations do the Khmer people have, and how has it affected them? Is changing livelihoods a good way to combat climate change? The article provides clarity on how an ethnic minority might adapt to survive and progress towards sustainable development by addressing these topics. The analysis in the paper also offers policy recommendations to support communities in their efforts to better prepare for the effects of climate change.

II. RESEARCH AREA AND METHODS

A. Research area

The terrain of Binh Phuoc is extremely varied, including lowlands, hills, and plateaus. In terms of land resources, this region contains more than half of the area with red basalt soil that is suitable for industrial crops, such as rubber, cashew, and pepper. There are 43 different ethnic groups living in the province. The primary source of income for ethnic minorities is agriculture (Binh Phuoc Calculation, 2015). However, the effects of climate change are getting increasingly severe and having a direct impact on local residents' lives. In this province, the average annual temperature increased by 0.45 oC between 1981 and 2018. Rainfall tends to increase by 2.3 mm/year at Phuoc Long station and decrease by 1.2 mm/year at Dong Phu station. The author claims that by 2100, precipitation will increase by 26.5% and temperature change will increase by 3.6 OC based on the RCP8.5 emission scenario. The chance of heat waves and dry spells, groundwater levels and flows, soil moisture mechanisms, and the amount of degraded land all alter as a result of climate change (Nam et al., 2020). Rainfall averages during the dry season (December to April) are barely 13% of the yearly total. Like the dry seasons of 2016 and 2019, there was no rain for three months in a row in Bu Dang district, Loc Ninh district, Dong Phu district, and Dong Xoai city (Nam et al., 2021). Farmers' livelihoods and quality of life are impacted by this, particularly those of ethnic minorities, such as the Khmer people, who reside in the province of Binh Phuoc.

Out of 43 ethnic groups, the Khmer people in Binh Phuoc number 19,315, placing them fifth (after the Kinh, Stieng, Tay, and Nung people). They are long-term Binh Phuoc residents who practice Theravada Buddhism and have the traditional characteristics of people from mountainous regions in their culture.

Research locations include Tan Xuan ward in Dong Xoai city; Nha Bich commune is part of Chon Thanh district; and Loc Khanh, Loc Thanh, and Loc Thinh commune are located in Loc Ninh district. There are more than a thousand Khmer residents in these places, where they have resided for a considerable amount of time. These are communities with more than a thousand Khmer residents who have lived there for a considerable amount of time. With rice and long-term industrial crops as the primary crops, the Khmer people in these areas have transitioned from shifting agriculture to settled farming since the 1990s. The drought that began in 2016 and is still going strong has had a significant impact on the lives and means of subsistence of the Khmer community in Binh Phuoc.

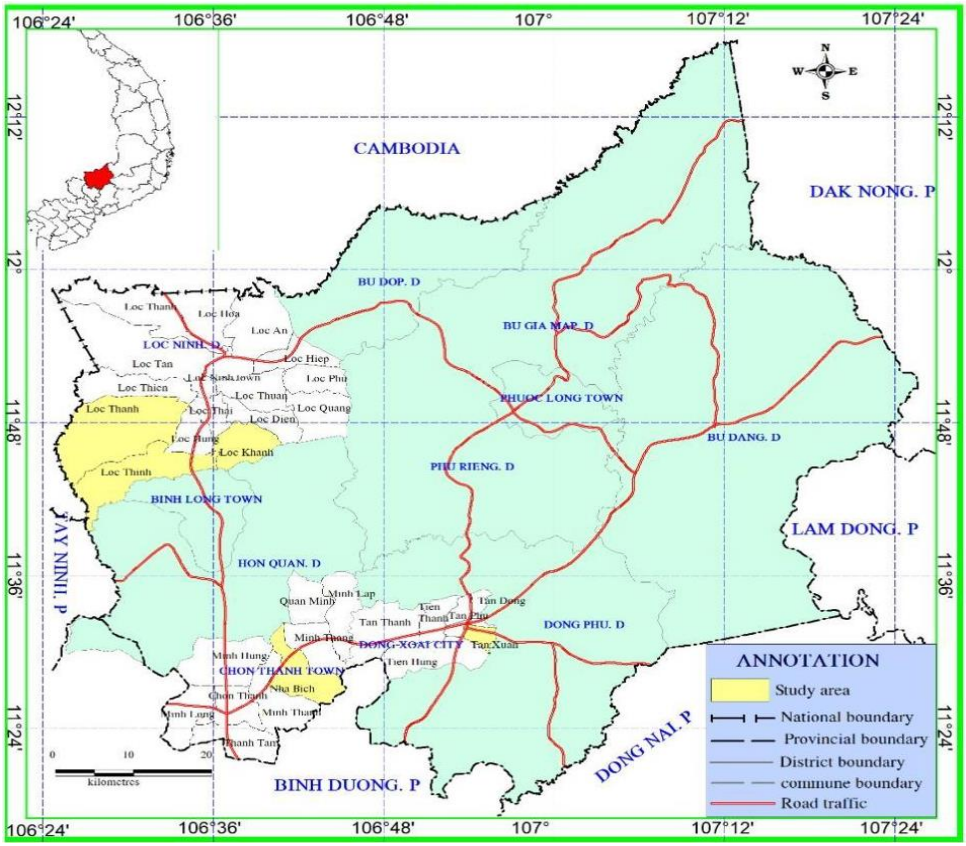

Fig 1. The study area map

B. Research Methods

Fieldwork, participant observation, and in-depth interviews are some of the research methods used in this article. At research sites, fieldwork aims to observe and record the Khmer people going about their livelihoods. In 2020, 2021, 2022, and 2023, participant observation sessions were held in the dry season. The author took part in both production activity and the efforts to deal with the drought during these sessions by identifying sources of water for irrigation and protecting crops from the sun. The goal of participant observation is to identify both achievements and challenges in the process of the Khmer people's recovery and adaptation from their vulnerable means of livelihood.

In addition to participant observation, fifteen in-depth interviews with heads of households from a variety of ages, jobs, and educational backgrounds were done. Four of them are under thirty years old, six are between thirty and sixty years old, and five are above sixty. The purpose of the in-depth interviews was to get an understanding of the vulnerabilities that extreme weather events cause for households, as well as the successes, worries, and expectations that households have when adjusting to such events. Friendly conversation took place during the in-depth interviews at the interviewee's residence. They are recorded, last 45 to 80 minutes, and typically conclude with a visit to the garden. All of this information was recorded, and the relevant portions were taken from the interview tape.

III. RESULTS

A. The impact of climate change on the agricultural production of the Khmer people

Having 1,319,652 people (398,992 households), the Khmer population in Vietnam makes up 0.46% of the total population of the nation. The majority of them, 1,141,241, are found in the Mekong Delta (General Statistics Office, 2020). There are 43 different ethnic communities in Binh Phuoc, and 19,315 of them are Khmers (Binh Phuoc Provincial Statistics Department, 2020). The primary source of income for the Khmer people is agriculture, but as extreme weather events become more frequent and serious, they have a significant impact on their quality of life. but since 2000, this area has lacked water in the dry season. The problem of a shortage of clean water in this region has been momentarily resolved. However, three months without rain in 2016, 2019, and 2021 resulted in a severe shortage of water for household consumption as well as manufacturing. One phenomena that happens in Loc Thinh commune, Loc Ninh district, during the dry season is having bought water for three consecutive months. At all study sites, a great deal of gardens perished, a great deal of fields were only productive in the rainy season, and they had to be abandoned during the dry season.

The effects of climate change and protracted drought have negatively impacted agricultural output, income, and the quality of life for the Khmer people. Since 1990, they have switched from slash-and-burn farming to commercial agriculture. To ensure food security, the transition happened gradually and food production was continued. The market price of pepper rose by 2014–2015, and Khmer people converted 2000 m2 of production land to 7000 m2. Planting 1000 m2 costs 25 million VND, therefore every family had to pay between 50 and 150 million VND. The Khmer people have mortgaged residential and production land at comparatively high interest rates from banks in order to have finances to invest in production. But since 2016, the weather has been harsher and harsher, leaving the Khmer pepper gardens without enough water to damage them and cause mass deaths. Additionally, the price of pepper reduced from 250,000 VND/kg in 2015 to 38,000 VND/kg in 2020, shocking the Khmer people. The Khmer people are deeply indebted as a result of crop failures, drought, and declining prices. Living in Loc Khanh commune, Loc Ninh district, Binh Phuoc province, Mr. Lam O's family is among those who mortgaged their home in order to obtain a loan for the purpose of growing pepper.

"*In order to borrow 100 million VND from the bank in 2015 to cultivate pepper, I mortgaged my house and land. The interest rate was 7% per year (for the first three years, the subsequent years increased according to the market). 4,000 m2 of almost 900 pepper bushes were planted by my family in place of the previous cashew garden. However, almost 200 of the shrubs in my pepper garden perished in 2016. I made an effort to care for it and looked for numerous ways to salvage the pepper garden, but there has been an ongoing drought in recent years, and the cost of pepper is excessively low at around 50,000–70,000 VND per kg. I had to give up on the garden since I was broke and had run out of money. I haven't had any money to invest in other crops up until now" (Mr. Lam O, 42 years old).*

From 2014 to 2016, the 5,000 square meter pepper garden owned by Ms. N's family produced more than a ton of peppers annually. However, 10% of pepper bushes perished from a lack of water following the 2016 dry season. Even though her family had invested in an irrigation system, about 90% of the garden died in the dry season of 2021, which greatly affected her family's quality of life.

Figure 2. Mr. Lam O's pepper garden

Figure 3. Mrs. N's pepper garden

Severe weather events including drought, frost, and unexpected rain also have an impact on the productivity and production of cashew crops, rice, and other crops. Rice can only yield one crop a year and must reduce the number of production crops it grows. During the last ten years, cashew trees have experienced low yield due to rime and unseasonal rains that coincide with their flowering season, despite the Khmer people having sprayed cotton and fruit conditioners on the plants. "*About ten years ago, there was a crop failure every year during the cashew flowering and fruit-producing season because of rain and rime. My family harvested nine tons of fresh cashew nuts per three hectares in 2013. However, since 2014, there has been an annual crop failure. In addition, cashew nut prices have decreased from 32,000 VND in 2016 to 21,000 VND in 2023*" (Mrs. N', 56 year old). Every weather change has had a significant impact on people's lives, requiring them to adapt in order to preserve and improve their quality of life.

B. Livelihood transformation and drought adaptation strategies

Humans have adapted to their surroundings through survival actions (Steward, 1955). For many generations, the Khmer people have used shifting agriculture methods to adapt to the mountainous environment of Binh Phuoc region. With the gradual transition to sedentary farming starting in 1975, the Khmer people mostly cultivate wet rice along with commodity crops including cashew, pepper, rubber, and buffalo. For Khmer families, agriculture serves as their primary source of income. Climate change has, nevertheless, had a significant impact on the community's production operations during the last ten years, particularly from 2016 to the present. To survive and develop, the Khmer people must continuously create daily life as well as adapt to extreme weather phenomena.

Crop recovery strategies:

The Khmer people have short- and medium-term answers to the water shortages, but they are all passive. They devised a plan to buy water for everyday use and irrigation at a cost of 80,000–100,000 VND/m3 in the event of a serious shortage of water.They devised a plan to buy water for everyday use and irrigation at a cost of 80,000–100,000 VND/m3 in the event of an acute water crisis. With this amount, Mr. Lam O's family had to pay 2,700,000 VND after purchasing 28 m3 of water to irrigate a 4,000 m2 pepper garden. Every year since the 2016 dry season, the indigenous Khmer community has had to purchase water. Pepper plants need special attention because losing a harvest can be very costly. However, purchasing water is not a sustainable solution, thus we require longer-term strategies. Thus, Khmer people also understand that purchasing water for agriculture and daily usage is merely a short-term fix in an emergency. To recover livelihoods and deal with weather-related shocks and vulnerabilities, communities require more sustainable adaptation strategies.

Drilling new wells, building tanks, and creating ponds to collect rainwater is one of the medium-term strategies to prevent and lessen drought among the Khmer people of Binh Phuoc. Many Khmers have opted for this strategy, meaning that every household has access to a well and at least one rainwater tank for everyday use. To irrigate their plants, families who grow fruit and pepper trees buy LDPE pipe systems and dig water reservoirs. "*Every home builds a tank to store rainwater for later use. A well and two to three water reservoirs are frequently dug by households that cultivate fruit and pepper gardens. My family recently excavated two more lakes to store water and drilled a well worth 10 million VND. The Khmer people purchased water pipes and 0.25-mm HDPE plastic tarpaulin to line the lake's bottom in order to prevent water waste. To save the pepper garden, I purchased LDPE water pipes to irrigate the whole garden.Additionally, I switched the pepper tree's pole from a dry to a fresh tree. It can provide sun shade for the pepper tree when it grows, but in 2020, my family's efforts were only able to rescue more than half of the pepper garden.By 2023, every pepper plant has perished*" *(Mr. Lam O, 42 years old)*

We witnessed the community's attempts to adapt to climate change throughout fieldwork and participant observation in the Khmer people's livelihood activities. Five households have integrated contemporary irrigation techniques with indigenous knowledge to

cover pepper roots with Chromolaena odorata and other leaves, which enhance soil humus and help retain water. These households continue to harvest an average of 9 kg/bush (3 tons/ha) from their pepper plants.

Despite being an inexpensive and efficient solution, very few homes use it. While using drip irrigation is a good way to preserve crops and save water, not many families utilize it because of its expensive cost and high tech requirements. The majority of the remedies that the Khmer people have devised to safeguard crops from climate change are not actually appropriate for them, which is why up to 80% of households have given up growing pepper.

Converting plant and animal varieties:

A strategy that is considered to have significant financial advantages for adapting to climate change is crop conversion (Nguyen Thi Thuy Lan, 2017).In order to improve their livelihoods and adapt to climate change, Khmer farming households in Binh Phuoc in this study switched their livestock and crops.

During the dry season, the Khmer people plant native dry rice types in rice fields without irrigation infrastructure. Some households moved from growing two crops to growing one crop during the rainy season and another crop during the dry season. Rice is being replaced by other crops including cassava, corn, and peanuts. Although this kind of production yields better outcomes and more financial gains than rice cultivation, households continue to think that cultivating other food crops is merely a stopgap measure. On the other hand, a growing number of homes are opting to produce industrial crops and fruit trees, believing that this is a long-term approach. Citrus fruit, cashew, and rubber trees are examples of perennials that yield large profits. "*Growing rice and other crops is hard but the income is low. The maximum production of rice is only 10 million VND per hectare; in contrast, 1 hectare of rubber yields an average monthly income of 14 million VND*" (*Mr. Lam O, 42 years old).* The Khmer people shifted from farming rice to growing rubber because it was more profitable. But only basalt-red soil yields good results for rubber trees. More money is needed for the growth of rubber and fruit trees than it is to grow rice and vegetables.Fruit tree cultivation is a recent practice that has emerged in the Khmer community as a result of interactions and acculturation with other ethnic groups. Thus, coordination with local government agencies and agricultural specialists is necessary before converting acreage to rubber and fruit trees.

Changing from planting pepper to rubber, cashew, and fruit trees is one way to adapt to drought. Pepper is a crop that needs to be watered and cared for every day, but because of the ongoing drought, most households' pepper gardens have collapsed. Most households have shifted to cultivating fruit trees, cashews, and rubber in order to deal with this predicament and recover economically. The Khmer people cultivate cashew trees in high, sloping, water-scarce locations because they are cheap to produce easy-to-grow plants that require minimal maintenance. In the midst of the lifeless pepper garden, the Khmer people planted cashews.Some homes decide to replace their pepper with durian. For most Khmer households, rubber is still the preferred tree. Compared to pepper, this plant has fewer pests and is more drought-tolerant. It may be harvested constantly for nine months of the year and has a great economic value. This livelihood method has produced large revenues and been demonstrated in the community by numerous households. "*The majority of the Khmer people living here have moved to growing rubber after their pepper garden died down. After just two years of care, the rubber tree is ready for harvesting in its sixth year. It offers consistent, reliable revenue for nine months out of the year. However, it also costs a lot to grow—roughly 50 million VND each hectare. A family with little resources can only raise cashew plants" (Mr. Lam O, 42 years old)* The cost of the investment prevents the Khmer people from switching their livelihoods and adapting to climate change, even though the economic benefits are greater than those of other crops. The Khmer people have had to constantly modify their everyday lives while living on the brink of uncertainty, but their success in adapting is also influenced by their access to livelihood resources and their economic situation.

Besides specializing in changing crops, the Khmer community converts livestock to suit climatic conditions. Before 2010, all families raised buffaloes from 5 to 30 heads. However, as the population increases, the grassland area shrinks, especially prolonged drought causes buffalo herds to lack food. Therefore, by 2022, only 2 out of 250 surveyed households will raise buffaloes, most other households have sold all their buffalo herds to switch to raising cows and goats. Cows are more drought-resistant than buffalos, and require less food than buffaloes.

Besides specializing in changing crops, the Khmer community converts livestock to suit climatic conditions. Before 2010, all families raised buffaloes from 5 to 30 heads. However, as the population increases, the grassland area shrinks, especially when prolonged droughts cause buffalo herds to lack food. Consequently, by 2022, just two of the 250 households studied will be raising buffaloes. To transition to raising cows and goats, the majority of other households have sold all of their buffalo herds. Compared to buffaloes, cows endure droughts better and need less food.The Khmer people collect straw for their cows at the end of every rice harvest season. With the Khmer people, cows are likewise symbiotic creatures because they provide milk and fertilizer at a high economic value without invading human food supplies. It is possible to sell adult cows for between 15 and 25 million Vietnamese Dong. This explains why raising cows is a common practice among Khmer communities. Goats are another new animal that the community has embraced. Out of the 250 homes studied, 19 of them raise goats. Raising this animal is pretty simple, as it needs minimal food or attention. Goats are raised by the Khmer people using acacia leaves in Goats are another new animal that the community has embraced. They breed goats not for meat but for financial gain. Still, a relatively small percentage

of households are pursuing this kind of career. They view raising animals as an adjunct to farming as a means of subsistence. There are no households that make raising animals their primary source of income.

Crop diversification:

A livelihood strategy that generates larger gross profit margins than monoculture is diversifying crops to include coffee, pepper, and fruit trees (primarily avocado, durian, and macadamia). For Vietnamese people who live in the highlands, this is another tactic to prepare for the risks brought on by climate change (Clément et al., 2023). The findings of our study demonstrate that the Khmer people have always developed and diversified crops in order to avoid and adapt to risks brought on by climate change, notwithstanding the reality of unpredictable agricultural production. They farmed a variety of crops on their productive land, including vegetables, cashew, rice, pepper, rubber, and fruit trees. The community inter-planted other crops with pepper to boost earnings after years of drought and significant damage to the pepper crop. Households have interplanted vegetables, corn, and beans in newly planted cashew or rubber gardens to ensure food security during the period that rubber cannot be harvested. At first, intercropping has given the family a source of money while also protecting food security and helping them recover from disruptions to their agricultural output.There are 3 hectares of productive land owned by Mr. Lam S's family. He cultivates rice on 0.4 hectares, pepper on 0.5 hectares, cashew nuts on 0.6 hectares, and rubber on 1.5 hectares. He claims that rubber provides a consistent income from March through December. Rubber leaf fall coincides with the two dry season's peak months, hence latex harvesting operations are temporarily halted during these times. Households gather pepper and cashews at this time.The pepper garden owned by Mr. Lam S's family had a good yield of roughly 2.5 tons/0.5 ha in prior years. Nowadays, many pepper roots die from a lack of water and pests. In the center of the garden, he planted fifty durian trees in 2017. The first fruits from the durian garden were harvested in 2023, yielding around 100 million VND in revenue for the family. Some families diversify their crop portfolios to reduce the risks associated with climate change.

Households lacking agricultural property have attempted to lease land or safeguard the rubber garden for the proprietor while growing vegetables in the center of the garden. In most cases, Ms. Thi P's family farmed rice and other crops on 3 hectares of recently planted rubber land that they rented from a landowner in a different province. She intercrops rubber plants with native rice cultivars in areas without irrigation water. After the rubber tree turned three years old, her family gave the land back to the original owner and went on looking for another land owner to rent land for production. Crop diversification is thus a means of achieving the maximum life expectancy while also assisting in the adaptation and recovery from production risks.

Livelihood transformation and livelihood diversification:

Most Khmers in Binh Phuoc used to make their livelihoods from agricultural production and hired labor in agriculture. Nonetheless, a significant number of Khmer individuals have changed careers in the last ten years, going into new fields including labor, construction, trading, etc. The effects of climate change are one of the primary reasons for the birth of new professions. Weather extremes reduce employment in the agriculture industry and make agricultural productivity insufficient to guarantee food security. The Khmer people must look for new livelihoods in order to deal with this problem. Many young individuals choose to become workers as one of their new livelihoods. This is a low-skilled position that doesn't require a lot of schooling. As a result, many families with little or no productive land have moved from past agriculturally linked professions to working as laborers. Mr. Lam M (44 years old), owns 8,000 square meters of rice-growing land. He worked in production and as a laborer in agriculture, such as picking pepper, collecting cashew nuts, and cutting grass for wealthy families. However, since 2019, the region's agricultural output has faltered, there are few agricultural jobs available, and he and his spouse have applied for positions at a leather shoe manufacturer that is owned by a foreign corporation.“*My family owns less than one hectare of land, and I labor for people in addition to producing things myself. My wife and I decided to seek a job in a Korean company because the harvest has been poor and I haven't had a job in recent years. Most people, including my family, agricultural production is not enough to make a living, so everyone goes to work. Being employed offers a more stable income; my spouse and I make roughly 20 million VND a month if we work overtime, and 8 million VND each person if we work 8 hours a day. I am able to attend my two children's schooling because of it*” (Mr. Lam M, 44 years old). People without education often find employment as rubber tappers for fields or homes owned by ethnic minorities. They must work from two in the morning till six in the morning and master hat mining skills for this profession. This employment is more free than working for a company, but it is also less paid and weather dependent. They are not able to participate in insurance and are forced to leave work in the event of rain. Since the majority of these workers lack literacy, their jobs are unstable, yet they have no alternative means of support. Their susceptibility to the weather grows when it's unstable.

Trading is an insider's more strategic and aggressive means of livelihood. This livelihood need financial capital, human capital capable of calculating input and output, and social capital to establish a trading network in order to invest in businesses. Thus, just 2.8% of the 250 homes surveyed adopt this livelihood approach. In 2020, the family of Mr. Lam B switched from farming to constructing a more than 400 m2 cafe. It is believed that his family's coffee industry activities offer a reliable source of income. The family of Ms. Thi Ph cultivates cashew and rubber trees on three hectares of land. In order to concentrate on investing in the

supermarket business in 2019, she sells the orchard annually.Among the causes of shifting livelihoods are unpredictable weather patterns and low crop output and the rationale behind the transition also reveals individual rationality aimed at maximizing profits. The Khmer people believe that the best livelihood strategy in the context of climate change is to diversify sources of income and allocate resources to various activities. The majority of families with more than three workers divide up labor resources and work at several jobs in order to identify income streams and avoid risks to their way of life. The four members of Mr. Lam V's family are: he and his wife, and two kids. Using 3 hectares of land (2 hectares for rubber and 1 hectare for cashew) and 7 cows, he and his spouse engage in agricultural production. Their workload is fairly demanding; he brings in additional seasonal workers as needed. He made the choice to let his two kids work other occupations so the family would have a steady stream of income.Therefore, the older son went to work as a worker, and the younger son opened a hairdressing and beauty service. The two children still support their parents' rubber tapping work in the early mornings and on holidays. Like Mr. Lam V's family, most households choose to diversify their livelihoods. In families with little labor and little land for production, they also distribute human resources into different fields.While the husband works as a worker or bricklayer, the wife stays at home and works as a hired laborer in agriculture, taking use of products from the river and streams, and taking care of the children. Diversifying one's source of income, enhancing livelihood security, and assisting rural people in managing risks in the event of shocks and potential natural disasters can all be achieved through livelihood diversification (Frank Ellis, 2000). This approach has also been adopted by the Khmer community in Binh Phuoc as a means of adapting to climate change in the present and the future.

IV. DISCUSSION AND POLICY IMPLICATIONS

Their life and ways of livelihood have been severely impacted by the recent drought and hoarfrost. The Khmer people have adopted both medium- and long-term adaptation tactics as well as emergency adaptations. These tactics are primarily individual ones and infrequently entail group implementation or government engagement. In an emergency, homes in the districts of Loc Ninh and Chon Thanh must purchase water at a cost of 80,000 to 100,000 VND/m3, which is ten times more than the going rate, in order to survive and use it for drinking, daily needs, and garden life-saving. People from the Khmer language explained the high cost of purchasing water by saying, "We cannot stand still and watch the garden die, the garden is our only asset, our home."They made every effort to save the pepper garden, even going so far as to mortgage their home and land for the investment. Tessier's (2023) study has demonstrated this emergency drought-fighting method, the farmers in this study are the majority group, and they have calculations to adapt. However, marginalized communities, such as the Khmer people, tend to mimic without considering the consequences, which leads to a propensity toward passivity. Therefore, the temporary solution only makes the Khmer farmers feel better for a short while; it is unable to address the issue of water scarcity, which has the effect of killing off a large number of family pepper gardens. It is important to talk about how the local government does not assist or interfere when expensive water is purchased for emergency drought adaptation. This demonstrates how little the government is doing to help people adapt to climate change. The authorities must inform the Khmer people of the drought condition so they can prepare backup plans, if the spirit of government for the people is to be adequately applied. The cost of the water that the community is supplied with needs to be regulated by the government. This has been resolved since 2021's dry season. Together with social organizations, the government has constructed public clean water tanks and supported tank vehicles that can supply household and drinking water during emergencies.

Khmer households have devised medium- and long-term remedies, such as drilling wells, excavating ponds, constructing water storage tanks, and changing and diversifying livelihoods, in addition to emergency reaction measures. Every home constructs a rainwater storage tank for daily usage, with a capacity of 10 to 20 m3. This helps to save water in order to avert drought. Similar measures have also been suggested by earlier research to adapt to climate change: diversifying crop types, altering crop varieties, and conserving water (Esham & Garforth, 2013; Aghapour Sabbaghi et al., 2020; Tessier, 2023). The Khmer minority likewise selects these strategies in order to adjust and lower their risk of drought. The issue is how to assist individuals in gaining access to crop types, funds for conversion, and accountability for the outcomes, even in the event that the remedy is sound. Will the farmer still have to bear the repercussions if, regrettably, the crop conversion fails? The state plays a crucial role in this matter because it is the only institution that promotes sources of capital for livelihood and mobilizes funds for climate change-related agricultural research. However, the Khmer people now consider that local authorities have failed to provide them with assistance or solutions in recent years. The Khmer people have developed their own solutions for livelihood diversification and conversion in order to adapt; they have also learned these strategies from neighboring ethnic groups. Depending on where a household gets its livelihood capital from, different risk response and livelihood recovery tactics yield different outcomes. Households with more than three hectares of arable land and steady financial resources heal from wounds and deal with adverse weather conditions successfully. Contrarily, households with little access to capital have trouble changing their methods of livelihood. As a result, they rarely succeed in adapting and are more likely to become impoverished. Households prioritize safety over all other goals, maintaining rice production to provide food security and allocating human resources to various activities, including workers, laborers, construction workers, etc.. Out of all of them, being a worker is the professional path that most families choose since it offers a

more reliable source of income than other jobs. The ability to read and write is a barrier to entering this field. Nonetheless, the results of our poll indicate that around 50% of heads of households lack literacy. We saw numerous adults over the age of eighteen who were not only illiterate but also unable to converse in the common language (Vietnamese) over the course of the investigation. The state has prioritized initiatives that focus on education and raising educational standards. The state has constructed schools in each community. Many households do not, however, still recognize the value of education in the process of establishing a living for themselves and their family.

In order to effectively improve livelihoods and strengthen climate change adaptation strategies, the following policies and solutions must be put into place: First, the speed at which climate change warnings are released affects farmers' capacity to react. However, the Khmer people think that because they were not informed about the drought phenomena, their responses ended up being inactive. As a result, in order to avoid extreme weather occurrences, the authorities must create detailed plans for every step and every location and immediately communicate information to everyone. Secondly, funding and resources for agricultural research aimed at mitigating the effects of climate change must be mobilized by the government. Investigate and construct irrigation systems to boost output and let the Khmer people directly obtain access to funding sources. In particular, financial resources to switch to high-yield, short-term cultivars resistant to rime and drought, and build cooperative models to increase output and create jobs for the populace. Functional departments must "hand in hand instructions" during implementation to steer clear of ideas that are merely political speech on paper but aren't popular with the general population. Third, the level of education and expertise possessed by the head of the household has a significant impact on how the Khmer people adjust. As a result, in order to enhance people's lives, local governments must offer training programs to raise awareness of climate change and how to adapt to it, as well as promote training to raise educational standards, skill levels, and career options. In order to determine the most effective means of adapting to extreme weather events, Khmer people themselves must also increase awareness, work on enhancing the educational attainment of family members, and conduct self-study. In order to determine the most effective means of adapting to extreme weather events, Khmer people themselves must also increase awareness, work on enhancing the educational attainment of family members, and conduct self-study. Agricultural extension staff have to encourage the Khmer people by setting the model of applying local knowledge in conjunction with scientific understanding to combat drought and adapt for future climate change.

IV. CONCLUSION

According to research findings, the drought issue has been worse since 2016. This has led to a shortage of water for everyday needs and production, mass crop mortality, and a major impact on livelihoods of the Khmer people. They have adopted a variety of strategies to deal with the drought, including short-term, intermediate- and long-term fixes. Many families have opted to adapt to climate change by, among other things, shifting their livelihoods and converting and diversifying their livestock and crop stocks. Changing livelihoods is seen as a means of adapting in the current day, whether it involves moving from agriculture to the production of rubber, cashew, fruit trees, or peppers and wet rice to working as a worker. The ability to possess and access livelihood capital is the deciding factor in the Khmer people's ability to successfully modify their way of life in order to adapt to the drought. The outcomes of adaptation vary, but the Khmer people's approach demonstrates that, despite being a marginalized community with little access to resources, they actively recover and change their way of life.To improve the capacity to adapt to extreme weather events, local authorities must have policies in place at every stage to lead and assist the Khmer ethnic. In order to present a complete picture of the effects of climate change and the Khmer people's responses, more research is required. This study highlights some policy concerns. Considering this, the provincial government of Binh Phuoc provides the most genuine and targeted solutions to assist the Khmer people and other ethnic minorities in adjusting to the local climate change.

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