

Correlation between Climate Change Impacts and Migration Decisions in Vietnamese Mekong Delta

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Abstract

Climate change poses new risks to human security and causes a new context for migration (CARE, 2009). Sang and Long (2012) showed that the largest source of migrants in Ho Chi Minh City (HCMC) originates from Mekong Delta while (Dun, 2009) demonstrated that environmental issues are important factors promoting migration in this region. To further study the impact of climate change on migration, the study aims at investigating a correlation between the environmental impacts of climate change and migration decisions. Based on 400 interviews with local people in Ben Tre and Dong Thap provinces (highest sources of immigrants in HCMC), statistical analysis (reliability analysis – Cronbach's alpha and factor analysis – EFA) proves that (1) the impacts of climate change on production activities; (2) the impacts of climate change on the quality of life; (3) the impacts of climate change on environmental quality are factors which have contributed to migration decisions of those suffering from climate change. Correlation analysis results showed that there is a correlation between the impacts of climate change and migration decisions ($p < 0.05$), and the decision to migrate directly proportional to the increase in the influence of climate change.

Key words: migration, climate change, environmental impact, Mekong Delta, Ho Chi Minh City (HCMC).

1. Introduction

Climate change poses new risks to human security and causes a new context for the migration (CARE, 2009). Climate change, either suddenly or gradually, negatively affected these migrants' living conditions, making their habitat impossible to survive (Deng & Zhao, 2014). IDMC (2013) reported that 32.4 million people were forced to flee their homes in 2012 by disasters such as floods, storms and earthquakes. Although millions of people have migrated because of environmental issues, this phenomenon is likely to increase in the coming decades as a result of climate change and population growth (ADB, 2012). Like many other countries in the world, climate change, natural disasters and relevant as sea level rise, prolonged drought, frequent flooding, food shortage, lack of clean water, land eroded, and the population flows will be the most serious challenges that Vietnam may face in the future. Since the last twenty years, many researchers have focused on the impact of climate change on migration

decision (Bates, 2002; Castles, 2002; Döös, 1997; WB, 2001) and many studies found the correlation between climate change and migration (Fang & Liu, 1992; Huang et al., 2003; McLeman & Smit, 2006; Meze-Hausken, 2000; Tyson, Lee-Thorp, Holmgren, & Thackeray, 2002). However, these studies did not study in detail how the correlation is, and that correlation was identified based on "a judge of general trend" (L. Perch-Nielsen, B. Bättig, & Imboden, 2008). Theoretical model conducted by L. Perch-Nielsen et al. (2008) which aimed at identifying a link between migration and climate change reasons, sea level rise and flooding phased out that the link strongly depends on factors related to the degree of vulnerability of people living in the affected areas. Jacobsen (1998) and Bates (2002) pointed out that environmental change is the main reason for migration. These studies also identified that drought (El-Hinnawi, 1985), land degradation (Kavanagh B, 1992), sea level rise (Jordan, 1994) are driving forces of migration.

So far, there are many studies which were conducted in Vietnam to identify the socio-economic impacts of climate change on local people. Thuy and Nam (2015) studied the consequences of climate change on agricultural production and found that climate change is among socio-economic aspects which affect agricultural production and migration of farmer. Recent studies showed that Mekong Delta will be affected by climate change, and in the forecast for the next 50 years, about 50% of the area under cultivation and millions of residents will suffer severely due to loss of housing or loss of livelihood (CARE, 2009). If sea level rises by 1 m, one-third of the Mekong Delta will be submerged in deep water (MONRE, 2016). In the future, one in every ten Vietnamese will face risk of losing their home when sea level rise in the Mekong Delta (Dasgupta, Benoit, Craig, David, & Jianping, 2007). Facing the threat from climate change and environmental pressures, people in the Mekong Delta has adapted in various ways. One possible mechanism is migrant which creating a strong attraction for migration flows to urban areas. Ha (2014) combined the climate change scenarios in Mekong delta with the results of flooding and salt intrusion scenario model to evaluate the vulnerability of rural water supply to

climate change in Mekong delta. The results indicated that ratio of rural people who are affected (1) by salt intrusion in 2012 which is 39.5% will increase up to 41.4%, 45.3%, and 47.6% in 2020, 2030, and 2050, respectively; (2) by flooding will increase from 66.7% to 71.9%, 74%, and 79.2% in 2020, 2030, and 2050, respectively. It is evident that similar to other studies in the world researches on the effect of climate change on migration show no difference. The ratio of vulnerable people and the ratio of land degradation due to climate change can be estimated by using mathematical model. However, there have no study to indicate how many percentage of among vulnerable people will decide to migrate. Studies of Quoi (1996), Thanh (2008), Sang and Long (2012) are just to identify the ratio of immigrant in Ho Chi Minh during different period. These studies did not show the ratio of vulnerable people who decides to migrate when suffers from climate change. Oanh and Tuyet (2016) have surveyed 1,000 migration households in HCMC of Vietnam and found that 16.5% of immigrants coming to HCMC for reasons related to their local environmental problems (crop losses, exhausted soils, ...). The link between climate change and migration is often not simple and direct. Specific impact factors of climate change are often difficult to distinguish and difficult to separate from other challenges as well. While migration decision is difficult to determine due to a single cause but rather the combined effects of multiple factors of economic, social and environmental.

The study of Dun (2009) in the Mekong Delta has shown that environmental factors have become important factors promoting migration in this region. However, no study has yet to specify the causes of the environmental factors contributing to migration as well as no proven has provided to show correlation between climate change and migration. Therefore, the objectives of this research are: (1) to identify the environmental impacts to the Mekong Delta which are recognized by local people; and (2) to determine the correlation among the impacts of environmental issues on migration capabilities in areas affected by climate change in the Mekong Delta of Vietnam.

2. Research method

2.1 Determine the awareness of people on environmental changes in areas affected by climate change in the Mekong Delta

Site selection

According to the survey results on the characteristics of immigrant in HCMC, Oanh and Tuyet (2016) showed that of the 1,000 immigrants distributed randomly in HCMC,

422 people come from the Mekong Delta. There are 2 provinces that have the highest migrants to HCMC are Ben Tre (16.6%) and Dong Thap (12.1%) (Table 1). Therefore, these two locations are selected as the source migration survey.

Table 1 Proportion of migrants in Ho Chi Minh City from Mekong delta

Place of residence (Province)	Frequency of occurrence (times)	Percentage (%)
An Giang	36	8.5
Bac Lieu	15	3.6
Ben Tre	70	16.6
Ca Mau	13	3.1
Can Tho	13	3.1
DongThap	51	12.1
Hau Giang	8	1.9
Kien Giang	28	6.6
Long An	33	7.8
Long Xuyen	1	0.2
Soc Trang	26	6.2
Tien Giang	46	10.9
Tra Vinh	32	7.6
Vinh Long	50	11.8
Total	422	100

Source: Oanh and Tuyet (2016)

Survey network

Results of "Building Resilience to Climate Change Impacts: Coastal Southeast Asia Ben Tre Province, Viet Nam" (IUCN, 2013) showed that Thanh Hai and Thanh Phong are the 2 communes in Thanh Phu district, Ben Tre province where are the most vulnerable to climate change. According to Phung (2010) in the context of climate change, corresponding to 75 cm sea level rise, Thanh Phu will suffer 23%, corresponding to an area of 90 km² flooded. Besides, in the case of salt intrusion from rising sea levels with salinity of 4 ‰, the study also forecasted Thanh Phu will suffer very serious.

Similar to the above analysis, in Dong Thap province, Tam Nong District is selected for the survey. For each district, there are 2 areas where the survey was focused: one in town and another in commune. Therefore, this research survey on 4 areas: (1) Thanh Phu town and (2) An Nhon commune in Thanh Phu District of Ben Tre Province, and (3) Tram Chim Town and (4) Tan Cong Sinh Commune in Tam Nong District of Dong Thap Province.

Number of surveys is calculated as:

$$50 \frac{\text{surveys}}{\text{location}} \times \frac{2\text{locations}}{\text{province}} \times 2\text{provinces} = 200 \text{ surveys}$$

Determine the awareness of people on environmental changes

As reported by the NOAA, 10 important indicators to identify climate change and global warming are classified into two main groups: (1) the increasing directives group, including air temperature near surface, humidity, temperature over oceans, sea surface temperature, sea level, ocean heat content, temperature over land, and (2) the reduction directive group, including amount of sea ice reduced, snow cover reduced, and glacier melting at the poles.

Besides, according to EPA, increase in temperature will cause the air in the troposphere warmer. The result of this phenomenon will lead to more rainfall; however, the distribution of rainfall is not uniform across the Earth's

surface. Therefore, temperatures rise, sea level rise, less rainfall and more droughts are indicators which are used to assess people's awareness about the environmental changes around. Depth interview methods in temperature and sea level rise and cross tabulation analysis of two elements less rainfall and more droughts can also be used to evaluate the reliability of the answers of the people. The survey questions will be used in the study include: (1) more rainfall, hurricanes, and tornados; (2) more erratic flooding; (3) warmer and much more extreme weather; (4) the cold weather much more extreme; (5) less rainfall; (6) more drought; (7) desertification; (8) sea level rise.

2.2 Mathematical model to determine the relationship among the impacts of climate change and migration decisions of local people

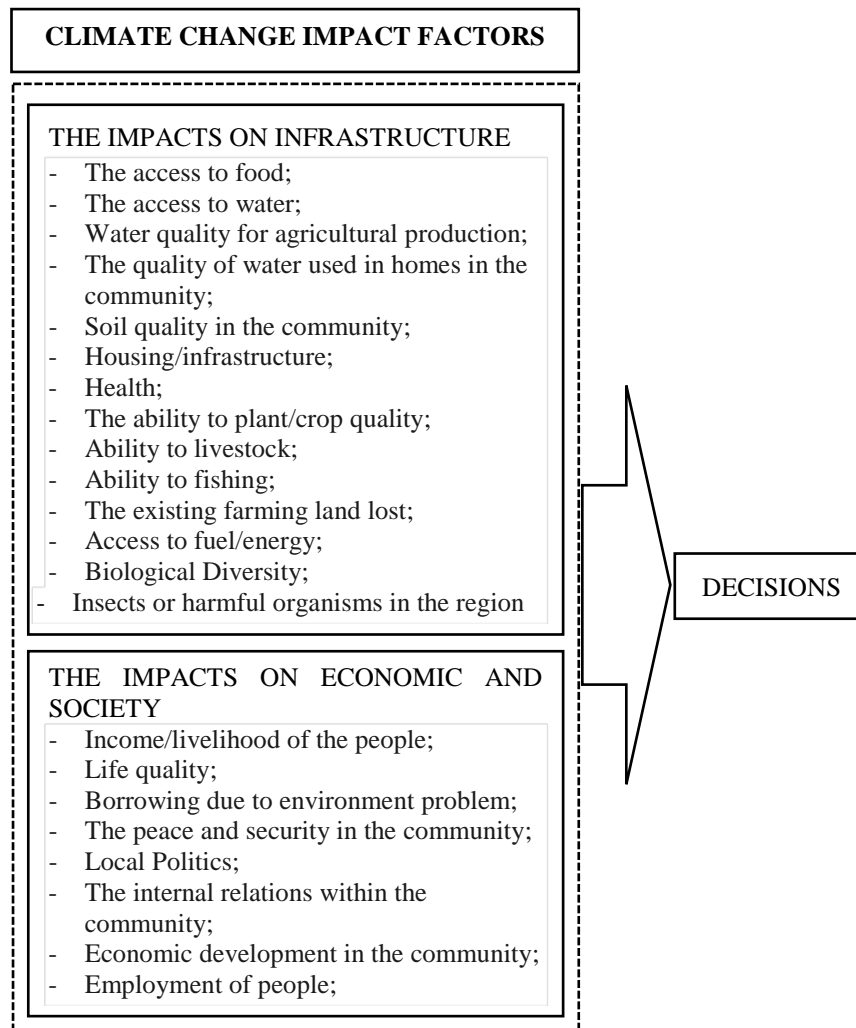


Fig. 1. Research model on the correlation between migration and the impact of climate change.

The model of Migration System by Mabogunje (1970) was used to explain why people in rural areas want to migrate to the cities. Curtis, Fussell, and DeWaard (2015) has shown via "migratory system" that a change in the system components, the new work appeared at immigration area or environmental issues in the place of residence will cause affecting migrants. This research model is developed based on above models, considered on the climate change effected to infrastructure, economic and social aspects at the survey areas. The research model is shown in Figure 1 to answer for the following research questions:

- What are the climate change impacts that are recognized by local people?
- How do the impacts of climate change correlate with migration decisions?

The survey results will be statistically analyzed including reliability analysis, factor analysis to identify factors affecting migration decisions. These results will determine the specific factors that influence the research.

The survey results analyzing method

The information collected on the current ambient conditions of households, the current state of the environment in areas affected by climate change in the Mekong Delta are synthesized using the tool excel. Correlation analysis, analysis of the difference is made by SPSS ver. 22. The correlation analysis tools used included crosstab analysis. Statistical graphs are built using SPSS tool.

3. Research results

3.1 Determine the awareness of people on environmental issues in areas affected by climate change in the Mekong Delta

Survey results of the awareness of people on environmental issues in areas affected by climate change in the Mekong Delta are presented below:

Typhoon. Although the Mekong delta has experienced substantial increase in the number of typhoons and tropical depressions has risen to 7 or 8 a year (ICEM, 2009), the surveys on the typhoon and cyclone in the Mekong Delta found that only 50% of households recognized this phenomenon occurs more and more while 44% did not recognized and 6% had no answer. Thang et al. (2010) also showed that the proportion of tropical cyclones are likely to increase gradually in the southern coast of passage.

Flood. Flooding in Mekong Delta has historically faced and even greater in the context of climate change because of rising sea levels, increased rainfall, and an eventual increase in the water supply from glaciers in the Tibetan Plateau. The result of a research showed that 90% of the agriculture land in Mekong delta would be affected by flooding (ICEM, 2009). However, this survey showed that the flooding phenomenon does not occur irregularly with 68.5% of the answer is "not happening".

Warm weather extremes. The survey shown that 79% of respondents as "being hotter". This result is consistent with studies of Thang et al. (2010) that the average temperature in the last 50 years tends to increase from 0.2 – 1.8°C and climate change scenario of the MONRE (2012) that up to 2020, the temperature in the Mekong Delta will increase 0,4°C when compared to the period 1980 - 1999. In-depth interviews shown that people agrees with the warm extremes increasing, they indicated that the weather is "hotter", "intense more sun", " unusual sunshine" and "warm all year round".

Rainfall. It was reported that rainfall in Mekong Delta has increased as high as 30% annual (ICEM, 2009). However, the survey shows 84.5% of people observes less precipitation in recent years. This result is also contrary to the forecasts of MONRE (2016) that the rainfall in Ben Tre, Dong Thap has increased up to 1.3% over the period 1980 - 1999. It has been showed that the rainfall has increased at the end of the rainy season but has decreased at the beginning of the rainy season over the last 10 years (ICEM, 2009). It may the reason why the local people couldn't have recognized well the phenomenon occurs. The contrary can also be explained since one measure in millimeters of water (MONRE) and another (interviewee) count in number of rainfalls.

Drought. The phenomenon of drought, survey shows 37% of people noticed the drought trend is happening more, 54.5% of people do not notice unusual and 8.5% of people do not care. For the phenomenon of desertification, 63.5% of people do not notice this phenomenon happens in the living area.

Crosstab analysis method was used to check the accuracy of the answers when comparing between 2 relationship answers: "less rain fall" and "more drought". Logically, if it is "less rain fall" then it is "more drought". The results shown that only 70 people in total 200 answered both "less rain fall" and "more drought". This indicates that only 35% of people really care and identify unusual weather phenomena in the region. Statistical analysis results are presented in Table 2.

Rising sea level. Climate change scenarios of MONRE (2012) reported that in the low emission scenario, by 2020,

water levels in the two survey areas will increase from 7-9 cm, in the medium emissions scenario and high average is 8-9 cm. However, this survey shows that people did not recognize the sea level rising. Only 27% of people noted that rising sea affected their life and production, 35% do not realize and 38 % was not interested. In- depth

interviews on the people say “yes” with the phenomenon shows that they are noticed the phenomenon usually occurs is: "Long-term flooding", "saltier water", "rising water level, saltier", "more water than in previous years", "pond water higher and higher, up to about 0.5cm from the previous year".

Table 2 Cross-table analysis: less rainfall and more drought

			More drought			Total
			Yes	No	Do not know	
Less rain fall	Yes	Total (person)	70	95	4	169
		Less rain fall (%)	41.4%	56.2%	2.4%	100,0%
		More drought (%)	94.6%	87.2%	23.5%	84,5%
	No	Total (person)	4	12	12	28
		Less rain fall (%)	14.3%	42.9%	42.9%	100,0%
		More drought (%)	5.4%	11.0%	70.6%	14,0%
	Do not know	Total (person)	0	2	1	3
		Less rain fall (%)	0.0%	66.7%	33.3%	100,0%
		More drought (%)	0.0%	1.8%	5.9%	1,5%
Total		Total (person)	74	109	17	200
		Less rain fall (%)	37,0%	54.5%	8.5%	100.0%
		More drought (%)	100,0%	100.0%	100.0%	100.0%

3.2 The correlation between the impact of climate change and the migration

0.778 and the correlation between the variables and total variation is greater than 0.4.

3.2.1 Analyzing the reliability of the research model

Analyzing the reliability of the research model was performed using the tool of statistical analysis, SPSS. Initial analytical results, for the survey question heading the impact of climate change on infrastructure in the region, have Cronbach's alpha coefficient of 0.8. This indicates that the group questions that have high reliability (good survey questions have Cronbach's alpha coefficient ranged from 0.6 to 0.9). However, when considered relative to the total variation, statistical analysis results indicate that the questions of "health" and "insects or harmful organisms" show lower correlation with total correlation, less than 0.4. This can be explained by the survey question about the phenomenon does not occur locally, or survey questions are not relevant to all the questions posed in the group, or questions mislead interviewer. Excluding these questions, the analysis has Cronbach's alpha coefficients higher which is 0.824, and the correlation between variables and total variation are greater than 0.4.

Thus, after completing the analysis of the reliability of the survey questions, the impact of climate change on the infrastructure include: (1) The access to food; (2) The access to the fresh water (which was cut off/interruption); (3) The quality of water for agriculture; (4) The quality of water used; (5) The quality of land; (6) Housing/infrastructure; (7) Ability to grow/the quantity or quality of crops (if any food crops/trees of all kinds); (8) ability to livestock (if any livestock); (9) The ability to catch fish/amount of fish (if any fishing); (10) The land for farming is lost; (11) The biodiversity (varieties of plant). A group of climate change impacts on the economy, including: (1) income/livelihood (the ability to earn for themselves); (2) Quality of life.

3.2.2 Factor Analysis

Factor analysis to examine the relationship between groups of survey questions and aims to ensure the measurement scale is unidirectional. In this study, factor analyzing was performed using SPSS tool. Results of factor analysis showed that the survey questions are by 0.824 KMO coefficient (KMO > 0.5), Bartlett's test with $p < 0.05$, and extraction sum of squared loadings is greater than 50%. However, load factors of the questions "approach to water resources" and "biological diversity" are less than 0.4. So, these questions are excluded from the group of factors that affected by climate change. KMO coefficient after removing of confounding questions was 0.794, Bartlett test with statistical significance ($p < 0.05$) and the extraction sum of squared loadings are greater than 50%. Factor analysis results shown that there are three groups of factors

For the group of questions about the impact of climate change on the economy, results of Cronbach's alpha coefficient are low, by 0.598. This proves that in the survey questions on economic; there exist questions which are not related to the study objectives. Therefore, the correlation with the total variation of these questions is not high. For higher reliability, the questions had a low correlation with the total variation (less than 0.4) will be removed from the questionnaire. After removing of confounding variables, the Cronbach's alpha coefficients is

motivating people to migrate. Analyzing the relationship between “the effects of climate change” and “migration decision” in the Mekong Delta will be made with 3 groups of factors. Group of the impacts of climate change factors, including:

1. The impact of climate change on production activities

- Breeding ability (if any livestock);
- Catching fish ability/amount of fish (if any fishing);
- Farming land lost;
- Planting ability/the quantity or quality of crops (if any food crops/trees of all kinds).

2. The impact of climate change on the quality of life

- Life quality;
- Income/livelihood (earning capacity to feed itself);
- The access to food;
- Housing/Infrastructure.

3. The impact of climate change on the quality of the environment

- The quality of water for agriculture;
- The quality of water used in community;
- Soil quality.

3.2.3 The correlation between migration and climate change

Correlation analysis showed that there was a correlation between the impact of climate change and migration decisions ($p < 0.05$), and the decision to migrate directly proportional to the increase in the influence of climate change. However, this correlation was only big enough (Pearson correlation coefficient goes close to 0.35) (Table 3). This allows to conclude climate change are affecting the local production activities, the quality of life, and the environmental quality.

Table 3 Analyzing the correlation between climate change’s effects and migration decisions

		The climate change effects are the reason why you migrate
The climate change effects are the reason why you migrate	Pearson correlation	1
	Sig. (2-tailed)	0.000
	N	199
Affect to production activities	Pearson correlation	0.236**
	Sig. (2-tailed)	0.001
	N	199
Affect to quality of life	Pearson correlation	0.332**
	Sig. (2-tailed)	0.000
	N	197
Affect to quality of the environment	Pearson correlation	0.295**

		The climate change effects are the reason why you migrate
	Sig. (2-tailed)	0.000
	N	198

** Correlation at significance level $p < 0.01$ level (2-tailed).

These effects cause economic damage to the people as "reduced crop yields," "impact on jobs". The effects will promote people migrating for a better life. However, the results also indicate that the correlation between migration and the impact of climate change is not high. Results of regression analysis also showed that the above reasons explain only 14.5% of immigrants in the region ($R^2 = 0.145$). This proves that besides the influencing factors mentioned above, there are other factors that affect the migration of people in the Mekong Delta. Besides, 87% of people involved in-depth interviews said climate change causes only negative effects and does not bring any benefit, and 11% of people said climate change also brings certain benefits for their lives as "floods improve soil quality" or "strong sunshine make people have more income from selling soft drinks".

In addition, statistical analysis shows only 14% of people that will have a decision to migrate due to the effecting of climate change. The main reasons for migration include: "moving to other places to escape poverty", "farming is less and less income; therefore, migration for better income", "wish to escape from poverty as soon as possible". Meanwhile, 75% of those surveyed said they would not move to another place because of "grandparents live here; therefore, still cling to live here despite poor", "very desirable but no health and the elderly", "uncertain at new places and jobs", and 11% of people have no opinion or did not answer this question.

The survey on “migration decision” of the people affected by climate change in Mekong Delta had low result that is also explained by those surveyed as the rest of the household has migrants.

Therefore, to be more accurate statistics on migration decisions, the survey questionnaire to gather more information "of those surveyed have to be the decision maker in the family" and "how many members were migrants in the household" as well as to collect additional data on the "age of migrants".

4. Conclusions and recommendations

From the research results can draw the following conclusions: (1) Studies have shown environmental factors (climate change) as people in Mekong Delta mentioned the effects to their lives, including: “rain-storm-hurricanes”, “extreme hot weather”, “rainfall and drought”; (2)

Research has proven that there are three factors that affect the decision migration of people due to climate change: (1) the impact of climate change on production activities; (2) the impact of climate change on the quality of life; (3) the impact of climate change on environmental quality. However, the correlation between migration decisions and the effects of climate change locally until the time of the study (2015) was not high.

Experience gained when analyzing the reliability of the responses from this study show that, precisely defining the research question is extremely important. The next studies when developing the research questions on climate change should consider on the correct question to ask phenomena occurring in the region. The question must have tight relationships with each other and with the research objectives and questions must be understandable to avoid misleading the people interviewed. The survey questions should be taken with 5-level Likert scale to assess the migration decisions of the people better. Research has shown that besides the elements have been identified from factor analysis to examine for other factors also may affect the migration decisions of the people. These factors should be included in the impact assessment of the next study.

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