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IMPACT OF WATER SECURITY ON PEOPLE'S LIVELIHOODS IN MEKONG RIVER DELTA, VIETNAM

(Case study in an Giang province)

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ABSTRACT

This research was carried out to analyze impacts of factors affecting water security on people's livelihoods and to evaluate vulnerability assement of livelihood in three different flooding levels and to propose some recommendation to minimize their impacts in the future. The study results showed that factors affecting water security in the study area include: (i) climate change; (ii) upstream dam development; (iii) intrinsic factors. Besides, the impact of water security in abnormal floods changes seasonal crop calendars and unexpected developments trend from 2000 to 2019 years and affects the livelihood of the people in the flood zone. Results show that Livelihood vulnerability index (LVI) of Phu Huu commune (0.397), located in early flooded zone, is higher than of Vinh An (0.299), Vinh Phuoc (0.357) commune, located in the late flooded Zone and LVI-IPCC index of Phu Huu commune (-0.043) higher than Vinh Phuoc (-0.042) and Vinh An (-0.031). Results showed that the relationship of high flood zone was high Livelihood vulnerability index and high adaptability and opposite. The study also offers some solutions to reduce livelihood vulnerability of flood due to changes in the context of climate change.

Keywords: Adaptability, Climate Change, Flood, Livelihood, Vulnerability, Water Security.

1. Introduction

The Mekong River Delta (Mekong Delta) plays a very important role in the economy in general and the food security strategy of Vietnam in particular, currently contributes more than 50% of food production and 90% of export. The impact of hydroelectric dams on the mainstream of the Mekong has been detrimental to the surrounding areas including the countries through which

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these rivers flow. The Mekong Delta, located at the end of the Mekong River, is facing negative impacts of upstream hydropower development such as reduction of natural resources, depletion of water resources, and saltwater intrusion affecting the livelihoods of people in agriculture, livelihoods and aquatic resources (MRC, 2019).

According to Resolution 120, the three priority pillars of agricultural production in the Mekong Delta are fisheries - fruit trees - rice. Resolution 120 is a breakthrough in innovative approach, from using resources respecting the laws of nature, from agricultural production to agricultural economics, from basic concern to economic growth, to harmonize economic growth with sustainable development. Currently responding to climate change (CC), especially water shortages, droughts and saltwater intrusion (MRC, 2019). Therefore, a reasonable state investment is required in both the structural and non-structural measures. There is a need for non-structural, pre-eminent overview to enhance climate change resilience and resilience in rural areas and agricultural production systems.

An Giang is one of the upstream provinces of the Lower Mekong River, so it is affected by annual floods. Floods in An Giang usually last from July to December every year (Nguyen Van Thieu et al., 2014), thus affecting agricultural production, in addition, because the flood season usually occurs in the rainy season, the amount of water coming from the Mekong River, combined with heavy rainfall causing floods in most of the districts in the province. During the years of great floods covering the whole city especially in low-lying areas flooded from 1.5 m to 4.5 m deep, causing great damage to property and people's lives (Irrigation Department, 2019). In addition, floods also bring a large amount of alluvium to accretion and improve soil fertility; field cleaning, alum washing (Dao Cong Tien, 2001); creating jobs and income for poor people in floodplain areas exploiting natural aquatic resources such as fishing, vegetable picking, tourism services. However, in recent years, the upstream countries of the Mekong River are planning to fully exploit the Mekong River to serve agriculture and hydroelectricity, which significantly reduces the water flow of the Mekong River. The upstream flow is forecasted to decrease to 33% between 2010 and 2039 (MRC, 2019). The fishing output of An Giang decreased significantly. In 2010, the fishing output was 37.2 thousand tons and in 2018 it was 23.1 thousand tons. The number of fishing households also decreased from 2010 to 2018, specifically, nearly 19.35 thousand households exploiting aquatic products in 2010, in 2018, the number of fishing households was only 6.7 thousand households (accounting for about 34,8% compared to 2010). In addition, the phenomenon of water shortage in drought years also affects the production of rice and crops of the people, of which irrigation water for agricultural consumption accounts for the highest proportion (accounting for 82- 96% of total water used). Therefore, assessment of livelihood vulnerability of people dependent on water resources is necessary for the authorities at all levels to develop solutions to stabilize livelihoods for people, especially the poor.

According to Hahn et al., (2009) related to livelihood vulnerability assessment, it is necessary to evaluate indicators to provide country, region and community vulnerability scores for adaptation action to mitigate vulnerability. To ensure development programs in reducing people's vulnerability to the effects of climate change, it is essential to understand who is vulnerable and

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why (Vo Van Tuan et al., 2015). In addition, in terms of adaptive capacity and vulnerability to global climate change, it is necessary to assess the livelihood vulnerability indicators in order to have practical response actions that tend to focus on risks which are difficult to deal with (Nguyen Duy Can et al., 2013). In terms of adaptive capacity and vulnerability to global climate change, understanding should be focused on contributing to the implementation of adaptation on a community scale. However, this approach is limited in addressing sensitive issues and shows capacity in responding to climate change. In the context of climate change, Hahn et al (2009) 's new approach to livelihood vulnerability assessment has been used in several studies in floodplains in the Mekong Delta as by Nguyen Duy Can (2013); Vo Hong Tu (2013); Vo Van Tuan (2014). However, most topics are not of much interest and in-depth analysis of water security. Stemming from the above argument, the topic "Impacts of Water Security on the livelihoods of people in the Mekong Delta, Vietnam" is done by applying simulation based on vulnerability index calculation livelihoods by Hahn et al. (2009) to serve as a scientific basis and to propose necessary solutions to improve people's livelihood strategies effectively and sustainably.

2. Research objectives

- Analyzing impacts of factors affecting water security on people's livelihoods in the study area.

- Assessment of people's vulnerability to livelihoods due to the impact of these factors

- Proposing people's livelihood strategy solutions to reduce vulnerability to water security impacts in the context of climate change.

3. Research method

To satisfy the research objective, sustainable livelihoods approaches (DFID, 2009) were used to assess livelihood vulnerability for flooding situation and the effects of flood in the context of vulnerability to sustainable livelihood framework. In this study, livelihood vulnerability is defined as the vulnerability to impacts or disturbance occurring inside and outside the farm relative to household livelihoods. Poor adaptability and resilience are also the result of a traumatic process (Vo Van Tuan, 2011). Specifically, in this study, to calculate the livelihood vulnerability to flood change of 3 different communes such as upstream commune (Phu Huu), midstream commune (Vinh An) and downstream commune (Vinh Phuoc) by applying LVI Index developed by Hahn et al. (2009). These components are the community vulnerability indicators to flood impacts shown in Table 1. These components are classified according to 5 different livelihood assets in the sustainable livelihood framework: Human, physical, social, natural, financial assets.

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4. Result discussion

4.1. Impacts of water security on agricultural production models in the study area

According to the results of interviewing farmers in 2020 in Figure 1, farmers show that the most affected farming patterns in all three area upstream (50%), midstream (46.7%), and downstream (41.7%), followed by aquaculture model in upstream (45.0%), midstream (41.7%) and downstream (36.7%). The local people believe that these are 2 models that directly affect water security, followed by upstream livestock (5.0%), midstream (11.6%), and downstream (21.7%). This is also acknowledged by the Rural Development Department, the Agricultural Extension Station, Fisheries Department, Veterinary Department through interviews with knowledgeable people (KIP).

Information box No. 1: Identify agricultural production models affecting water security

According to the results of interviews with knowledgeable people (KIP) in 2020 from the rural development department, the agricultural extension station, the veterinary sub-department has identified the affected water sources according to the order of cultivation model and then the aquaculture model, and then the livestock model. In which, the two models that most affect the deteriorating water security are crop cultivation and aquaculture due to direct use of water. Although livestock has little impact on water security, because of climate change and deteriorated water security, pathogens and different diseases are increasing.

(Source: summary of KIP interviews, 2020)

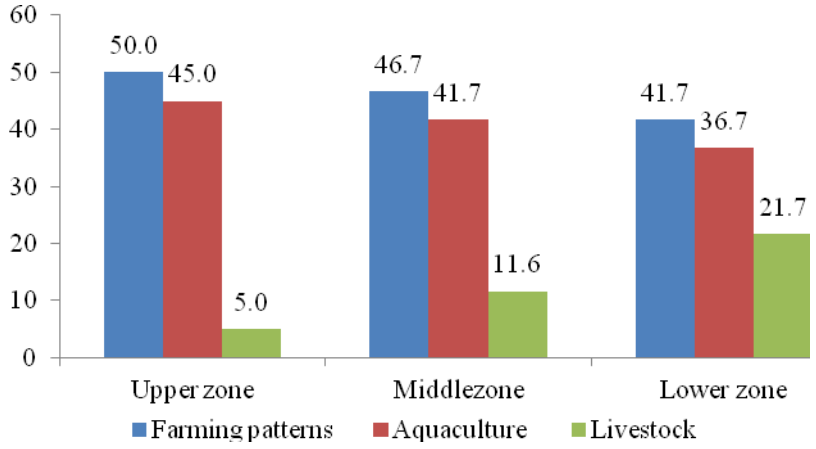

Figure 1: Impacts of water security on agricultural production models in the study area

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Resolution 120 clearly states that it is necessary to act in accordance to Heaven's Will, the Mekong Delta is a large land accounting for 12% of the area, 19% of the population of the country, a dense network of rivers, canals and channels; has advantages in the development of agriculture, food industry, tourism, and renewable energy; is a major agricultural production center of Vietnam, contributing 50% of rice production, 65% of aquaculture production and 70% of fruit trees of the country, 95% of rice exports and 60% of fish exports and also integrating climate change and water resources into the resolution to deploy to localities for sustainable development in the Mekong Delta. However, when implementing in localities, there are many difficulties due to limited funding as assessed by the KIP interview in 2020.

Information box no.2: Remark of the implementation of Resolution 120 in localities that integrate climate change and water resources for sustainable development

According to the results from the interview with the knowledgeable people (KIP) in 2020, it shows that Resolution 120 mentioned two words that are very meaningful and highly appreciated: "Heaven's will" which means cultivation in accordance to the laws of nature. The resolution emphasizes that all water resources must be considered as natural resources such as freshwater, saltwater, and brackish water, which must be adapted accordingly. Implementation of this resolution faces many difficulties during implementation at the local and community level is slow and budget for implementation is limited.

(Source: summary of KIP interviews, 2020)

Through the results of interviewing farmers in 2020 in Figure 2, people who attended training on climate change and water security are very limited in upstream (86.7%), midstream (96.7%), downstream (98.3%) area. This shows that the training on climate change and water security has not been implemented and has not received attention at the community level.

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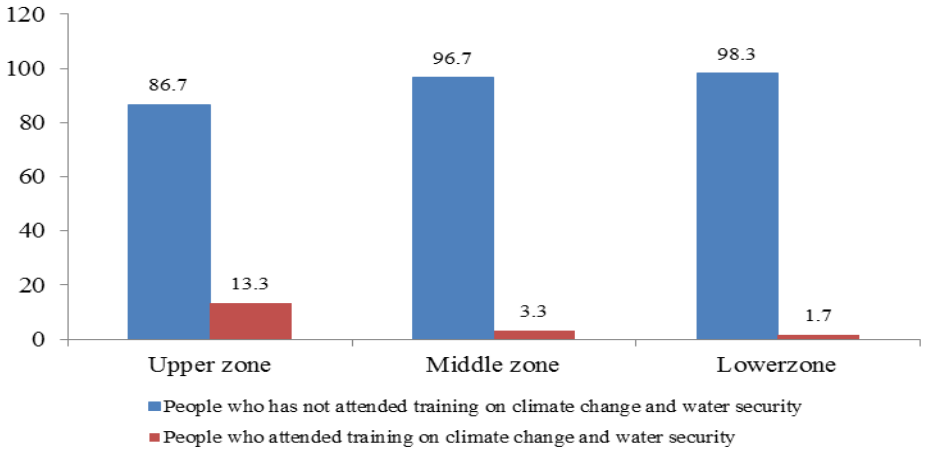

Figure 2: People participated and have not participated training on climate change adaptation and water security

According to the results of interviewing farmers in 2020 in Figure 3, information of the people is received through local loudspeakers, television and newspapers, local authorities, and the internet. But information and content mainly on the policies of the Party and the State and information on climate change, water security in agricultural production is very limited. People receive information through local loudspeakers at upstream (70.0%), midstream (66.7%), downstream (60.0%), TV and newspaper in the upstream (16, 7%), midstream (21.7%), downstream (20.0%), local government in the upstream area (13.3%), midstream (6.6%), downstream (20, 0%), internet only available in the midstream area (5%). This shows that the local loudspeakers play an important role to the people in the three study areas. However, people also think that attractive information on climate change and water security should be enhanced through water-saving adaptation models in the face of climate change and increasing water security so that people can update their knowledge and cultivate effectively and sustainably.

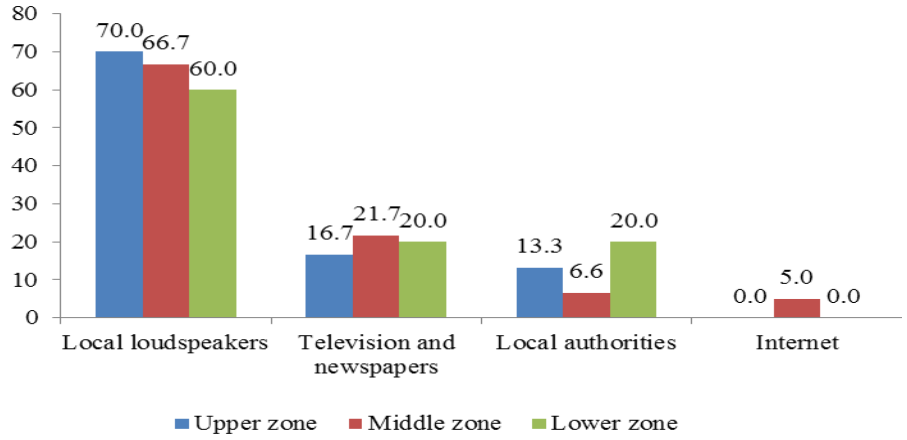

Figure 3: Sources of information about climate change and water security related

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4.2 Factors affecting water security in the study area

According to the farmer interview results in 2019, Figure 4 shows that factors affecting water security in the study area include: (i) climate change; (ii) upstream dam development; (iii) intrinsic factors.

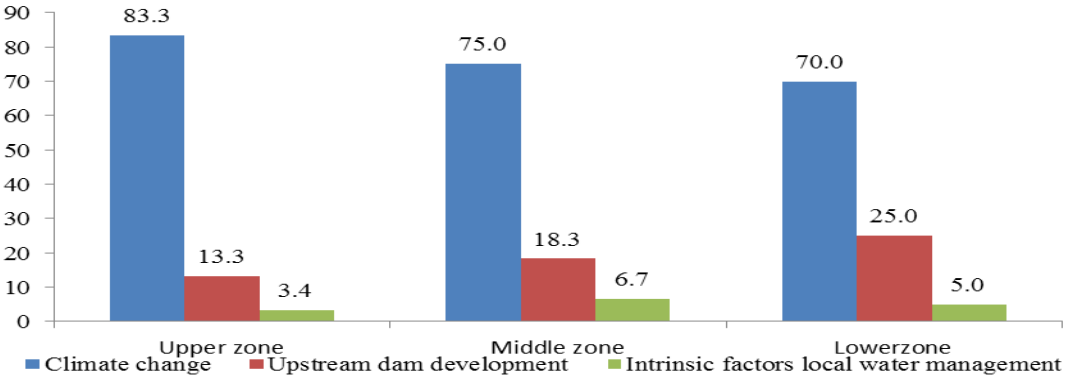

Figure 4: Factors affecting water security in the study area

+ Climate change: it increases the intensity and frequency of natural disasters and extreme events related to water resources. The United Nations Water Commission also predicts 2/3 of the world's population will be affected by the challenge of water resources by 2025. According to the results of interviews with farmers in 2020, the climate change factor is one of three factors affecting the deterioration of water security for people in the upstream area (83.3%), midstream (75.0%), and the downstream (70%). Climate change is changing erratically in terms of weather and environment in the study area especially for temperature and rainfall demonstrated in Figures 5 and 6.

+ Characteristics of temperature: Average annual temperature in the period from 1985-2018 is 27.4 compared to years without big change in Figure 5. However, the highest monthly average temperature is in April and May ranged from 28,6 to 28,8 ^{o}C. From February, the average temperature increases rapidly, after the maximum in April due to seasonal rains, the average temperature will decrease gradually until the end of April affecting the agricultural production situation in the study area.

+ Characteristics of rainfall: The rainy season varies very clearly according to specific location and time shown in Figure 6. From December to April is the dry season, the rainfall of 5 months of the dry season accounts for 10% of the total yearly rainfall. In which, the transition period from dry season to rainy season (April) and from rainy season to dry season (November) accounts for 16% of total annual rainfall. The rainy season lasts from early May to mid November. The rainy season which lasts for 6 months accounts for nearly 90% of the total annual rainfall. The rainy season does not change according to the rules, leading to an imbalance in the distribution of rainfall and annual rainwater storage. The rainy season does not change according to the rules, leading to an imbalance in the distribution of rainfall and annual rainwater

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storage. The influence of the El Nino effect, which usually occurs every 4 years, makes flooded areas such as An Giang, Dong Thap and Kien Giang provinces lack of water. Prolonged drought affected agricultural production in the study area. Meanwhile, the sea level rise and saltwater intrusion are going deeper inland, especially during the dry season like 2016 and 2019, it has affected agricultural production in the study area. Therefore, water resources are affected most strongly and directly by climate change, leading to problems of livelihood, economy and environment.

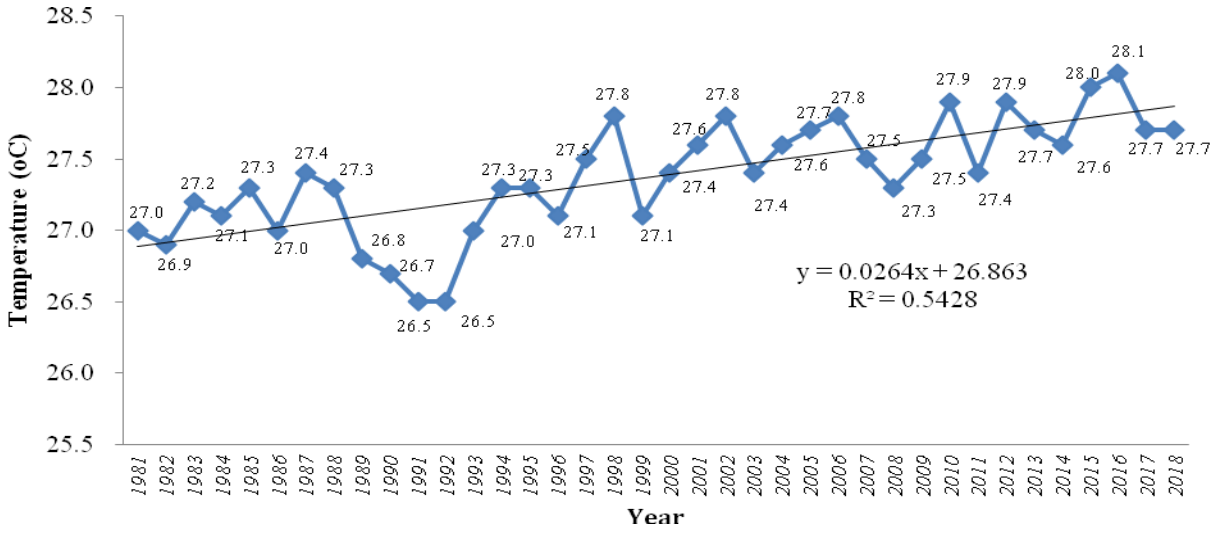

Figure 5: Average temperature over the years 1981-2018
(Source: Hydrometeorology Station, An Giang Province, 2019)

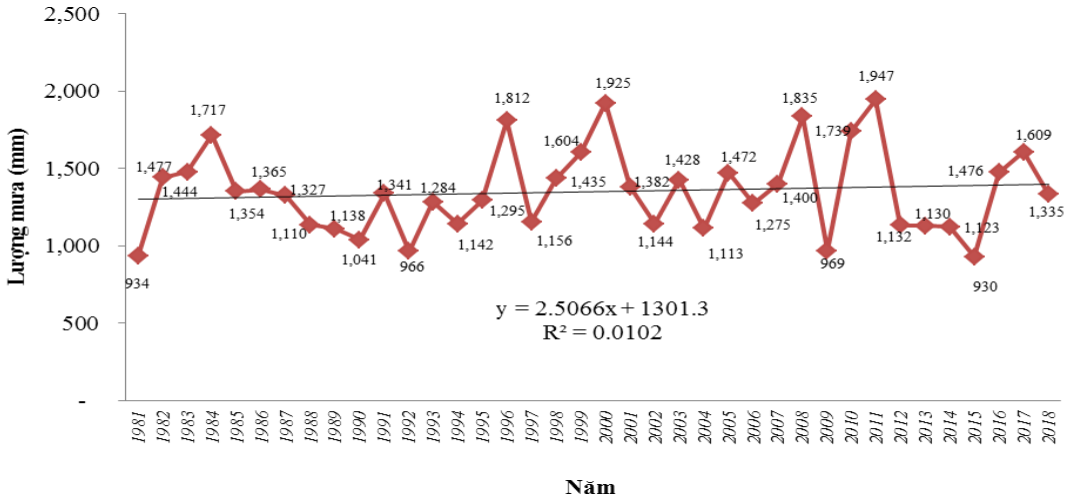

Figure 6: Average annual rainfall, from 1981-2018
(Source: Hydrometeorology Station, An Giang Province, 2019)

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Building hydropower dams in the upstream area: This is also a factor affecting the security of water sources in the upstream (13.3%), midstream (18.3%) and downstream area (25.0%). Local people believe that the development of hydroelectric dams in the upstream area prevents river flowing to the downstream affecting natural fishing, decrease of sediment, living and production of people.

Information box No. 3: Causes of sediment reduction

According to Mr. N.V.H, 63 years old in Phu Hiep hamlet, Phu Huu commune, An Phu district, An Giang province, low flood and closed dyke system are the two main causes leading to the reduction of sediment in the recent years. According to the farmers' experience, over the years, the water overflowed with large currents, the water was a silvery red color, containing a lot of sediment. Farmers do not spend much on land preparation, the amount of fertilizer used is also less, and the rice crop is better. In recent years, the construction of closed dykes together with in-field transport system prevented floodwater into the fields. Floodwaters flows through many sections of canals and narrow pipes to the field, not overflow like before. Therefore, the amount of sediment deposited in the field is decreasing compared to the past when there is no closed dyke and dam upstream.

(Source: In-depth interview, 2020)

Internal factors: This is also the factor affecting water security in the study area in the upstream (3.4%), midstream (6.7%), and downstream area (5.0%). The villagers said that internal factors such as ineffective water management on the use of shared water sources such as river water also caused conflicts between the models of rice cultivation, animal husbandry, and aquaculture which leads to water pollution.

4.3. Solutions to adapt to climate change and water security of the people in the study area

In agricultural production, weather forecasting and water security projections such as floods, saline intrusion, and drought are seen as an effective strategy in making agricultural decisions in crop production, aquaculture, animal husbandry. Local farmers can change the seasonal calendar accordingly to reduce losses.

- Solutions to adapt to water security in agricultural production: local people have adapted and transformed water-saving models and adapted to water security in the study area such as the alternating wet and dry irrigation model, the drip irrigation system, the IPM models, 3 down 3 increases, 1 must 5 decreases. In addition, people need to adjust the seasonal calendar and choose livestock breeds and plants to suit changes in water security. Moreover, it is important to evaluate the effectiveness of models and expand in the study area and in the Mekong Delta.

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- Water security management policy solutions: The State also needs to have insurance policies for people in flooded areas on water security to ensure production and adapt to water security in order to reduce and ease vulnerability in climate change conditions. To reduce vulnerability, it is necessary to build up an early warning system on water security for the people to manage and minimize livelihood damage caused by floods; it is necessary to strengthen propaganda and dissemination of knowledge to prepare for the flood season, organize training courses to adapt to climate change and unusual flood events in the study area.

- Strengthening communication and trainings to provide knowledge about climate change and water security through local loudspeaker system, on television to help farmers update knowledge on how to adapt to environmental changes

5. Conclusions and recommendations

5.1. Conclusion

Water security plays a very important role in livelihoods and agricultural production in the study area. Survey results show that factors affecting water security in the study area include climate change, upstream hydropower dam development, and intrinsic factors in the study area. The index of livelihood vulnerability caused by the impact of flood security of the areas outside the dike is higher than the area inside the dyke. Water security is correlated with livelihoods, production experience, and cultivated areas inside and outside the study area through the pearson correlation test (α is 0.22, 0.02, 0.00, respectively.) at 5% significance level. Research results on livelihood vulnerability indicators (LVI) from 10 main components, 30 subcomponents and 5 livelihoods sources in the ring dike and outside the ring dike show that the index of livelihood vulnerability due to flood water security impacts outside the ring dike is higher than that in the ring dike area. In addition, the livelihood vulnerability index of the study area decreased gradually according to main factors such as social network, knowledge - skills, natural resources, income and finance, livelihood strategy, natural disasters and there are difference in the upstream, midstream and downstream areas. The study also provides some climate change and water security adaptation to minimize vulnerability to impacts of water security in the context of climate change.

5.2 Recommendations for further research

The follow-up study continues to carry out research on the impacts of water security on agricultural production by different target groups (rich, medium, poor and ethnic minorities) in the provinces that affect security and people's livelihood in the context of climate change. From there, there is a more comprehensive set of data to compare and evaluate on the impacts on water security in the context of climate change.

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