

## Study on Assessment of Indigenous Knowledge in Adapting to Floods of Farmers in an Giang province, Mekong Delta, Viet Nam

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### Abstract

This research was carried out to systematize and assess the appropriateness of farmer's indigenous knowledge and their adaptive capacity with floods. The research aimed at providing scientific foundation for proposing solutions to conserve and enhance the effectiveness of valuable indigenous knowledge in reducing vulnerability of people living in flooded areas. The results showed that local people are using several effective indigenous knowledges for coping with floods. However, the valuable indigenous knowledge has not recorded yet, nor documented in written materials for sharing to young generation and communities. Besides, some indigenous practices are not suitable in practice which required reevaluation for current flood adaptation strategies. The research suggested some solutions to conserve the most valuable indigenous knowledge for pro-active adaptation of local people in changing climate.

**Keywords:** Climate Change; Indigenous Knowledge; Flood; Adaptation

### Introduction

An Giang, one of the headwater provinces in the Mekong River Basin, should be influenced by the annual floods. When floods coming, besides bringing a huge amount of silt and improving soil fertility, field sanitation, washing alum [3]; as well as creating jobs and income for local people through natural fishing, aquatic vegetable picking, tourist services, etc. However, from 2000 to the present, the abnormal flood circumstances have affected livelihoods of local people. To be able to adapt to the changes of the flood, with the changes of the society and environment, human must always know how to use indigenous knowledge to exploit natural resources appropriately and manage more flexibly [2]. Indigenous knowledge in adapting to floods in An Giang is understood as experience that has been accumulated by the local community over many generations and inherited widely. It is reflected in the lives of local people and harmonized responses to floods every year to effectively exploit resources brought by the flood, but to avoid the damage caused by floods [6,15]. Responding to floods activities based on prior knowledge of the local community should be investigated and disseminated effectively to contribute to the sustainable development of the locality before the circumstances of climate change are affecting vagaries of floods. There

had many systematical research and evaluation relevance system to indigenous knowledge to adapt to flooding changes in agricultural production in the study area in the scene of climate change, preserve medicinal plants, preserve genes, local varieties, live with floods in the Mekong Delta, change the weather of author [1,4,5,7-9,11,16]; However, the fact that there has not had many systematical research indigenous knowledge system and assessment of indigenous knowledge in adapting to floods of farmer's in study sites in context climate change. . For these reasons, it is necessary to carry out the study on "Contribution of indigenous knowledge to adapt to floods in An Giang province". This research was carried out to systematize and assess the appropriateness of farmer's indigenous knowledge and their ability adapt with the flood in An Giang province, results of the research will provide a scientific foundation for proposing solutions to conserve and enhance the use of indigenous knowledge in reducing the vulnerability of people living in flooding changes in agricultural production in the study area in the scene of climate change.

### Research objectives

Generally, the main purpose of the study is that to provide information on farmer's indigenous knowledge and their adaptive capacity.

ity to floods in An Giang province provide a scientific foundation for proposing solutions and policies to conserve and enhance the use of indigenous knowledge in reducing the vulnerability of people living in flooded areas and livelihood strategies of flood affected people are both effective and sustainable.

The research will focus on the specific objectives below:

- To systematize and evaluate the suitability of indigenous knowledge and the ability of farmers to adapt to floods in different conditions.
- To find out the needs which should be done to build the links between traditional knowledge and modern techniques to adapt with the effects of flood.
- To propose conservative measures and promote the value of using indigenous knowledge of farmers in An Giang province.

### Research questions

The research is focusing to answer the following questions:

- What is farmer's indigenous knowledge and their adaptive capacity to floods of different zone?
- To what extents the traditional knowledge has been used helping the local people to adapt with flood?
- What should be done to make sure the traditional knowledge will be work well in terms of interaction with modern techniques to reduce flood damage?
- What are proposing solutions to conserve and enhance the use of indigenous knowledge in reducing the vulnerability of people living in flooding areas and livelihood strategies of flood affected people are both effective and sustainable?

### Research methods

To achieve objectives provided, the study was analyzed and synthesized from different information sources. Field survey was conducted from July 2015 to March 2016 at upper zone (Phu Huu, Phuoc Hung communes), middle zone (Vinh An, An Hoa communes) and lower (Vinh Phuoc, Luong An Tra communes), An Phu, Chau Thanh, Tri Ton district, An Giang province.

The research is focusing to answer the following questions:

- **Literature review:** to refer the previous researches and reports which related to climate change, the status of drought and its impact, especially in the Mekong delta. Both the quantitative and qualitative methods were used for survey. The research was done following these methods: in - depth interview (for both local authorities and local people), focus group discussions and questionnaires.

- **In - depth interview:** the team has conducted in depth interviews those people who are representative of local authorities at the three levels (province, district and commune). By interviewing, the general information about the how local people know about flood and their actions to cope with it will be understood. In addition, the demand of local people may be found out in this step. Also, individual people who showed appreciable knowledge of environment change were selected for in- depth interviews. The interviews focus on the story of using their own knowledge to adapt with the effect flood. The in - depth interviews were conducted by using semi-structured questionnaires. Information were written down and recovered by voice recorder.
- **PRA (Participatory Rural Appraisal):** the meeting was done, the participants for the meeting were 15 people. It was done in the upper zone (Phu Huu, Phuoc Hung communes), middle zone (Vinh An, An Hoa communes) and lower (Vinh Phuoc, Luong An Tra communes), An Phu, Chau Thanh, Tri Ton district, An Giang province. Therefore, these households have enough time to experience and accumulate local living experiences while gaining indigenous knowledge that has been applied to life experiences and to get a general understanding about the life of local people, their assets and also to know how they have faced with the flood in context of climate change. The criteria to people that they are farmers, who are experienced households living with floods and more than 50 years of living of study sites. These five tools were used: time line, mapping, seasonal calendar, problem tree, Venn diagram, ranking. The participants are people doing in agricultural production in the community.

### Questionnaires

Questionnaires is used to find out the damages of flood on the livelihood of local people, questionnaires mainly to identify current observed flood and its effects of such changes particularly on local livelihoods; the resources available to them, and the extents the traditional knowledge to help the people live and cope with the effects of flood. Interview local experienced households living with floods and more than 50 years of living of study sites such as: the upper zone (Phu Huu, Phuoc Hung communes), middle zone (Vinh An, An Hoa communes) and lower (Vinh Phuoc, Luong An Tra communes). Therefore, these households have enough time to experience and accumulate local living experiences while gaining indigenous knowledge that has been applied to life experiences. Totally, 360 questionnaires were done, the interviewees are divided into two groups: (i) people living in high dyke (180 households); (ii) people living in no dyke (180 households).

Results and Discussion

Flood occurrence during 1926-2015 and adaptation with flood of people in An Giang province

Flood occurrence over the years in the period of 1926 – 2015 in An Giang province

The annual flood season in the upstream lasts about 6 months; at the same time, the level of inundation varies between 0.3 to 3 meters depending on the topography of each place. Floods are divided into three levels including high, medium and low levels according to upstream flood levels, corresponding to the water level at Tan Chau Station at more than 4.5 m, 4 - 4.5 meters and less than 4 meters respectively. Large flood occurs when at the same time having a large amount of water pouring in from upstream, large long-lasting rains and the impact of surges in place. The daily increase and decrease flood levels for about 10-20 centimeters for big floods and 5-7 centimeters in normal floods [3]. According to the data recorded by meteorological radio of An Giang province from 1926 to 2015, there has appeared 22 times of greater floods and 31 times of small floods [4]. In particular, 2015 was a special year having the smallest flood of all the years (Figure 1). Small floods have caused considerable disturbance of crop calendar, affecting agricultural production, causing difficulties to the people's livelihood depending on floods as fishing, fishing gear production and means participating in fishing fish during floods.

**Figure 1:** Flood peak of Tan Chau from 1926 to 2015.  
Source: Meterological radio of An Giang, 2016 [10].

Local people stated that small and slow floods in 2015 had a direct impact on the lives of many residents living by catching shrimp and fish in the commune. According to statistics of the [10], flood peak since 2000 has had the lower trends (Figure 2), the number of catches of natural fisheries resources has had the decreased tendency between 2000 and 2015 (Figure 3). In addition, the research results of [12,13] proved that within 10 years, natural fish production in An Giang region has decreased by about two thirds of wild

fish; aquaculture production exploited per capita/household/year decreased significantly, from an average of 1,120.5 kg/household in 2000 reducing to 563.7 kg/household in 2010, equivalent to 49.7% reduction.

**Figure 2:** Flood peak from 2000 to 2015.  
(Source: Meterological radio of An Giang, 2016 [10].

**Figure 3:** Yield of natural fisheries exploitation from 2000-2015.  
(Source: Protecting fisheries Sub – department of An Giang, 2016) [14].

According to the results from the survey, when the water level decreases, fishing yields naturally also decreases; when flood levels increase, the fishing yields also rise. This shows that there is a linear correlation between the flood water level and fish production by a factor of  $R^2 = 0.87$  (Figure 4).

Adaptability and flood forecasting of the people in An Giang Province

According to Mr. Nguyen Minh Nhi, former Chairman of An Giang People's Committee, An Giang people in particular and the Mekong Delta in general are familiar with the annual flood season and was named as "flooding season". This is the name that many generations of people in the wetland calling the floods. This call is

full of optimism, expressing the spirit of active living with floods; considering flood exploitation as one of the advantages to develop. Limiting the harmful effects of the initial flood is “avoiding flood” through measures such as building houses with floor, moving people and animals to higher places, choosing plants and arranging appropriate seasonal schedule to keep up harvested before the flood, ect. To do so, the people living in the flood zone are experienced the impending flood situation such as high or low flood, flood sooner or later. The experience that people are used to predict floods including small flood in every 3 years will have one major flood year; looking downwind in the South. If strong winds accompanied by rain, fast and flowing water over, the flood of that year will be high, whereas if the flood of small anticyclone. Besides, in recent months in the flood season, they also see the expression of a number of species of plants, insects, and fish eggs to predict the flood situation in the coming years that helps them prepare appropriate seasonal schedule and prepare fishing gear and means of fishing accordingly. However, people also said that in recent years the flood prediction based on the above expression has been no longer true, namely in 2011, though small bamboos grow less than mature bamboos, the floor was still high; or in 2015, water had its infancy, but still did not have flood (PRA, 2016).

Figure 4: Correlation between the flood water level and fish production.

Situation on indigenous knowledge of the local people in flood forecasting, weather and agricultural production

Indigenous knowledge of the local people in flood forecasting

Household interview results (2016) showed that people used natural characteristics to predict flood. These experiences mainly passed on from generation to generation (Table 1). In addition, upstream communes seem to have more flood forecasting experience than midstream and downstream ones because floods occur earlier with higher vulnerability (Figure 5).

Signs	Descriptions
Flood period	<ul style="list-style-type: none"><li>• In May and July of the Lunar year, the water rises quickly; In July and August, flood starts.</li><li>• Big flood takes place during Year of Dragon or October of Lunar year.</li><li>• Every 3 year with small flood, 1 big flood will take place.</li></ul>
Water color	<ul style="list-style-type: none"><li>• The water is red or dark.</li><li>• More algae in water (water ovum) or water ovum appears early (In May, June of lunar year)</li></ul>
Plant observation	<ul style="list-style-type: none"><li>• Reed shoots have 4-5 segments during Lunar May (2 segments indicate small flood)</li><li>• Reed leaf tip has more than 2 segments. (1 segments indicate small flood)</li><li>• Reed has 50 cm long segments.</li><li>• Grass leaf grows near the tip or grows multiple segments.</li><li>• Young bamboo shoot grows higher than older ones.</li><li>• Elaeocarpus grophilus roots grows more than usual.</li></ul>
Animal behavior observation	<ul style="list-style-type: none"><li>• Bees, ants, termites, weavers nest on tall trees; rats burrow on high places.</li><li>• Swallow, storks come in groups</li><li>• Spider web appears more than usual in lunar July</li></ul>
Water measure	<ul style="list-style-type: none"><li>• On December 30 of lunar year, people weigh a bottle of river water; On January 1, people get a different river water bottle at the same position then weigh two bottles, big flood are about to take place if the later bottle is heavier.</li></ul>

Table 1: Prediction for severe floods.

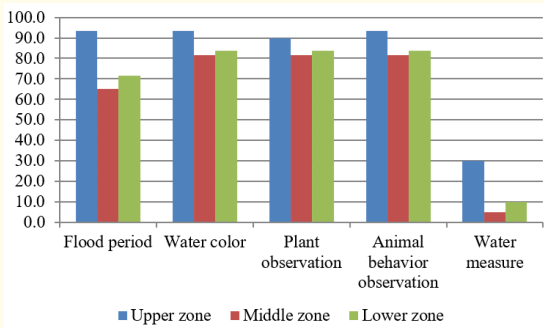


Figure 5: The difference in people’s flood forecasting in flood areas.

Source: Interviewing household, 2016, n=180.

Indigenous knowledge of the local people in weather forecasting,

Household interview results (2016) showed that upstream communes seem to have more weather forecasting experience than midstream and downstream ones (Table 2).

Signs	Descriptions
Rain period change	<ul style="list-style-type: none"><li>• Rains start in the beginning of lunar March or April.</li><li>• More rains take place during lunar June, July.</li></ul>
Night sky observation	<ul style="list-style-type: none"><li>• Gloomy sky or less stars means rain the day after.</li></ul>
Daytime sky observation	<ul style="list-style-type: none"><li>• Windy and cloudy with thunderstorms</li><li>• Large pale blue clouds</li><li>• Heavy, soaked or black clouds with cold winds</li><li>• It was hot for several days</li></ul>
Animal behavior observation	<ul style="list-style-type: none"><li>• Dragonfly flying low means rain flying high means sun, flying in the middle means shady</li><li>• Ants stay higher place or move their nests and eggs to higher places.</li><li>• Winged ants appear, rains take place the day after.</li><li>• Termites appear, rains take place the day after.</li><li>• Flies and gadflies attack paddy fields, rains are about to take place.</li></ul>

Table 2: Signs for rain forecasting.

Indigenous knowledge of the local to adapt to floods in agricultural production

Currently, due to unusual and complex weather, unpredictable nature so the accuracy of flood and weather prediction is no longer as high as before, in addition to the impact of science and technology, the number of people with indigenous knowledge is not many. Specifically, 89.4,% of the interviewees said that the current flood situation is not predictable; 10.0% said that they change their predictions a little and only 13.3% said that the weather situation remains in their predictions (Figure 6) .

Figure 6: Assessing the accuracy of the predicted flood and weather local people.  
Source: Interviewing household, 2016, n=180.

However, in agricultural production, local people in three research areas still obtain a lot of experience to adapt such as crop calendar change, seed cultivation, fertilization, tillage and harvest accordingly (Figure 7).

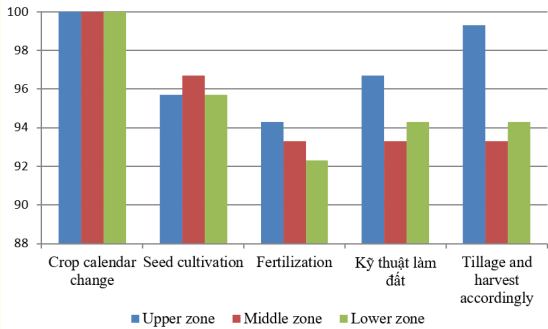


Figure 7: Indigenous knowledge to the local people in adapting to flood in agricultural production.

Source: Interviewing household, 2016, n=180.

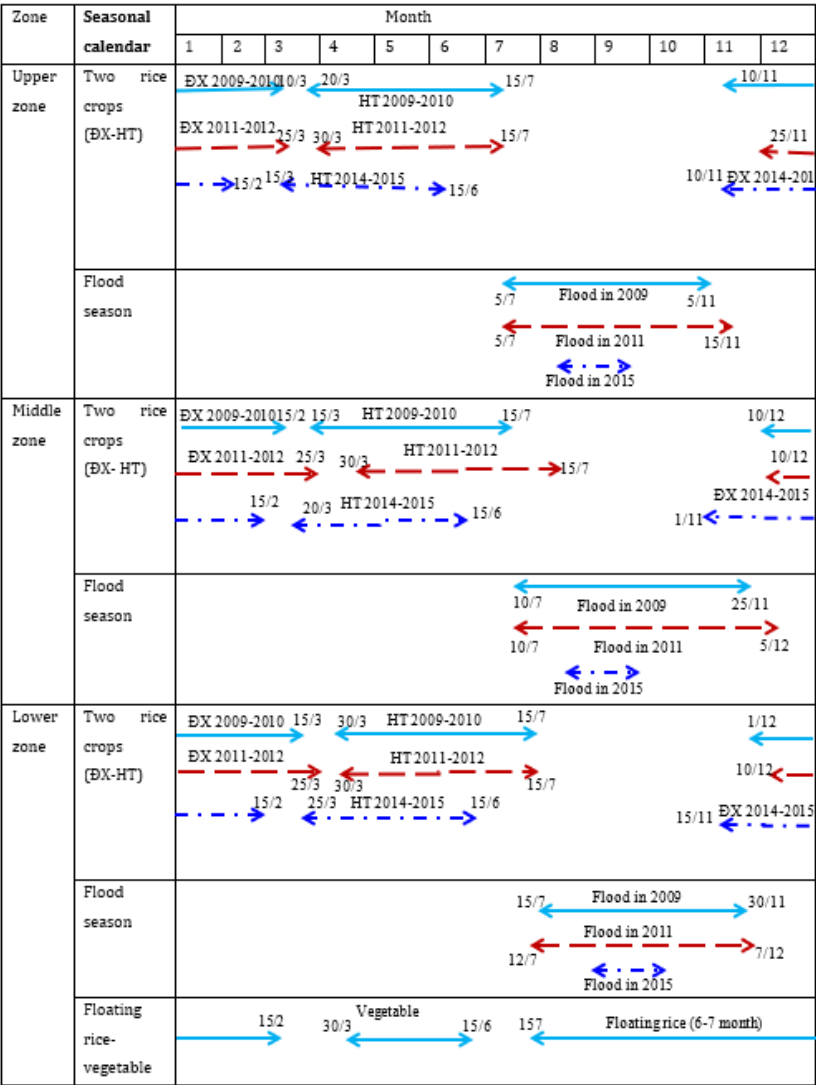
Focus group discussion results showed that people with more experience in changing crop calendar according to different level of flood years (Table 3). However, extraordinary floods also caused disadvantages in rice cultivation such as short recover for the soil, no time to decompose rice straw after tillage, farmers must pumped flood water out of the field to do seeding. In particular, small flood in 2015 reduced the sediment of the soil, which increases the cost of cultivation of rice and vegetables.

The information channel used to monitor rainfall, flooding for the next generation

People use various information channels to predict the flood from reviewing rain and flood information through the daily weather forecast to exchange information between together. In particular, daily weather report on TV is the most effective assessment thanks to easy access, regularity and relatively accurate information. Local news channel and neighbors’ information is the 2<sup>nd</sup> most effective assessment; Communal meeting and radio are the two least effective information channels (Figure 8). The local knowledge on forecasting weather, flood is transferred to the next generation based on weather expression observation, television forecasts; folk songs, proverbs about weather predictions such as "dragonfly flying low means rain flying high means sun, flying in the middle means shady" or "big flood in Dragon lunar year" are no longer applicable. The indigenous knowledge on coping with floods transferred to the youngsters such as house reinforcement during the rainy season, moving to safe place, learning to protect themselves in the flood season (Table 4) in which self protection such as swimming skill is the most focused. Up to 92.2% of interviewees said that all family members are able to swim, not including children younger than 5 years old. Swimming skill is taught by family members (75.6%); learning with neighboring children (8.9%); 2.2% of children learns from local swimming



class and 1.1% learns to swim in school. In the upstream area, the proportion of children able to swim since 4-5 years old is higher than the midstream and downstream areas because flood takes place earlier than the other areas.



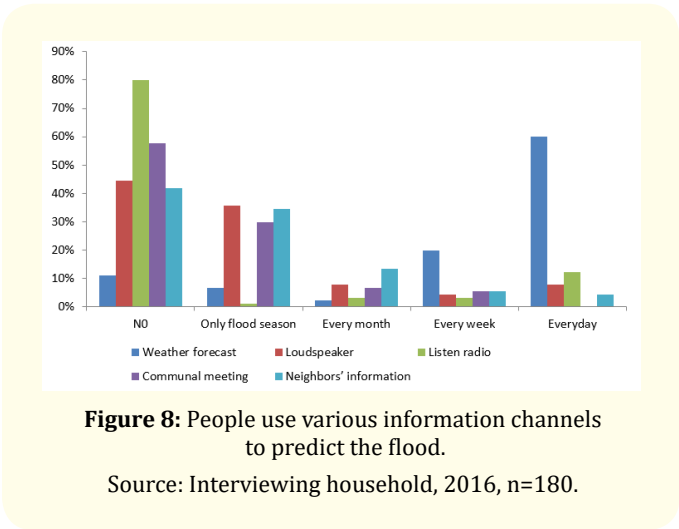
**Table 3:** Seasonal calendar of high flood, medium flood, small flood in study side.  
Source: PRA, 2016

Note: DX: Winter Spring, HT: Summer-Autumn.

Skills	Mean	Std.	Importance
How to identify flooding period, flood water level, weather	3,07	1,467	High
Self-protection during flooding season	4,36	0,975	Very high
Disadvantages and benefits of flood	2,74	1,312	Pretty high
Experience and skills in fishing	2,01	1,176	Low
Preparing house, food, clean water ...	2,30	1,328	Pretty high
Usual diseases, natural cures	2,07	1,243	Pretty high

**Table 4:** The importance of the teaching indigenous knowledge for the next generation.  
Source: Household survey results in 2016, n=180

Note: Scale from 1 to 5 :( 1: ≤ 1: Unimportant, 2: 1,1- 2: Low important, 3: 2,1 - 3:pretty important, 4: 3,1 - 4: Highly important, 5: 4,1 - 5: very important)



Conservation measures and promoting indigenous knowledge in flood adaptation

- The local knowledge mainly due to collected experience during agricultural production and transferred by word of mouth for the next generation without writing and widely dissemination. Therefore, in order to preserve and promote indigenous knowledge, it should be collected, documented and widely disseminated to the people.
- Local knowledge becomes less effective due to flood change and extreme weather. Therefore, local knowledge and scientific and technical knowledge should be combined to promote the its values and overcome the limitations.
- In order to maintain and promote local knowledge, it should be integrated into projects of local development.

Conclusion

Indigenous knowledge plays an important role in adapting to changes in the environment. As a national resource, it also contributes to the sustainable development of the local community in inexpensive ways, including the participation of people and achieving sustainable development. The study compiled 39 indigenous knowledge and adaptability to floods and weather forecasts in agricultural production and livelihoods of local people in the study area. Much indigenous knowledge is valuable in predicting and adapting to floods. However, this knowledge has not been specifically recorded and stored appropriately for transmission to the latter and widely shared in the community.

Indigenous knowledge of local people is based on the specific characteristics of the organisms and changes in environmental conditions such as warning signals for local people to forecast floods and weather to prepare for appropriate change in production and life. In addition, there is some indigenous knowledge that is no longer relevant and misleading compared to the present. It

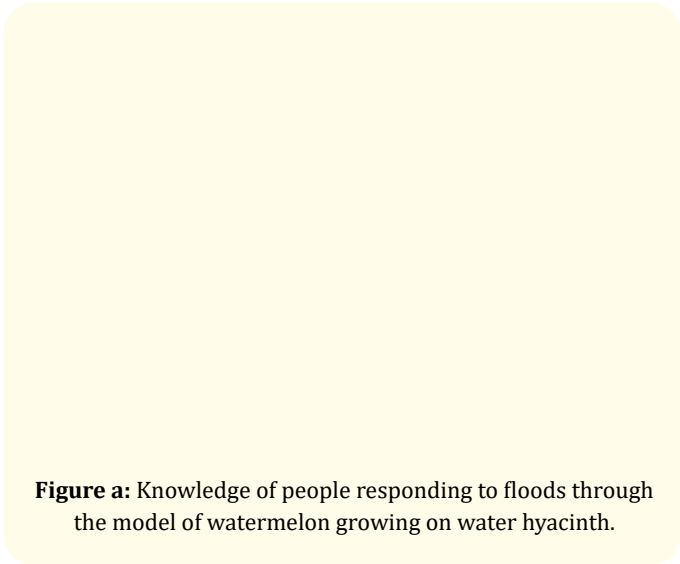
should be considered in the current context due to human impacts and climate change. Therefore, the possibility of flood forecast of the people also decreased, only a small number of people can predict the flood, the weather. It is necessary to increase knowledge and encourage people to combine indigenous knowledge and scientific knowledge to minimize the damage caused by floods.

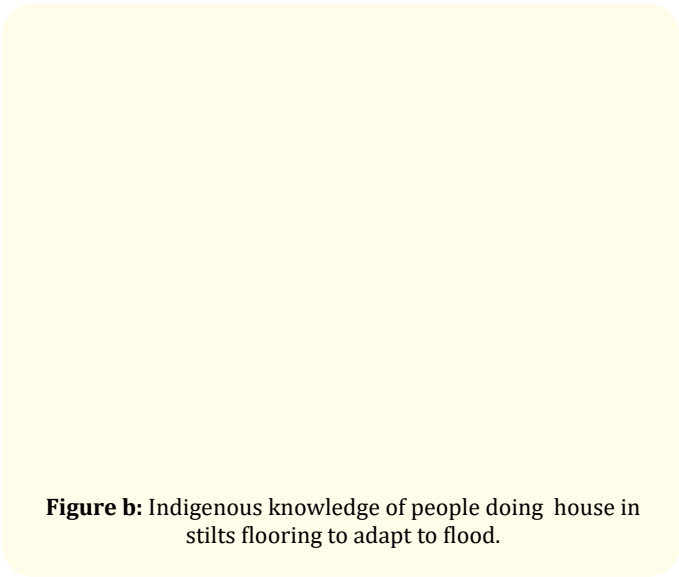
The Government should also have insurance policies for people in flood-prone areas to ensure production and adaptation to floods in order to reduce vulnerability to climate change. In other to mitigate vulnerability, an early warning system for floods should be established for the people to manage and mitigate the vulnerability of livelihoods caused by floods; Strengthening propaganda and dissemination of knowledge to prepare for the flood season, opening training courses adapted to abnormal floods.

Recommendations

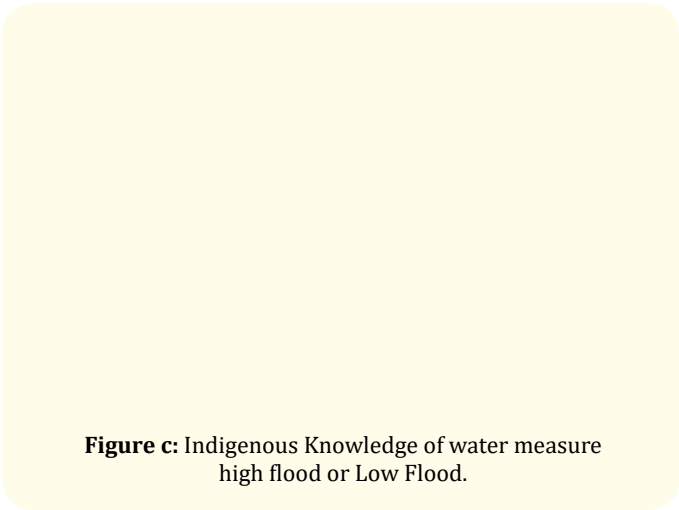
- It is necessary to recognize and preserve the remaining indigenous knowledge to accurately predict and adapt to floods more efficiently and sustainably, as well as facilitate the exchange and sharing of experiences between the people in the same and other localities.
- In order to develop local knowledge effectively and sustainably currently and in the future, community knowledge should be strengthened and combined with technological advances to help farmers adapt to environmental changes.
- Indigenous knowledge should be documented and summarized into a book to predict and adapt to flood changes and extreme weather events.
- Indigenous knowledge should be integrated into farmer service system and technical transfer such as providing suitable seed varieties for local conditions.

Appendices

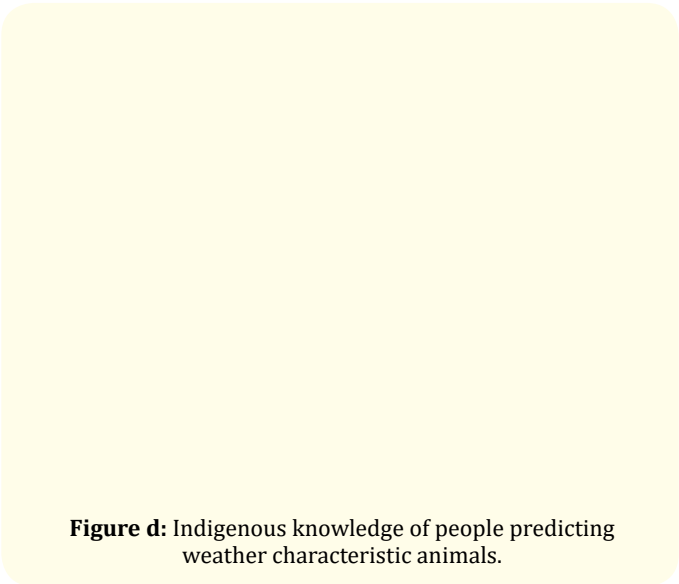




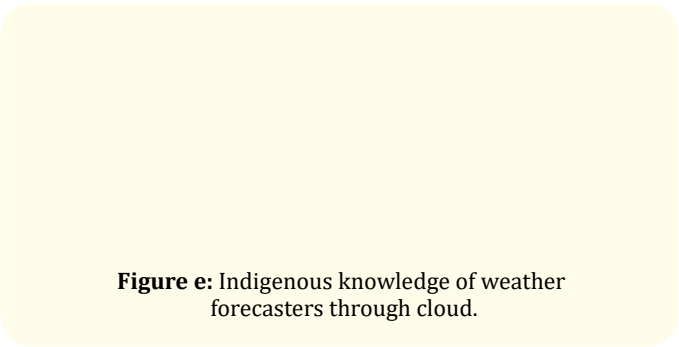
**Figure b:** Indigenous knowledge of people doing house in stilts flooring to adapt to flood.



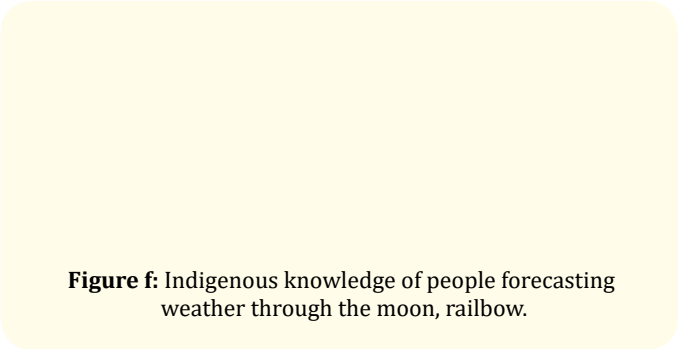
**Figure c:** Indigenous Knowledge of water measure high flood or Low Flood.



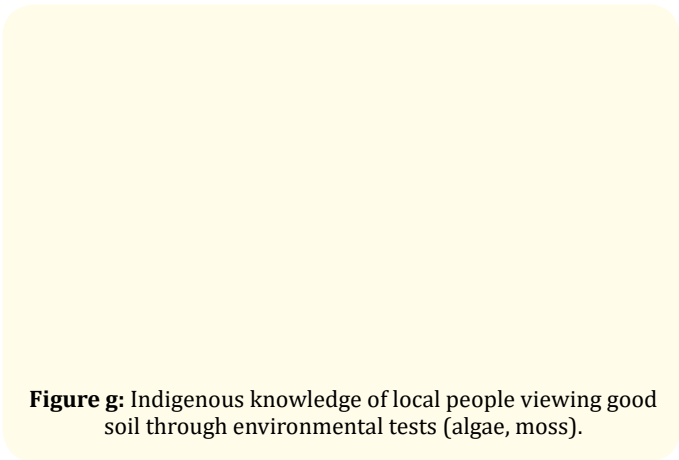
**Figure d:** Indigenous knowledge of people predicting weather characteristic animals.



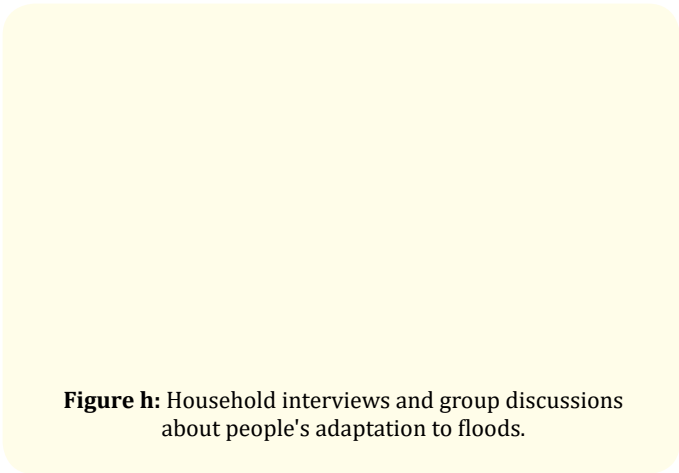
**Figure e:** Indigenous knowledge of weather forecasters through cloud.



**Figure f:** Indigenous knowledge of people forecasting weather through the moon, railbow.



**Figure g:** Indigenous knowledge of local people viewing good soil through environmental tests (algae, moss).



**Figure h:** Household interviews and group discussions about people's adaptation to floods.



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