 DOI: 10.35382/18594816.1.41.2020.645

ASSESSMENT OF LIVELIHOOD MODELS WITH HIGH ADAPTABILITY TO CLIMATE CHANGE FOR APPLICATION IN TRA VINH PROVINCE, VIET NAM

Nguyen Hoang Lam[1], Pham Kim Long[2], Trinh Ngoc Ai[3], Tran Thi Ngoc Bich[4], Nguyen Thanh Tuu[5], Vuong Tuan Phong[6], Duong Hoang Oanh[7]

Abstract – *Tra Vinh Province is an important agricultural production area of the Mekong Delta in Viet Nam, but its economic development is being heavily affected by climate change. In this study, a set of 14 quotas with the Delphi method were used to assess the climate change adaptability of 24 livelihood models (horticulture, animal husbandry, and aquaculture models) in Tra Vinh Province to find livelihood models with the greatest adaptability. The adaptability was calculated using relevant parameters including weighted scores, raw data points, and mean points of each model. Calculations show that two models have great adaptability (CN01 and TS14), twenty models have relatively pretty good adaptability (CN01, CN03, TS02, TS03, TS05, TS06, TS07, TS08, TS09, TS10, TS11, TS12, TS13, TS14, TS15, TS16, TT01, TT02, TT03, TT04 and TT05), two models have average adaptability (TS04 and TS01), and no models have low adaptability. These two successful models can be applied to farmers in Tra Vinh Province but attention needs to be paid to economic issues such as capital or market. These twenty good adaptive and two average adaptability models should be improved for future applications.*

Keywords: adaptability, climate change, livelihood, Tra Vinh Province.

I. INTRODUCTION

Climate change is expected to affect crop and livestock production, water balance, input supplies, and other components of agricultural systems [1]. However, the nature of these biophysical effects and the human responses to them are complex and uncertain. Agriculture is one of the sectors that plays an important role in providing food - locally and for export - therefore, they are most affected by climate change [2]. Furthermore, Viet Nam is one of the countries that has been severely impacted from climate change during recent decades [3].

The Vietnamese Mekong Delta (VMD) is a major producer and supplier of agricultural products for consumption and export, therefore agricultural productions and services become the main livelihood source for people in the VMD [4]. However, this region is most heavily affected by climate change due to low elevation, with a coast of more than 600 km - often influenced by two different types of tide; from the East Sea (irregular semidiurnal tide) and the West Sea (irregular tide) - creating an extremely complicated hydrological regime [5].

The following prediction has been made that if the tide rises by 75 cm, 19% of the Mekong Delta will be flooded, additionally if sea levels rise 1 meter by 2100, 38% of the VMD will be flooded, almost 35% of the population, 4% of the railway system, 9% of the national highway and 12% of provincial highway will be affected [6]. Due to such geographical characteristics, the VMD will be adversely affected by climate change.

As Tra Vinh Province is located in the Southern coastal area of the VMD, which has flat terrain, and converging rivers meeting the sea, popular elevation from 0.1 – 1 m accounts for 66% of the natural area, it has potential land for agriculture and aquaculture that is relatively large. Therefore, Tra Vinh Province is one of 10 Provinces which will be most severely affected by climate change in the VMD, if the sea level rises 1 m. The total flooded area can be estimated up to 21.3%, which will heavily affected the Province's

[1,2,3,4,5,6,7]Tra Vinh University
Email: nhlam@tvu.edu.vn
Received date: 26th April 2020; Revised date: 10th December 2020; Accepted date: 15th December 2020

agricultural production [7].

With the manifestations of climate change such as high temperature, prolonged drought, saline intrusion, high tides, and winds; Tra Vinh Province's economy will be facing risks when the sea level is increasing day by day, specifically in agriculture, fishing, fresh water supply, small production, retail trade, and tourism [8]. Each manufacturing industry will be differently effected by climate change, particularly, cultivation sectors leading to loss of cultivated land, reducing agricultural yield and quality and increasing the risk of diseases. Breeding activities are also affected by saline water intrusion, alum pollution, fresh water scarcity, with aquacultural activities frequently affected by weather and natural disasters. This is including but not limited to rising sea levels coupled with rising temperatures, storms, large waves, high tides and other extreme weather phenomena [9]. According to Hao et al. [3], the results of applying a set of assessment quotas for climate change show that the level of awareness, skills, and experiences of climate change adaptation of households being low, the ability to access infrastructure, facilitate changes in livelihoods, and the policies from the local government are the factors that influence mastery of climate change at a household level. This study aimed to evaluate the climate change adaptability of some livelihood models in horticulture, animal husbandry, and aquaculture, and statistically analyze the differences in the ability of these models to adapt in Tra Vinh Province in the context of climate change.

II. MATERIALS AND METHODS

A. Data collection

To collect relative data from related studies, a review of documents and reports on natural and socio-economic conditions, and published journal papers which were related to Tra Vinh Province, was conducted. The primary data was collected through interviews and field surveys about conditions around agricultural areas, and an assessment of the impacts of natural elements on agricultural production. The interviews mainly focused on the farmers personal information (educational level, age, number of people in household, income, and so on), and parameters to evaluate the models' ability to adapt to climate change which meet the criteria of Table 1. The content of the interview questionnaires was based on relevant criteria in Table 1, each has an index and each was evaluated and scored by a number of different questions (scale from 1 to 5) [3]. There were 100 interviewed households for all models whom the Mekong Delta Climate Change Adaptation Project (AMD Tra Vinh Project) has selected to implement 24 models with the total area is 24.47 ha.

This study was conducted based on secondary data from the AMD Tra Vinh project and primary data from interviews with those households. In this research, 24 livelihood models were implemented and investigated in Chau Thanh (CT), Cang Long (CL), Cau Ke (CK), Tra Cu (TR), Duyen Hai (DH), Cau Ngang (CA) and Tieu Can (TC) District of Tra Vinh Province, which are Egyptian chicken (*Fayoumi*) farming specializing in eggs (was coded as CN01), Binh Dinh chicken (*Gallus gallus*) farming (CN02), Egyptian chicken (*Fayoumi*) farm drop garden (CN03), Rearing Chinese Pangasid-catfish (*Pangasius krempfi*) (TS01), Rearing trionychid turtle (*Trionychidae*) (TS02), Rearing featherback fish (*Notopterus notopterus*) combined with snakeskin gourami (*Trichogaster pectoralis*) (TS03), Rearing golden catfish (*Clarias macrocephalus*) model (TS04), Rearing South trionychidae turtle (*Amyda cartilaginea*) (TS05), Farming crab (*Somanniathelphusa sinensis*) in shrimp ponds (TS06), Rearing commercial frogs (*Hoplobatrachus rugulosus*) in a combination of mixed fish (TS07), Rearing blood cockles (*Anadara granosa*) on the river under the canopy of mangroves (TS08), Rearing giant freshwater prawn (*Anadara granosa*) in 2 stages (TS09), Semi-intensive giant freshwater shrimp (Anadara granosa) in ponds (TS10), Rearing giant freshwater shrimp (*Anadara granosa*) in male snakehead fish (*Channa maculata*) ponds (TS11), Raising tiger prawns (Penaeus monodon) with milkfish (*Luciocyprinus*) (TS12), Rearing mud clams (*Geloina coaxans*) on riverbank alluvial grounds (TS13), Farming mud clam (*Geloina coaxans*) under the forest canopy (TS14), Rearing featherback fish (*Notopterus notopterus*) (TS15), Breeding male giant freshwater shrimp (*Anadara granosa*) according to the press the cray method and spreading the net (TS16), New peanut (*Arachis hypogaea*) variety test (TT01), Japanese purple sweet potato (*Ipomoea batatas*) (TT02), Growing mung beans (*Vigna radiata*) on inefficient rice land (TT03), Planting green asparagus (*Asparagus officinalis*) (TT04), and Producing vegetables in a safe way (TT05).

According to Thang [10], each criteria and each quota has different scores, the calculation was based on the number of the question of that quota, including (1) Adaptability of each model has a maximum of 75 points, including 5 quotas, each quota has 15 points; (2) Economic efficiency of a model has a maximum of 8 points, including 2 quotas, each one has 4 points; (3) Social efficiency of a model has a maximum of 9 points, including 3 quotas, 3 points for each one; and, (4) Environment efficiency a of model has a maximum of 8 points, including 4 quotas, wherein each quotas has 32 points.

Table 1: A set of the criteria for climate change adaptability [3]

No.	Criteria	Quota	Code
1	Adaptability	Location and topography	CT 01
		Production season	CT 02
		Object of production	CT 03
		Layout of components	CT 04
		Experiences of production	CT 05
2	Economic efficiency	Profit rate (Total revenue/ Total expenditure)	CT 06
		Time to recover capital	CT 07
3	Social efficiency	Create jobs for workers	CT 08
		In accordance with local guidelines and policies	CT 09
		Ability to replicate the model	CT 10
4	Environmental efficiency	Limiting waste generation	CT 11
		Reusing waste	CT 12
		Saving energy	CT 13
		Improving environment	CT 14

B. Calculation methods

The calculation of scores, which was used for ranging models, was carried out according to the following steps:

- Step 1 - converting scores for all quotas in the set of criteria: Since each one had a different number and score; the points of the interview questions were converted into common points of each index.

- Step 2 - calculating the weighted scores (w_i) of each quota: For each evaluation quota, there would be a different level of assessment of climate change adaptability of each model - whichever is higher the weighted scores will have an important level for that index of ability, based on the Delphi method to calculate the weighted scores [11]. From the questionnaires, the score was changed for each quota of each model (scale from 1 to 5), then determine the ranking of each index (m_i) by formula (1): m_i = (Total score of each index i) /(Total of interview sheet) (1)

From m_i, figured out the weighted scores of each index (w_i') by formula (2):

$$w_i' = m_i/m_i(max) \qquad (2)$$

Then, the main weighted score (w_i) was determined from w_i' by formula (3)

$$w_i = w_i'/\Sigma w_i' \qquad (3)$$

- Step 3 – calculating the raw data points (Bi) of each evaluation quota: From questionnaires, Bi was calculated by the average of 14 quotas in each model, the scale was assessed from 1 to 5, that is, the lower the score for each quota, the lower the suitability and adaptability capacity of the model, whereas the higher the overall score for each quota, it seemed more suitable and adaptable to climate change.

- Step 4 – calculating the main points (A_i) for each quota: A_i was computed by the formula (4)

$$A_i = B_i.w_i \qquad (4)$$

- Step 5 – Calculating the overall assessment score (X) for each model: the overall assessment score was calculated by the formula (5)

$$X_i = \Sigma A_i \qquad (5)$$

- Step 6 – Model classification: After calculating the overall assessment score, the classification of models was divided by the general score level X with $1 \leq X \leq 2$ (low adaptability); $2 < X \leq 3$ (average adaptability); $3 < X \leq 4$ (pretty good adaptability); and $4 < X \leq 5$ (great adaptability).

All data were collected, calculated, and graphed using Microsoft Excel.

III. RESULTS AND DISCUSSION

A. *A general evaluation of the models*

Based on surveys of implemented models in Tra Vinh Province, the general information is given in Table 2. Specifically, there are 03 animal husbandry models, 16 aquaculture models, and 05 horticulture models. All of these models were used to apply assessment criteria and rank the ability to adapt to climate change. These tables indicated the number of interviewed households, the gender of the member in a family, age of respondents, number of people in a family, and ethnic group. The majority of people had actively cooperated with the AMD Tra Vinh Project, none of them were excluded from the total of 100 interviewed households. All people understood the questions, and the interviewees in each household were the ones who directly implement the farming models. The research results of Thang [10] showed the different pressures of climate change on gender in production.

B. *Characteristics of households implementing models*

The results of Table 2 indicated that the average number of people in a household was about 4.2, however, there was an exception of 11, the number of people who directly implemented the models ranges from 1 to 2, with most of family members working far from home. The average age was 49.5 years old, which illustrates that farmers still are in the ‘working age’ (from 15 – 65) [12]. Figure 1(A) demonstrates the education levels of the 100 implementers, it was found that 4% did not have a chance at education, 18% had an elementary school background, 48% had a secondary education level, 19% had higher education and the others had a college certificate. The results indicated that people who were educated will have a better ability in implementing models than others. Because they have a better awareness of experiences as well as problem solving difficult situations. According to these implementers’ opinions however, farmers must have the experience and passion in order to operate models well.

Of the 100 interviewed household, up to 85 households had male implementers, the remainder were women. This means that there is a difference in gender in implementing models. In farming, labor is considered as one of the key elements in production, however, almost all households that mainly used family labor restricted hiring outside employees. According to Skinner [13], in many countries (especially Viet Nam), both males and females are affected by expressions of climate change within different areas, including education, career, and information access. In agriculture, the different impacts of climate change on gender equality also plays an important role in ensuring food security in the future, the gender of those who are directly involved in the process shows that men are primarily involved in the early stages (preparation) and the final stage (harvest), while women participated throughout all processes, therefore, the damages caused by natural disasters or the effects of climate change will first influence women, the gender of the implementers will also affect the final success of the model, the result of Thang et al. [14] showed males to be more successful.

C. *Characteristics of livelihood and economy*

Based on the results of the investigated survey, we divided households into 4 groups: poor, near-poor, normal and wealthy family based on the income of each family [15], [16]. According to Figure 1(B), among the 100 interviewed households, up to 25 households are poor, 66 are near-poor, 6 are normal and the remaining were wealthy. These groups of families are suitable for the

Table 2: Overall information about 24 livelihood models(*: by median; **: by average)

Code	Location	Number of interviewed households	Gender		Age of respondents*	Number of people in household**
			Male	Female		
CN01	CL	3	2	1	46.0	4.7
CN02	CA	7	6	1	42.0	3.9
CN03	CL	6	2	4	52.0	3.5
TS01	TR	1	0	1	55.0	4.0
TS02	CK	9	9	1	43.0	5.0
TS03	CA & CT	4	4	0	45.5	4.5
TS04	TR	1	1	0	45.0	3.0
TS05	DH & CL	3	3	0	60.0	4.3
TS06	DH	2	1	1	58.5	4.0
TS07	TC	2	2	0	50.0	4.5
TS08	DH	4	4	0	44.5	3.8
TS09	DH	4	4	0	54.5	2.3
TS10	TC	8	6	2	57.0	4.8
TS11	CT & CL	4	3	1	47.5	4.3
TS12	CA & DH	4	4	0	44.5	3.3
TS13	DH	2	2	0	55.5	4.5
TS14	DH	2	0	2	40.5	5.5
TS15	CA	2	2	0	50.1	3.0
TS16	CL	2	2	0	58.0	4.5
TT01	CA	10	10	0	53.5	5.1
TT02	CA	4	3	1	49.5	4.3
TT03	CT & CL	4	3	1	42.0	4.5
TT04	TR	6	6	0	49.0	5.0
TT05	CK	6	6	0	44.5	4.3
Average**		4.2	3.5	0.7	49.5	4.2

survey because this method primarily assesses the impact of climate change on the poor. This data demonstrates that the number of ‘poor’ and ‘near-poor’ families are much higher than ‘normal’ and ‘wealthy’ families. The survey results showed that 91% of household livelihoods greatly relate to the ability to adapt to climate change. This is consistent with the fact that livelihoods play a key role in generating revenue and improve the living standards for households [3].

The results of the survey also illustrated the relationship between education levels and family types, all of the implementers in the ‘wealthy’ family group (3 households) have a college or university degree, some implementers have higher education but they still are grouped as ‘normal’ family or ‘near-poor’ family. All of the implementers with only an elementary degree are in the ‘poor family’. This is in agreement with the result reported by [16].

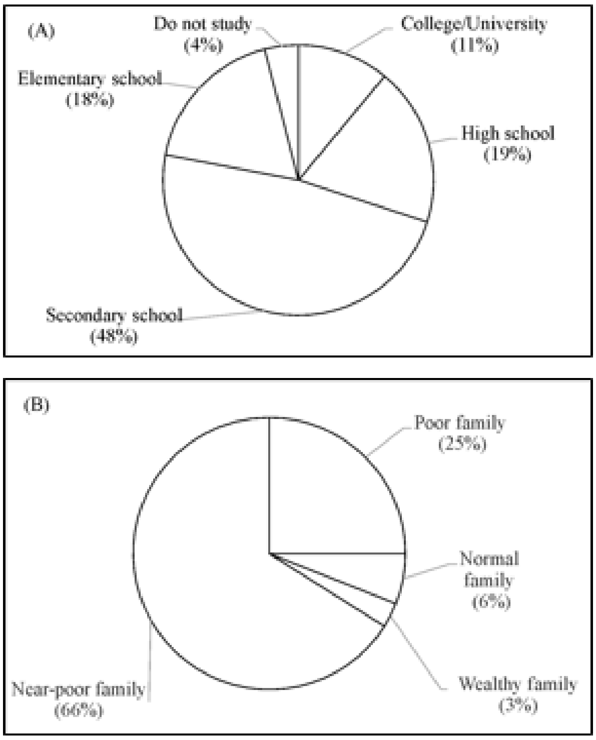

Fig. 1: A) Rating of education levels of implementers, (B) Rate of family type of households

D. Peoples' awareness relating to climate change

The vulnerability of households changes rapidly depending on the ecological subregions due to the impacts of climate change, and the continuous changes of socio-economic factors. Such as the change to use upstream water, flood prevention, salinity prevention projects, intensive farming, mechanization, and price fluctuations of raw material inputs and agricultural output [17].

There are many livelihood factors affecting farmers' ability to adapt to climate change, like the lack of labor, contaminated surface water, incomplete dike systems, and difficulty in accessing loans [4]. Moreover, human awareness of climate change is one of the factors for the model to be successfully implemented and sustained.

The increase in the number and intensity of natural disasters - for example storms, tropical depressions, salty and drought periods - are difficult to predict [18]. To solve these above problems, people need to apply various technical solutions such as building durable animal lodging, correct water storage in the house, preparing food for animals, mounding for plants, changing cattle and poultry, and planting for various seasons. These implementers had opportunities to obtain knowledge about climate change through information systems such as television shows, radio channels, meetings and newspapers; therefore, poor and near-poor implements still have opportunities to access the information through above ways.

E. The evaluation results of models

The interview and survey results were the basic assessment for building the matrix to compare each quota of each model to other models. The weighted scores were the most important levels of each producing model. The weighted scores of models play a significant role in descriptive statistic of different quota in a model, particularly, in quota number 12, the highest and the lowest value is TS10 (0.092) and TS05 (0.039), respectively. The largest weighted score value was in No.13 of model TS11 (0.094) and the smallest in No.12 (TS05) and No.14 (TS02). With the calculated results of weighted scores, a prediction of the trends of climate change adaptability of models can be seen. The raw data points of each model show the real adaptability of models, the result showed the different raw data point among quotas in a model and among other models. The computed results demonstrated that CN01 has the highest total score of 62.1, in contrast, TS01 was found with the lowest score, 34.3. The differences amongst models were also observed, due to the characteristics of each model that differ for each index. The biggest difference is 3.8 for No.7 - the capital recover time, CN01, is fastest – with 4.8 points. But TS01 has only 1.0 point, and for No.12, waste reuse, CN03, reaches to 4.8 points but TS04, TS06, TS10, TS13, TS15, TS16 are only 1.0 point. The remaining quotas are varied and range from 1.5 to 3.5. It showcases significant differences in raw data points between models, demonstrated by the actual adaptable level of each model to changes in the climate. The main points were calculated by the main weighted scores (w_i), the raw data points (Bi) and the formula (4).

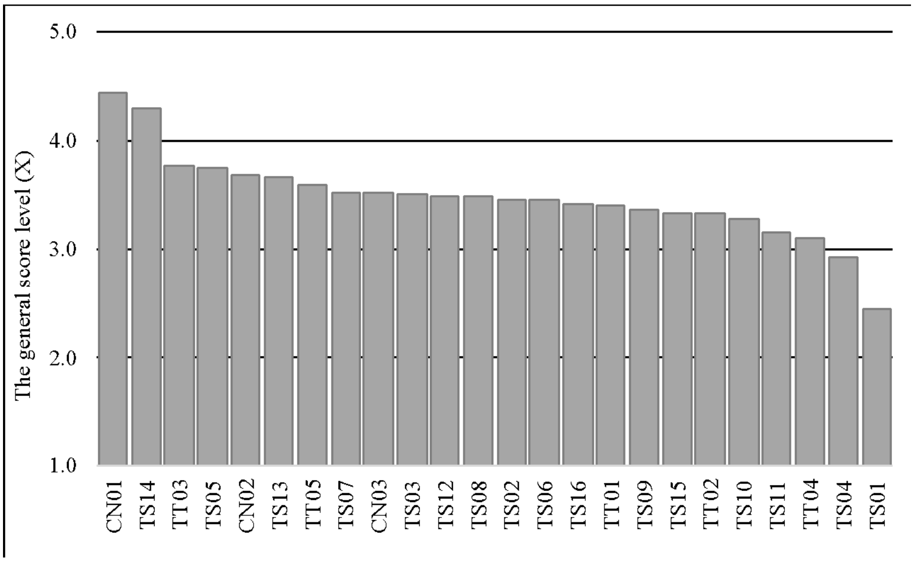

Fig. 2: The general score level (X) of 24 livelihood models

The main point A showed the difference among 14 quotas of each model; however, the main point is not the main value that can show the ability of model. The general score level (X) is the final value to assess the climate change adaptability of models and the result in Figure 2 shows that two models have the greatest climate change adaptability (CN01 and TS14), two models have average climate change adaptability (TS01 and TS04), and the remaining twenty models have good adaptability. Due to the dike system against the saline intrusion in production areas, the dikes were closed so that most of the evaluated models showed good adaptability with the saline condition and hot weather. Additionally, saving water and inside house production models have significantly limited the direct impact of salt water and a hot environment, such as rearing South Trionychid turtle or Egyptian chicken farming specializing in eggs.

CN01 (Egyptian chicken farming specializing in eggs model) has the highest points for climate change adaptability. Egyptian chicken breed, a new breed of chicken in Viet Nam, adapts very quickly to the weather conditions of Tra Vinh, the farmers invest only a small amount of money. Besides, the chicken breeding technique is not complex so this model can be easily applied to rural areas. TS14 model (Farming mud clam under the forest canopy) is found to be the highest aquaculture model and has high points for climate change adaptability. The characteristics of this model are high adaptability with the weather conditions and local estuaries - especially in the coastal area of Tra Vinh Province where there is a dense river system and large silt regions - this model can be replicated in coastal submerged forest areas and can exploit the benefits from the forest and save food sources for investment costs. The TT03 model (Growing mung beans on inefficient rice land model), is considered as being the utmost adaptable to climate changes in cultivation. The usage of previously inefficient land to cultivate mung beans, is part of the planning to minimize the need for bare land but still bring benefits to farmers, the characteristics of green pea plants in accordance with hydrological conditions, weather and land in Tra Vinh Province, implementation of this model was found to be easily replicated.

In summary, this study only focused on the rural areas of Tra Vinh Province, the number of available households for investigation was limited. For a better overview, there is a need to widen the evaluation to the different regions. In addition, an in-depth evaluation of the economy is needed, combined with the results of assessing the ability to adapt to the climate, from which the models can be selected for both economic efficiency and adaptability with climate change to be replicated in households.

IV. CONCLUSION

Although it is still too early to reach a definite conclusion, it seems that public awareness of climate change is gradually being improved, and climate change adaptable indexes of models were proved to be above average to high which twenty models have relatively pretty good adaptability (CN01, CN03, TS02, TS03, TS05, TS06, TS07, TS08, TS09, TS10, TS11, TS12, TS13, TS14, TS15, TS16, TT01, TT02, TT03, TT04 and TT05), and two models have great adaptability (CN01 and TS14). There are only two models have average adaptability (TS04 and TS01), and no models have low adaptability. These results support the managers and policy makers who form laws to respond to climate change for agricultural development within Tra Vinh Province.

There is a need to organize more training sessions, communication activities, and release materials on climate change adaptation, as a basis to help improve the knowledge of implementers. The implementation of livelihood models with support from the Government and non-government organizations (NGOs) is imperative to select prospective models, which are economically, technologically effective and adaptable to climate change, distribute locally and to farmer groups in accordance with sustainable livelihood development.

ACKNOWLEDGMENTS

The research was supported by the AMD Tra Vinh Project. We are also grateful to Ms. Rachel Louise Soubra from Tra Vinh University for reviewing this paper.

REFERENCES

[1] Yazdi S.K, Shakouri B. The effects of climate change on aquaculture. *International journal of environmental science and development*. 2010; 1(5):378–382.

[2] Trang D. T. H. The impact of climate change on the efficiency of agricultural production in the area along Tam Giang lagoon, Thua Thien Hue Province. *Hue University Journal of Science (HU JOS)*. 2014; 94:6.

[3] Hao N. T, Tue N.T, Quy T. D, Hoai, N. D, Nhuan M. T. Evaluation of household-level adaptation to climate change in Hoa Vang District, Da Nang city. *VNU Journal of Science: Earth and Environmental Sciences*. 2016; 32:140–152.

[4] Tuan L. A, Thuy H. T, Ngoan V. V. The impact of climate change on people's livelihood in the Mekong Delta) In *Conference: The 6th Forum for Nature Conservation and Culture for the Sustainable Development of the Mekong Delta region, Viet Nam*. 2014a.

[5] Tin T. M, Long V. V, Diep T. H, Minh V. Q. Application of multi-criteria analysis in assessing the impact of climate change on agricultural production in the Provinces along the Mekong Delta, Viet Nam. *Can Tho University Journal of Science*. 2018; 54:202–210.

[6] Diep N. T. H, Minh V. Q, Diem P. K, Tao N. V. Assessing the impact of climate change on the status of rice cultivation in the coastal areas of the Mekong Delta under the climate change scenario. *Can Tho University Journal of Science*. 2015: 167–173.

[7] The United Nation. *Migration and climate change*. 2014. Available from https://www.un.org/en/sections/issues-depth/migration/index.html [Access on 05 February 2020]

[8] Tuan V. V, Dung L. C, Ha V. V, Nhan D. K. Adaptability of farmer for climate change in Mekong delta. *Can Tho University Journal of Science*. Part D: Political, economic and legal science. 2014b; 31:63–72.

[9] Thuy L. N, Nam P. D. Impact of climate change on agricultural production and migration of farmers. *Journal of Sociological Science*. 2015; 01(129):82–92.

[10] Thang L. V. Scientific arguments for the selection and refinement of community-based climate change adaptation models in Central Viet Nam and proposed replication. Summary report on scientific and technological results. *Science and technology program serving national target program to cope with climate change*. 2015:11–15.

[11] Dalkey N, Helmer O. An experimental application of the Delphi method to the use of experts. *Management Science*. 1963; 9(3):458–467.

[12] General Statistics Office of Viet Nam. Mid-term census results of 2014: Population sex-age structure and related socio-economic issues in Viet Nam. *United Nation Population Fund (UNFPA)*. 2016. Available from https://vietnam.unfpa.org/sites/default/files/pubpdf/PD_Tieng%20Viet_Co%20cau%20tuoi-gioi%20tinh%20dan%20so%202014_2016.pdf [Access on 27th April 2020]

[13] Skinner E. *Gender and climate change: Overview report*. Institute of Development Studies UK. 2011.

[14] Thang N. T, Giang N. T. H, An N. T. Effects of climate change on the role of gender in agricultural production: research case at Giao Lac, Giao Thuy,

Nam Dinh. *Journal of Science & Development*. 2015; 13:464–473.

[15] Prime Minister. *Decision number 59/2015/QD-TTg, dated on November 19th, 2015 about issued a multi-dimensional approach to poverty applied for the 2016-2020 period*. 2015. Available from https://thuvienphapluat.vn/van-ban/van-hoa-xa-hoi/Quyet-dinh-59-2015-QD-TTg-chuan-ngheo-tiep-can-da-chieu-ap-dung-2016-2020-296044.aspx [Access on 27th April 2020]

[16] Ministry of Labour, War invalids and Social Affairs. *Multidimensional poverty report in Viet Nam, poverty reduction in all dimensions to ensure a quality life for everyone*. 2015. Available from https://www.undp.org/content/dam/vietnam/docs /Publications/Bao_Cao_MDP_16_Dec_2018.pdf [Access on 27th April 2020]

[17] Tuan V. V, Dung, L. C. Factors affecting the livelihood outcomes of farm households in the Mekong Delta, *Can Tho University Journal of Science*. Part D: Political, economic and legal science. 2015; 38:120–129.

[18] Brander K. Impacts of climate change on fisheries. *Journal of Marine Systems*. 2010; 79(3):389–402