

Integrating Farmer's Experiences Using Indigenous Knowledge Practices to Adapt to Climate Change in Sustainable Development in Mekong Delta, Vietnam

Pham Xuan Phu*

Department of Rural Development and Natural Resources Management, Faculty of Agriculture and Natural Resources, An Giang University, Viet Nam National University Ho Chi Minh City, Vietnam

***Corresponding Author:** Pham Xuan Phu, Department of Rural Development and Natural Resources Management, Faculty of Agriculture and Natural Resources, An Giang University, Viet Nam National University Ho Chi Minh City, Vietnam.

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Abstract

This research was carried out to learning as an everyday of farmer's experiences using indigenous knowledge practices to adapt to climate in sustainable local development. The effectiveness of valuable indigenous knowledge has contributed in reducing vulnerability of people living in flooded areas in in the community in the context of climate change. However, this knowledge has not been specifically recorded and stored appropriately to pass on to later people and share widely in the community. The study proposes some solutions to preserve the most valuable indigenous knowledge so that people can actively adapt to climate change.

Keywords: Adaptation; Climate Change; Indigenous Knowledge; Learning

Introduction

An Giang is one of the watershed provinces of the Mekong Delta, so it is affected by floods every year. According to Duong Van Nha [2], when floods come, besides bringing a large amount of silt for accretion, improving soil fertility, cleaning fields, washing alum, floods also create jobs and incomes for people. people through wild fishing, aquatic vegetable picking, tourism services. However, floods also bring some disadvantages to people, specifically from 2000 up to now, the abnormality of floods has affected people's livelihood activities. To be able to adapt to the changes of floods, to changes in society and the environment, people must always know how to use indigenous knowledge to exploit natural resources appropriately and manage a more flexible way [7]. Indigenous knowledge in flood adaptation in An Giang is understood as the accumulated experience of the local community over many generations and widely inherited, it is reflected in the local people's living and harmoniously respond to annual floods in order to effectively exploit the resources brought about by floods, while avoiding flood-induced injuries [23]. Flood response based on the available knowledge of the local community needs to be effectively understood and disseminated to contribute to the sustainable development of the locality in the face of climate change that is affecting change in the environment, abnormal changes in floods. There

have been many researches on indigenous knowledge on adaptation to climate change, conservation of medicinal plants, conservation of genes, local varieties, living with floods in the Mekong Delta, and changing weather conditions by [1,4,5,7,9,11,12,14,15,21,23]. However, the reality shows that there have not been many studies on the reliability of indigenous knowledge in the ability to adapt to the changes of floods in agricultural production in the study area in the context of climate change. For these reasons, it is to carry out the study on: "Integrating farmer's experiences using indigenous knowledge practices to adapt to climate change in sustainable development in Mekong Delta, Vietnam: A case study in An Giang province".

Research objectives

The research is focusing on the specific objectives below:

- To understand the current status of indigenous knowledge of flood adaptation in the community and application of indigenous knowledge in the community in the context of climate change.
- To promote the value of using indigenous knowledge of farmers in An Giang province to reduce the vulnerability of farmers in agricultural production in the context of climate change.

Research questions

The research is focusing to answer the following questions:

- What is farmer’s indigenous knowledge in applying to floods of different zone?
- How is farmer’s indigenous knowledge and their adaptive capacity to floods of different zone?
- What are solutions and policies for supporting local people reduce vulnerability for flooding in the context of climate change on using indigenous knowledge of farmers in An Giang province?

Research methods

To satisfy the research objectives, the study approaches sustainable livelihoods and uses the survey and assessment method based

on KAP (knowledge-attitude-behavior) [26]. The information is collected by a combination of quantitative and qualitative research methods. The data were collected from many different subjects in the study area and used by many different tools. Data collection is carried out according to the following process: (1) Key informant Panels (KIP); (2) PRA(participatory Rural Appraised) group discussion; (3) interviewing farmers; (4) in-depth interviews. The collected information was verified by mutual verification in order to supplement information that other methods could not collect, and at the same time to ensure objectivity in the research (see Table 1).

In the study, using the PRA method, the paired ranking tool was used to rank the priority of indigenous knowledge on flood adapta-

No	Implementation content	Objects	Tools/methods	Sample observe
1	Key Important Panels (KIP)	Local officials	The content of the interview is designed on a semi-structured sentence board	24
2	Group discussion	People live in areas without dikes (Phu Huu, Vinh An, Vinh Phuoc communes) and with dikes (Phuoc Hung, An Hoa, Luong An Tra communes)	The content of the group discussion is based on a semi-structured questionnaire	12
	Seasonal calendar	Communes of Phu Huu, Vinh An, Vinh Phuoc, Phuoc Hung, An Hoa, Luong An Tra	Seasonal scheduling of agricultural production changes the flood regime	12
	Direct observation	People live in areas without dikes (Phu Huu, Vinh An, Vinh Phuoc communes) and with dikes (Phuoc Hung, An Hoa, Luong An Tra communes)	Sightseeing, taking photos, taking notes on key information about farmers’ livelihoods and indigenous knowledge of farmers adapting to floods.	12
	History of the community	People in the study area	An overview of livelihood milestones over time and indigenous knowledge of flood adaptation	12
	Ranking Matrix of difficulty	People live in areas without dikes (Phu Huu, Vinh An, Vinh Phuoc communes) and with dikes (Phuoc Hung, An Hoa, Luong An Tra communes)	Paired ranking matrix of difficult issues and priorities in the study area	12
	SWOT analysis	People live in areas without dikes (Phu Huu, Vinh An, Vinh Phuoc communes) and with dikes (Phuoc Hung, An Hoa, Luong An Tra communes)	Analyze strengths, weaknesses, opportunities, threats and propose solutions	12
3	Sociological investigation of research subjects	People live in areas without dikes (Phu Huu, Vinh An, Vinh Phuoc communes) and with dikes (Phuoc Hung, An Hoa, Luong An Tra communes)	Interview content will be designed on a structured questionnaire	360
4	In-depth interview	Farmers live in three different ecological zones in the study	Through the questionnaire to find out the relationship and different livelihoods among the three regions in the study	18

Table 1: Methods of data collection in the study site.

tion in forecasting in agricultural production and life. Because the tool is easy to implement, and cross-checks the community’s prioritization issues on a particular priority area. During the discussion of the community’s priority issues, the practice used a large sheet of A0 paper to list the ranking problems on the top and left side of the matrix, each cell representing compare pairs with the list listed at the top and left; For each pair of comparisons; ask a group of participants in the research community which (preference) issue is important, record the answer in the appropriate box of the rating matrix; ask the reason for that choice; note information into the ranking criteria matrix. Continue to perform another pair of comparisons and continue to compare as above until all the comparison pairs of the matrix are exhausted. After completing the matrix table of ranking problems, count the number of occurrences of each problem that is considered important. which is also the score of each problem, the highest number of points is the 1st priority and vice versa.

For solutions to preserve and preserve indigenous knowledge of people in local communities. The study used the SWOT method and combined from many different survey sources from the household survey with the opinions of the people, the KIP group survey for local authorities and combined with the method.

The study is based on the sampling principle of [17,22] as follows: (1) When N is large, a small percentage is recommended to be used, (2) Appropriate sample size should not be less than 30 observations, (3) Sample size should be commensurate with budget and time requirements. Therefore, in order to select these households, the research uses the method of interviewing local knowledgeable people to let them know and point out the next households in the study area and interviewing the repeated information. with a total of 360 households survey questionnaires for 6 communes (each commune selected 60 households).

The sample selection criteria are defined as follows:

The research areas	The study sites	People living in agricultural production		Total of sample
		No dyke	Higher dyke	
An Phu District (Upper zone)	Phu Huu commune	60		120
	Phu Hung commune		60	
Chau Thanh district (Middle zone)	Vinh An commune	60		120
	Vinh Hoa commune		60	
An Phu disict (Lower zone)	Vinh Phuoc commune	60		120
	Luong An Tra commune		60	

Table 2: The structure of survey in study site.

- **District:** Three districts are selected to represent three different ecological regions of the province, including An Phu (upper zone), Chau Thanh (middle zone) and Tri Ton (Lower zone)
- **Communes:** In each district, two communes, including one with dike and one without dike, were selected in study site.
- **Household:** Each commune selected to interview 60 households. The farmers are selected purposefully, the interviewees are households with experience of living with floods over 50 years old because they are qualified in terms of experience time and living experience, knowledgeable about the local area, local indigenous knowledge. To select these households, the study used the method of interviewing local knowledgeable people to identify the next households in the interview process in the study area.

Results and Discussion
Indigenous knowledge of people in forecasting weather through signs of animals

According to [3,26] showed that when applying KAP (knowledge-attitude-behavior for a field of natural environment and natural disasters, an observed phenomenon or event has Repeated percentages above 50% are still accurate (suitable for practical applications). However, for an observed phenomenon or events where the percentage occurs repeatedly 50% of the observations are incorrect (not suitable, not applicable in practice). The results of Table 3 show that people can predict the weather by observing the expression of some animals such as dragonflies, frogs, toads, birds, bees, ants, snails, laybug, termitesn, flies. Which are some signs from animals that people have accumulated have been explained by scientific basis in accordance with studies Research by [1,15]. This predictive knowledge is trusted by the people, and at the same time wishes to preserve and promote this indigenous knowledge.

Animal behavior observation	Descriptions	Forecasting	Frequency (Household)	Percentage (%)	Household reliability level
Dragonfly	Dragonfly flying low means rain flying high means sun, flying in the middle means shady	Daily, reliable	360	100	Preserve and promote
Frogs,toads	Make a croaking sound longer and louder than usual when it’s going to rain	Daily, reliable	360	100	Preserve and promote
Bird	Flying high in clear weather, flying close to the ground signal that it’s going to rain	Daily, reliable	335	93	Preserve and promote
Bee, butterfly	Disappearing from the flower garden signals that it is going to rain	Daily, reliable	306	85	Preserve and promote
Laybug	Moving in swarms signals warm weather; when looking for shelter in cold weather.	Daily, reliable	259	72	Preserve and promote
Ants	Ants stay higher place or move their nests and eggs to higher places.	Daily, reliable	342	95	Preserve and promote
Termities	Termites appear, rains take place the day after.	Daily, reliable	342	95	Preserve and promote
Snails	Snails float on the pond, showers are coming	Daily, reliable	306	85	Preserve and promote
Flies	Flies and gadflies attack paddy fields, rains are about to take place.	Daily, reliable	270	75	Preserve and promote

Table 3: Weather forecast based on the expression of some animals.

Note: Daily, reliable: Farmers rely on their ability to “read” daily weather changes and a repeatable confidence level of accuracy > 50%, based on the theory of WHO (2008) and Ellen, V., 2009 show that when applying KAP (knowledge-attitude-behavior for a field of natural environment and natural disasters.

Indigenous knowledge of people in forecasting weather through signs of plants

In the past, people relied on signs of plants for people to rely on weather reports as shown in table 4. Whenever the weather changes, some plant species such as Western grass, banana flower, Si (Sanh) tree are very sensitive. It is sensitive to the weather, so its physiological activities change. Based on this change, people can forecast the weather very accurately. However, at present, due to the impact of climate change and human impact, this forecast is

no longer accurate and not suitable for the changing conditions of climate change.

Indigenous knowledge in weather forecasting through signs of the sky, clouds and rainbows

Besides signs from animals and plants, people can also rely on natural manifestations such as clouds, rainbows, moon and stars, river water to predict the weather, these signs are appreciated by people. is reliable and desirable for conservation (Table 5). This is also consistent with the study of [19].

Indication	Descriptions	Forecasting	Frequency (Household)	Percentage (%)	Household reliability level
Western grass	The grass suddenly rises higher, the next flood season will be high	Seasonal forecast, unreliable	162	45	Not suitable for reality
Water banana flower	Water banana flowers bloom white, prepare for heavy rain	Seasonal forecast, unreliable	126	35	Not suitable for reality
Si roots	Roots are white, with rain	Seasonal forecast, unreliable	162	45	Not suitable for reality

Table 4: Indigenous knowledge of farmers to predict the weather through signs of plants.

Note: Not suitable for reality: Farmers rely on their ability to “read” daily weather changes and reliable repeatability accuracy < 50%, based on WHO (2008) and Ellen (2009) shows that when applying KAP (knowledge-attitude-behavior for a field of natural environment and natural disasters.

Indication	Descriptions	Forecasting	Frequency (Household)	Percentage (%)	Household reliability level
Cloud	Chicken fat clouds are windy, dog fat clouds are rain	Daily, reliable	342	95	Preserve and promote
	Blue clouds are sunny, white clouds are rainy		234	65	Preserve and promote
	Dark clouds cover the mountainside, about to rain		342	95	Preserve and promote
Moon	When the moon is full, it’s drought, when the moon is scattered, it’s rainy	Daily, reliable	270	75	Preserve and promote
	The moon is red, it’s going to rain		306	85	Preserve and promote
Rainbow	Pouring to the South, signaling the great drought. Pouring to the North, there will be heavy rain	Daily, reliable	346	96	Preserve and promote

Table 5: Indigenous knowledge of people to forecast the weather through signs of sky, clouds, stars, rainbow.

Indigenous knowledge of people in flood forecasting and adaptation

Through living with annual floods, local people have accumulated a lot of experience to forecast and adapt to floods in order to protect people’s lives and properties in life and agricultural production. Table 6 shows that people with a lot of indigenous knowledge predict floods by means of plant signs, flood cycle and duration, wind direction, water color or water balance. In which, based on wind direction and animals account for the proportion due to daily forecast. It is necessary to preserve and promote this indigenous knowledge. This is also consistent with the study of [19].

Indigenous knowledge of people in identifying good and bad soil through animal signs and environmental indicators

Table 7 shows that people know the soil is good or bad based on the sound of ticks and the presence of algae and moss on the ground based on the indicator of the environment to know if the soil there is good or bad, this is also consistent with the study. According [8] shows that good soil has many environmental indicators such as algae, moss, overgrown plants, and bad soil, environmental indicators reduce biodiversity.

Indication	Descriptions	Forecasting	Frequency (Household)	Percentage (%)	Household reliability level
Plants	Dandelion tree blooms earlier than the flood season, which is a sign of early flood	Seasonal forecast, unreliable	126	35	not suitable
	Cotton flowers bloom around September-October, there is no flood		90	25	not suitable
Flood cycle and time	Three years of small floods and one year of big floods.	Seasonal forecast, unreliable	162	45	not suitable
Wind direction	If the southerly wind blows strongly with rain, the water rises quickly and flows strongly, then the flood will be high that year	Daily, reliable	284	79	Preserve and promote
River water	A few hours before Tet, fill a plastic bottle with river water. Weigh water. When the new year is just around the corner, take a plastic bottle of the same type and fill it with river water, weighing two bottles. If the bottle taken at Tet is heavier, the next flood season will be higher than the previous one Seasonal flood forecast, unreliable	Seasonal forecast, unreliable	126	35	not suitable
Water color	Observe the water color of the rotating water in the fifth lunar month. If the color of the water is murky red, there will be a lot of silt coming back and there will be big floods and early floods	Seasonal forecast, unreliable	162	45	not suitable

Table 6: Indigenous knowledge of people predicting floods through signs of plants, flood cycle and duration, wind direction, water color.

Indication	Descriptions	Forecasting	Frequency (Household)	Percentage (%)	Household reliability level
Hear the sound of cicadas	Based on the sound of cicadas, the land there will be better than a place without cicadas	Performed regularly, reliably	317	88	Preserve and promote
There are many algae and algae	Based on a lot of algae and moss clinging to the walls of ditches and ponds, this is a good environmental indicator	Daily, reliable forecast	346	96	Preserve and promote

Table 7: Indigenous knowledge of people to identify good soil and bad soil through animal signs and environmental indicators.

Indigenous knowledge of people in preserving varieties, preserving food and raising livestock and poultry

Table 8 shows that in order to preserve the varieties from being eaten by salt and bacteria, people do it by putting those varieties in a jar and covering the top and bottom with neem leaves to prevent termites and bacteria from eating them. oval has a special substance. As for how to preserve dry food that is not eaten by termites and bacteria, people use it by hanging and storing it in the kitchen, because when cooking with smoke, termites and bacteria cannot get there and move to another place. Therefore, people consider that this indigenous knowledge should be preserved and promoted in accordance with local conditions.

In the opinion of the people, when raising livestock and poultry near the kitchen, there is no disease and less disease because when cooking the stove smoke and fire bacteria have no or little disease for livestock and poultry. The results of Table 8 show that 75% of the interviewed households want to preserve and promote this knowledge. This also confirms the same study of [13] on disease management and prevention in livestock and poultry, with many factors affecting susceptible livestock and poultry. on livestock and poultry such as environmental sanitation, breeding stock, management of disease prevention and control, the distance from the rearing area near the kitchen, there is no disease and less disease. It also shows that people still disinfect to limit the disease by sprinkling lime powder to prevent disease more effectively than other drugs.

Indication	Descriptions	Indigenous knowledge	Frequency (Household)	Percentage (%)	Household reliability level
Preserving seeds	Put the seeds in a jar, cover the top and bottom of the seeds with oval leaves, the seeds will not be eaten by salt and bacteria.	Reliable, daily maintenance knowledge	306	85	Preserve and promote
Food preservation	Hang food in the place where the kitchen is cooking	Reliable, daily maintenance knowledge	346	96	Preserve and promote
Raising livestock and poultry	Raising livestock and poultry near the kitchen is not and less susceptible to disease because when cooking smoke and fire, bacteria have no or little to make livestock and poultry not and less sick.	Knowledge of livestock and poultry farming done regularly and reliably	270	75	Preserve and promote

Table 8: Indigenous knowledge of people to preserve varieties, preserve food and livestock.

Indigenous knowledge of people in seed germination and fertilization

Table 9 shows that in order for seeds to germinate at a high rate by drying and cleaning seeds, put them in small bags and bury them in the mud for 5-10 days, so you can see the germination rate, then do the numbers. large amounts. Experience of people fertilizing based on the color of rice leaves as green rice leaves as banana buds is good. If the rice leaves are slightly yellow, it is a lack of phosphorus. Green rice leaves are better than banana buds because of excess protein. People assessed that this knowledge

should be preserved and promoted to suit local conditions. This is also consistent with the studies of [6,16,18,25] showed that if nitrogen is lacking, the rice plants will be stunted, have little bushy bloom, small shoots, short and narrow leaves, become yellow and die early, stunted rice plants do not grow. During the reproductive stage, if there is a lack of nitrogen, the rice plant will have short panicles, few seeds, small seeds and many degenerated seeds. Excess nitrogen, rice plants develop excessive leaves, young tissue, soft, easy to fall, dense foliage, high amount of free nitrogen in the plant, so the plant is susceptible to disease, greatly reducing yield.

Lack of phosphorus, rice plants also dwarfs, blooms poorly, leaves are very straight and narrow and darker than usual or turns purple, the rice will bloom and ripen late, the grain is not full and the qual-

ity is reduced. Lack of potassium (K) rice plants have an almost normal height and number of shoots, the leaves are still green but drooping, weak, easy to fall, most susceptible to disease is brown spot disease.

Indication	Descriptions	Indigenous knowledge	Frequency (Household)	Percentage (%)	Household reliability level
Nurturing seeds to germinate	Seeds are dried, cleaned, put in small bags, buried in the mud for 5-10 days, taken up to see, and calculated the germination rate.	Knowledge of nursery and daily fertilization, reliable	306	85	Preserve and promote
Bón phân	Green rice leaves like banana buds are good, if they turn yellow, they lack phosphorus, if they are greener than banana buds, they have too much nitrogen.	Knowledge of daily fertilizer application, reliable	342	95	Preserve and promote

Table 9: Indigenous knowledge of people in seed germination and fertilization.

Indigenous knowledge of people in building flood-adapted houses, using tamarind tree in the river to attract fish, using natural medicinal plants to cure diseases

Table 10 shows that people adapt to floods by using timber as pillars to build their houses on stilts, on the poles there are steps so that the floor can be raised when the flood rises or lowered when the flood recedes to adapt to the flood situation changes in flood, people believe that this indigenous knowledge should be preserved and promoted and can be replicated with other localities with similar conditions to adapt to floods in the changing conditions of climate change reduces the risk posed by floods.

Similarly, people use tamarind tree in the river with the aim of attracting more fish. This is explained because tamarind is a plant with many thorns and fragrance, so when used to place tamarind

tree, it attracts fish to hide. However, water tamarind trees are less and less. This is also consistent with the study of [10,20,24] showed that water tamarind or acacia tamarind is a type of plant that is classified as a herbal plant familiar to people in the South and Central regions using fresh tamarind leaves, with a mild aroma, soften, cook as bath water to treat rash. However, along with the process of urbanization, today this plant is being lost and forgotten about this medicinal plant. Therefore, it is necessary to preserve and preserve this herbal plant to cure common local diseases. In addition, people have also used medicinal plants available in nature to treat common diseases with good health and effectiveness. People assessed the need to conserve and promote locally available medicinal plants. This is also consistent with the research of [10,20] showing that natural medicinal plants are increasingly being lost and need to be preserved and preserved. Natural medicine to cure common local diseases.

Indication	Descriptions	Indigenous knowledge	Frequency (Household)	Percentage (%)	Household reliability level
Building houses to adapt to floods	As a stilt house, the floor can be raised or lowered	Indigenous knowledge of building houses on stilts with good, reliable experience	342	95	Preserve and promote
Set the scrub with sorrel	The yield of fish caught is more than when using other crops	Indigenous knowledge daily fishing application, reliable	270	75	Preserve and promote
Healing	Using natural medicinal plants to cure some common diseases	Indigenous knowledge applying natural medicinal plants for daily healing, reliable	349	97	Preserve and promote

Table 10: Indigenous knowledge of people building houses on stilts to adapt to floods, using tamarind to place tea in the river to attract fish, using natural medicinal plants to cure diseases.

Conclusions and Recommendations

Conclusion

Indigenous knowledge of local people is based on the specific manifestations of organisms and changes in environmental conditions as warning signals for local people to forecast floods and weather to prepare in adapting to changes in production activities and life for the future. Indigenous knowledge has contributed to reduce vulnerability of local people in adapting to changes in floods in the context of climate change.

Recommendations

It is necessary to have policies to encourage the preservation indigenous knowledge and local flood management.

It is necessary to have a policy to protect intellectual property rights on indigenous knowledge in flood-prone localities.

It is necessary to study and build more models of living with floods in the context of climate change using indigenous knowledge, and to replicate effective models as evidence to confirm the role and importance of indigenous knowledge in the community.

Further research on of indigenous knowledge in the field is needed for customs, culture, breeds, crops and livestock for different ethnic groups such as: Cham, Hoa, Kinh and Khmer in different flood and coastal areas in the Mekong Delta.

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