TODDLER'S IMMUNITY AGAINST DENGUE HEMORRAGHIC FEVER BASED ON SEX AND AGE: THE ROLE OF ENVIRONMENT AND FAMILY'S HABITUAL VARIABLES

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ABSTRACT: Normally, a rural region in the developing countries, which is undergoing transformation process from agricultural economy to industrial economy, is followed by environmental degradation such as deforestation, deterioration of air quality and micro-climate. Besides, it is also acompanied by the change in family behavior in relation to their adaptaion which also leads to the prevalence of various diseases including Dengue Hemorrhagic Fever (DHF). These phenomena are being experienced by many villages in South Lampung Regency especially in the suburban area of the capital city, Bandar Lampung. This research aims to investigate the influence of environmental factors, sex, the age of toddlers and the family's habit on toddlers' immunity against DHF. The research was conducted from July to October 2016 in South Lampung Regency especially in the 7 districts with a relatively high number of DHF cases on toddlers namely Natar Agung Jati, Bakauheni, Ketapang, Tanjung Sari, Sidomulyo, and Katibung. The data analysis was conducted at the Forest Resource Inventory Laboratory, Faculty of Agriculture, The University of Lampung, Indonesia. The macro environmental variables investigated are the level of regional urbanism, the amplitude (maximum-minimum) of air temperature [TEMP_AM], average rainfall [RAIN], forest and agroforestry acreage [RTH_AGRF] as well as fishpond and other water bodies such as dyke, pond, retention basin and the like [RTH_POND]. The [RTH_AGRF] and [RTH_POND] data are provided through the record of Landsat satellite image interpretation that recorded on June 21, 2016, on *path123/row 064* segment followed by field validation. The climate data are obtained from the Board of Climatology, Meteorology and Geophysics of Lampung especially from Branti, Panjang and Bakauheni Stations. Case data on toddlers who have been medical tested as positive for DHF on the basis of laboratory tests for the period of January 2015 to June 2016 were obtained from Health Department of South Lampung. Each case was surveyed to conduct observation on the family's habit. The same observation was also conducted on 1 –3 families with uninfected (immune) toddlers who lived around the case location. To test the hypothesis, the log-linear model postulate is used, whose the resistant toddlers are scored by *Y=1* and the affected ones are scored by Y=*0*. Optimization of 15 model parameters was done with Minitab 17 software at 15% of the real level. The conclusions of the variables that significantly influence are air temperature amplitude (every increase of 1^0C the resistance decreased to 1/1000); the area of green open space (each 1,000 ha reforestation, the resistance increased 25.05 times); the area of fishponds and ponds (every increase of 1,000 ha, the resistance increased 24.03 times), toddlers' sex (male is 2.21 times more resistant than female); inner family's habits: (a) using mosquitoes repellent, (b) cultivating fish, and (c) not hanging clothes where the toddlers of those who have mentioned habits are more resitant consecutively 11:48; 2.95; and 10.62 times than those who do not do the habits. It is suggested that to conduct research in other regencies as well as integrate the nutritional status and another disease history before the toddlers are affected by dengue hemorrhagic fever (DHF).

Keywords: DHF, toddler, environmental factors, age, sex and family habit

1. INTRODUCTION

As it can be examined in the data of Central Bureau of Statistics (2017) that the pattern of the economy of South Lampung Regency is nowadays beginning to experience a transition from the pattern that relies on the utilization of natural resources and agriculture into the processing industry economy. This phenomenon is indicated by community revenues that have exceeded 25% from industry sectors and services (Bakri et al, 2014). In such a process of the transition, environmental problems are experiencing rapid escalation. Critical deforestation is the first consequence for the need of land provision and of initial capital for more intensive economic activities such as for the development of plantation, agriculture, terrestrial fisheries, residential, and other utilization (Bakri et al 2014 and 2017). The continuing impacts of deforestation are the escalation of erosion, floods in the rainy season, drought in the dry season (Bakri et al., 2014). It will also be followed by industry sector activities that cause contamination in land and water pollutions (such as fertilizer residues, pesticides and solid and liquid waste from various industries) and into the air polution such as CO, CO_2, SO_2, NO, NO_2, CF_4 etc. This trigger air temperature amplitude turmoil, contribute climate change, reduced buffering capacity of waste assimilation, the leads to decrease ecological equillibrium, reduce adaptibility or even loss of certain species and the emergence of new mutant dominance, including causal species or vector diseases such as tuberculosis, pneumonia, malaria and dengue fever. Considering that each region is a unity of ecosystem, that shocking phenomenon to the ecological equilibrium of the region (McMechael, 2000 and Nurhaida et al, 2009) becomes a public domain which the negative impacts cannot be borne individually but together.

With regard to those conditions, Hardin (1968), Ostrom (2003) and Crowe (2003) stated environment as public goods which are always experiencing tragedy which is called by those scholar as public goods tragedy that well known as the tragedy of the common. This term refers to the situation where everyone will not voluntarily refrain their behavior in order to avoid exploitation of open access natural resources that releasing negative impacts (such as waste or contaminants) into their surrounding environment. That reluctancy occurs because they are not sure that the others will behave the same. According to Rustiadi et al (2011), the identifier as well as issues which always happen on every public goods or resource (*CPR: Common Pool Resources*) which the benefits or the negative effects cannot be distributed exclusively to everyone.

The negative effects of resource exploitation as expressed by McMechael (2000) and Nurhaida et al (2009) are examined from the behavior of rent seekers who are very exploitative on common pool resource. Those rent seekers are never subjected to adequately pay for any damage to environment occurred as environmental impact. The impacts are also followed by the ecological shock to the environment as described by Putra et al (2015), Wigaty et al (2015) and Rosari et all (2016) then triggers the new mutants. In addition, there are also many individuals in the community who experience a decrease of adaptation potency to environmental deterioratiom. The results are in the form of endemic plague and various new diseases such as avian and swine influenza and other zoonotic diseases (Candra et al, 2016; Adyaksa et al, 2017). The diseases plague caused by the tragedy towards environment also can be found in Lampung Province which has experienced the deforestation since 1905 and culminated when the decentralization of governance (see Bakri et al, 2014 and 2017), which some of them are reported by: Adyaksa et al (2017) for pneumonia; Putra et al (2015) and Igaty (2015) as well as Suwandi et al (2014) for malaria; Rosari et al (2017) for pulmonary tubercolusis; Tamza (2015) and Mustika et al (2016) for dengue hemorraghic fever (DHF).

All escalation or the epidemic of various diseases is a phenomenon which describes the tragedy of a CPR, which in Lampung Province is triggered by the critical ecological degradation of forest area (Bakri et al, 2014 and 2017). This phenomenon is known as a common problem in a region or public domain. Fundamentally, solution control is not only sufficient through curative practice that focuses on the patient, but also it needs to be accompanied by the restoration of environmental equilibrium performance of the ecological area of human dwelling. The increase of the area of public space like green open space in a suburban area (such as community forest, agroforestry, or village forest) can restore that equilibrium performance which finally suppress the incident of diseases as reported by Wigaty (2015), Rosari et al (2017) and Mustika et al (2016). Moreover, behavior coaching or building households to suppress the growth and the growth of germs or vectors of disease is also a strategic public policy intervention about home sanitation that includes recycling used goods, using mosquito repellent, draining water tank, maintaining sewerages, and keeping fish in the pond.

All this time, not many researchers have published their works about the huge contribution of the environmental factors (including land cover and meteorological as well as socioeconomic determinats transformation rural to urban community accompanied by the changing family behavior that commonly provides and ecological stimulation for *Aedes* mosquito growth (see Salam et al, 2017). Many factors have contributed to the spread of the mosquito vector and the disease, among others, via the urbanization process, which has left regions of the world without sufficient running water, septic tank systems or inefficient waste management (Weaver and Reisen, 2010). So do the effects of those factors to toddlers' immunity against DHF based on age or sex distributions are not yet much reavel well. The result of this research, at least, can be applied to solve the classical problem in conveying public budget in people house of representative that very rare based on the locally scientific researchs about targeting of reducing DHF cases. In other word that can be used as a scientific basis for specific public policy formulation in the area that needs justification of its performance targets before the plan of the public funds use is approved by the budgeting committee of The People's Representative Council or Regional People's Representative Council.

Setting out from these reason we conducted on this reserach aimed at determining the contribution of environmental factors (level of regional urbanism, amplitude of air temperature, rainfall) and family habit factors (recycling used goods, using mosquito repellent, draining the water tank, maintaining the water channel, and keeping the fish in the pond) on the immunity of toddlers towards Dengue Hemorraghic Fever (DHF) according to age and sex of toddler live in South Lampung Regency.

2. RESEARCH METHOD

The research was conducted on starting from July to October 2016 consisting of fieldwork and laboratory analysis. The field study was conducted in 7 districts in South Lampung Regency where many cases of toddlers, who are infected by Dengue Hemorraghic Fever (DHF) recorded from January 2015 to August 2016 namely Natar, Jati Agung, Bakauheni, Ketapang, Tanjung Sari, Sidomulyo and Katibung Districts. Data analysis was conducted at Forest Resource Inventory Laboratory, Faculty of Agriculture, University of Lampung. Materials used were HVS paper, A0 paper, stationery, ink, and satellite imagery. The tools used are laptops, printers, plotter, compass, clinometer, GPS, camera, ArcGIS software, and Minitab.

Basically, this research can be divided into 4 steps: preparation, field survey, data analysis, and hypothesis testing. The steps of this research are presented diagrammatically in Figure 1.

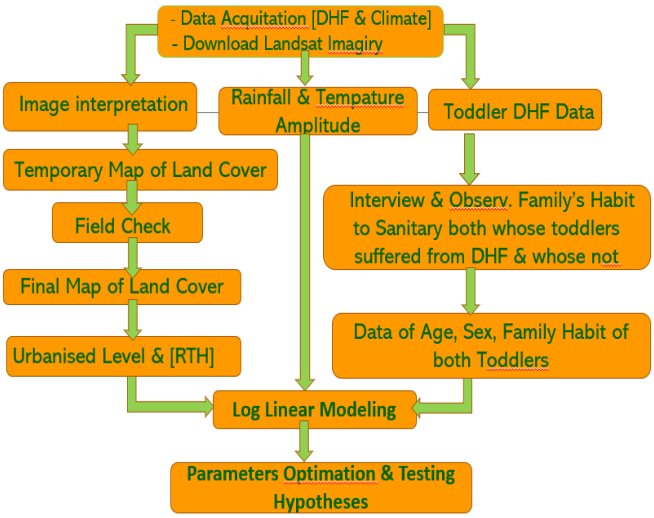

Figure 1. The research steps

At the preparation step, it is done simultaneously in the form of collecting the secondary data to Health Department of South Lampung Regency, BMKG (Board of Meteorological, Climatological and Geophysical Affairs) of Branti and Masgar Offices. Conducting the acquisition (*download*) the Landsat ETM+7 satellite imagery. From Health Department of South Lampung Regency, it can be noted that there were 42 toddlers who were positively affected by DHF (according to laboratory test result) for the period of time between January 2015 and June 2016 followed by toddlers' age and sex as well as their address. From BMKG Branti and Masgar Climatology Office, the climate data especially the maximum to minimum temperature [TEMP_AM] and monthly rainfall average [RAIN] for the same period were found.

Landsat ETM+7 satellite imagery is downloaded on the middle of June 2016 from the National Aeronautics and Space Agency of United States, NASA website namely www.earthexplorer.usgs.gov which is recorded on September 23, 2015, dan June 21, 2016, on *path123/row 064* segment which covers South Lampung Regency. Both recording dates are selected in order to conduct cross-correction to be able to improve the image quality through cloud coverage elimination. Both recording dates are selected because of the cloud cover which is relatively thin which is around 3% and 9% from all *path123/row064*. Therefore, the correction of image quality was excellent and relatively easy to conduct interpretation. The assumption is that between the period of September 23, 2015, and Juni 21, 2016, there was no significant change of land use. Satellite imagery in this research was used to map the land use. The interpretation was conducted using ArcGIS software by applying guided classification system. The land cover classification which is used follows SNI (Indonesian National Standard)

7645_2010 which includes: (*i*) permanent land cover, (*ii*) temporarily land cover, (*iii*) urban land, and (iv) bare land. Urban land cover in the form of forest (forested area), plantation and agroforestry were classified as permanently land cover or green open space [RTH_AGRF]. Moreover, the land use in other rural areas in the form of pond, fishpond, and retention basin are cathegorized as pond green open space [RTH_POND]. This image interpretation result was presented as Temporary Land Cover Map (TLCM) which is then conducted field checking for validation towards the result of interpretation in field survey activity.

At field survey step, two simultaneous activities were performed: (*i*) checking the appearance of all existing polygon sample in Temporary Land Cover Map (TLCM) and, (*ii*) interview followed by observation to every family with DHF affected toddlers in the period of January 2015 to August 2016 plus 1 to 3 family whose children were not infected lived within 100 m radius for that period of time. Thus, 114 respondents in total were collected. The data to be collected from the respondent is a healthy living behavior of the family including habitual variables or family habits include: (i) hanging clothes in rooms [HUNG], (ii) recycling used goods [RYCL], (iii) using mosquito repellent [REPT], (iv) draining the bathtub [BATH], cleaning and maintaining the sewerage around their houses [SWRG], draining water reservoir and bathtub [POOL] and cultivating fish in their pond [FISH]. The third step in this research is modelling followed by hypothesis testing. The model postulate applied is logit regression model or binary probability regression as expressed below:

$$Ln\ [P(x=1)/P(=1-x)] = \beta_0 + \beta_1[URBAN]_i + \beta_2[RAIN]_i + \beta_3[TEMP\_AM]_i + \beta_4[RTH\_AGRF]_i$$

$$+\beta_5[RTH\_POND]_i + \beta_6[SEX]_i + \beta_7[AGE]_i + \beta_8[BATH]_i$$

$$+ \beta_9[POOL]_i + \beta_{10}[RECYL]_i + \beta_{11}[REPT]_i + \beta_{12}[SWRG]_i + \beta_{13}[FISH]_i$$

$$+ \beta_{14}[HUNG]_i + \varepsilon_i$$

While β_0 to β_{14} were the model parameters and ε_i is the error of the model, then the symbols in the model for the independent variables, how to give the scores or units together with how to obtain or acquire the data are presented in Table 1. As for independent variables, $[Y]_i = 1$ for toddlers who are not affected by DHF and $[Y]_i = 0$ for the affected toddlers. For the parameter optimization, it used Minitab 17. The hypothesis test used Gald Test on 15% of the real level.

Table 1. The independent variable, symbol used in model, scoring, unit and the procedure of preparation

Independent Variables	Symbol in Model	Scoring or Unit	Procedure of preparation
A. *Group of external environmental variables*			
1. Urbanised level of district	[URBAN]	=1 if *urbanised*	Counting
2. Monthly rainfall	[RAIN]	Cm	Collecting data from BMKG*, arithmetic counting
3. Monthly Amplitude of air temperature	[TEMP_AM]	^0C	

	4. Acreage of forest & Agroforestry	[RTH_AGRF]	1,000 ha	Landsat imagary interpretation, field check, then counting the acreage of forested, agroforest, bare land, & pond for each district
	5. Acreage of fish pond	[RTH_POND]	1,000 ha	
B.	*<u>Group of internal variable</u>*			
	1. Sex 2. Age	[SEX] [AGE]	1=if *male* Month	Interview during field survey
C.	*<u>Group of Family's habit variables</u>*			
	1. Draining bath tube	[BATH]	=*1* if *Yes*, =*0* if *the other*	Interview and observation during field survey
	2. Covering and draining water tank	[POOL]		
	3. Recycling used goods	[RECY]		
	4. Wearing mosquito nets as repellent	[REPT]		
	5. Maintaining sewerage channals	[SWRG]		
	6. Cultivating fish in pond	[FISH]		
	7. Hanging clothes in bedroom	[HUNG]	=1 if *No*, =*0* if *Yes*	

Note: *BMKG of Lampung Province: Board of Meteorological, Climatological and Geophysical Affairs

3. RESULT AND DISCUSSION

The Toddler's External Environmental Characteristics of Research Area

Descriptive statistics can be use d to provide an overview of data behavior that includes upper limit, lower limit, and centered size as well as range size of the entire sample data. Therefore, the data of this research result need to be described according to the characteristics of the environment as the variable that greatly influences the life cycle of *Aedes aegepty* mosquito as the vector of dengue virus carriers as well as the various physiological processes of toddlers theirselve who will also affect the immunity of toddlers when infected by dengue virus. The probabilty of DFH virus infection incidency is much depend upon distribution of the *Aede* mosquito. As for the distribution limits and vector capacities are greatly influenced by the biological and ecological requirements of the mosquito vectors. Accordingly, their requirements are related to an integrated complex system constituted of climate, land use-land cover (LULC), topograpic area, and socioeconomic variables (Godsey et al, 2005 and DeGroote et al, 2007). The extaernal environmental characteristics which are studied in this research include the level of district urbanism [URBAN], monthly rainfall average [RAIN], the difference of maximum and minimum air temperature [TEMP_AM], green open space performance either in the form of forest or agroforestry [RTH_AGRF] as well as open space which is used as fishpond [RTH_POND]. The descriptive statistics of environmental variables for 7 districts of this study area are presented in Table 2.

Table 2. The urbanised level of district region and the climate in 2015

No.ط)	District of	Urbanised Level٩)	Monthly rainfall [mm]	Air Temperature [OC]		
				Maximum [a]	Mimimum [b]	Amplitude [= a - b]
01.00	Natar	urban	153.00.00	34.07.00	22.00	12.07
02.00	Tanjungsari	urban	153.00.00	34.07.00	22.00	12.07
03.00	Jati Agung	rural	153.00.00	34.07.00	22.00	12.07
04.00	Katibung	rural	148.01.00	35.03.00	22.05	12.08
05.00	Sidomulyo	rural	148.01.00	35.03.00	22.05	12.08
06.00	Ketapang	rural	137.03.00	35.04.00	22.06	12.08
07.00	Bakauheni	urban	137.03.00	35.04.00	22.06	12.08
		Average*=	146.01.00	34.71	22.04	0,547222222
		Sd*=	08.18	00.56	00.03	0.53

Source: BMKG (2016, unpublished);

Note: ط) No.1-3=Branti Station; 4-5= Panjang Station; 6-7=Bakauheni Station

*based on the 3 stations

٩) based on the type of general community's earning (agriculture=rural; industry=urban)

The second important variables were the climatic elements in relation to dengue virus epidemiology and *Aedes aegepty* mosquito vector as well as the internal physiology of toddlers is air temperature. In this research, the maximum and minimum monthly air temperature, as well as the difference or the amplitude, are recommended [TMP_AM]. In this research, the amplitude (or maximum fluctuation) between the maximum and minimum temperature is examined as a better measurement than the maximum or minimum temperature as the trigger of ecological shock. With the greater amplitude, it means that there is a great fluctuation in air temperature that maybe become more favorable for *Aedes aegepty* mosquitos population to grow abundantly or even vice versa. The large amplitude also forces the physiological adaptation of toddlers which may be able to decrease toddlers' immunity if they are stung by *Aedes aegepty* and infected by virus dengue. As it can be examined in Table 2, the value of [TMP_AM] in 2015 was quite big, which was 12.68 [Sd=0.53]^{0}C on the average from three observation stations. Whether the fluctuation of air temperature amplitude during the year of 2015 has a real effect on toddlers' immunity towards DHF or not will be answered in the hypothesis test section.

Besides climatic elements, (rainfall and air temperature amplitude) in Table 2 is also presented the level of regional urbanism namely a measure which can be used to illustrate the economy pattern (primary sector of the resource as the community income) from each district area which became the location of this research. The urban area is characterized by the dominance of economy in industrial and services sectors. In this context, Natar, Branti Raya, Tanjung Sari and Bakauheni can be categorized as urban areas [URBAN], whereas the others are categorized as rural areas. The grouping into these two regional categories is important to investigate the effect, whether it gives real influence on the immunity of toddlers towards DHF or not. The important aspect is that it can be used as a measure of the extent in the form of environmental impact (*public bad*) especially in the form of the decrease of toddlers' immunity towards DHF when an area is developing from a rural area to an urban area. Therefore, the development planners can take the advantage of those parameters to plan the development policy options well.

Besides the characteristics of urbanised level and climate which can control the ecological equilibrium performance of district area is land cover and Green Open Space performance (RTH). In the research, RTH data are acquired through the interpretation of the record of Landsat imagery June 21st,2016 by using the base of classification National Standardization Agency SNI Number 74645_2010. For the sake of making correspond to our study purpose, we then converted the land use classification into the 5 catagories. The results are presented in Figure 2 with the distribution of the extents shown in Table 3. The widest built land is Natar District which is 12,650 ha, the second is Jati Agung District which is 10,699 ha or equal to the proportion of 50,6% and 44,6% the area of the respective districts. This built land variable is important to investigate in this research whether it gives impact towards DHF prevalence on toddlers in these research areas. As it can be observed in Table 3 that the land cover of the largest forest in seven districts in these research areas is Katibung District covering the area of 2,382 ha or 17.2% of the total area of each sub-districts. While Natar and Jati Agung Districts do not have any cover which can be categorized as a forest.

However, the cover of agroforestry in these two districts is the widest, namely 7.197 ha and 6.973 ha respectively, it is equivalent to the proportion of 28.8% and 29.0% of the area of each district. Green open space (RTH) in the form of the largest fish pond is Ketapang District which is about 1,986 ha or occupies about 15.5% of the total area of this district. The existence of fish ponds in this study is also expected to provide a significant role in the control of ecological equilibrium in each districts area namely it can control the endemic growth of Aedes aegepty mosquito as a vector carrying dengue virus.

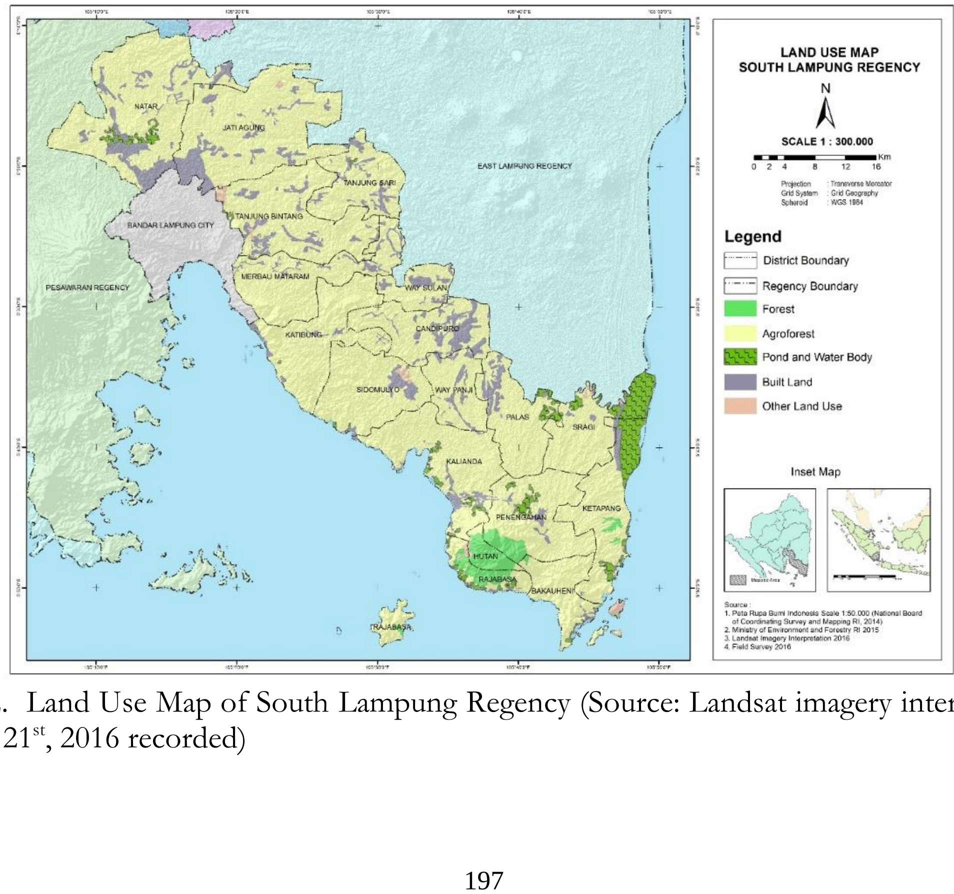

Figure 2. Land Use Map of South Lampung Regency (Source: Landsat imagery interpretation on June 21st, 2016 recorded)

Table 3. The acreage of land use in the 7 districts in research area

District of	Forested Land		Agroforest Land		Built Land		Fish Pond	
	Ha	%	Ha	%	Ha	%	Ha	%
1. Natar	0	0.0	7,197	28.8	12,650	50.6	0	0.0
2. Tanjung Sari	132	1.4	5,044	54.5	1,909	20.6	0	0.0
3. Jati Agung	0	0.0	6,973	29.0	10,699	44.5	0	0.0
4. Katibung	2,382	17.2	3,255	23.5	5,713	41.3	90	0.7
5. Sidomulyo	226	1.8	3,374	27.0	6,114	49.0	81	0.7
6. Ketapang	110	0.9	1,283	10.1	8,744	68.9	1,986	15.7
7. Bakauheni	118	1.8	2,273	33.9	4,182	62.4	87	1.3
Average=	424	3.30	4,200	29.56	7,145	48.20	321	2.61
Sd=	867	6.19	2,279	13.31	3,759	15.59	736	5.78

Source: Landsat interpretation (June 26th, 2016)

In addition, another important variable to specify is the sex of toddlers either who are suffering from ore infffected by DHF *versus* who are immune. As it can be found in Table 4, in this research, there are 37 male toddlers and 25 female toddlers who suffer from DHF or it is equivalent to the proportion of 32.5% and 25.9% respectively of all toddlers. For example, we take 114 toddlers. In Natar District, there are 24 toddlers (21.1% of 114) who are suffering from DHF and it is the biggest number of toddlers who are affected by DHF with the proportion of 15 male toddlers 9 female toddlers or it is equivalent to 13.2% and 7.9% of the example's total of 114 toddlers. In contrast, from all research areas, there are 35 (31.0%) male toddlers and 17 (14.9%) female toddlers who are immune to DHF. While in Natar District, there are 20 (17.5%) male toddlers and 6 (5.3%) female toddlers. That description shows that in general, male toddler has greater immunity towards DHF. These findings lead to the allegation on the relation to the influence of environmental variables and the influence of habit or clean life behavior from the family.

Table 4. The distribution number of toddler who suffers and does not suffer from DHF based on sex

No.	District of	Suffer	Male		Female		Total	
			n1	%	n2	%	n1+n2	%
1.	Natar	Yes	15	13.2	9	7.9	24	21.1
		No	20	17.5	6	5.3	26	22.8
		Sub total=	35	30.7	15	13.2	50	43.9

2.	Jati Agung	Yes	8	7.0	6	5.3	14	12.3
		No	6	5.3	2	1.8	8	7.0
		Sub total=	14	12.3	8	7.0	22	19.3
3.	Bakauheni	Yes	2	1.8	2	1.8	4	3.5
		No	2	1.8	5	4.4	7	6.1
		Subtotal =	4	3.5	7	6.1	11	9.6
4.	Ketapang	Yes	4	3.5	0	-	4	3.5
		No	0	-	1	0.9	1	0.9
		Subtotal =	4	3.5	1	0.9	5	4.4
5.	Tanjung Sari	Yes	2	1.8	1	0.9	3	2.6
		No	2	1.8	1	0.9	3	2.6
		Subtotal =	4	3.5	2	1.8	6	5.3
6.	Sidomulyo	Yes	2	1.8	3	2.6	5	4.4
		No	2	1.8	2	1.8	4	3.5
		Subtotal =	4	3.5	5	4.4	9	7.9
7.	Katibung	Yes	4	3.5	4	3.5	8	7.0
		No	3	2.6	0	-	3	2.6
		Subtotal =	7	6.1	4	3.5	11	9.6

Source: research result (2016)

Toddlers' family's habits

Family's habitual behavior, an example where toddlers are nurture, is descriptively presented in Table 5. The first hygine life habit from the family is covering and draining water tank or bathtub habit [POOL] in respective houses. From all research areas, there are 82 families (71.9%) who have this habit where in 33 (28.9%) families, the toddlers are affected by DHF. While other 32 families (28.1%) who do not have this habit, there are 9 families (7.9%) whose toddlers are affected by DHF and 23 families (20.2%) whose toddlers are not affected by DHF. By only using these descriptive data, it seems that there is no pattern: whether this habit has a real influence towards the immunity of the toddlers.

Draining the bathtub habit [BATH] is a hygine life habit or behavior which is also estimated to have sinificant effect on toddlers' immunity towards DHF for respective families. As it can be examined in Table 5, that the number of the family which have this habit is very high, there are 98 families (86%). Among families who have that habit, in fact, there are 36 families (31.6%) whose toddlers are affected by DHF, while in other 62 families (54.5%), the toddlers are free from DHF. And among families which do not have the habit, there are 16 (14.0%) families where in 6 families (5.3%) of it, the toddlers are affected DHF and the toddlers in other 10 families (8.8%) are free from DHF.

Table 5. Distribution of number of toddlers who infected *versus* immune from DHF based on their family's habit

No.	Family's habit [SYMBOL]		Infected DHF		Immune		Total	
			n1	%	n2	%	n1+n2	%
1	Covering & draining water tank	Yes	33	28.9	49	43.0	82	71.9
	[POOL]	No	9	7.9	23	20.2	32	28.1
		Sub Total=	42	36.8	72	63.2	114	100.0
2	Draining bath Tube	Yes	36	31.6	62	54.4	98	86.0
	[BATH]	No	6	5.3	10	8.8	16	14.0
		Sub Total=	42	36.8	72	63.2	114	100.0
3	Recycling used goods	Yes	16	14.0	27	23.7	43	37.7
	[RECYL]	No	26	22.8	45	39.5	71	62.3
		Sub Total=	42	36.8	72	63.2	114	100.0
4	Applying nest mosquito repellant	Yes	6	5.3	23	20.2	29	25.4
	[REPT]	No	36	31.6	49	43.0	85	74.6
		Sub Total=	42	36.8	72	63.2	114	100.0
5	Maintaining sewerage	Yes	29	25.4	45	39.5	74	64.9
	[SWRG]	No	13	11.4	27	23.7	40	35.1
		Sub Total=	42	36.8	72	63.2	114	100.0
6	Cultivate fish in pond	Yes	29	25.4	45	39.5	74	64.9
	[FISH]	No	13	11.4	27	23.7	40	35.1
		Sub Total=	42	36.8	72	63.2	114	100.0

7	No hanging clothes in the bedroom	Yes	39	34.2	44	38.6	83	72.8
	[HUNG]	No	3	2.6	28	24.6	31	27.2
		Sub Total=	42	36.8	72	63.2	114	100.0

Source: research (2016)

Healthy behavior or hygine life habit variables which furthermore considered quite important is the habit of recycling used goods [RECYL] which many believed to be the nest and breeding spots for *Aedes aegepty*. There are 43 families (37.7%) in which 16 families (14.0%) the toddlers are affected by DHF and in the rest 27 families (23.7%), the toddlers are free from DHF. While families who do not have this habit, there are 71 families (62.3%) of which 26 families (22.8%), the toddlers are affected by DHF and the rest 45 families (39.5%) are free of DHF.

The habit of wearing mosquito repellent [REPT] is quite common in rural areas such as the use of mosquito nets. This variable needs to be observed whether it has a role in suppressing the DHF rate or not. There are 29 (25.4%) families who have this habit where 6 families (5.3%) of it, the toddlers are affected by DHF and in the remaining 23 families (20.2%) the toddlers are free from DHF. While for families who do not have this habit, there are 85 families (74.6%) of which 36 families (31.6%), the toddlers are affected and in the rest 49 families (43.0%), the toddlers are free from DHF. It seems that the use of this mosquito-defying method has a major influence to suppress DHF attacks on toddlers. Poor household sanitation often becomes the cause of the proliferation of *Aedes aegepty* mosquitoes. Therefore, in this research, it is also necessary to investigate the household habit in caring sewerage channnals surround their house [SWRG]. As it can be examined in Table 5, there are 74 families (64.9%) who have this habit, of which 29 families (25.4%), the toddlers are affected by DHF and the rest 45 families (39.5%) are free from DHF attacks. There are also 40 families (35.1%) who did not have the habit of doing this [CARE] where 13 families (11.4%) of it, the toddlers are affected by DHF and the rest 27 families (11.4%) are free from DHF. There seems to be no good coherence between this [CARE] variable and the immunity of toddlers towards DHF.

The connection between DHF and the nutritional status which is commonly accepted in an area of health issue. The issue may develop an imagination of how important the supply of protein to the toddlers' mothers who are still breastfeeding. This imagination on the importance of observing the relationship between the family who keep the fish [FISH] with the immunity of toddlers towards DHF remembering the fish can also be functioned to control the larvae of *Aedes aegepty* mosquitoes besides becoming the protein supply to breastfeeding mothers. The evaluation effect of this [FISH] variable on the immunity of toddlers towards DHF is also synergized with the presence of ponds, dyke, fishponds retention basin, and the like [POND] in this research area that reaches the condition as previously described. In addition, the utilization of land use [POND] beside for the irrigation of dry land cultivation and paddy fields, is also for fisheries that can give influence on toddlers' immunity towards DHF through mosquito larvae controlling and also through the supply of protein for improving the quality of nutritional status of toddlers through breastfeeding. From all research samples, from 114 families, there are 74 families (64.9%) who have fish-keeping habit [FISH] where 29 families (25.4%) of it, the toddlers suffered from DHF and 45 families (39.4%) are free from DHF. While in 40 families (35.1%) who did not have this habit, there are 13 families (11.4%) whose toddlers suffered from DHF and 27 families (23.7%) are not affected by DHF.

Custom or common habit either in the urban or rural community which can be the cause of the proliferation of mosquitos is hanging the clothes. This research takes hanging the clothes as a habit [HUNG]. There are 83 families (72.8%) who said that they do not hang the clothes, where 39 families (34.2%) of it, the toddlers suffered from DHF and 44 families (38.6%) are free from DHF. And there are 28 families (27.2%) who are accustomed to hanging the clothes where 3 families (2.6%)of it, the toddlers are affected by DHF attack and in other 28 families (24.6%), the toddlers are free from DHF. It seems that there is a strong relationship between [HUNG] variable and DHF. However, this estimation needs to be tested more systematically together with other dengue-bearing determinants.

The Results of Parameter Optimization and Hypothesis Testing

The results of the parameters optimization are presented in Table 6. The first group of variables is the external environmental variable group which includes the level of district urbanism [URBAN], monthly rainfall [RAIN], monthly temperature amplitude [TEMP_AM], the area of green open space and agroforestry [RTH_AGRF], and the green open space which is used for dike and fishpond [RTH_POND]. As it can be examined in Table 6, it turns out that the level of urbanism [URBAN] does not affect significantly to the todller's DHF resistance. It is hypothesized that the urban environment is an environment which is transitioning from the rural economy to the urban economy. In the transition period, the development of slum area occurs fast, mosquito ecology becomes rampant, the distance between houses becomes tighter, the intensity of people encounter becomes more frequent, the transmission between people is also faster due to the intensity and frequency, mosquito's stings are also getting bigger and more frequent. In this research, Natar, Tanjungsari, Branti Raya and Bakauheni districts are categorized as urban areas while others are rural areas. Generally, in urban areas, there are ecological disturbance so that the ecological equilibrium from the level of microorganisms to the level of meso and external organism also experience the transition from the environment which is still natural to the artificial environment.

The influence of this ecological equilibrium shift also affects the abundance of germs of various diseases including dengue viruses and their transmitting vectors (*Aedes aegepty* mosquitoes). Finally, this influence also leads to the impact of human ecology. This influence in urban areas which is hypothesized is also strengthened by the degree of interaction between humans which is relatively more intensive than in rural areas. In this research, those symptoms can also be observed, that if the rural area is transformed into an urban area, the immunity of toddlers towards DHF will be reduced that is only 0.71 times. In Table 6, the value of Odds Ratio is 0.71. However, this [URBAN] influence is not significantly effected (P = 0.505 or > 15%). Thus there is insufficient evidence to reject H_0. In other words, the hypothesis $\beta_1 = 0$ is acceptable as well as it rejects H_1 at once.

The second variable of external environment variable group is the monthly rainfall average [RAIN]. The effect of this variable is also hypothesized through its influence on the epidemiology of *Aedes aegepty* mosquitoes, external environmental sanitation as well as the survival of the natural enemies of the mosquito itself. As it can be examined in Table 6, that if the monthly rainfall average [RAIN] in the districts where toddlers live increased 1 mm per month then the average of immunity of toddlers towards DHF will decrease to only about 0.67 times, as indicated by the Odds Ratio. However, this effect is considered not significant (P = 0.16 or> 15%). Therefore, there is not enough evidence to reject H_0. In other words, the hypothesis $\beta_2 = 0$ is accepted.

The third variable of the external environment variables groupe in this research is the monthly extreme temperature amplitude [TEMP_AM]. This variable can be used as a measure for the fluctuation of monthly temperature. In this research, it is the largest temperature occurrence which is reduced by the lowest temperature ever recorded in 2015 in every station which is the representative of the district covering this research area. As it can be examined in Table 6, that if [TEMP_AM] increases 1^0C then the immunity of toddlers against DHF attacks declined significantly that it only becomes 1/1000 times. This influence is real (P = 0.093 or <10%). It is estimated that the rise or decrease of air temperature gives influence through two mechanisms.

Table 6. The role of external environment, and the family's habit variables on the toddler immunity (based on age and sex) against DHF in South Lampung Regency

Predictor (unit)	*Symbol*	*Coef.*	$=\beta_n$	*SE Coef.*	`Z	*P*	*Odds Ratio*
Constant	-	681.000	$=\beta_0$	411.68	1.65	0.098	-
1 *<u>Group of external environment variables</u>*							
Ubanised level (*=1 if urban, =0 if rural*)	[URBAN]	-0344147	$=\beta_1$	0.712193	-0.48	0.629	0.71
Monthly rainfal (*mm/month*)	[RAIN]	0.0395186	$=\beta_2$	0.285684	-1.41	0.160	0.67
Air temperature amplitude (^0C)	[TEMP_AM]	-48.8124	$=\beta_3$	29.04490	-1.68	0.093**	0.00
Forested & agroforested area (*1,000 ha*)	[RTH_AGRF]	5.16770	$=\beta_4$	1.724241	1.78	0.076**	25.05
Acreage of fish pond (*1,000 ha*)	[RTH_POND]	3.17946	$=\beta_5$	1.55979	2.04	0.042***	24.03
2 *<u>Group of internal variables of toddler</u>*							
Sex (*=1 if male, =0 if female*)	[SEX]	0.792597	$=\beta_6$	0.499247	1.59	0.112*	2.21
Age (month)	[AGE]	-0.0226066	$=\beta_7$	0.0155364	-0.146	0.164	0.89
3 *<u>Group of family's habit variables</u>*							
Draining bath tube (*=1, if yes*)	[BATH]	-0.306176	$=\beta_8$	0.598202	-0.51	0.609	0.74
Covering and draining water tank (*=1, if yes*)	[POOL]	-0.0695948	$=\beta_9$	0.794255	-0.09	0.930	0.93
Recycling used goods (*=1, if yes*)	[RCLY]	-0.386107	$=\beta_{10}$	0.512031	-0.75	0.451	0.68
Applying nest mosquito repellant (*=1, if yes*)	[REPT]	2.44086	$=\beta_{11}$	0.794304	3.07	0.002***	11.48
Mainting sewerage (*=1, if yes*)	[SRWG]	-0.0782993	$=\beta_{12}$	0.591169	-0.13	0.895	0.92
Cultivating fish in ponds (*=1, if yes*)	[FISH]	1.08335	$=\beta_{13}$	0.633511	1.71	0.087*	2.95
No Hanging clothes in bedroom (*=1, if yes*)	[HUNG]	2.36244	$=\beta_{14}$	0.674288	3.50	0.000***	10.62

Log-Likelihood = -57.089	Test that all slopes are zero: G = 35.871, DF = 14, P-Value = 0.001

Source: research result (2016); Note: *=15%; **=10%; ***=5%

The first one is the ecological suitability for microbiological growth. The dominance of *Aedes aegepty* virus may occur probably because the other microbes are not able to survive. From a toddler's perspective, it may be due to the toddler's physiology which the resilience (adaptation potency) is weak towards the shock of extreme temperature change so that the antibodies in the immune system are less developed especially when the dengue virus begins to attack the blood vessels in the toddler's body. Both of these mechanisms can take place together so that the immunity of toddlers towards DHF dropped significantly due to the shock of air temperature in that month. Therefore, there is sufficient evidence to reject H_0 in this research. In other words, that $\beta_3 = 0$ must be rejected which also means that the increase of [TEMP_AM] variable gives negative effect or decreases the immunity of the toddlers against DHF attacks.

Another variable from the type of toddler's external environment group is green open space in the form of land cover (forested area) and agroforestry [RTH_AGRF]. The result sggest that [RTH_AGRF] is increased about 1000 ha, then it brings positive impact to the immunity of toddler against DHF that it will increase to 25.05 times. According to Nyhus and Tilson (2005), that forest ecosystem is an ecosystem that has steady state of ecological equilibrium as well as high biodiversity. According to Nyhus adn Tilson (2005) taht in the buffering zones of Way Kambas and Bukit Barisan Selatan National Paks the biodiversity in agroforestry land use is higher than taht of a well-managed production forests surround.

In the context of great ecological balance as well as the high biodiversity, it is estimated that the dominance of dengue virus and abundance of *Aedes aegepty* mosquitoes can also be depressed in a position that is low position so that the population is no overwhelming. In addition, the environmental amenity which can be obtained from forest ecology (such as the result of the increase of O_2 supply and CO_2 sequestration as well as the shade generated by forest vegetation canopies aggregately can also support the comfort of the toddlers in their sleep or the comfort of the breastfeeding mother. Finally, the [RTH_AGRF] variable increase can positively affect the increased immunity of toddlers against DHF. The increase of the immunity seems to be very real (P = 0.076 or <10%). Therefore, it can be said that there is strong evidence to reject H_0 which also means that $\beta_4 \neq 0$ must be accepted.

The last variable which is included in the external environment variable group of this research is the other green open space such as fishpond and other water bodies such as dyke, pond, retention basin and the like [RTH_POND]. As it can be examined in Table 6 above that imply for every increase in the acreage of this variable of 1,000 ha, it will asscociate with the impact on the increasing of toddlers' immunity against DHF to be 24.03 times as reflected by the Odds Ratio of this variable. This increase is significant effect *i.e.* P = 0.042 (or <5%). Hence, this result connote thta there is strong evidence to reject H_0 as well as accepting H_1 which also means that $\beta_5=0$ is rejected. These findings also provide the evidence that green open spaces [RTH_POND] can play an excellent ecological role for avoiding DHF or environmental sanitation management to suppress the incidence of dengue fever which attacks toddlers. In South Lampung Regency, the people generally utilize their land resources intensively, including the assets [RTH_POND] that are used for fish cultivation. Because almost all water bodies in this region are connected with a natrural drainage system, there always exsist wild fish communities even if the [RTH_POND] is not intentionally used for cultivating it.

Considering the life cycle of *Aedes aegepty* which also involves the growth of mosquito's larvae in freshwater, while fish also eat mosquito's larvae, then it can be learned why the increase of area [RTH_POND] is asscosiated with the improvement of toddlers' immunity against DHF obviously. Normally at natural or mand made water body grow somes biological control agents as the predator to mosquitoes. The predator could be spider Ndava et al (2018) or fish (Bowatte et al, 2013). The second variable of this group is actually the internal variable of the toddler's own body. The variable includes toddlers' sex [SEX] and their age [AGE]. Sex is important to reveal its role on the immunity of toddlers against DHF remembering the immune system can be different according to the sex which is related to the differences of hormones and enzyme systems. It is similar with the age [AGE], growth and the interaction of toddlers towards environment can be very different from the experience of each toddler on various germs and it leads to the development of antibodies following the age of the toddler itself. In relation to this research finding, we should recall the virus charactrerics. The virus has not been determined whether it is a living thing or not. In the wild, the virus does not show signs as living creatures: does not show respiratory activity, does not metabolize cells, does not secrete, and does not reproduce like splitting replication and so on. However, in the media or host tissue in the form of living things, the symptoms as new living creatures are shown by the virus. Today, it is understood that there are two types of viruses, namely DNA virus and RNA virus. The DNA molecule (deoxyribonucleic acid) is a molecule that is the major component in the cell nucleus of any living organism. While the RNA molecule (ribonucleic acid) is a component of the protoplasm of living cells.

When a DNA virus succeeds in invading a cell from a living organism, it takes the cytoplasm of the host cell, its character changes as a living cell which is a symbiotic, it respirates, synthesizes proteins, generates cell secretions, and reproduces by splitting or replicating itself as long as there is still any supply of nutrients from the tissues of host cells or as long as there are still many living cells within the host tissue. The self-reproduction behavior of the symbian cells between the virus and the host ("symbian cell_virus-host cell") is evasive and radical and extends throughout the host tissue. This character is known as viral. However, considering each process of splitting of the host cell or the symbian cell must be controlled by the nucleus, the core of the symbian cell does not have either a good "command" or a perfect one so that all the process of protein synthesis (in order to split itself) by sequencing the arrangement of the sugar-base chain which are millions of them (double Helix DNA of Thymine Guanine Adenine Cytosine repeatedly according to certain squenzing genetic codes) did not go well either and the results were never perfect in terms of genetics. In other words, the result of the splitting of viral symbian cells is always defect, bad and harming the host cells. Mechanism of cell splitting of tumour or cancer follows this pattern. Replication for many RNA viruses occurs in cellular compartments mainly originated from the production and reorganization of virus-induced membranes. Dengue virus translates, replicates and assembles new viral particles within virus-induced membranes from endoplasmic reticulum. In these compartments, all of the components required for replication are recruited, making the process efficient. In addition, membranes protect replication complexes from RNAases and proteases, and ultimately make them less visible to cellular defense sensors (Alcaraz-Estrada et al, 2010).

Likewise with the character of dengue virus that is an RNA virus. When the dengue virus succeeds in invading the host cell through sting by *Aedes aegepty* mosquito, it goes into the bloodstream and circulates throughout the body following the flow of blood, these dengue viruses attack (attacking) the host cells to take host cells and to have a symbiotic relationship with the nucleus of host cells blood vessel tissue, and then performs the continuous viral splitting. Thus, the wall of blood vessel experiences the increase of permeability so that there is much leaking blood fluid (blood plasm) go out from the blood vessel especially for the capilar vessel. Due to lacking of plams, the tension become very low. If this condition turns into critical, it can cause circulatory failure known as shock syndrome which often causes death. Kesuma et al (2017) reported that the mortality rate on dengue fever toddler patients who experienced shock could increase significantly *i.e.* 400 times compared to those who do not experience the shock. Clinical symptoms of leakage of blood vessels are indicated by the presence of red spots in patients on critical DHF patients. When there is so much red blood plasma outside the blood vessel, the metabolism of body cells experiences the interference and even death due to lack of oxygen supply or nutrients.

This description provides the argument that disease caused by virus such as Dengue Hemorraghic Fever (DHF) still has no cure. Antibiotics are obviously pointless to kill the virus because the virus is not a living cell. Until now, there is still no antibiotics found which are capable of killing the "symbian cells between the virus and the host". Therefore, the DHF treatment is only focused on efforts to strengthen the immune system of patients, namely the efforts in order to strengthen antibodies in the body to make it more effective to suppress the virulence power (viral characteristic) of dengue virus. The vaccine application is the major of curative efforts in order to stimulate human antibody power to supress the replicating process of virus proliferation. But the mechanism by which the immune response to virus (for exampleserotype DENV) protects against or contributes to severe disease remains controversial. Antibodies neutralize infection when bound to virus particles in sufficiently large numbers. In contrast, at concentrations that fall below the threshold for neutralization, antibodies can promote entry of DENV into cells expressing Fcγ receptors (FcγR) via a process called ADE: antibody-dependent enhancement (Halstead et al, 2010). This means that internal variables in the patient are the key to the process of survival against DHF virus infection.

In this research, the internal variable group of patients used is sex [SEX] and age [AGE] of toddlers.The sex variable [SEX] is found in this research that it has significant effect ($P = 0.112$ or <15%) in which male has the immunity 2.21 times than that of female toddler has. This finding also reinforces the finding of Tamza (2015) that the survival rate of male against DHF is 16 times higher than female have. These finding suggests contrary to some researchers. Acoording to (Klien et al, 2015) for example tht the intensity and prevalence of viral infections are typically higher in males, whereas disease outcome can be worse for females. Females mount higher innate and adaptive immune responses than males, which can result in faster clearance of viruses. Not yet known exactly why it could be so. The first possibility is that the lipoprotein arrangement of the vascular tissue walls composing cells of male is more robust or rigid so it is not easily penetrated by the bite of *Aedes aegepty* mosquitoes so that not much virus can pentraten into blood vessels. Secondly, it is possible that the antibodies in men are more excellent in suppressing the virulence of dengue virus. It still needs further research that focuses on histological relationship between the blood vessel and virulence power and the immunity of toddlers against DHF virus infection

The second internal variable group is age [AGE]. It can be examined in Table 6 that for the age range between 1 to 59 months, there is a decrease in toddlers' immunity against DHF virus infection. Therefore, a toddler who is 1 month older, the immunity decreased to only 0.89 times, as it is shown by its Odds Ratio. Based on the past exposuring on the microbial infections that stimulate to the development of adaptive immunity, we wished that the older the toddler the more immune should be. This research finding also in contrast with what Tamza (2015) has reported that the survival rate against DHF increased significantly by 1.13 times if the age increased by 1 year, especially in toddler and children segment. It still needs further research about the influence of age on immunity and survival power towards DHF.

The third variable group is the social environment variable in the form of family habit where the toddler is taken care of or nurtured. Household habit is the habit where toddlers' parents lived. In this research, family habit variable is also hypothesized to have a strong association with the immunity of toddlers against DHF. This type of variable affects the toddler's external environment especially the growth of the *Aedes aegepty* vector. Variables which are included in this type of variable cover the family habits in: draining the bathtub [BATH], covering and draining drinking water tendon [POOL], recycling used goods [RECYL], using mosquito repellent such as mosquito nets [REPT] taking care of drainage such as sewer and gullies [SWRG], keeping fish [FISH] and the habit of not hanging shirts or clothes in bedrooms [HUNG].

Among the 7 variables categorized as these family's habit variables, only the [REPT], [FISH], and [HUNG] variables which have significant influence to immunity of toddlers against DHF. While other four variables in this group did not have a significant effect. In this case, the household behavior in using mosquito nets, autan or other methods of using mosquito repellent [REPT] is easy to understand. These protections against mosquito bites can obviously prevent and protect the toddlers from suffering from the DHF. For families who have this habits are proven to have much higher theeir toddler's immunity against dengue hemorrhagic fever (DHF), which is 11.48 times higher than those families who do not have that these habits, as it is connoted by the Odds Ratio score on Table 6. This effect is significant as indicated by P = 0.002 (or <1%). Thus, H_0 ($\beta_{12} = 0$) must be rejected while H_1 ($\beta_{12} = 0$) must be accepted.

The influence of habit in cultivating fish in the pond around the house [FISH] also showed a significant influence on the immunity of toddlers against the DHF attack, with value P = 0.087 (or <10%). In families who have this habit, their toddlers have the immunity of 2.95 times higher than families who do not have fish-keeping habit [FISH]. Thus, there is strong evidence to reject H_0, which also means that the hypothesis $\beta_{14} = 0$ must be rejected and must accept H_1. This finding is an individual micro behavior of each family or household. However, the finding is also synergized with the influence of external environment variables, especially on [POND], where every increase of 1,000 ha in each district, it will also positively influence in the effort to improve the immunity of toddlers against DHF attacks that is 24.03 times from the beginning condition or before pool area expansion is done. However, it is worth to note here that these two variables in influencing the immunity of toddlers against DHF are linearly independent or have an effect on each without any autocorrelation between two variables.

The last family habit variable group is the habit of not hanging clothes in bedrooms or rooms in the house [HUNG]. This variable is found to have strongly significant effect (P = 0.001 or <1%) on the increase of the immunity of their toddlers against DHF. In families who have the habit of not hanging clothes, then the immunity of their toddlers against DHF is equal to 10.62 times higher than the immunity of toddlers whose families have a habit of hanging clothes in bedrooms. The mechanism of this habit is easy to understand that the cloth hangers in bedrooms could be the nest of mosquito. Hence, mosquitoes are safe from the repellent efforts such as spraying or expulsion with mosquito coils and so on. Thus, for families who have a habit of hanging clothes in bedrooms, their toddlers become more susceptible towards the attack of DHF. Therefore, there is strong evidence to reject H_0, which also means the hypothesis $\beta_{14} = 0$ must be rejected and H_1 must be accepted.

5. CONCLUSIONS AND SUGGESTIONS

From this research, it suggested that the variables which give significant influence on the immunity of toddlers against DHF: air temperature amplitude (every 1^0C increase, the immunity decreased to 1/1,000); the area of green open space (every 1,000 ha reforestation the immunity increased 25.05 times higher than the beginning condition); the area of fishpond and pond (every 1000 ha addition, the immunity increased 24.03 times higher than the beginning condition), the sex of toddler (male is 2.21 times more resistant than female), internal family's habits: (*a*) using mosquito repellent, (*b*) keeping fish, and (*c*) not hanging clothes, where the families who did it so, the toddlers are more resistant consecutively for 11.48; 2.95; and 10.62 times than who did not do the habit. It is suggested to conduct research in other districts as well as to integrate the nutritional status and the history of diseases before affected by DHF.

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7. REFERENCES

Adhyaksa. A., S. Bakri, T. Santoso. 2017. Pengaruh tutupan lahan terhadap insidensi pnumonea pada balita: Studi di Provinsi Lampung. *Jurnal Sylva Lestari, 5(1):26 - 34*.

Alcaraz-Estrada, S. L., M. Yocupicio-Monroy, and R. M. del Angel. 2010. Insights into dengue virus genome replication. *Future Virol.*5(5) 575-592.

BPS. 2017. Lampung Selatan dalam Angka. Badan Pusat Statistik Provinsi Lampung.

Bakri, S., D. Darusman, B. Juanda, dan Bahruni. 2014. Pembangunan ekonomi wilayah di bawah kendala degradasi sumberdaya alam di Provinsi Lampung. *Jurnal Sosio Ekonomika. Vol. 18 (2):161-170.*

Bakri, S., A. Setiawan. 2017. Welfare improvement model through forest function recovery, the strengthening for small entreprise performance and the farmer's parity: Study in Lampung Province-Indonesia. *Working Paper* presented in The International Seminar of Agricultural Engineering (ISAE), Bandar Lampung 10th-12th August, 2017.

Bowatte, G., P. Perera, G. Senevirathne, S. Meegaskumbura, M. Meegaskumbura. 2013. Tadpoles as dengue mosquito (Aedes aegypti) egg predators. *Biological Control, 67:469–474.*

Candra, D., E. Warganegara, S. Bakri, and A. Setiawan. 2016. Helminthiases identification of wildlife and domestic livestock in Way Kambas National Park, Lampung-Indonesia. *Acta Veterinaria Indonesiana*, *Vol. 4*(*2*):*57-67*, http://www.journal.ipb.ac.id/indeks.php/

Crowe, B. L. 2003. The tragedy of the commons revisited. *Science 166:1103-1107*

DeGroote, J., Mercer, D.R. Fisher, J. Sugumaran. 2007. Spatio temporal investigation of adult mosquito (Diptera: Culicidae) populations in an Eastern Iowa County, USA. *J. Med. Entomol.* , *44*, 1139–1150.

Godsey, M.S., Blackmore, M.S., Panella, N.A. Burkhalter, K.; Gottfried, K.; Halsey, L.A.; Rutledge, R.; Langevin, S.A.; Gates, R.; Lamonte, K.M. 2005. West Nile epizootiology in the southeastern United States, 2001. *Vector-Borne Zoonotic Dis.*2005, *5*, 82–89.

Halstead, S.B., S. Mahalingam, M.A. Marovich, S. Ubol, and D. M. Mosser. 2010. *Intrinsic antibody-dependent enhancement of microbial infection in macrophages: disease regulation by immune complexes.* Lancet Infect Dis.10(10): 712–722. Doi:10.1016/S1473-3099(10)70166-3.

Hardin, G. 1968. The tragedy of the commons. *Science 162:1243-1248.*

Ndava, J., S. D. Llera and P. Manyanga. 2018. The future of mosquito control: The role of spiders as biological control agents: A review. *International Journal of Mosquito Research, 5(1): 06-11.*

Kesuma, A.R. 2017. Pengaruh variable lingkungan eksternal dan kondisi penderita DBD, terhadap severitas dan survival: Studi pada balita di Rumah Sakit Abdul Moeloek (RSUAM) Provinsi Lampung. *Thesis* Programn Studi Magister Ilmu Lingkungan, Program Pascasarjana Univeritas Lampung, Bandar Lampung.

Khoiriah, A. A., S. Bakri, D. S. R. Wardani. 2016. *Pengaruh perubahan penggunaan lahan, tingkat kemiskinan, dan pendapatan sektor perekonomian terhadap indeks pembangunan manusia. Jurnal Syva Lestari, (Accepted, in press*).

McMichael1, A. J. 2000. The urban environment and health in a world of increasing globalization: issues for developing countries. *Bulletin of the World Health Organization, 78 (9):1117-1126.*

Mustika, A.A. S. Bakri, dan D. S. R. Wardani. 2016. Perubahan penggunaan lahan di Provinsi Lampung dan pengaruhnya terhadap insidensi demam berdarah dengue (DBD). *Jurnal Syva Lestari, Vol.4 (3):35-46.*

Nguyen, T. H., Nguyen T. L., Huan-Yao L., Yee-Shin L., Le Bich L., Kao-Jean H., Chiou-Feng L., Do Q. H., Vu Thi Q. H, Lam T. M., Trai-Ming Y., Jyh-Hsiung H., Ching-Chuan L., dan S. B. Halstead. 2005. Association between sex, nutritional status, severity of dengue hemorrhagic fever, and immune status in infants with dengue hemorrhagic fever. *Am. J. Trop. Med. Hyg.*, 72(4): 370–374.

Nurhaida, I., A. Setiawan, dan G. A. B. Wiranata. 2009. Akar masalah pertautan konflik manusia dengan satwa liar di kaawasan penyangga Taman Nasional Way Kambas. *Jurnal Sosiohumaniora.*

Nguyen, T. H., Nguyen T. L., Huan-Yao L., Yee-Shin L., Le Bich L., Kao-Jean H., Chiou-Feng L., Do Q. H., Vu Thi Q. H, Lam T. M., Trai-Ming Y., Jyh-Hsiung H., Ching-Chuan L., dan S. B. Halstead. 2005. Association between sex, nutritional status, severity of dengue hemorrhagic fever, and immune status in infants with dengue hemorrhagic fever. *Am. J. Trop. Med. Hyg.*, 72(4): 370–374.

Nyhus, P. and R. Tylson. 2005. Agroforestry, elephant, and tigers balancing conservation theory and practice in human dominated landscape of South East Asia. *Agriculture, Ecosystem and Environment, 104: 87-97.*

Ostrom, E. 2003. How types of goods and property rights jointly affect collective action. *Journal of Theoritical Politics, Vol. 15 (3):239-270.*

Putra, A. K., S. Bakri, dan B. Kurniawan. 2015. Peranan ekosistem mangrove pada ketahanan masyarakat terhadap malaria: Studi kasus di Kecamatan Labuan Maringai, Kabupaten Lampung Timur. *Jurnal Syva Lestari, Vol. 3 (2): 63-70.*

Rochlin, I.; Ninivaggi, D.V.; Hutchinson, M.L.; Farajollahi. 2003. A. Climate change and range expansion of the Asian Tiger Mosquito (*Aedes albopictus*) in Northeastern USA: Implications for public health practitioners. *PLoS ONE*.https://doi.org/10137/journal.pone.0060874.

Rustiadi, E., S. Saefulhakim, D. R. Panuju. 2011. *Pengembangan Wilayah.* Yayasan Obor, Jakarta.

Saputri, D., E., S. Bakri, dan R. Zuraidah. 2015. Peranan sistem ekologis hutan repong damar dan riwayat penyakit terhadap pendapatan, asupan pangan dan status gizi balita. *Jurnal Syva Lestari, 3 (1): 63-70.*

Salam, M.F., Fizer, C., Pilant, A.N., and Whung, P.Y. 2017. Systematic Review: Land cover, meteorological, and socioeconomic determinants of *Aedes* Mosquito habitat for Risk Mapping. *Int. J. Environ. Res. Public Health* 2017, *14*(10), 1230; doi:10.3390/ijerph14101230.

Rosari R. S. Bakri, T. Santoso. 2017. Pengaruh perubahan tutupan lahan terhadap insidensi tuberkolusis paru: Studi di Provinsi Lampung. *Jurnal Syva Lestari, 5 (1):71-80.*

Suwandi, J.F., 2014. Supargiyono, W. Assmara, adn H. Kusnanto. 2014. Mapping and prevalence of *Malaria falciparum* patients with ACT failed therapy, in Hanura Public Health Center, Pesawaran, Lampung, Indonesia. Open *Journal of Epidemiologi, 4:169-177.* http://www.scirp.org/journal/ojepi, http://dx.doi.org/10.4236/ojepi. 2014.43023

Tamza, R. B. 2015. Pengaruh lingkungan tempat tinggal dan golongan darah terhadap tingkat suvival terhadap DBD. *Thesis Magister Ilmu Lingkungan,* Program Pascasarjana Unila, Bandar Lampung.

Wigaty, L., S. Bakri, T. Santoso, dan D. S. R. Wardani. 2016. Pengaruh perubahan penggunaan lahan terhadap angka kesakitan malaria : Studi di Provinsi Lampung, *4 (3):1-10.*

Weaver S.C. and W.K. Reisen. 2010. Present and future arboviral threats. *Antiviral Res.* 85, 328–345.