MINISTRY OF EDUCATION AND TRAINING

MINISTRY OF HEALTH

NATIONAL INSTITUTE OF HYGIENE AND EPIDEMIOLOGY

TRAN CONG TU

ACTUAL SITUATION AND EVALUATION OF APPLICATION OF ECOHEALTH APPROACH IN THE PREVENTION OF DENGUE IN CAT BA TOURIST AREA, HAI PHONG

Specialism: Public Health
Code: 62 72 03 01

SUMMARY OF THE THESIS FOR THE DEGREE OF DOCTOR OF PUBLICH HEALTH

Hanoi - 2019

The Work has been successfully completed at:
NATIONAL INSTITUTE OF HYGIENE AND EPIDEMIOLOGY

Science Instructors:

1. Prof. PhD. Vu Sinh Nam
2. PhD. Tran Vu Phong

Reviewer 1: .....
.....
Reviewer 2: .....
.....
Reviewer 3: .....
.....

The thesis has been defended at Institute-level thesis evaluation council held in National Institute of Hygiene and Epidemiology.
at.. …, date ..…month ..…year 2019

This thesis may be found at:

1. Natinal Library
2. Library of National Institute of Hygiene and Epidemiology

LIST OF ANNOUNCED RESEARCH PROJECTS RELATED TO THESIS TOPIC

1. Trần Vũ Phong, **Trần Công Tú,** Trần Chí Cường, Vũ Ngọc Thúy, Nguyễn Thị Thu Hạnh, Trần Như Dương, Vũ Sinh Nam, Nguyễn Trần Hiển (2013), "Xác định các yếu tố sinh học - sinh thái - xã hội biến đổi liên quan đến du lịch và sốt xuất huyết dengue tại đảo Cát Bà, Hải Phòng", *Tạp chí Y học Dự phòng*, tập 23, số 11(147),tr. 113-119.
2. **Trần Công Tú,** Vũ Vi Quốc, Trần Vũ Phong, Trần Chí Cường, Nguyễn Thị Thu Hạnh, Đoàn Văn Doan,Trần Như Dương, Nguyễn Thị Yên, Nguyễn Trần Hiển, Vũ Sinh Nam (2017). "Xác định tác động kinh tế của dịch sốt xuất huyết dengue lên hộ gia đình và sự phát triển du lịch tại đảo Cát Bà, Việt Nam năm 2013-2014", *Tạp chí Y học Dự phòng*, tập 27, số 8-2017, tr 175-183.
3. **Trần Công Tú,** Trần Vũ Phong, Trần Chí Cường, Trần Hải Sơn, Vũ Ngọc Thúy, Nguyễn Thị Thu Hạnh, Đoàn Văn Doan, Phạm Thị Hương, Trần Như Dương, Nguyễn Trần Hiển,Vũ Sinh Nam (2018), "Đánh giá hiệu quả phòng chống sốt xuất huyết dengue dựa trên tiếp cận về sinh thái học, sinh học và xã hội học tại đảo du lịch Cát Bà, Việt Nam năm 2013-2015'', *Tạp chí Y học dự phòng*, Tập 28, Số 7-2018, tr. 79-87.

INTRODUCTION

The explosion and reappearance of infectious diseases which society are facing today are the result of the complex interactions occured in a system of connection between nature and man. Tourist destinations are global hotspots for outbreaks and the spread of infectious diseases, especially dengue dengue fever (SXHD).

Dengue dengue (SXHD) is one of the diseases that can spread very quickly through tropical and subtropical regions and is now expanding its reach to some temperate regions. The increase in dengue epidemic is related to many factors such as biology (vector transmission, agents, hosts, etc.), ecology (geography, climate, change of land use purpose ...), sociology (water practices, labor structure ...)

An ecological approach in dengue research was introduced in Asia in 2005 by initiating multinational cooperation on ecology, biology and society with the expectation of using the approach. "Eco-health" to develop and implement proactive surveillance and prevention measures for a tourism Cat Cat locality. With the reasons and necessity as stated above, the PhD student carries out the research with the objective:

1. Description of some epidemiological, biological, ecological and social characteristics of dengue fever in Cat Ba tourist area, period 2000-2013
2. Evaluating the effectiveness of interventions to apply ecological health approaches in dengue dengue prevention in Cat Ba tourist area, 2013-2015

NEW CONTRIBUTIONS FROM THE THESIS:

The study provides data on the relationship between tourism development, land use change, a number of social and climatic factors with the increase in dengue outbreak in Cat Ba Island, Cat Hai District, Haiphong city.

The study provides evidence for the effectiveness of measures to prevent malaria control using eco-health based on interdisciplinary coordination between government, health, tourism, education and collaborative networks that reduce population vector transmission and number of dengue cases in Cat Ba - Hai Phong international tourist area.

The research results are scientific and can be used as background data when replicated in tourist destinations in Vietnam as well as other areas in Southeast Asia.

THESIS OUTLINE

This thesis covers 127 pages and including: 19 tables, 16 figures, 2 pages preamle, 31 the overview pages , 22 materials and method pages, 35 outcomes pages, 26 discussion pages, 2 conclusion pages, 1 recommendation page.

Chapter 1. OVERVIEW

1.1 DENGUE STITUATION

Dengue-like outbreaks was well known more than 3 centuries ago in tropical, subtropical and temperate climates. The first outbreak described in 1635 in parts of French West India, before early 992 AD, had a similar disease of dengue infection, also reported in China. In the eighteenth, nineteenth and early twentieth centuries, outbreaks similar to dengue occurred in tropical climates and some temperate climates.

In the 2015 outbreak, there were 2,118,639 cases, mainly in South America (74.3%), with 1,076 deaths. The number of cases and deaths in Brazil is the highest in the region with 1,534,932 cases, of which 811 deaths. Countries with high mortality: Dominican Republic (89), Columbia (61), Peru (51).

In Southeast Asia, the number of cases and deaths from Dengue dengue have increased over the past 3-5 years with ongoing outbreaks areas. Dengue causes the greatest public health difficulties in Southeast Asia and can summarize some of the features of Dengue in this region as follows:

- Up to 8 in 10 countries in the region are severely affected by dengue fever (70% of countries).
- Dengue is a leading cause of hospitalizations and child deaths in these countries.
- The incidence of dengue infection in the region has increased significantly over the past 17 years; and since 1980 - here the number of dengue cases has increased nearly 5 times compared to 30 years ago.
- The range of risk of developing dengue infection is spreading in each country and there are new countries in the region with SXHD.
- In 2019, SXHD is trending to spread and become a major epidemic in some countries such as Laos, Cambodia and Thailand.

1.1.1.Dengue stituation in Vietnam

Dengue hemorrhagic fever is a local disease outbreak in Vietnam, especially in the provinces of the Mekong Delta, Central Coast and the Northern Delta. Due to geographical and climatic characteristics, in the South and Central, the disease occurs year-round, in the North and the Central Highlands the disease usually occurs from April to November. Before 1990, Dengue hemorrhagic fever cycle properties are relatively clear, with an average distance of 3-4 years. After 1990, the disease occurred continuously with increasing intensity and scale. The outbreak occurred in 1987, there were 354,000 cases and more than 1500 deaths. After the second largest epidemic in 1998, the country recorded 234920 cases and 377 deaths, the rate of infection / 100,000 population was 306 and the mortality / infection rate was 0.19%.

1.1.2.Dengue stituation in Catba district and Haiphong city

Hai Phong City, located in the Northeast of Vietnam, is one of the three growth points in the North of the country's socio-economic development strategy. The disease situation in Hai Phong is also quite complicated. From 1998 - now, the Dengue Prevention and Control Program in Hai Phong has been implemented in all districts, communes and wards; including 225/225 communes and wards. The number of infected patients decreased over the years from 1998-2008 and then tended to increase gradually from 2009-2015 [10]. Four major outbreaks occurred in Hai Phong in 2001 (285 cases), 2009 (271 cases), 2013 (321 cases) and 2017 (1001 cases). From 1999 to 2008, patients with DID were concentrated in 3 urban districts, but from 2009 to 2015, the focus of Deng was focused on Cat Hai tourism island district (of which the high proportion of patients concentrated on the island. Cat Ba tourism). Up to June 2019, there were 327 cases recorded in Hai Phong, and Cat Hai district recorded 4 new cases recorded including 1 positive.

1.2 APPLICATION SITUATION OF ACCESS TO ECOLOGICAL HEALTH IN PREVENTION OF DIFFERENTIAL DISEASES IN PRODUCTION IN THE WORLD

An interdisciplinary survey of ecological, biological and social factors associated with dengue in urban and peri-urban areas, and thereby developing community-based interventions to reduce vector source of dengue transmission. The groups conduct a detailed situation analysis to identify and describe the local socio-ecological conditions, and thereby build an interdisciplinary network for the purpose of propaganda and introduction. effective interventions appropriate to each locality in reducing vector population causing SHXD. The research results show a significant reduction in the vector density in all the study sites (2 countries in South Asia and 4 countries in Southeast Asia), and interventions in effective and effective vector source reduction. The evidence is based on local evidence-based ecology very well with the World Health Organization's strategy in integrated vector management (IVM).

In the framework of multinational research in Asia, conducted under the support of TDR and the Canadian Center for International Development Studies (IDRC), develop a strategy to contribute to the improvement of dengue prevention. It uses cross-sectoral analysis to better understand the biology, ecosystems and social factors related to SXHD, thereby developing and evaluating interdisciplinary management measures for ecosystems and communities. Co-centered towards reducing habitat.

Chapter 2. METHODS

2.1 STUDY SUBJECTS, STUDY TIME AND PLACE

2.1.1 Study subjects

Community (indigenous people and resident workers) of Cat Ba town.

Aedes aegypti and Aedes albopictus mosquito population in Cat Ba island district, Hai Phong city.

2.1.2 Study site

Catba town belong to Cathai district, Haiphong city

2.1.3 Study time

Research period of objective 1: 9 / 2012-8 / 2013

Research period of objective 2: 9/2013 – 8/2015

2.2 METHOD

2.2.1 Sample size

2.2.1.1 Sample size for object 1

Sample size for dengue vector survey

Sample size: The number of households to be surveyed for the vector in the study is calculated using the sampling formula of the descriptive study with the minimum number of household samples calculated by the formula:

$$n = \frac{z^2_{1-\alpha/k} P(1-P)}{d^2}$$

n: is the minimum sample size; Z: coefficient of confidence; P: is the proportion of households positive for larvae or mosquitoes Aedes (15%); d = 0.05 (precision desired). Applying the formula of calculating the sample size of the World Health Organization, n = 196 households are rounded to 200 households.

Model and sampling of economic effects of a dengue outbreak

Sample size: the total number of cases recorded in Cat Ba island area during the dengue outbreaks in 2013 was in line with the Ministry of Health's dengue dengue surveillance case.

How to choose a sample: The sample unit is a patient with dengue in Cat Ba town selected. Select all cases in the outbreaks of Cat Ba Island from the list of Cat Hai Medical Center

2.2.1.2 Sample size for object 2

Evaluate the dengue vector population

Sample size: The number of households to be surveyed to collect vectors in the study is calculated by the sampling formula of the descriptive study with the minimum number of households calculated by the formula:

$$n = \frac{z^2_{1-\alpha/2}[P_1(1-P_1) + P_2(1-P_2)]}{d^2}$$

Using the formula for calculating the sample size of the World Health Organization, n = 154 households were calculated. To avoid the case that the selected household was away, we added 20% of the sample (~ 185) in combination with the Ministry of Health's regulations on the number of households in the source larvae surveillance we chose n = 200 households. for an investigation. Including 100 intervention households and 100 control households for each quarterly vector survey.

Investigate changes in community knowledge, attitudes and behaviors (KAP), and community acceptance

Sample size: The sample size of the survey applied the formula to calculate the sample size for the study to estimate the two ratios used in the intervention research design.:

$$n = \frac{\left(z_{1-\alpha/2}\sqrt{2\bar{P}(1-\bar{P})} + z_{1-\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)}\right)^2}{\left(P_1 - P_2\right)^2}$$

Substituting the above values for the formula we calculate n is 216. The backup sample for cases of refusal to participate in the study or other reasons is 15%. The sample size was 260. Each household interviewed a head of household or a representative of the household. In fact, 260 people were surveyed in 200 households and 60 hotels. Of which 100 households and 30 hotels in the intervention area, 100 households and the remaining 30 hotels in the control area.

2.2.2.Analyze and process data.

All collected data is cleaned before data entry. Data entry is carried out by 2 independent computers for comparison, avoiding errors in the input process. Import using Microsoft Excel software and convert all data into Stata format.

2.2.3 Ethics in research

The project complies with the applicable guidelines and procedures of the Helsinki Declaration (Version 2008), ethical principles for biomedical research involving human organs. , international principles on animal research, and applicable laws and regulations of the Vietnamese Ministry of Health as well as the National Institute of Hygiene and Epidemiology. The content of the research was approved by the ethics committee in biomedical research of the National Institute of Hygiene and Epidemiology under Decision No. 09 IRB dated 11/06/2012.

Chapter 3. RESULT

3.1. Describe some epidemiological, biological, ecological and social characteristics of dengue disease in Cat Ba tourist area, period 2000-2013

3.1.1. Some epidemiological characteristics of DHF

Table 3.1. Distribution of patients with dengue by age, gender in Cat Ba town, 2000-2013

Age	2000-2008	2009	2010	2011	2012	2013
Ca ≤ 15 years old (1)	0	9 (8%)	3 (12%)	2 (25%)	1 (17%)	22 (11%)
Ca > 15 years old (2)	0	101 (92%)	22 (88%)	6 (75%)	5 (83%)	178 (89%)
Men (3)	0	50 (45%)	11 (44%)	3 (38%)	2 (33%)	102 (51%)
Women (4)	0	65 (55%)	14 (56%)	5 (63%)	4 (67%)	98 (49)
Total	**0**	**115**	**25**	**8**	**6**	**200**

The table 3.1 shows that the prevalence by age/general prevalence is highest in adults> 15 years of age, accounting for 75% to 92%, in the small age group (≤ 15 years old), the prevalence is small, from 8% to 25%. The difference in the prevalence by age group was statistically significant with p <0.05. For the rate of morbidity in women (accounting for 49% - 67% of the total number of cases) is greater than for men (33% - 51%), the difference in the incidence of gender is not statistically significant with p> 0.05.

3.1.2. Collect biological data

3.1.2.1. Species composition, vector indices in Cat Ba, 2012-2013

Index of mosquitoes, larvae of two species Ae. aegypti and Ae. albopictus in Cat Ba tourist island area through 2 cross-sectional surveys (N = 2) is analyzed in the following tables:

Table 3.2. Index of mosquitoes and larvae of two Ae species. aegypti and Ae. albopictus in Cat Ba in December 2012 and July 2013 (N = 2)

Index (n=200)		**12/ 2012 (Winter, Cold and dry)**		**7/2013 (Summner, Hot and rainny)**		**P**
	Loài	*Ae. albo (1)*	*Ae. ae (2)*	*Ae. albo (1)*	*Ae. ae (2)*	
Adult	HI	3,00	7,00	7,00	11,00	$P^{1,3}<0,05$; $P^{2,4}<0,05$
	DI	0,05	0,12	0,15	0,26	$P^{1,3}<0,05$; $P^{2,4}<0,05$
Larvae and pupae	CSNBG	12,00	3,00	16,00	12,00	$P^{1,3}>0,05$; $P^{2,4}<0,05$
	CSMĐBG	6,6	0,46	6,13	3,02	$P^{1,3}>0,05$; $P^{2,4}<0,05$
	BI	24,00	14,00	22,00	12,00	$P^{1,3}>0,05$; $P^{2,4}>0,05$
	Q/N	0	0	0,20	0,08	

The results in Table 3.2 show that Cat Ba island has the presence of both mosquitoes, in which the mosquito density and the index of houses have *Ae. albopictus* are all lower than *Ae aegypti* at both times of the year. In winter (cold and dry - December 2012), mosquito density (DI) Ae. aegypti (0.12 head / house) is lower than the DI of summer (hot and rainy) (0.26 head / house).

Results of the vector survey showed that there were larvae in both Cat Aedes aegypti and Aedes albopictus in Cat Ba. In winter, the density of *Aedes albopictus* larvae (6.6 individuals / house) is 14.3 times higher than that of *Aedes aegypti* (0.46 heads / house), the difference is statistically significant (p <0, 05).

3.1.3. Data on ecology

3.1.3.1. Correlation between SXHD rate with temperature, rainfall and humidity in Cat Ba by month, period 2000-2012

Table 3.3. Correlation between monthly average temperature, total monthly rainfall, monthly average humidity and incidence of Dengue, 2001-2012

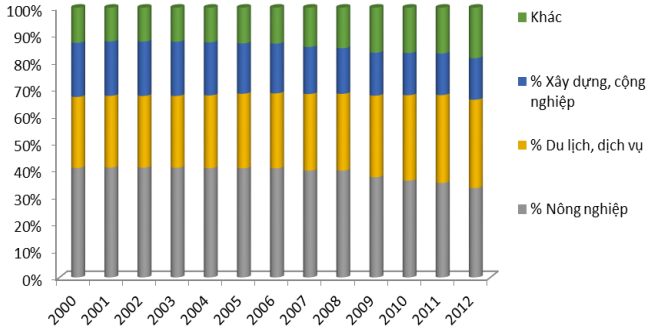
Correlation between monthly average temperature, total monthly rainfall, monthly average humidity and incidence of Dengue			**Dengue**	**Note**
Spearman	Dengue	Hệ số tương quan	1,000	
		Sig. (2-tailed)	.	
		N	144	
	temperature	Hệ số tương quan	**0,198****	
		Sig. (2-tailed)	0,012	<0.05
		N	144	
	Temperature one month before	Hệ số tương quan	**0,205****	
		Sig. (2-tailed)	0,009	<0.05
		N	144	
	Humidity	Hệ số tương quan	**0,123****	
		Sig. (2-tailed)	0,063	>0.05
		N	144	
	Rainfall	Hệ số tương quan	**0,137****	
		Sig. (2-tailed)	0,04	
		N	144	<0.05
	Reinfall one month before	Hệ số tương quan	**0,249****	
		Sig. (2-tailed)	0,001	<0.05
		N	144	
**. Correlation is significant at the 0.01 level (2-tailed)				

Analysis of the correlation between the incidence of dengue fever and temperature in Cat Ba by month in the period of 2001 to 2012 showed a positive correlation with R = 0.198, with statistical significance with p = 0.012 (<0, 05). Thus, the increase in the ambient temperature increases the SXHD (Table 3.12). In addition, when analyzing the correlation between the prevalence of dengue fever and the average temperature of the previous month in Cat Ba from 2001 to 2012, there was a positive correlation with R = 0.205, which is statistically

significant with p = 0.009 (<0.05). Last month's average rainfall was correlated with a higher rate of dengue infection with the average monthly rainfall.

3.1.4. Data on sociology

3.1.4.1.Labor structure



The data from Figure 3.1 shows a growing trend of people working in the tourism service industry. The proportion of people working in tourism services increased by 1.27 times in 2012 compared to 2000 (p <0.05). Most people working in travel services are not local, but come from other places and stay during the 6-month tourist season (April October). This is also the season for dengue fever.

3.1.4.2. Number of tourists and number of hotels, tourist facilities

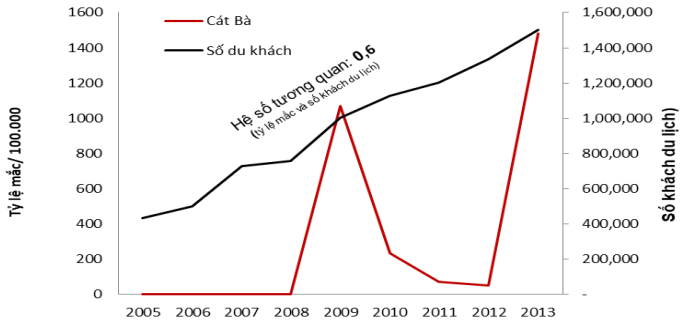


Figure 3.2. Prevalence / 10000 people of DHF in Cat Ba town and number of tourists, 2005-2013

Analysis of the correlation between the incidence of SXHD and the number of tourists in Cat Ba by month in the period 2005 to 2013 showed a positive correlation (R = 0.63, p = 0.0001).

3.2 Evaluating the effectiveness of interventions to apply ecological health approaches in dengue prevention in Cat Ba tourist area, 2013-2015

3.2.1. Prevention of dengue dengue fever

Table 3.4. Collaborator activities,9/2013 – 8/2015

Number	Activities	900 household	70 Hotel
Collaborator	Number of households (households) and hotels (KS) are inspected	19.560	1580
	The percentage of households and households is checked monthly	91,9%	94%
	The number of BG drives is detected and processed	4.679	386
Fish and Abate	Number of larva eradication campaigns	4	

	Number of times the DCCN is processed by Abate	2589	156
	Number of times the containers were released fish	1296	142
Community activities	Number of people propagandized (as of August 2015)	25.894	
	Number of tourists being propagated	17853	
	Number of propaganda pictures	1500	
	Number of leaflets propaganda	2000	
	Number of hotels with certificates of Eco Ecology Hotel	70	

3.2.2. Evaluate the vector index of dengue virus transmission

3.2.2.1. Density vector SXHD before and after the intervention

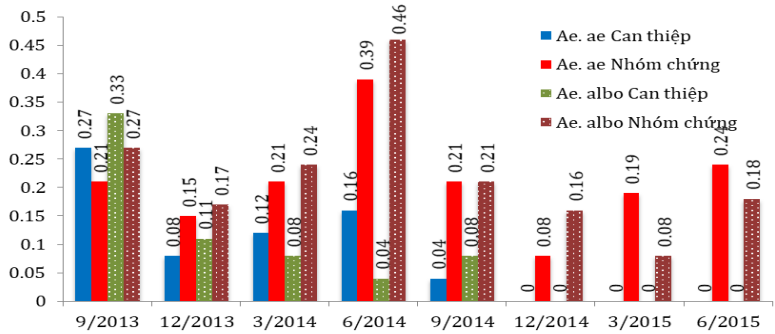


Figure 3.3. Mosquito density Ae. Aegypti and Ae. Hotel area albopictus, before and after the intervention

Mosquito density Ae. aegypti follow up quarterly at the intervention area of the hotel area are lower than the control point, and lower than the baseline in September 2013 ($p < 0.05$). Mosquito density Ae. aegypti after intervention (0 heads / house) decreased by 100% compared to before intervention (0.27 heads / house) ($p < 0.05$). Mosquito density Ae. albopictus follow up quarterly at the

intervention area of the hotel are lower than the control point, and lower than the baseline in September 2013 (p <0.05). Mosquito density Ae. albopictus after intervention (0 heads / house) decreased by 100% compared to before intervention (0.33 heads / house) (p <0.05).

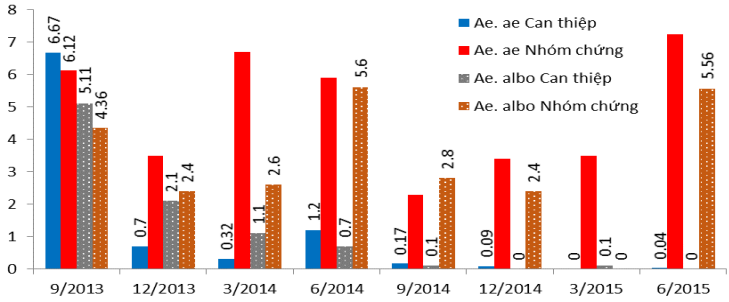


Figure 3.4. Density of Ae larvae. aegypti and Ae. Hotel area albopictus, before and after the intervention

Density of Ae larvae. aegypti follow up quarterly at the intervention area of the hotel area are lower than the control point, and lower than the baseline in September 2013 (p <0.05). Density of Ae larvae. aegypti after intervention (0.04 heads / house) decreased by 99.4% compared to before intervention (6.67 heads / house) (p <0.05). Density of Ae larvae. albopictus is lower than the control point, and lower than the baseline in September 2013 (p <0.05). The density of larvae after intervention (0.00 children / house) decreased by 100% compared to before the intervention (5.11 heads / house) (p <0.05)

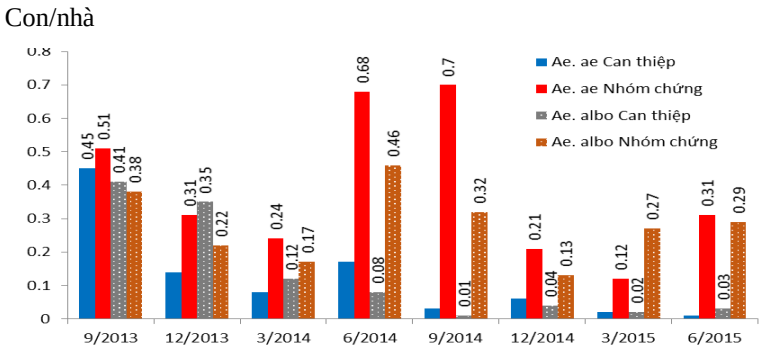


Figure 3.5. Mosquito density Ae. aegypti and Ae. Residential area albopictus, before and after intervention

Mosquito density Ae. aegypti follow-up quarterly at the intervention area in the residential area were lower than the control point, and lower than the baseline in September 2013 ($p < 0.05$). Mosquito density Ae. aegypti after intervention (0.01 children / house) decreased by 97.8% compared to before intervention (0.45 heads / house) ($p < 0.05$). Mosquito density Ae. albopictus is mostly lower than the control point, and lower than the baseline in September 2013 ($p < 0.05$). Particularly for 2 surveys in December 2013 and March 2014, the difference was not significant ($p > 0.05$). Mosquito density Ae. albopictus after intervention (0.03 head / house) decreased by 93.7% compared to before intervention (0.41 heads / house) ($p < 0.05$).

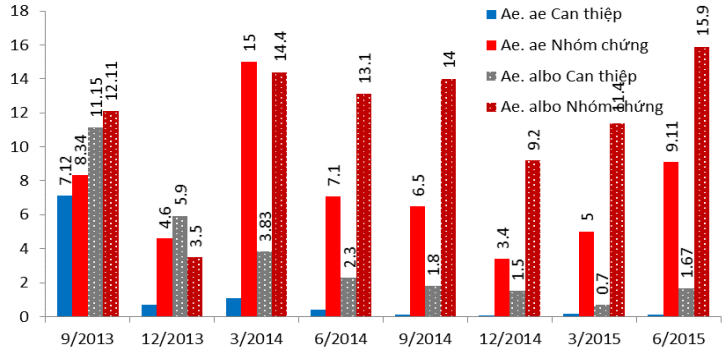


Figure 3.6. Density of Ae larvae. aegypti and Ae. Residential area albopictus before and after the intervention

Density of Ae larvae. aegypti follow-up quarterly at the intervention area in the residential area were lower than the control point, and lower than the baseline in September 2013 ($p < 0.05$). The density of larvae after intervention (0.01 animals / house) decreased by 98.8% compared to before the intervention (7.12 heads / house) ($p < 0.05$). Density of Ae larvae. albopictus is lower than the control point, and lower than the baseline in September 2013 ($p < 0.05$). The density of larvae after intervention (1.67 head / house) decreased by 85% compared to before the intervention (11.15 heads / house) ($p < 0.05$).

3.2.2.2. Key breeding sites before and after intervention

Results of changing Key breeding sites before and after the intervention are shown in Figure 3.7

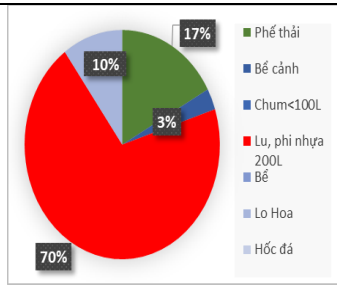
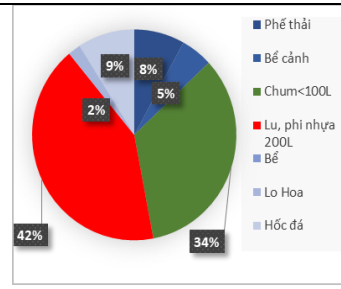
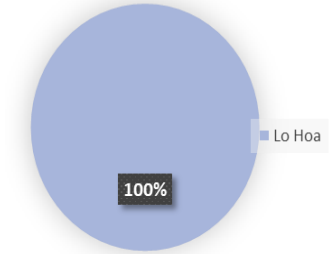
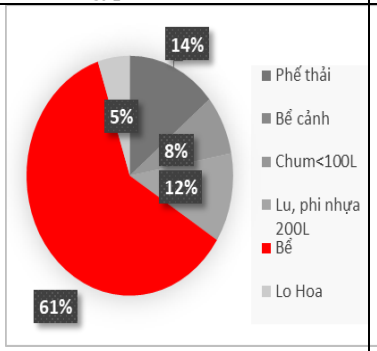
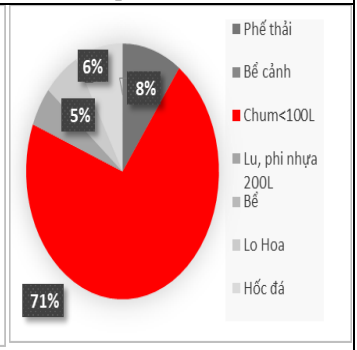
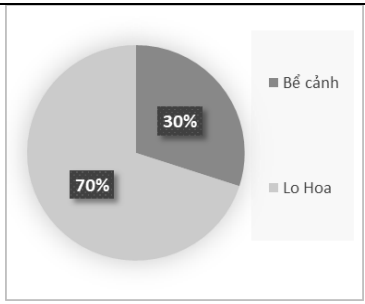
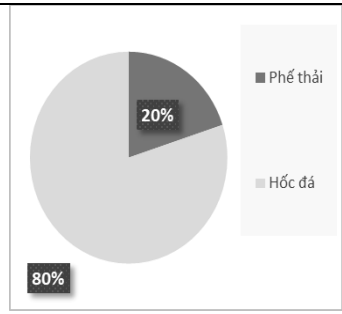
	Aedes aegypti	*Aedes albopictus*
9/2013 Before intervention	 MĐBG: 6,67 larva/house	 MĐBG: 5,11 larva/house
6/2015 after intervention	 MĐBG: 0,04 larva/house	MĐBG: 0 larva/house

Figure 3.7. *Ae. Albopictus and Aedes aegypti* key breeding sites in hotel area before and after the intervention

In the hotel area, the Ae. aegypti key breeding sites were identified as jar 200L plastic drums and discard; the *Ae. Albopictus* key breeding sites were identified Jar 200L, plastic drums and jar <100L. After 2 years of intervention, the number of larvae of both species decreased significantly (Ae. Aegypti: 0.04 larvae/house, Ae. Albopictus: 0 larvae / house), the Ae. aegypti key breeding

sites were identified only in vases, can not collect larvae of Ae. albopictus in the intervention area (Figure 3.7)

	Aedes aegypti	*Aedes albopictus*
9/2013 Before intervention	 MĐBG: 11,15 larva/house	 MĐBG: 7,12 larva/house
6/2015 after intervention	 MĐBG: 0,09 larva/house	 MĐBG: 1,67 larva/house

Hình 3.8. *Ae. Albopictus and Aedes aegypti* key breeding sites in local resident area before and after the intervention

In the local household area, the Ae. aegypti key breeding sites were identified as Tank, jar 200L, plastic drums and discard; the *Ae. Albopictus* key breeding sites were identified jar <100L. After 2 years of intervention, the number of larvae of both species decreased significantly (*Ae. Aegypti*: 0.09 larvae/house, *Ae. Albopictus:* 1,67 larvae / house), the *Ae. aegypti* key breeding sites

were identified only in vases and aquarium; the *Ae. aegypti* key breeding sites were identified only in rock holds and discards.

3.2.3. Evaluate KAP for prevention of malaria infection

Table 3.5. Practicing prevention and control of vectors after intervention

Practicing right	Before intervention (n=260)		After intervention (n=260)		CSHQ (P)	HQCT (%)
	ĐC (n=130) %	CT (n=130) %	ĐC (n=130) %	CT (n=130) %		
Spraying	29,20	37,00	31,00	56,30	34,3 (p<0,05)	28,47
Collection and destruction of waste tools	42,00	50,00	46,90	59,30	15,7 (p<0,05)	5,24
Wash your tank regularly	27,00	19,00	26,30	31,00	38,7 (p<0,05)	41,37
Release fish, Abate into containers	20,00	18,00	23,40	68,20	73,6 (p<0,05)	59,08

P: compare before-after; CSHQ; efficiency index; HQCT: intervention effectiveness

At the point of intervention, the rate of practice of Dengue vector prevention measures of people and hotels increased compared to before the intervention ($p < 0.05$) and intervention effectiveness from 5.24 % to 59.08%. Especially, the rate of practice using fish and Abate to kill larvae in the intervention area is 73.6% and the intervention effect is 59.08%. Practicing the use of chemicals to kill mosquitoes, the measures to prevent mosquitoes, kill larvae are higher than the control area ($p < 0.05$) (table 3.5).

3.2.4 Monitoring of dengue cases

Proportion of SXHD / 100,000 people before and after the intervention

Table 3.6. Comparing the proportion of patients with DF before and after the intervention

Site		Before (Case/100.000)	After (Case/100.000)	CSHQ P	HQCT
Intervention	Number	1378,5	112.5	91,8	6,42
	Ratio (%)	1,38	0,11	p <0,05	
Cotrol	Amount	1435,3	25	98,3	
	Ratio (%)	1,44	0,03	p <0,05	

Chapter 4. DISCUSSION

4.1. Describe some epidemiological, biological, ecological and social characteristics of dengue fever in Cat Ba tourist area, period 2000-2013

4.1.1 Epidemiological characteristics of dengue infection in Cat Ba town

Research results in Cat Hai district (including 1 small island Cat Hai and big Cat Ba island) show that SXHD before 2009 was very small and focused mainly on Cat Hai island. The first major dengue epidemic was reported in 2009 with 427ca cases / 100000 people. SXHD is recorded at all ages, the highest in the older age group (> 15 years) accounts for 75-92% of cases, the lowest in the under-15 age group accounts for a small rate of 8% to 25%.

4.1.2. Một số đặc điểm sinh học tại khu du lịch Cát Bà trong mối liên quan đến SXHD

Nghiên cứu này đã cho thấy sự có mặt của cả hai loài muỗi *Ae. aegypti* và *Ae. albopictus* tại đảo du lịch Cát Bà đặc biệt là tại khu vực Thị trấn Cát Bà, tuy nhiên phân bố của chúng không tương đồng tại các điểm dân cư địa phương và khách sạn. Giống như một số nghiên cứu xác định phân bố muỗi *Aedes* truyền bệnh SXHD tại các tỉnh thuộc khu vực Miền Bắc, loài muỗi *Ae. aegypti* thường ưa trú đậu trong nhà và sinh sản tại các dụng cụ

chứa nước (DCCN) nhân tạo (lọ hoa, bể nước, chum vại, chậu cây cảnh...) gần gũi với con người vì thế thường có mặt tại các khu vực có mật độ đô thị cao còn muỗi *Ae. albopictus* lại trú đậu ngoài nhà và sinh sản trong các DCCN nhân tạo (hốc cây, phế thải, hốc đá đọng nước..) vì thế thường có mặt tại khu vực có diện tích ngoài nhà rộng: vườn tược, rừng cây, khu ngoại cảnh của của khách sạn lớn, khu nghỉ dưỡng.

4.1.2. Some biological characteristics in Cat Ba tourist area related to Dengue

This study has shown the presence of both Ae mosquitoes. aegypti and Ae. albopictus on the tourist island of Cat Ba, especially in the area of Cat Ba town, however their distribution is not similar between local population and hotels areas. Like a number of studies determining Aedes mosquito distribution of dengue infection in Northern provinces, Ae. aegypti mosquito often prefer to stay in the house and breed in artificial water containers (vases, water tanks, jars, pots ...) close to humans so often present in the areas with high urban density and Ae. albopictus mosquitoes resides outside the house and breeds in artificial IPs (tree holes, wastes, stagnant water holes, etc.), so it is often present in areas with large outside areas: gardens, forests areas, exterior of large hotels and resorts

4.1.3. Some ecological and household characteristics in Cat Ba tourist area in relation to biodiversity

Research results show that climatic factors (temperature, humidity and precipitation) and number of cases of dengue fever are strongly correlated ($p < 0.05$). In particular, descriptive analysis shows that the dengue epidemic in Hanoi and the Northern region occurs annually and seasonally with an increasing trend over time. The annual low number of dengue cases occurs from December to March, then increases from April to July with the highest levels in September and October.

Temperature has a positive effect on the vector index. like MAC and BI. When the temperature starts to rise from April, May is the time to start increasing gradually of the DM and BI index, the temperature continues to remain high until October (average monthly temperature is from 25- 30.30C)

4.1.4 Dengue fever, social factors and tourism development

Our research shows that social factors such as water storage characteristics, labor structure changes during infrastructure development in response to the rapid increase of tourists. correlation in the increased risk of dengue fever of local communities, temporary seasonal labor as well as tourists moving from the epidemic area to Cat Ba ($p < 0.05$). In fact, the approach based on multi-sectoral cooperation and data collected to assess high-risk areas has brought about certain effectiveness, especially in 2017 when many provinces in the region In the northern region, outbreaks of dengue fever did not occur in Cat Ba outbreak as large as 2013.

4.2. Assess the effectiveness of intervention

4.2.1. Assessing interventions to prevent Dengue

In this study, two different CTV systems were established. In residential areas, we have set up a system of collaborators based on the same principles and criteria as the community-based model for preventing and controlling malaria. In the hotel area, a system of 70 CTVs was formed in 70 hotels. The hotel collaborators do not visit households and other hotels but only operate, manage mosquito and larvae-killing activities as well as supervise cases of tourist dengue, hotel staff, then report Report to the steering committee monthly. This collaborator system is not paid a monthly fee like a residential CTV, but their hotel is awarded the certificate of Eco Health Hotel. Enhance multi-disciplinary coordination especially in the integrated communication activities. associated with local tourism events, especially before the DHF season and also at the beginning of

the tourist season such as the opening season of the tourist season, the Green Tourism Campaign, the Children's Festival of Cat Ba Island. .

4.2.2. Evaluate the effectiveness of dengue vector control

Results showed that the vector transmission index (mosquito density index, larvae density indicator) in the two intervention areas, residential area and hotel area, decreased compared to before the intervention ($p < 0.05$), while in the control area, differences in vector populations were not statistically significant. In the local population area, after intervention, the mosquito population decreased by 97.8% for Ae. Aegypti and 93.7% for Ae. Albopictus, larvae population decreased 98.8% for Ae. Aegypti and 85% for Ae. Albopictus.

Regarding the source larvae nest in Cat Ba, the results showed that there is a difference in the source larvae nest of Ae. Aegypti between hotel and residential area.

4.2.3. Knowledge, attitude and practice of Dengue prevention

Assessing the attitude of people in the prevention and control of dengue fever shows that, after the intervention, the attitude of agreeing to use the methods of prevention and elimination of larvae increased compared to before the intervention, with statistical significance ($p < 0.05$). The rate of agreeing to use Abate releasing method, releasing fish into DCCN increased from 19.5% to 61.3%, effective intervention was 57.39%. General assessment of the dengue dengue vector prevention practice of the people, the results show that the dengue dengue vector control practice of the people after the intervention increased higher than before the intervention. The analysis was statistically significant ($p < 0.05$), with intervention effect from 5.24 to 59.08.

CONCLUTIONS

1. Describe some epidemiological, biological, ecological and social characteristics of dengue fever in Cat Ba tourist area, period 2000-2013

In Cat Ba town, Cat Hai city, Hai Phong city in the period of 2000-2013, there were two cases of dengue infection with the highest rate of infection / 100,000 among districts of Hai Phong city (incidence rate / 100,000 people respectively is 427ca / 100000 people and 1803ca / 100000 people) with some main epidemiological characteristics as follows:

- Patients with dengue are recognized mainly from August to November every year, adults (> 15 years old) with Dengue fever account for the majority (75-92%), 65% of cases are local people, the remaining are seasonal workers from other places.
- Dengue dengue fever has affected the health and economy of households in Cat Ba island, Cat Hai district. The average cost for a case of dengue fever in a household was 10,726,036 VND.

Tourism development in Cat Ba, Cat Hai, Hai Phong city (including shifting land use purpose, career restructuring, increasing tourist facilities and services, number of tourists , temperature, rainfall conditions) have increased the risk of SXHD in Cat Ba, Cat Hai, Hai Phong City:

- The number of tourists in 2012 increased by 4.1 times, the number of tourist establishments increased by 1.65 times compared to 2005. The high correlation between the number of tourists ($R = 0.63$, $p < 0.05$)), the total number of tourist establishments ($R = 0.21$, $p < 0.05$) with the number of cases of dengue infection by month in Cat Ba.

- There is a low correlation between the average temperature factor (R = 0.20) and the average rainfall last month (R = 0.24) with the number of monthly dengue cases in Cat Ba (p <0.05)
- The presence of both AHD aedes aegypti and Aedes albopictus vectors with high density in residential and hotel areas (*Ae. aegypti* from 1.3 to 4.56 larvae/house, *Ae. albopictus* from 5.6 to 6.91 larvae/hou)

2. Evaluating the effectiveness of interventions to apply ecological health approaches in dengue dengue prevention in Cat Ba tourist area, 2013-2015

The ecological health method through multi-sectoral and community-based coordination is highly effective in proactively preventing and controlling SXHD in Cat Ba, Cat Hai and Hai Phong:

- Compared with before intervention, mosquito density Ae. aegypti decreased by 97.8% to 100%, larvae density decreased by 99.4% to 98.8% in residential areas and hotel areas. Mosquito density Ae. albopictus decreased by 93.7% to 100%, larvae density decreased from 85% to 100% in residential areas and hotel areas.
- Knowledge, attitude and behavior of people increased compared to before the intervention (p <0.05). The effectiveness of intervention increased from 9.6% to 59.08%. The control scores have increased but not significantly (p> 0.05).
- No recognition of patients with DF after 2 years of application of prevention methods in the intervention area.
- The method of preventing community-based SXHD, applying ecological health is accepted by the people and responded by the authorities..

RECOMMENDATIONS

The application of multi-sectoral and multi-disciplinary ecological health approaches at the hotel facilities is a good way to prevent dengue infection, so this application should be further studied and applied in Other tourism in Vietnam.

Further in-depth studies on assessing the risk of dengue infection need to be conducted based on factors related to the characteristics of each geographical region, from which the epidemic risk forecast and the application of ecological health approaches in prevention and control can be forecasted.